MIJN RUIMTEVAART VERZAMELING VAN 07 MEI 2002

TOT 20 MEI 2002. REGISTER VAN A TOT Z.

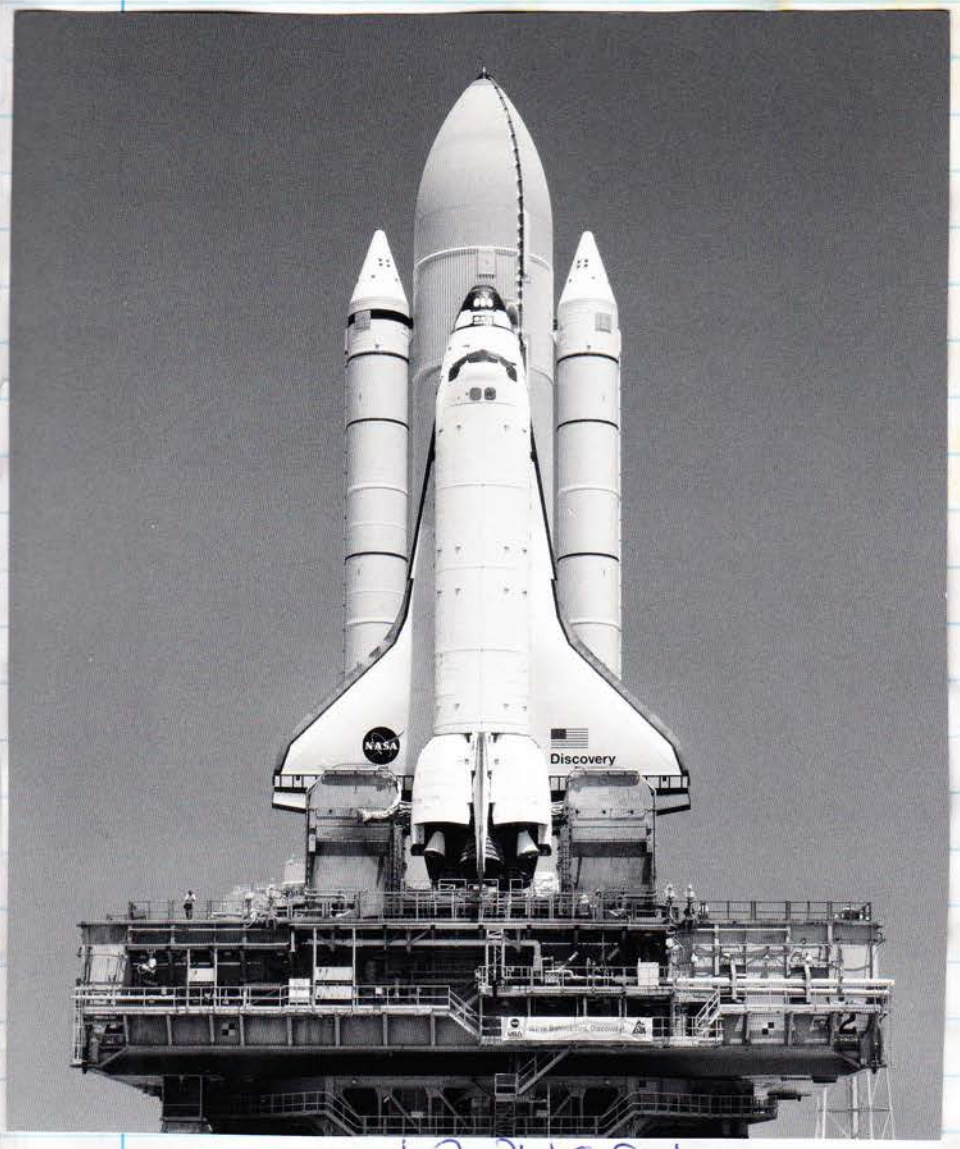
DEEL 90.

(VERVOLG E):

Even wat tijd over tussen STS-110 en STS-111. Dus lekker snel nog een extra klapper. STS-11 zal een vlucht maken naar het internationale Ruimtestation Alpha en daar Expedition Five afleveren en Expedition Four weer mee terugnemen. Leonardo is ook aanboord. Deze zal voorraden, kleding en andere zaken afleveren bij ISS. Dus even concreet. Deze klapper, Deel 90, een extraatje tussendoor en in Deel 91 STS-111.

73498

DaveBöskes
Venlo
11 mei 2002.



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Bolden enjoyed observing how liquid food did not behave in space.

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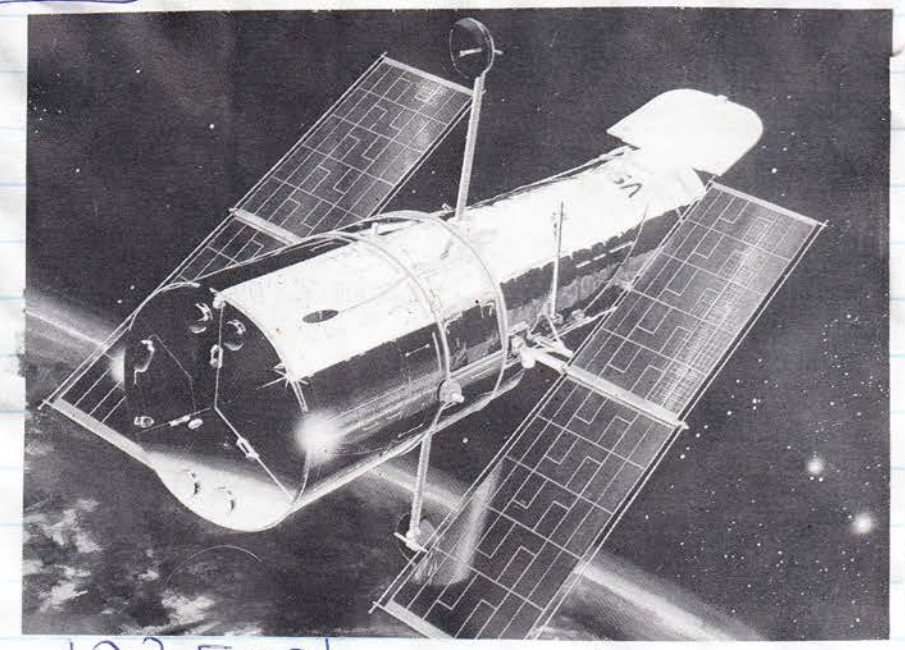

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MAIDEN FLIGHTS

This collection consists of the First Space Shuttle Flight of each of the orbiters in NASA's Fleet. Orbiter numbers start at 101 (Enterprise - a prototype) and end with the newest Orbiter Vehicle - Endeavour (OV) 105. Challenger was dubbed OV-99 because it was originally a structural test model.

COLUMBIA
OV-102 STS1
Launched April 12, 1981

CHALLENGER
OV-99 STS6
Launched April 4, 1983

DISCOVERY
OV-103 41D
Launched August 30, 1984

ATLANTIS
OV-104 51J
Launched October 3, 1985

ENDEAVOUR
OV-105 STS49
Launched May 7, 1992

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Knowing that it would be his last space flight, Bolden (left) enjoyed STS-60 to the fullest.

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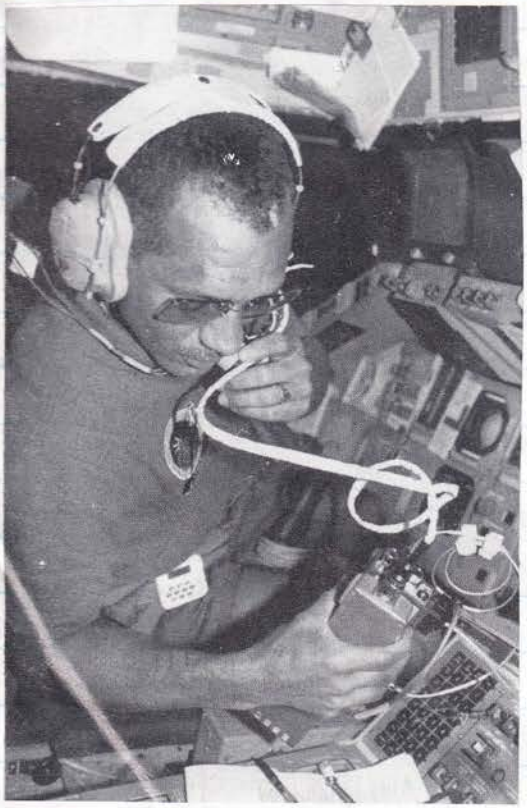

With STS-45, Bolden achieved his dream of commanding a Shuttle flight.

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Spaceflight Vol 44 March 2002

Space Shuttle mission report

Endeavour carries fourth crew to Space Station

by Roelof Schuiling

The Space Shuttle orbiter Endeavour was launched from the Kennedy Space Center (KSC) Launch Complex 39B on the STS-108 mission at 5:19:28.0043 on the evening of Wednesday 5 December 2001. The mission - also designated ISS's Utilization Flight One (UF-1) - carried the Multi-Purpose Logistics Module (MPLM) "Raffaello", a number of experiments, and brought up the Expedition Four astronauts. These relieved the Expedition Three crew members who had been aboard the ISS since August of 2001. Security measures were at a significantly higher level than on previous Space Shuttle missions and increased Department of Defense support was provided in the KSC area due to terrorism concerns. It was the twelfth Shuttle mission to the ISS and the first utilisation mission. Previous Shuttle flights had primarily concentrated on the assembly sequence and crew support.

STS-108 had been scheduled for launch on 29 November; however problems with docking a Russian Progress cargo carrier to the ISS delayed the launch until 4 December and a weather delay caused a further one-day slip to 5 December 2001.

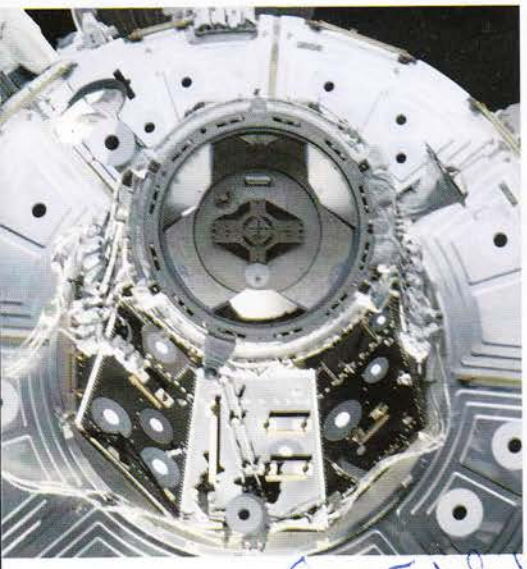
The Italian MPLM Raffaello is one of three pressurised cargo carriers designed to fly in the Shuttle orbiter's payload bay. Upon reaching the ISS they are then be docked to the Space Station where their cargo is accessible from inside the ISS. Named for the 16th century artist Raphaello Sanzio, the Raffaello was making its second space flight. It first flew, also an Endeavour mission, on STS-100 in April 2001. The $150 million dollar module carried a series of Resupply Stowage Racks and Resupply Stowage Platforms. The MPLM measures 6.4 metres in length and 4.6 metres in diameter and it can carry up to 9.1 metric tons of cargo.

Endeavour's payload bay also contained the Multiple Application Customized Hitchhiker-1 (MACH-1) which was mounted between the Endeavour's airlock and the MPLM across sub-bay 3, as well as the Lightweight MPESS Carrier (LMC) which was mounted in the aft end of the payload bay in sub-bay 13. The MACH-1 was a collection of experiments mounted on a cross-bay GAS Bridge assembly and included the STARSHINE-2 reflective mirror satellite, the Capillary Pumped Loop Experiment - 3, the Prototype Synchrotron Radiation Detector, two Space Experiment Modules and a GAS canister containing seven experiments. The LMC carried four GAS canisters while two additional GAS canisters were mounted on the starboard payload bay wall just ahead of the MACH-1.

The orbiter's middeck area carried the Avian Development Facility (ADF) and the Commercial Biomedical Testing Module-Animal Enclosure Module (AEM). The ADF was flown to validate subsystems and contained two experiments on development in space of Japanese quail eggs. The AEM carried a commercial experiment that utilized mice to study osteoporosis in humans.

Also aboard Endeavour were nearly 6000 American flags that were carried into orbit. The "Flags for Heroes and Families" campaign honours victims, survivors, and relief workers associated with the 11 September terrorist attacks on the United States. The families of victims and survivors will receive these flags and a memorial certificate.

While astronaut Dominic Gorie conducts the docking approach of Endeavour to the Space Station, another crewmember photographs the Androgynous Peripheral Attachment System (APAS) docking area of Pressurized Mating Adapter 2 (PMA2). NASA



Flight crew

Endeavour's crew of four consisted of two veteran space flyers and two new astronauts who were making their first flight.

The mission was commanded by Dom Gorie, 44, Capt., USN who was making his third space flight. He had previously logged over 504 hours of space flight time serving as Pilot for the STS-91 and STS-99 Shuttle missions.

Smoke billows from Launch Pad 39B as the Space Shuttle Endeavour lifts off into an afternoon sky to begin the STS-108 mission to the Space Station. NASA

Endeavour's Pilot for STS-108 was Mark E. Kelly, 37, Lt. Cdr., USN who had been selected for astronaut training in 1996 and was making his first space flight.

Mission Specialist One was Linda M. Godwin, 49, PhD who had logged over 633 hours of space flight while flying on STS-37, STS-59, and STS-76. During her STS-76 mission she also logged seven hours of EVA time.

Mission Specialist Two was first-time space flyer Daniel M. Tani, 40, who was also selected for astronaut training in 1996.

The Expedition Four crew members riding up to the Space Station consisted of three experienced space flyers.

Expedition Four Commander is Yury Ivanovich Onufrienko, 40, a Colonel in his country's air force. He commanded the Mir 21 expedition in 1996 from 21 February to 2 September 1996.

Flight Engineer was Carl E. Waltz, 46, Col., USAF, who was a veteran of three missions prior to STS-108 and acquired over 833 hours of space flight time as a mission specialist aboard STS-51, STS-65, and STS-79

Also flying as Flight Engineer was Daniel W.

Bursch, 44, Capt., USN. He too, was a veteran of three missions, having logged over 746 hours on STS-51, STS-68, and STS-77.

Mission day one

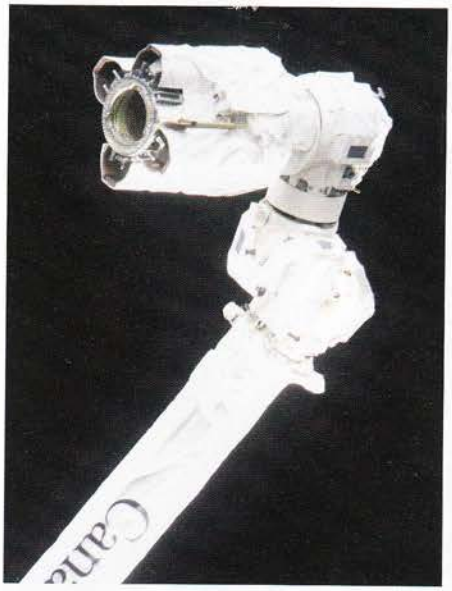
Following Endeavour's flawless launch on 5 December 2001 and the arrival on-orbit, the crew began the routine of unpacking equipment and setting up their computers. Two and a half hours into the mission the first of Endeavour's experiments was activated. At the time of their launch the International Space Station (ISS) had been 402 km above the Indian Ocean and a series of firing Endeavour's manoeuvring and thruster engines would be required to bring the two spacecraft to a docking on mission day three. The first of these firings, which was termed NC-1, occurred shortly before 9:00 pm. Endeavour's Orbital Maneuvering System engines were fired so as to refine the orbital parameters that would bring the spacecraft to the ISS.

After completing their first mission supper, the STS-108 crew settled in for their first night of sleep in space as they began their first sleep period at 12:19 am on Thursday, 6 December. At this point in the flight Endeavour was scheduled to return to Earth on Sunday, 16 December. Later in the flight this would be extended one day to Monday, 17 December.

Mission day two

After being awakened at 8:19 on the morning of Thursday, 6 December, Endeavour's crew spent their first full day in space preparing for the upcoming rendezvous with the ISS and for the Extravehicular Activity (EVA) spacewalk scheduled for later in the mission. During the day Commander Dom Gorie and Pilot Mark Kelly fired the orbiter's manoeuvring engines and thrusters in two firings so as to adjust Endeavour's orbital path as they continued to close with the ISS. The crew checked out the rendezvous systems and the navigational aids that they would use during their final approach to the Space Station. Pilot Kelly and Mission Specialist-One Linda Godwin powered up the Remote Manipulating System's (RMS) robotic arm and checked its performance. They then used the RMS television cameras to perform a survey of the orbiter's payload bay, the experiments, and the Raffaello MPLM cargo carrier mounted in the bay.

EVA astronauts Godwin and Mission Specialist-Two Dan Tani powered up and tested the space suits they would be wearing for a scheduled spacewalk set for later in the mission on Monday, 10 December. The Space Shuttle crew had a few hours of off-duty time during the evening as they prepared for a busy week docked



View of the end effector of the Canadarm2/Space Station Remote Manipulator System (SSRMS) taken by a STS-108 crewmember through an aft flight deck window during the docking approach of the Space Shuttle Endeavour to the Space Station. NASA

to the ISS. Meanwhile, aboard the ISS, the Expedition Three crew of Commander Frank Culbertson, Pilot Vladimir Dezhurov and Flight Engineer Mikhail Tyurin spent their final day alone on the ISS unloading a Russian cargo supply craft that had arrived the previous week and packing for the trip home after more than four months in space.

With the orbiter about 5633 km behind the ISS and closing at a rate of 418 km per orbit, Endeavour's crew began their second eight hour sleep period in space at 11:19 pm - a schedule they would follow for the next week.

Mission day three

Endeavour's crew began their day with the orbiter 1231 km behind the ISS and closing rapidly with the Station. The crew continued with preparations for the rendezvous and docking and at 12:44 pm they reached a point about 15 km behind the ISS. At that point Mission Commander Gorie and Pilot Kelly commanded the Endeavour's thrusters in a final rendezvous manoeuvre firing called the Terminal Initiation burn. During the next orbit of the Earth the on-board radar system tracked the ISS and provided distance and closing rate information. A series of small mid-course correction thruster firings brought Endeavour to a point about 800 m below the ISS.

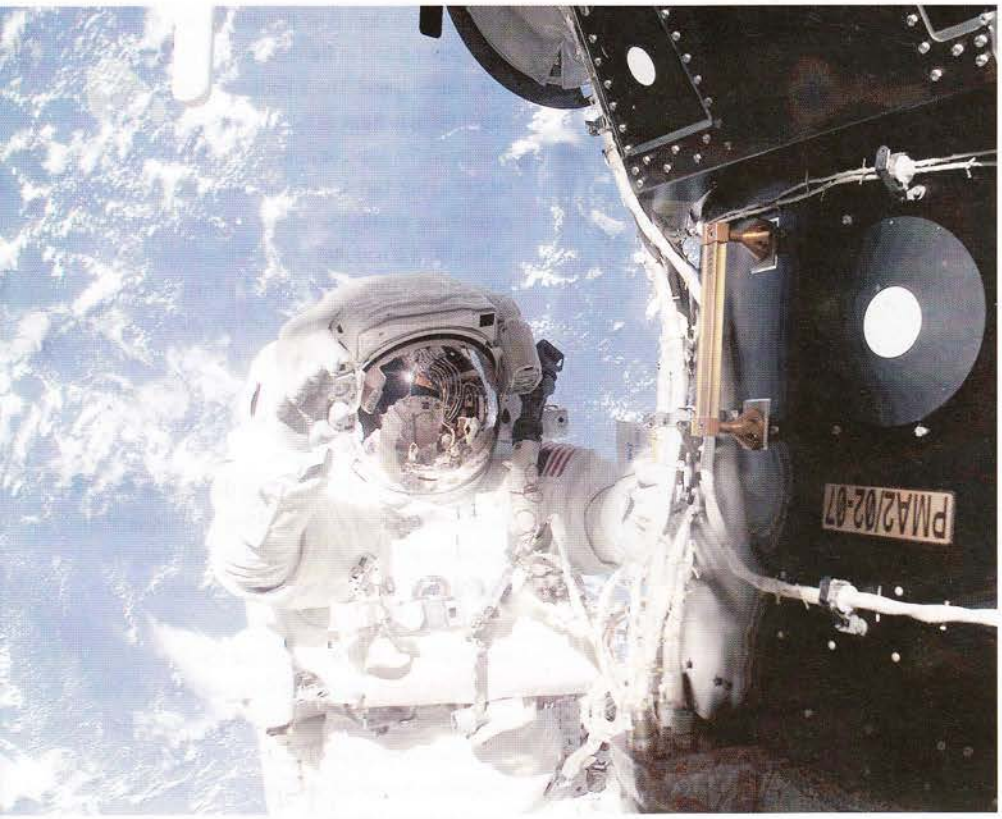
Gorie took over manual control and brought Endeavour up to a point 183 m below the ISS. During the approach operation Mission Specialist Linda Godwin operated a handheld laser ranging device and Mission Specialist Dan Tani coordinated checklists and procedures aboard the Shuttle. Gorie then flew the orbiter in a quarter-circle around and in front of the ISS along its direction of travel. There Endeavour stopped about 90 m in front of the docking port. From that point, Endeavour approached the ISS at a rate of about 160 m per hour. At a distance of about nine metres the orbiter's approach was halted for a scheduled check of the alignment between the two spacecraft. The final approach to the docking port on the Destiny laboratory module was at a speed of about 20 mm per second. The docking occurred at 3:03 pm as the orbiting complex of Shuttle and ISS were passing southwest of Cardiff, Wales.

Initial indications were that the Shuttle's docking ring and the ISS docking mechanism did not align correctly; however, after allowing the relative motion between the two spacecraft to dampen out, a successful hard mate was accomplished. Hatches between the two spacecraft were opened at 5:42 pm and the 10 spacefarers greeted one another as they began eight days of joint operations. Briefings on their respective spacecraft were begun as the two crews merged into one.

Mission day four

The fourth mission day of STS-108 was marked by the removal of the Raffaello MPLM from Endeavour's payload bay and the official end of the Expedition Three crews' 117-day residency aboard the ISS. Endeavour's Pilot, Mark Kelly and Mission Specialist-One Linda Godwin used the RMS robotic arm to remove the Raffaello from the payload bay at 12:01 pm. The transfer from the orbiter to the ISS took just 54 minutes as the robot arm grasped the module and removed it from the payload bay and then attached the module to the Unity Node's berthing mechanism. The hatch to the MPLM was opened at 8:30 pm on Saturday, 8 December and the supply transfer operations were begun. Supplies and equipment were also transferred from the Endeavour's mid deck to the ISS during the day.

The formal exchange of Space Stations crews took place as the Expedition Three crew of Frank Culbertson, Vladimir Dezhurov, and Mikhail Tyurin removed their customised seat liners from the Russian Soyuz spacecraft and these were replaced by the customised seat liners of the Expedition Four crew of Commander Yury Onufrienko, and Flight Engineers Dan Bursch and Carl Walz. As each Expedition Four crewmember's seat liner was installed and checked out he officially became a resident of the ISS and the Expedition Three astronauts became members of Endeavour's crew. The crew transfer was completed at 5:11 pm. Handover briefings were continued between the two crews though much



Astronaut Daniel Tani traverses along the Pressurized Mating Adapter 2 (PMA-2) on the Space Station backdropped against the blue and white Earth during the four-hour extravehicular activity (EVA). Tani was joined on the space walk by Linda Godwin. NASA

of the time joint Shuttle-ISS operations were taking place.

Mission day five

The crews' activities focused on continuing the transfer of supplies and equipment between the Raffaello MPLM and the ISS. Over 2700 kg of new food, supplies and equipment were transferred to the ISS during the day as Expedition Three astronauts continued with briefings and handover operations to the Expedition Four ISS crew. Endeavour's thruster jets were fired to gradually increase the altitude of the ISS by about 3.2 km over a period of an hour in the first of three planned reboost efforts for the mission during the week of docked operations.

The 10 ISS and Endeavour crewmembers took time from their operations to pay tribute to the heroes of the 11 September 2001 attacks on New York and the Pentagon. Endeavour carried 6000 small United States flags that will be distributed to heroes and families of the victims of the attack after the completion of STS-108. Also aboard were a United States flag found at the World Trade Center site after the attacks, a United States flag flown above the Pennsylvania capitol, a United States Marine Corps flag from the Pentagon, a New York Fire Department flag, and a poster that included photographs of fire-fighters lost in the attacks. Shuttle Commander Dom Gorie said that the flag from the World Trade Center elicited especially poignant thoughts among the crew. "This was found among the rubble and it has a few tears in it. You can still smell the ashes. It is a tremendous symbol of our country. Just like our country it was a little battered and bruised and torn, but with a little bit of repair it is going to fly as high and as beautiful as it ever did. And that is just what our country is doing."

The hatches between the Shuttle and the ISS were closed at about 7:43 pm on Sunday, 9 December with the Expedition Four crewmembers remaining aboard the ISS. This hatch closure was done in preparation for the EVA operation planned for the following day. Closing the hatches allowed the pressure in the Endeavour's cabin to be reduced in order to protect the space walkers from decompression sickness when they went to the low-pressure pure oxygen environment of their space suits.

Mission day six

The day's activities centred on an EVA spacewalk by astronauts Linda Godwin and Dan Tani to install thermal insulation blankets on two Beta Gimbal Assemblies (BGA) that control the rotation of the ISS solar arrays as they track the Sun. The thermal blankets will protect the BGAs from variations in temperature that have been causing current spikes from motors inside the BGAs. Godwin, designated EVA-1, and Tani, designated EVA-2, left the Shuttle's airlock at 12:52 pm on 10 December. Mission Commander Dom Gorie coordinated activities from inside the Shuttle's cabin and Pilot Mark Kelly operated the RMS robotic arm in support of the EVA. The two spacewalkers were transferred part of the way up the ISS truss by the robot arm as they held on to tethers securing them to the arm. This was as far as the arm could reach in transferring them. They then manoeuvred hand-over-hand to their work site 24.4 m above the payload bay atop the P6 truss. They installed the blankets on the port array BGA first and then moved to the starboard unit.

After accomplishing the blanket installation, the EVA duo attempted to secure a brace on the starboard array wing. The wing has four braces and one did not latch properly when installed during the STS-97 mission in 2000. They were unable to get the brace to latch properly, however engineers feel that the three braces that are latched correctly are sufficient to hold the array. On their way back down from the top of the Station they retrieved a cover which had been removed from a Station S-band antenna during a previous flight. The cover, used to protect the antenna prior to its installation, was returned to Earth and may be reused. They also performed several "get ahead" tasks that will help the STS-110 mission in 2002. That mission will install a central truss section on the Station and Godwin and Tani positioned two Circuit Interrupt Devices on the ISS exterior Z1 truss. They will be installed during the STS-110 mission. They also retrieved several tools from exterior storage and the tools were placed inside ISS so as to save time retrieving them during the STS-110 EVA operation. The EVA was completed at 5:04 pm for a four hour and 12 minute spacewalk. The EVA operation completed a record year of 18

Linda Godwin works in the Rafaello Multi-Purpose Logistics Module (MPLM) on the Space Station. NASA

spacewalks; 12 originating from the Space Shuttles and six from the ISS. In 2002 there are 22 spacewalks currently planned.

Just before 7:00 pm the hatches between Raffaello and the ISS were reopened and transfer operations resumed. At this point in the mission over 1590 kg of material had been transferred from the MPLM and over 300 kg had been transferred from the Endeavour's cabin.

Mission day seven

The STS-108 astronauts began their seventh day of the mission on the morning of Tuesday, 11 December 2001. Three months had passed since the 11 September attacks and in remembrance the national anthems of the United States and Russia were played in the ISS, Endeavour, and the ISS and Shuttle control rooms at Mission Control. The event took place at 8:46 am - the exact moment of the attack three months previously. STS-108 Lead Flight Director Wayne Hale told the Mission Control crews that "More than 3000 people perished this day three months ago, including more than 200 citizens from countries that are family members of the International Space Station programme - Canada, Italy, France, Germany, Japan and Russia."

The crew of Endeavour learned that they would be spending an extra day in space as Mission Control advised them that their landing was rescheduled from Sunday to Monday, 17 December. The extra day would give them time to assist in additional maintenance work on the ISS. These tasks included work on a treadmill and an air conditioner.

The second of three reboost operations was performed as Endeavour's thrusters were fired in a series of pulses over an hour to raise the ISS orbit by almost five km.

Mission day eight

Logistics operations continued during the day. Crew activity was now including repacking unwanted ISS equipment aboard the Raffaello MPLM. Over 816 kg of equipment had now been loaded aboard Raffaello for transshipment to Earth.

Endeavour's crew also assisted the Expedition Four crew in replacing most of the components of a treadmill today. The Expedition Four crew will use the treadmill almost daily during their five and a half month stay aboard the ISS. The old parts from the treadmill, after replacement, were loaded aboard the Raffaello for shipment back to Earth. There they will be refurbished and, ultimately, reused.

A third reboost of the Station by Endeavour was performed. This was the final reboost of a set of three that raised the Station's orbit by about 14.5 km. The Station's average altitude was now about 387.85 km.

The Expedition Four (green shirts), STS-108 (blue shirts) and Expedition Three (white shirts) crews assemble in the Destiny laboratory on the Space Station. The Expedition Four crew members are (from front to back) cosmonaut Yuri Onufrienko, mission commander; astronauts Daniel Bursch and Carl Walz, flight engineers. STS-108 crew members are (back row) astronauts Linda Godwin, mission specialist; Mark Kelly, pilot; Dominic Gorie, commander; Daniel Tani, missions specialist. Expedition Three crew members are (from front to back) astronaut Frank Culbertson, mission commander; cosmoanuts Vladimir Dezhurov and Mikhail Tyurin, flights engineers. Onufrienko, Dezhurov and Tyurin represent Rosaviakosmos. NASA

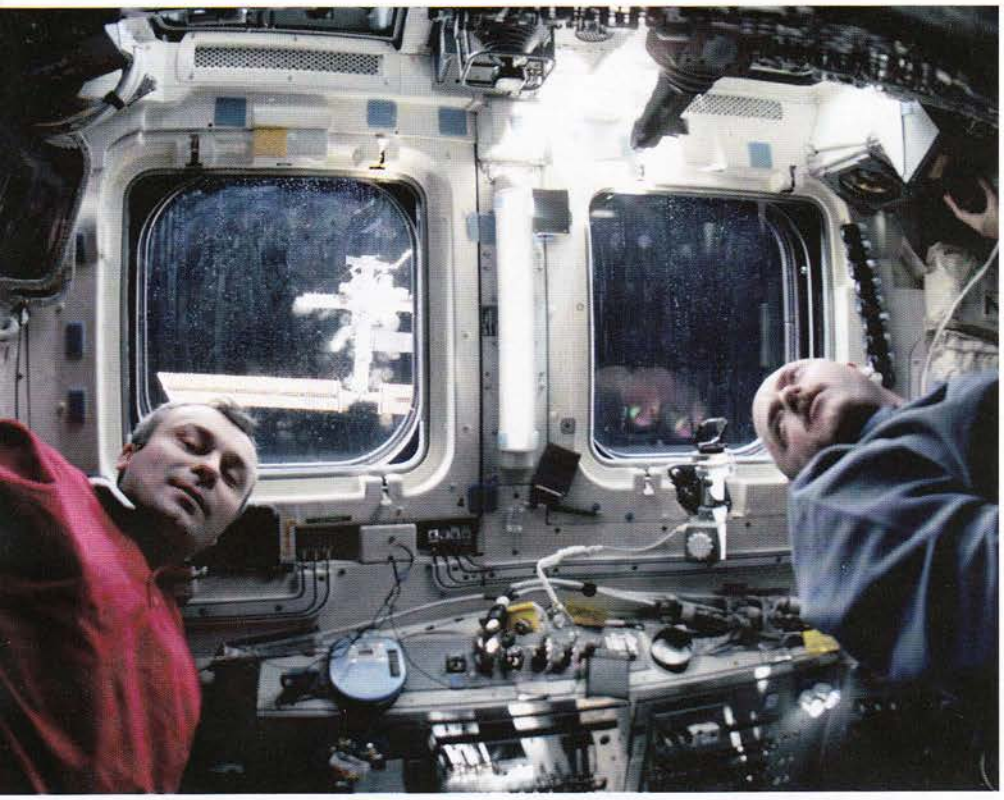
Mission day nine

Overnight the crew and Mission Control noted a transient problem with one of the three Inertial Measurement Units (IMU) aboard Endeavour. The IMU in question, IMU-2, was one of two units then on line, the third being off line to conserve electricity. IMU-2 was immediately taken off line and the third was brought on line to replace it. The IMUs are the primary navigation units for the Shuttle, however the loss of one IMU has no impact on the mission and Endeavour could operate well with only one IMU if needed. After being taken off line IMU-2 operated satisfactorily but controllers considered the unit as failed.

With a light schedule of activities for this day the STS-108 crew were allowed an extra hour of sleep. Logistic transfer operations continued during the day and over 70 percent of the trash and gear, including the Expedition Three Soyuz seat liners, to be loaded aboard Raffaello was now stowed in the MPLM.

Shortly after 4:00 pm on Thursday, 13 December a ceremony to officially transfer command of the ISS from Frank Culbertson to Yury Onufrienko was held in the Destiny module as the Expedition Four and STS-108 crews looked on.

Mark Kelly (left) and Daniel Tani, hold a bag of several American flags on the aft flight deck of the Space Shuttle Endeavour. NASA



As seen though a window on Endeavour's aft flight deck, the Space Station now staffed with its fourth three-person crew, affords cosmonaut Vladimir Dezhurov (left), joined here by astronaut Mark Kelly, a farewell look from the Shuttle following undocking. NASA

73533

Mission day ten

During the morning Yury Onufrienko and Vladimir Dezhurov worked to replace a faulty compressor in the Zvezda module as the crews completed cargo transfer operations. Over 2700 kg of material had been transferred to the ISS and over 900 kg of unneeded trash, gear, and equipment had been moved into the Raffaello MPLM. Handover briefings between the Expedition Three and Expedition Four crews continued, as they had during docked operations.

73534

About 11:00 am the Raffaello hatches were closed and about 2:20 pm Pilot Mark Kelly and Mission Specialist Linda Godwin began the process of bringing the module back into Endeavour's payload bay. Kelly used the robot arm to detach the MPLM from the ISS and place it back inside the Endeavour's payload bay. Raffaello was latched back in the bay at 5:44 pm on 14 December.

At Mission Control the flight controllers were modifying the next day's planned departure of Endeavour from the ISS. Mission Control was notified early on the 14th that a spent Russian rocket upper stage that had been launched in the 1970s could pass within five km of the ISS on 16 December. Mission controllers replanned the departure to allow an additional reboost effort that would result in the debris passing about 65 km from the Station.

Mission day eleven

The Expedition Four and STS-108 crews said their final farewells as the hatches between the two spacecraft were closed at 8:16 am on the morning of Saturday, 15 December. At 9:55 the orbiter's thruster jets were fired in a series of pulses to increase the ISS orbit about 1,200 meters so as to remain well clear of a spent Russian rocket.

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When the time came for the separation of the two spacecraft, Mission Specialist Linda Godwin sent a command to the docking system that releases the docking mechanism and powerful springs pushed the Endeavour away from the ISS. Endeavour's steering jets were shut off during this period to preclude any inadvertent firing during the initial separation. Endeavour undocked from the ISS at 12:28 pm as the two spacecraft flew 386 km above the Indian Ocean off the coast of Australia. Pilot Mark Kelly reactivated the thrusters after Endeavour had moved about 0.6 m away from the Station. Working from the control station on the aft flight deck Kelly brought the Endeavour out about 137 m from the ISS. From that point he flew a one and a quarter circular path over, behind, under, in front, and again over the ISS. The complete fly-around lasted about 90 minutes. At the completion point, above the ISS, Kelly fired the Endeavour's thrusters to separate the orbiter from the vicinity of the Station.

With Endeavour successfully undocked and moving away from the ISS, the astronauts aboard had a chance for several hours of off duty time before turning in for the night.

Mission day twelve

The Endeavour's crew members were awakened for their final full day in space at 4:13 am. The last few days had seen their sleep cycle gradually moved earlier so as to support a mid-day landing at the Kennedy Space Center on Monday, 17 December.

Activities through the day centred on routine prelanding checks and stowage operations. The Endeavour's flight controls were checked and the systems to be used in the reentry and landing the next day were tested.

About 10:00 am a small satellite was released from the payload bay. The satellite, named STARSHINE 2 was released from a canister in the payload bay. The satellite has over 845 mirrors and over 30,000 students from 660 schools in 26 countries will optically track the satellite as it orbits the Earth for eight months. The students, many of whom helped polish the mirrors, will use the information they collect to calculate the density of the Earth's upper atmosphere.

Mission day thirteen

The STS-108 crew was awakened at 4:19 am on 17 December for their final day in space. There were two landing opportunities at the Kennedy Space Center on this day. One was at about 12:55 pm and the second was at 2:32 pm. Weather was predicted as being good and the alternate landing site in California was not activated.

73536

Deorbit preparations aboard Endeavour began just before 8:00 am. The payload bay doors were closed at 9:10 am and the crew began climbing into their seats at 10:50 am. Mission Commander Dom Gorie, Pilot Mark Kelly, Mission Specialist Linda Godwin and Mission Specialist Dan Tani were seated on the flight deck. Below them in special recumbent chairs to reduce the effects of gravity was the Expedition Three crew of Frank Culbertson, Vladimir Dezhurov and Mikhail Tyurin. About 11:35 they were given the "go" for reentry and landing on the first opportunity. The reentry burn began at about 11:52 and Endeavour commenced it's return to Earth after a voyage of over 7.7 million km. Endeavour's main landing gear touched down on Runway 15 at 12:55.11 pm on the afternoon of 17 December 2001 after a flight of 11 days, 19 hours, 35 minutes, and 43 seconds. The nose landing gear touched down 13 seconds later and Endeavour rolled to a full stop one minute and six seconds after initial touchdown. This had been the 57th landing at the Kennedy Space Center. STS-108 was the last flight of year 2001.

19754

Clear skies in December

Sir, Please find enclosed a photograph of the Space Shuttle Endeavour docked with the International Space Station taken at 17.32 GMT on 11 December 2001, while it was passing over the UK during STS-108.

Due to favourable weather conditions the combination was visible over the UK on most evenings throughout its mission. I managed to see the STS-108 mission 14 times including three very brief sightings of Endeavour before it docked.

I believe there have been 44 potentially visible missions over the UK (ie launched into the correct orbit) but how many of these missions have actually been seen and recorded?

R.S. Ling
Lowestoft, England

73537

Final Space Shuttle mission of 2001

73538

The Space Shuttle Endeavour (left) was launched from the Kennedy Space Center, Florida, on 5 December en route to the International Space Station and the last manned flight of 2001.

The primary task of the STS-108 mission was to deliver the Expedition Four Crew - Commander Yuri Onufrienko, and Flight Engineers Carl Walz and Dan Bursch - and return the Expedition Three crew home to Earth. It was the 12th Shuttle mission to visit the Space Station.

The Expedition Three crew - Frank Culbertson, Vladimir Dezhurov and Mikhail Tyurin - had been aboard the Station since August. Dominic Gorie commanded Endeavour with Mark Kelly as pilot. Astronauts Linda Godwin and Daniel Tani were mission specialists.

NASA used the flight to honour victims of the September 11 terrorist attacks by sending nearly 6000 flags into orbit as part of the 'Flags for Heroes and Families' campaign.

After the mission the flags were due to be mounted on specially designed memorial certificates and presented to the survivors and families of the victims of the attacks.

Spaceflight : februari 2002

19755

STS-108: vierde bemanning afgeleverd, reparatie zonnepaneel

73539

Space Shuttle missie STS-108 stond in het teken van de aanslagen op het World Trade Center en het Pentagon. Allereerst waren er de vele bijzondere spullen aan boord, zoals de vlag die op een van de twee WTC-torens had gewapperd en vrijwel ongeschonden was teruggevonden en 6000 vlaggetjes voor de familie van de slachtoffers. Daarnaast was er de bemanning van het ruimtestation, die zou terugkeren naar een 'veranderde aarde'. Maar het meest opvallende waren de uitgebreide veiligheidsmaatregelen. Even was er zelfs sprake dat de lancering net zo geheim zou zijn als in het verleden de militaire missies. In het geval van een vlucht naar het ISS heeft dat echter weinig zin, omdat iedereen kan uitrekenen hoe laat een Shuttle moet vertrekken om in de juiste baan te komen. Het bleef daarom bij luchtdoelraketten bij het lanceerplatform en strenge regels voor pers en publiek.

Door ERIK VAN DER HOORN

Lancering

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In september zag het er even naar uit dat Frank Culbertson, Vladimir Dezhurov en Mikhail Tyurin tot januari 2002 in de ruimte moesten blijven, omdat er een defect werd vermoed aan de bevestigingspunten van de Orbital Maneuvering System (OMS)-gondels van alle vier de Shuttles. Op 6 oktober besloot NASA echter dat de lancering van Endeavour kon doorgaan.

Terwijl gevechtsvliegtuigen boven Cape Canaveral cirkelden, werd de Shuttle op 31 oktober naar lanceerplaats 39B gerold voor een lancering op 29 november. Maar een dag voor die datum ontstonden problemen aan boord van het ISS. De koppeling van het bevoorradingsschip Progress-6, dat een paar dagen eerder was gelanceerd, verliep niet zoals gepland.

Er bleek een stuk van een rubberen afdichtingsring tussen het koppelsysteem te zijn gekomen. Op maandag 3 december moesten Dezhurov en Tyurin daarom eerst een ruimtewandeling maken. Met een in elkaar geknutselde haak slaagden ze erin om het stuk rubber te verwijderen, waarna de Progress en ISS stevig aan elkaar gekoppeld konden worden.

De lancering van Endeavour werd daarna nog een dag uitgesteld vanwege het slechte weer in Florida. Op woensdagavond 5 december vertrok Endeavour met een kleine week vertraging naar het ruimtestation.

Koppeling

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Ook de koppeling van Endeavour en het station verliep niet vlekkeloos. Toen beide ruimteschepen op vrijdagavond 7 december contact met elkaar maakten, lukte het aanvankelijk niet om een vaste verbinding tot stand te brengen. Maar nadat de astronauten een half uur de tijd hadden genomen om alle bewegingen van de Shuttle en ISS helemaal te laten wegebben, lukte het wel. Het was de 12e keer dat een Shuttle afmeerde bij het station en het eerste bezoek dat Culbertson, Dezhurov en Tyurin ontvingen in 119 dagen.

Raffaello

Het eerste punt op de agenda was het vastmaken van de Italiaanse Raffaello-module aan de Unity-module van het station. Raffaello werd op zaterdag de 8e door Linda Godwin met de robotarm uit het ruim van Endeavour getild. De module was gevuld met bijna 3000 kilo materiaal, waaronder voedsel.

Daarna was het tijd om de Expeditie-3 bemanning af te lossen. Nadat de Sojoez-zittingen van Culbertson, Dezhurov en Tyurin waren vervangen door die van Yuri Onufrienko, Dan Bursch en Carl Walz, was de wisseling een feit.

Ruimtewandeling

73542

Op maandag 10 december maakten Linda Godwin en Daniel Tani een ruimtewandeling. Die was bedoeld om een probleem met een van de twee grote zonnepanelen van het ISS te verhelpen.
Aanvankelijk zou het een ingewikkelde klus worden, waarbij een onderdeel van de motor waarmee het paneel de zon kan blijven volgen, moest worden vervangen. Uiteindelijk kwamen de technici met een simpelere oplossing. Godwin en

Vluchtgegevens

Vlucht	:	STS-108 (107e Shuttle-missie)
Ruimteveer	:	Endeavour (17e vlucht)
Doel/lading	:	ISS-UF1; 1 EVA; MPLM Raffaello; Starshine-3
Lancering	:	5 december 2001, 23:19.28 uur Ned. Tijd
Lanceerplaats	:	Kennedy Space Center, platform 39B
Omloopbaan	:	385 kilometer, 51.6 graden t.o.v. evenaar
Vluchtduur	:	11 dagen, 19 uur, 35 minuten, 42 seconden
Landing	:	17 december 2001, 18:55.10 uur Ned. Tijd
Plaats	:	Kennedy Space Center, baan 15

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Vluchtleider Wayne Hale (midden) staat stil bij de gebeurtenissen op 11 september. Geheel rechts staat astronaute Shannon Lucid, die tijdens deze vlucht een van de verbindingsmensen was in Mission Control.

Tani hoefden nu alleen maar een isolerende deken aan te brengen, die de temperaturen in de motor omlaag moesten brengen. De wandeling, de 31e bij het ruimtestation, duurde vier uur en twaalf minuten.

Herdenking

Op zondag had de bemanning al even stilgestaan bij de gebeurtenissen op 11 september. Frank Culbertson, die de piloot van het vliegtuig dat op het Pentagon stortte persoonlijk had gekend, voerde toen het woord. Dinsdag de 11e, precies drie maanden na de aanslagen in Amerika, was het tijd voor een grotere herdenkingsdienst. Het Amerikaanse en Russische volkslied werden ten gehore gebracht en iedereen in Mission Control in Houston stond op van z'n stoel.

Vluchtleider Wayne Hale hield een toespraak en ook Culbertson, Onufrienko en Shuttle-commandant Dom Gorie zeiden nog de nodige woorden.

Dag verlenging

De bemanning van STS-108 was erg zuinig met z'n energie omgesprongen, waardoor de vluchtleiding dinsdagochtend goed nieuws had: de vlucht werd met een dag verlengd. Die dag konden ze mooi gebruiken om de inmiddels leeggepakte Raffaello helemaal vol te laden met afval en om de lopende band aan boord van het station - gebruikt voor fitness-oefeningen - te repareren.

Op woensdag ontstond er een mankement aan een van de drie Inertial Measurement Units (IMU's) van Endeavour, instrumenten die worden gebruikt voor de navigatie. Vroeger had dit tot een noodlanding geleid (STS-44), maar inmiddels is het vertrouwen in de systemen van het ruimteveer zodanig gegroeid, dat twee IMU's genoeg zijn.

Bemanning STS-108

CDR	:	Dom Gorie (44), 3e vlucht
PLT/RMS	:	Mark Kelly (37), 1e vlucht
MS-1/EV1/RMS:		Linda Godwin (49), 4e vlucht
MS-2/EV2	:	Daniel Tani (40), 1e vlucht
Heen:		
ISS-4	:	Yuri Onufrienko (40), 2e vlucht,
ISS-4	:	Daniel Bursch (44), 4e vlucht
ISS-4	:	Carl Walz (46), 4e vlucht
Terug:		
ISS-3	:	Frank Culbertson (52), 3e vlucht
ISS-3	:	Vladimir Dezhurov (39), 2e vlucht
ISS-3	:	Mikhail Tyurin (41), 1e vlucht

CDR = Commandant, PLT = Piloot, EV = Ruimtewandelaar, RMS = bediening robotarm, ISS = Expeditielid

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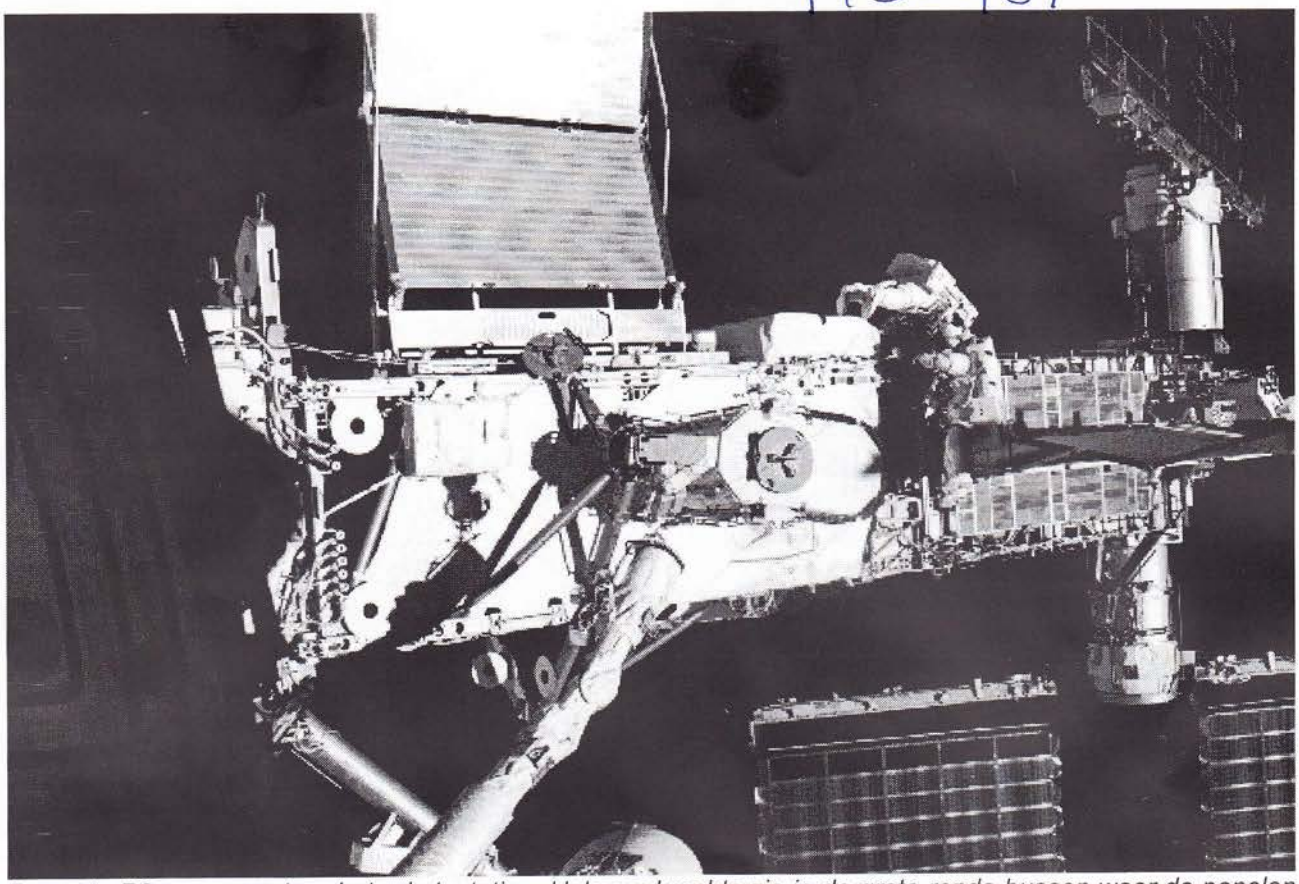

De grote P6-zonnemast op het ruimtestation. Helemaal rechts zie je de grote ronde bussen waar de panelen draaien om in de zon te blijven. Linda Godwin en Daniel Tani (rechts in het midden op de foto) deden daar het nodige onderhoudswerk.

Donderdag plaatste de bemanning de Rafaello weer aan boord van Endeavour. De robotarm werd ditmaal bediend door Shuttle-piloot Mark Kelly.

Ruimteschroot 73549

De ontkoppeling op vrijdag liep wat vertraging op door een stuk ruimteschroot, een Russische rakettrap uit de jaren zeventig. Deze kwam zo dicht in de buurt van het station (nog altijd zestig kilometer), dat de baan van ISS moest worden verhoogd. De stuurraketten van de Shuttle werden hiervoor 20 minuten lang ontstoken.
Aan het eind van de missie lanceerden de astronauten nog een klein satellietje, de Starshine-3. Die wordt de komende tijd vanaf aarde gevolgd door studenten.

Landing

Na een vlucht van bijna 12 dagen (129 voor de Expedition-bemanning) landde Endeavour op maandag de 17e op het Kennedy Space Center.

Lanceerschema Space Shuttle
Missie: STS-109 **Lancering:** 21 februari 2002 **Shuttle:** Columbia **Doel:** Onderhoud Hubble Space Telescope (SM3B), 5 ruimtewandelingen. **Bemanning:** Altman, Carey, Grunsfeld, Currie, Linnehan, Newman, Massimino.
Missie: STS-110 **Lancering:** 4 april 2002 **Shuttle:** Atlantis **Doel:** ISS 8A (S0-frame, mobiele basis Canadarm-2) **Bemanning:** Bloomfield, Frick, Jerry Ross (7e vlucht!), Smith, Ochoa, Morin, Walheim.
Missie: STS-111 **Lancering:** 2 mei 2002 **Shuttle:** Endeavour **Doel:** Space Station Utility Flight (UF)-2; ISS-4 bemanning terug **Bemanning:** Cockrell, Lockhart, Chang-Diaz (7e vlucht!), Perrin (Frankrijk), Valeri Korzun (ISS-5), Peggy Whitson (ISS-5), Sergei Treschev (ISS-5).
Missie: STS-107 **Lancering:** 27 juni 2002 **Shuttle:** Columbia **Doel:** Spacehab & Freestar-brug in laadruim **Bemanning:** Husband. McCool, Anderson, Chawla, Dave Brown, Clark, Ilan Ramon (Israel).
Missie: STS-112 **Lancering:** 1 augustus 2002 **Shuttle:** Atlantis **Doel:** Space Station 9A (S1-frame, CETA-A karretje voor ruimtewandelaars) **Bemanning:** Ashby, Melroy, Sellers, Magnus, Wolf, Yurchikhin (Rusland).
Missie: STS-113 **Lancering:** 6 september 2002 **Shuttle:** Endeavour **Doel:** Space Station 11A (P1-frame, CETA-B karretje voor ruimtewandelaars, ISS-5 bemanning terug) **Bemanning:** Wetherbee, Loria, Lopez-Alegria, Herrington, Ken Bowersox (ISS-6), Don Thomas (ISS-6), Nicolai Budarin (ISS-6).
Missie: STS-114 **Lancering:** 16 januari 2003 **Shuttle:** Atlantis **Doel:** Space Station 12A (P3/P4-frame, ISS-6 bemanning terug) **Bemanning:** Collins, Jim Kelly, Noguchi (Japan), Robinson, Ed Lu (ISS-7), Yury Malenchenko (ISS-7), Sergei Moschenko (ISS-7).

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The Space Shuttle Endeavour, controlled by the flight crew of STS-108, is backdropped over a large area of cloud cover on Earth as it nears its rendezvous with the Space Station. The Raffaello logistics module that is being brought up to the orbiting outpost is clearly visible in Endeavour's cargo bay.

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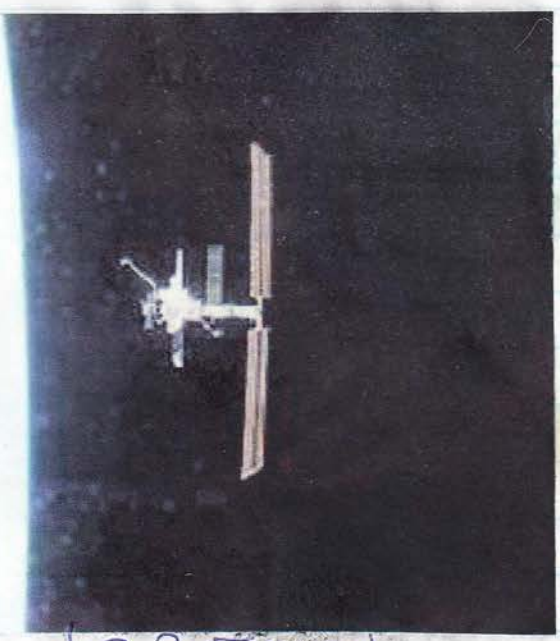

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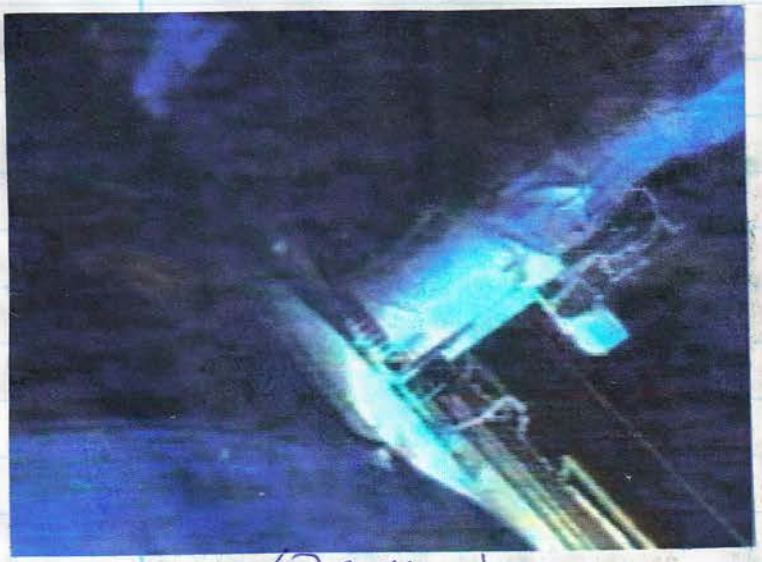

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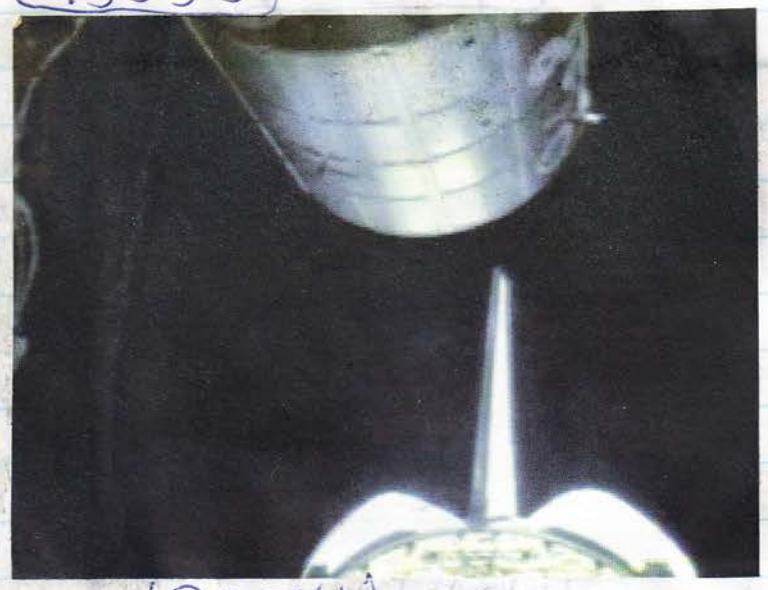

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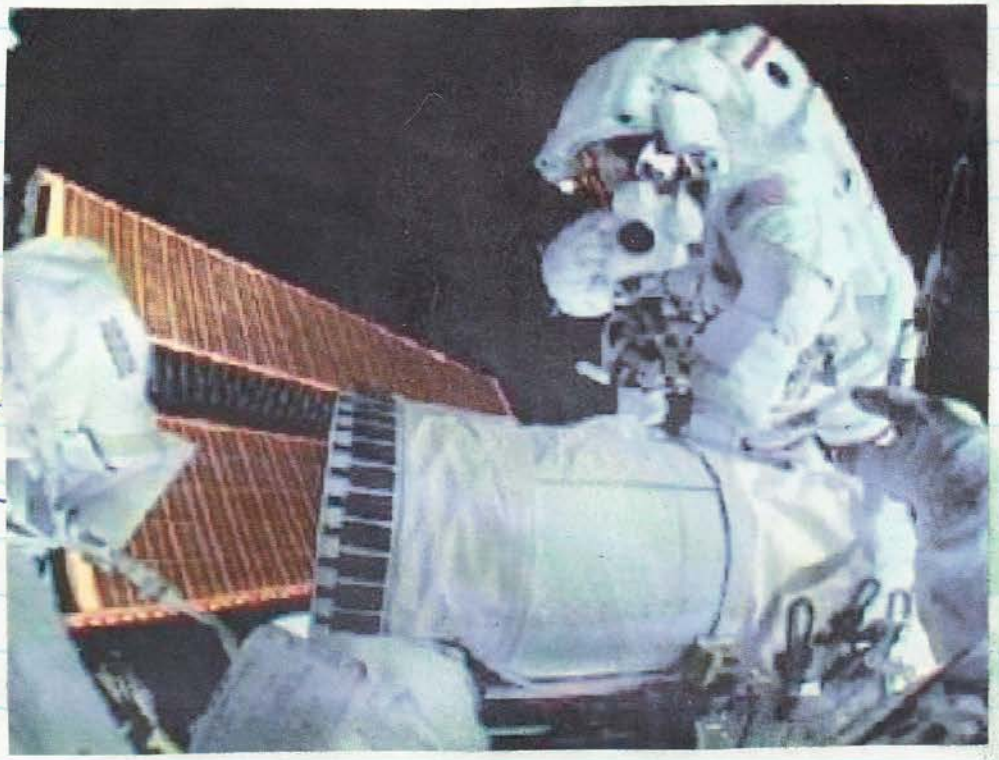

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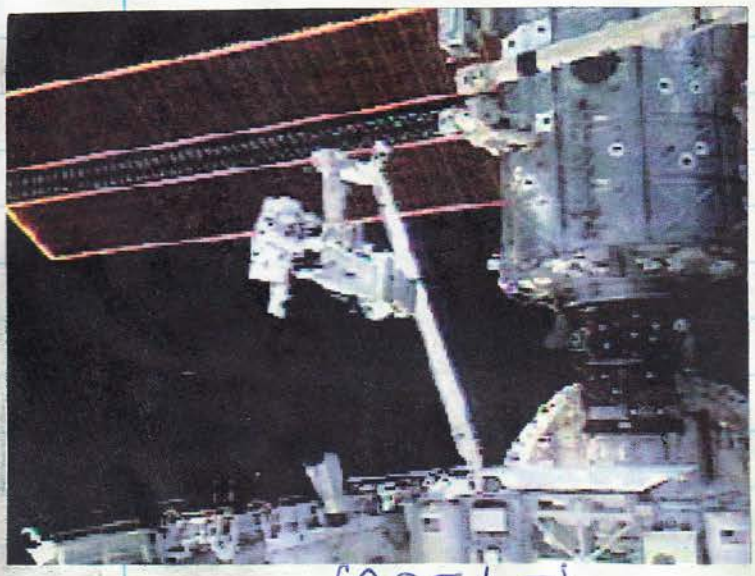

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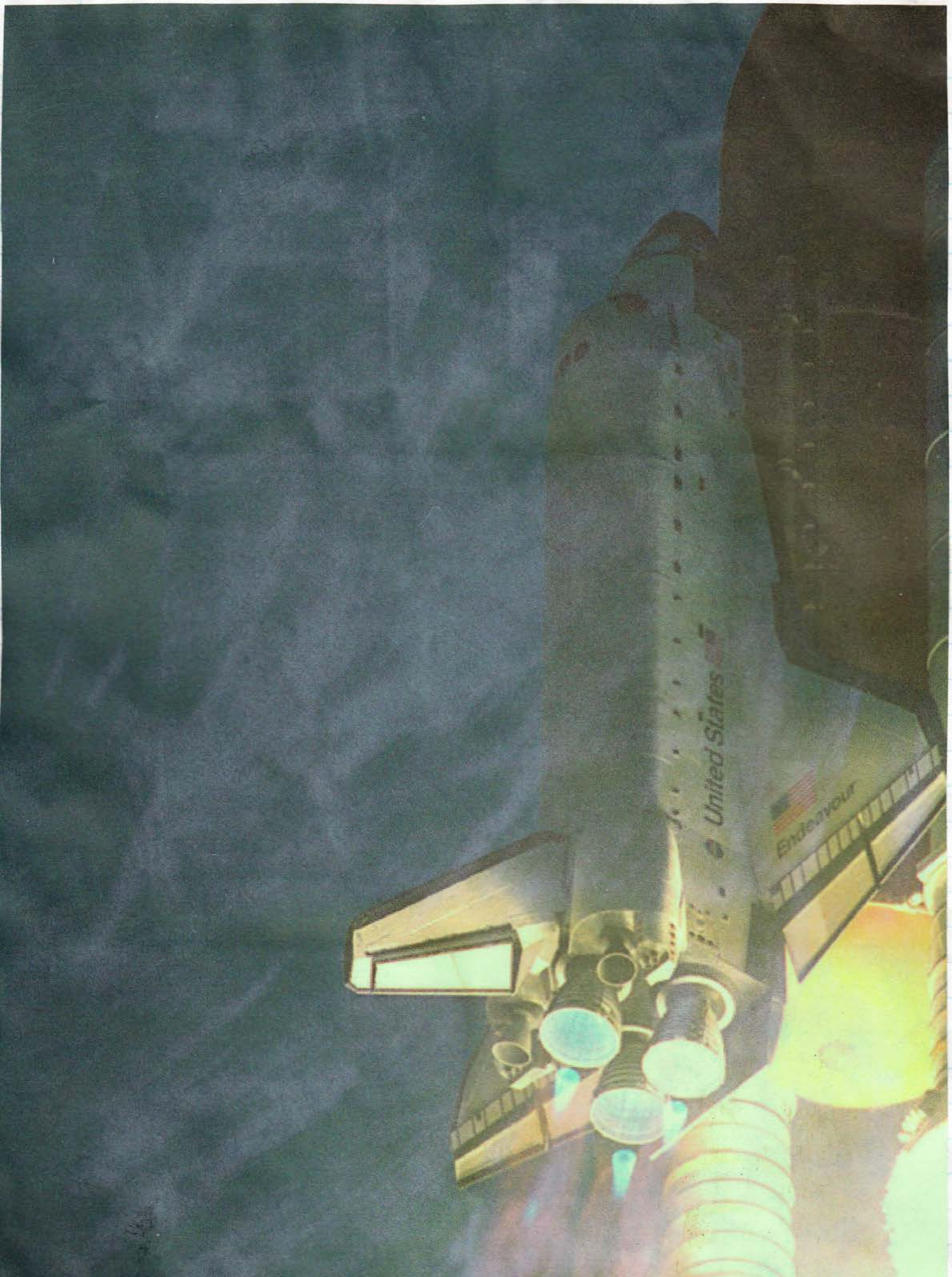

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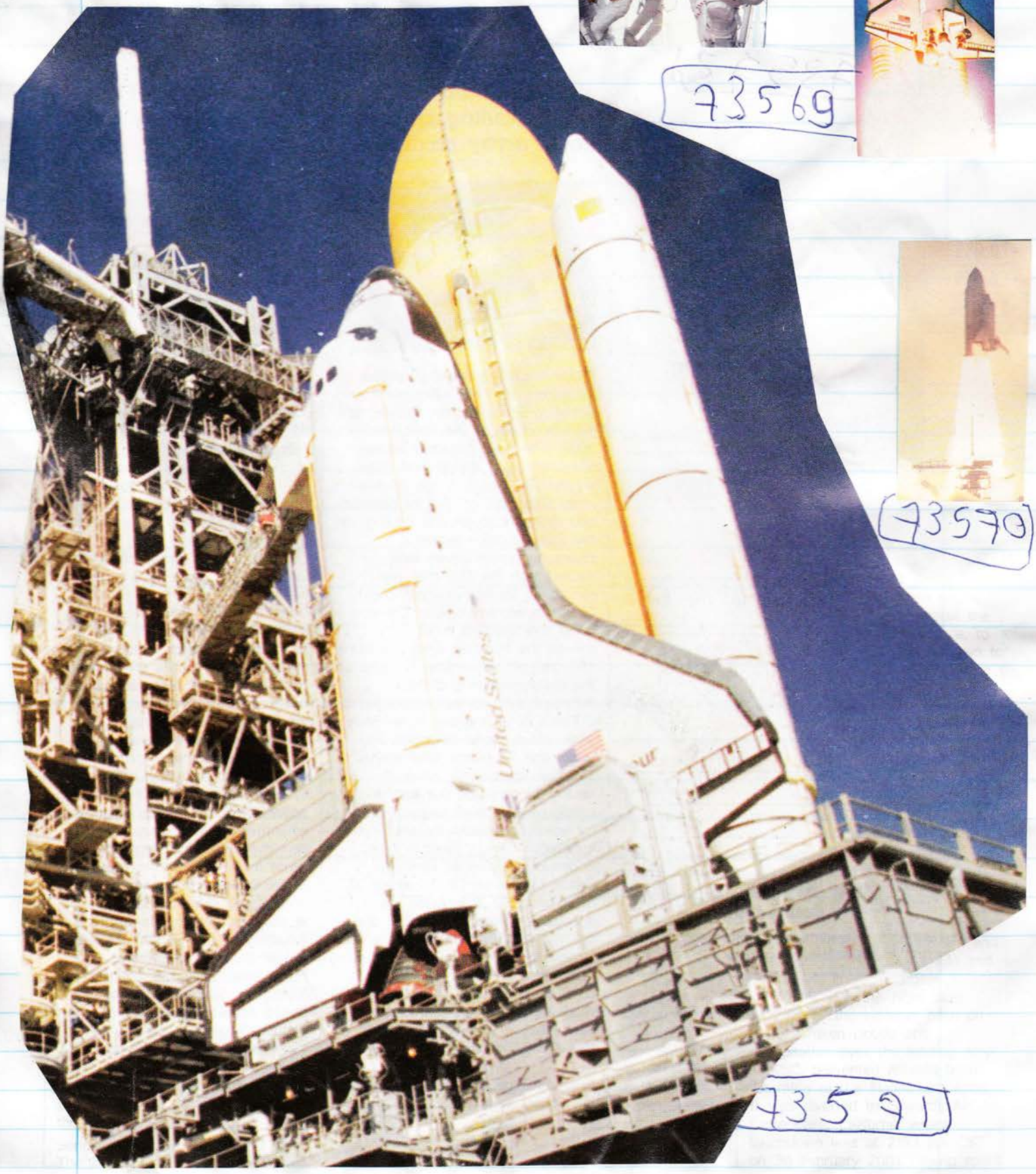

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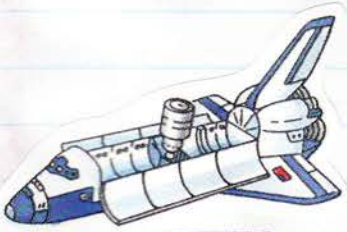

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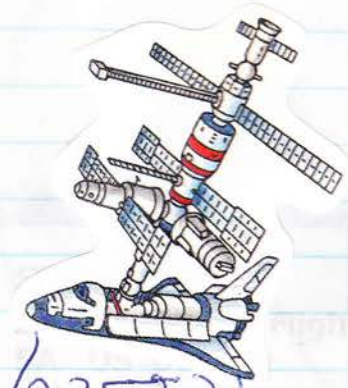

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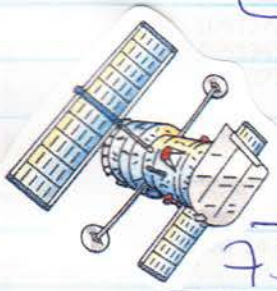

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Endeavour

Fourth crew to Space Station

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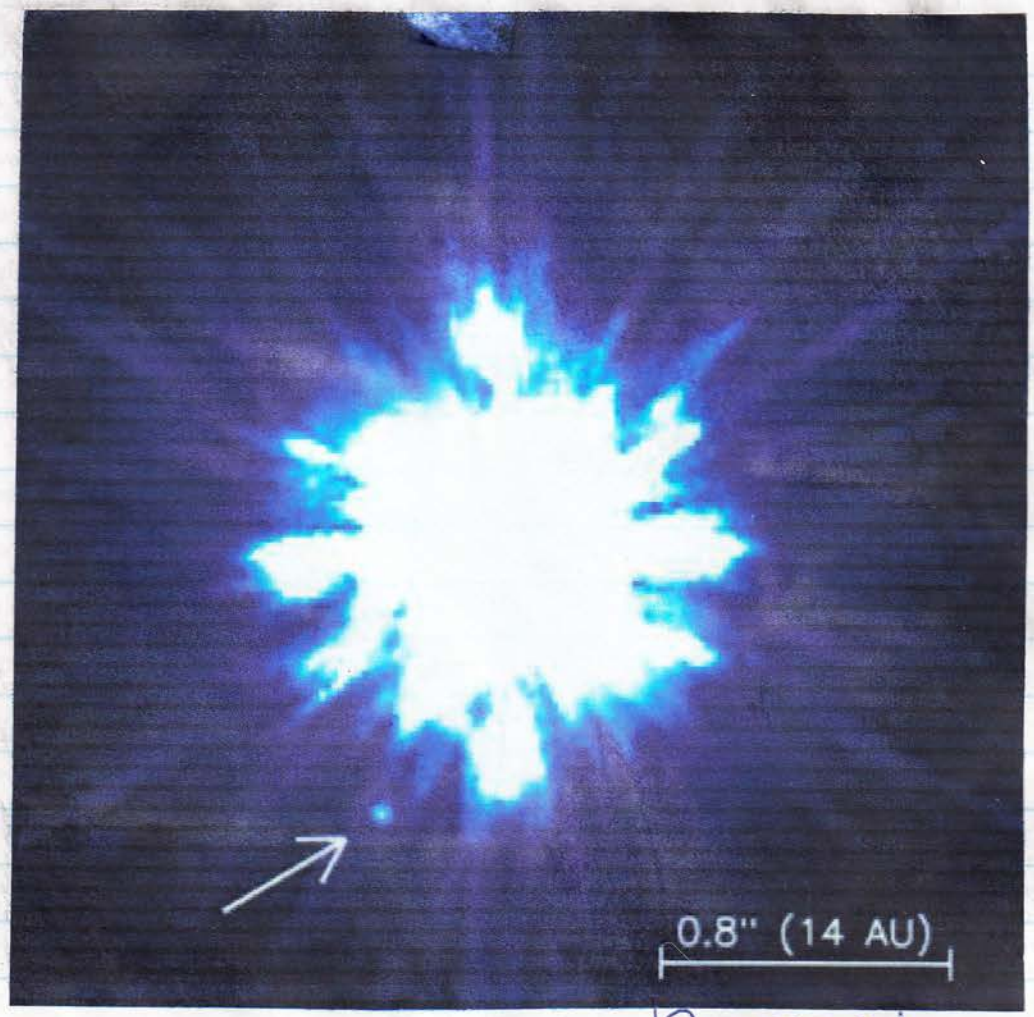

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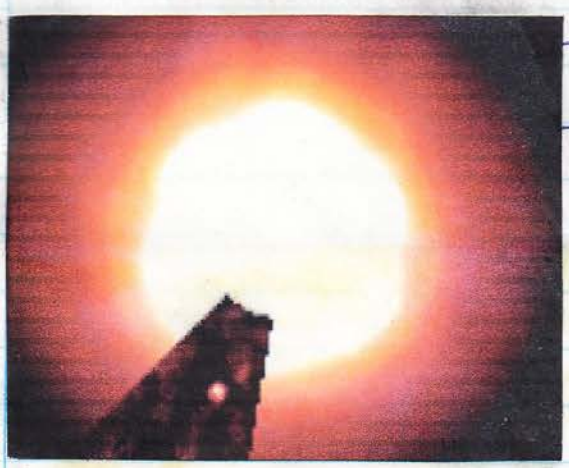

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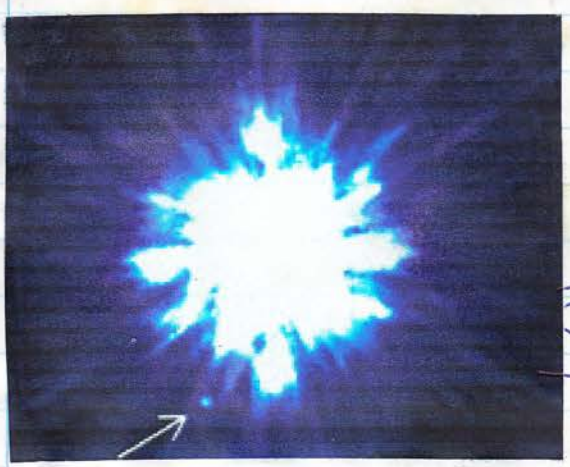

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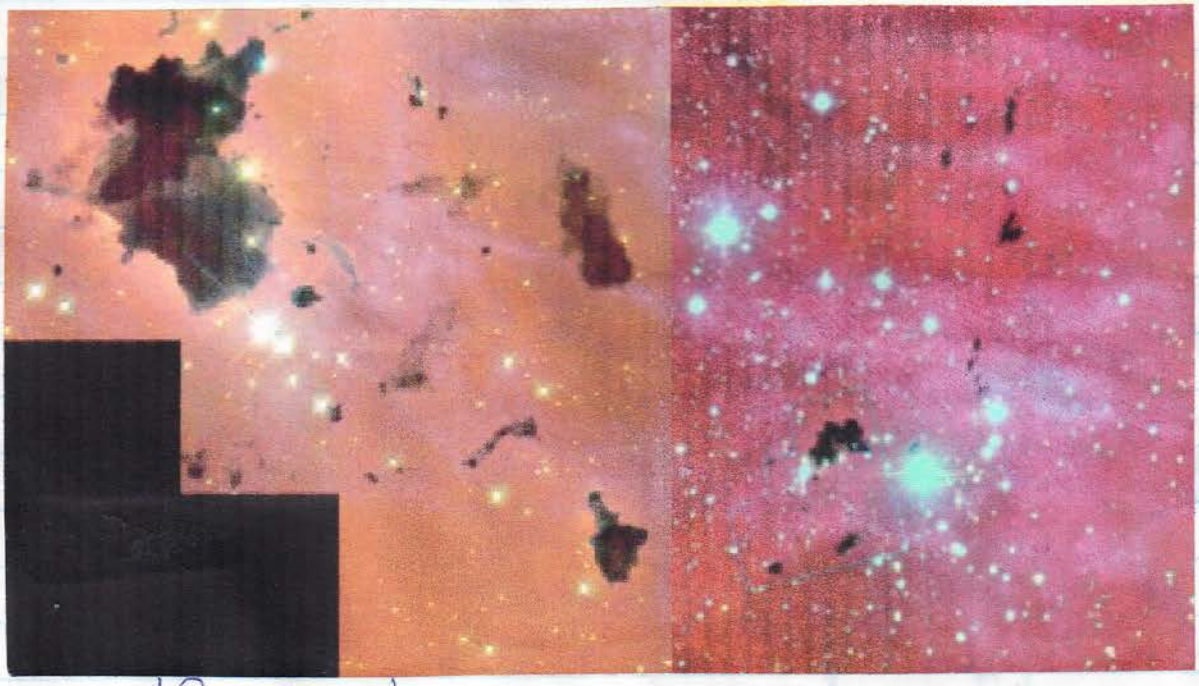

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CNN : 07 JANUARI 2002.

IN A FIRST, OBJECT NEAR A STAR CAUGHT ON CAMERA.

Astronomers have taken optical images of a giant planetlike body orbiting near a sunlike star, making it the closest ever observed around a star through direct imaging. The distance between the substellar object known as brown dwarf and its parent star is less than that between the planet Uranus and the sun. The observation is the latest in a flurry of star system discoveries, made using new ground-based technology that in some cases generate sharper pictures than space telescopes. "This discovery implies that brown dwarf companions to average, sunlike stars exist at a separation comparable to the distance between the sun and the outer planets in our solar system," said University of Hawaii astronomer Michael Liu, who with colleagues announced the findings Monday. Brown dwarfs, middling objects between planets and stars, are considerably more massive than the largest planets but do not have enough mass to ignite the thermonuclear reactions necessary to become stars. This one, located 58 light-years away in the constellation Sagitta, contains more than 12 times the mass of all the planets in our solar system, astronomers estimate. Its parent star is roughly 2 billion years old, slightly younger than our sun. "This companion is probably too massive to have formed the way we believe that planets do, namely from a circumstellar disk of gas and dust when the star was young," Liu said in a statement. "This finding suggests that a diversity of processes act to populate the outer regions of other systems." In recent years, dozens of distant planets have been found, but only through indirect means, such as observing the gravitational tug on their parent stars. That technique has failed to turn up brown dwarfs, only working within the first 4 astronomical units (AU) of a star system, or four times the distance of the Earth and sun. In our solar system, the giant planets reside in the planetary outskirts. Saturn orbits the sun from a distance of about 10 AUs. Uranus floats around at 19. The newly discovered brown dwarf is 14 AUs from its parent star, known as 15Sge. Liu and his partners made the discovery using the Gemini North and twin Keck telescopes, which stand atop Hawaii's Mauna Kea, where observatories take advantage of the volcanic mountain's thin, clean and dry air. Even so, atmospheric turbulence usually blurs images taken by observatories on the ground. But new techniques compensate for the effect and can in some cases generate images with higher resolution than the Hubble Space Telescope. "Only by using adaptive optics to produce very sharp images could we have found this companion. It is too faint and too close to its parent star to be seen otherwise," said Liu, who presented the images at a meeting of the American Astronomical Society.

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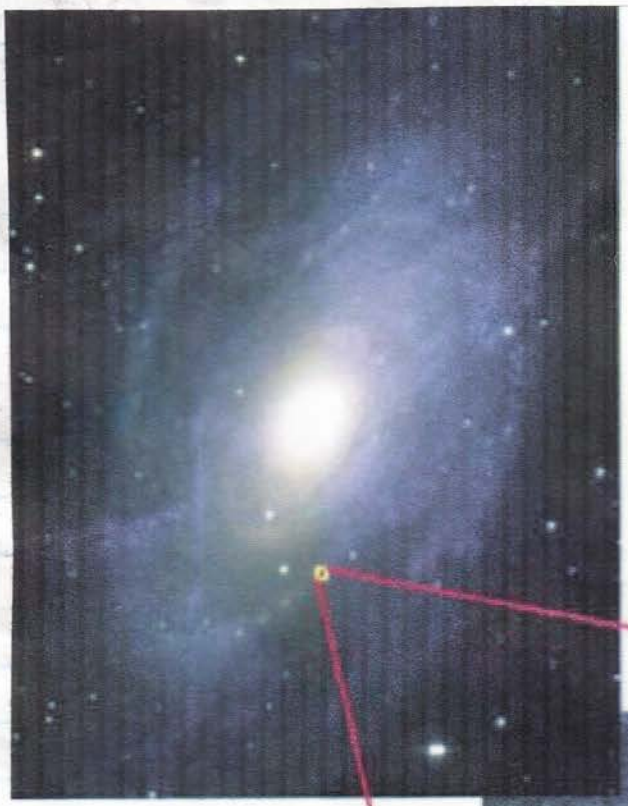
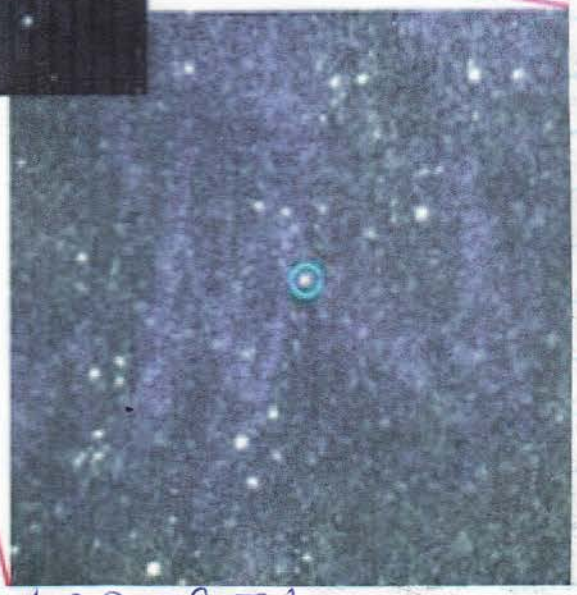


An X-ray image taken by the Chandra Observatory shows a very bright point source in a spiral arm of the galaxy Messier 81, shown as the yellow box on this optical color image.



An optical image taken with the Hubble Space Telescope shows a blue star at the location of the very bright X-ray source. This is the companion star orbiting the black hole.

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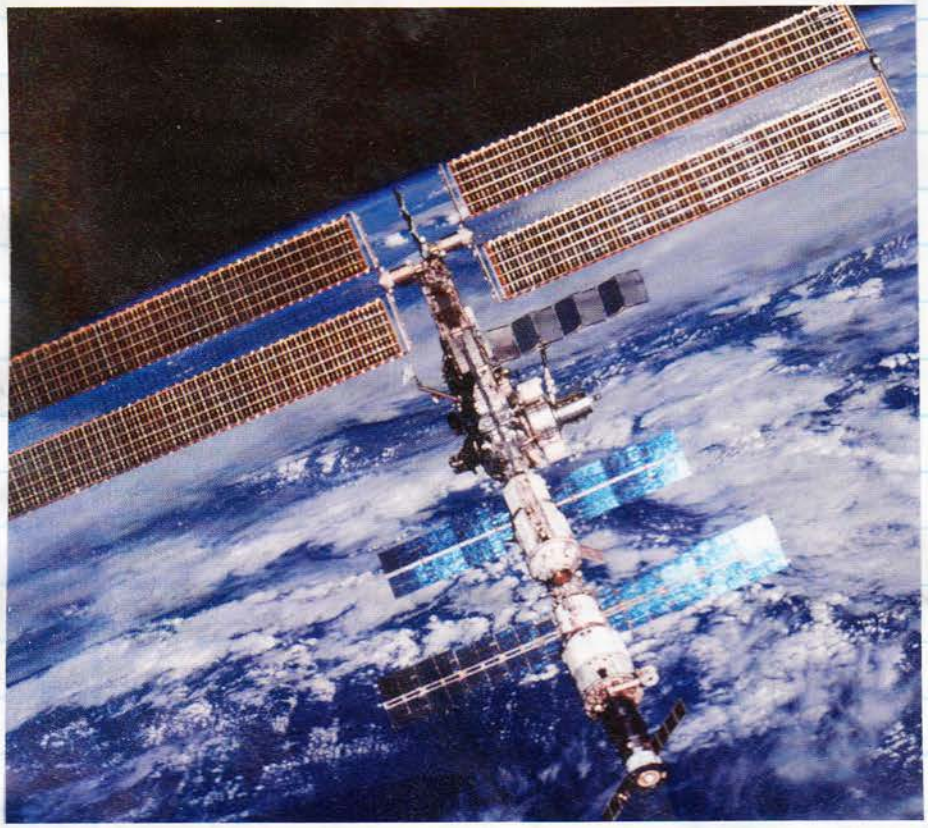
Task force damns NASA's ISS management



Space Station in orbit as seen by astronauts from Discovery in 2001. NASA

NASA will be unable to complete assembly of a fully functional International Space Station (ISS) by 2006 with a remaining budget of $8.3 billion. It has also been impossible to assess the actual cost of the programme so far due to the agency's poor and misleading accounting skills, says the ISS Independent Management and Cost Evaluation task force, established by former NASA administrator Dan Goldin this year.

Goldin announced his planned end-2001 resignation in October, while NASA's associate administrator for space flight, Joseph Rothenberg is retiring in December. The ISS has gone $13 billion over-budget in a four year period, the task force said. The total cost of the station could reach $95 billion by the time assembly has been completed.

NASA's sheer mis-management of the ISS and its budget has been heavily criticised and there has to be a radical improvement, says the task force, headed by Thomas Young. NASA's management has been sloppy, its accounting faulty and the project over manned.

The main reason for the problems has been NASA managing the budget on a year-by-year, annual budget basis rather than on managing the entire programme.

Another reason were questionable contractor costs which remained unchecked. The task force indicated that, despite other assembly options, it is highly likely that the ISS will continue to operate as a three-crew, rather than six-crew base and the scientific potential of the station - its original main justification - has somehow to be maintained.

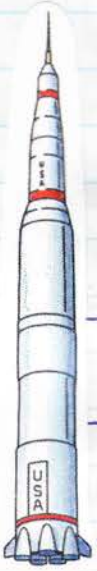
However, this will be difficult since the six-crew Habitation Module has been cancelled and science equipment delayed, including a centrifuge module which will not be flown to the station until 2008. $6.7 billion cost savings over the next five years could be made by reducing the number of Space Shuttle flights to the ISS from six per year to four.

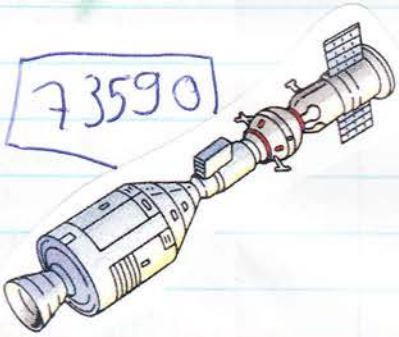
Six crew could operate on the ISS for a month if the Soyuz TM crew return vehicle swap-over system was extended from its current seven day period.

The Space Shuttle could remain attached to the ISS for a month, with the use of an enhanced Extended Duration Orbiter fuel cell system.

Young also proposed staffing cuts of up to 1,000, including some at NASA Houston and Huntsville-based control centres, as the ISS is also managed from a mission control in Russia. He also recommended the appointment of an ISS science director.

Young added that his board "are not confident to go beyond core completion until NASA's credibility has been demonstrated".





Spaceflight; januari 2002

SKYLAB-II WIVES PATCH

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Left photo: The wives of the Skylab-2 astronauts in the back of an antiqu car, note the wives patch on the back of the car. Photo: Ardis Shanks.

Right photo: Three old-fashioned girls greet their men upon their return from a 59 day spaceflight at Ellington Air Force Base.

1979

735951

From left to right: Helen-Mary Garriott, Sue Bean, Ardis Shanks and Gracia Lousma. Photo: Ardis Shanks.

Roadrunner Beep Beeping a Path to Moon

Apollo 14

Back to the Moon

735961

In the Today newspaper of Thursday, February 04, 1971 there was an article about the Back-up patch of Apollo-14.

19770

SPACE.COM : 08 JANUARI 2002.

PLANET FOUND AROUND GIANT STAR GIVES CLUES TO EARTH'S FATE.

WASHINGTON D.C. - Astronomers have found evidence for the first known planet orbiting a giant star that is aged and swollen the way our Sun will one day be, hinting that planets can survive the latter stages of a stars life. Over the past five years or so, astronomers have found about 80 extrasolar planets. All are large, some several times the mass of Jupiter. Until today, none had been spotted around very large stars.The new discovery, presented here today at a meeting of the American Astronomical Society, involved a star called iota Draconis, which is 13 times larger than the Sun. 'Until now, it was not known if planets existed around giant stars,' said Sabine Frink, a post-graduate researcher at the University of California, San Diego. 'This provides the first evidence that planets at earthlike distances can survive the evolution of their host star into a giant.' The planet orbits iota Draconis once every 1.5 years and so is thought to be at a distance similar to Earth's distance from the Sun. But the planet is nothing like Earth. It is probably made mostly of gas and is at least 8.7 times the mass of Jupiter, the researchers say, though it could be much larger. Frink made the find with the help of a seasoned team of planet hunters using a method that has been used to discover most other planets outside our solar system. The technique does not actually see planets. It notes the wobble of a host star caused by the gravitational pull of a planet. The method cannot determine an upper limit to the planet's mass. The discovery is likely the first in a line of findings -- expected over the next few years with the help of improved techniques and new space-based telescopes -- that will help scientists sort out the fate of Earth and the rest of our solar system. A few billion years from now, the Sun will swell into a giant star. Earth will be bathed in 60 times more radiation than today, and temperatures will rise to several hundred degrees. Scientist don't agree on exactly what will happen, but the prospects are grim across the theoretical board.'The oceans will evaporate, and the water vapor will escape Earth's atmosphere,' said Andreas Quirrenbach, a U.C. San Diego researcher who was also on the team that made the discovery. Ongoing research aims to determine the exact nature of the planet. 'Observing the fate of this companion to a dying star is a reminder of the ultimate fate of our own Earth,' said Debra Fischer, a team member from U.C. Berkeley. Researchers Geoffrey W. Marcy of U.C. Berkeley and Paul Butler of the Carnegie Institution were also involved in the finding.The star iota Draconis is 100 light-years from Earth in the constellation Draco. It is visible with the naked eye in the morning sky, just east of the Big Dipper.

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SPACE.COM : 08 JANUARI 2002.

STRANGE OBJECT FOUND, DEFYING IDEAS OF SOLAR SYSTEM FORMATION.

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WASHINGTON D.C. - Solar system creation theorists got more to chew on Monday when astronomers announced the discovery a huge object called a brown dwarf orbiting a star nearly as closely as Saturn is to our Sun. Added to recent findings of extrasolar planetary systems that are markedly unlike the one around the Sun, the new finding makes our solar system look like an oddball in the galaxy.Brown dwarfs are large balls of gas, much more massive than Jupiter but not heavy enough to generate the thermonuclear fusion that powers a star. In recent years, these strange, in-between objects have been found in so many bizarre configurations that researchers are scrambling to figure out whether they are dealing with one class of object or several. Lone brown dwarfs have been spotted wandering through space fairly nearby. Others have been detected at vast distances from other stars, forming in nests. Brown dwarfs might even spawn their own planetary systems. And scientists have struggled and argued over the specific differences between brown dwarfs and planets, especially how and where they are born. Finding a brown dwarf in a region around a star thought to be reserved for planets will only exacerbate ongoing disagreements. "This finding suggests that a diversity of processes act to populate the outer regions of other solar systems," said Michael Liu, a University of Hawaii astronomer who led the team that made the discovery. Liu and his colleagues, a group of venerable planet hunters, found the object using the Gemini North and Keck telescopes at Mauna Kea, Hawaii. The results were presented here at a meeting of the American AstronomicalSociety. The brown dwarf is just 14 Astronomical Units away from the star (1 AU is the distance from Earth to the Sun). Saturn is 10 AU from the Sun, and Uranus, the next planet out, is 19 AU. The object is between 55 and 78 times as massive as Jupiter, which is the largest planet in our solar system. Researchers say the configuration of a star and such a large, close companion can't be explained by current theories of solar system formation. Stars are created by the gravitational collapse of a cloud of material. Planets, however, are thought to develop out of a flat, rotating disk of material left over from the creation of a star. Planet evolve when smaller rocks, like comets and asteroids, get together. Jupiter and the other gas giant planets probably have origins in such rocky cores, which grew large enough to attract a huge gas envelope, most astronomers believe. "This [brown dwarf] companion is probably too massive to have formed the way we believe that planets do," Liu said. Many stars also are known to form as pairs, orbiting each other. There's little question that the newly found object is a brown dwarf, said Alan Boss, a planet formation theorist at the Carnegie Institution. It probably formed out of the same cloud of material from which the star formed, he said. The presence of the brown dwarf might inhibit the formation of planets, said Boss, who was not involved in the research. Or, he said, it might actually foster the development of planets, according to competing theoretical models. Further study of this and similar systems will be needed to learn how they form, the researchers agreed. Hints of the brown dwarf were initially spotted a decade ago by a team of extrasolar planet hunters. Geoff Marcy and Debra Fischer at the University of California at Berkeley, along with Paul Butler of the Carnegie Institution, have helped find many of the 80 or so known extrasolar planets. Their technique, which notes slight wobbles in a star caused by large, closely-orbiting planets, could not definitively identify what they suspected was a brown dwarf farther out from a star called HR 7672, which is 58 light-years away from Earth. Current techniques cannot find small planets, either. The extrasolar planets that have been identified in the past 5 years are all very large. Most are bigger than Jupiter and orbit very close to their host stars. Some are as close as Mercury is to our Sun. Already, astronomers were struggling to explain how planets so large could exist so close to stars. And they wonder whether this is normal, or whether other solar systems like ours might be the norm but simply have eluded detection so far. The answer bears on whether there are other Earth-like planets out there, which might support life. Answers won't come, however, until technology allows for the discovery of small extrasolar planets, assuming they exist. One space-based observatory that would do this, called Kepler, was approved by NASA in late December and is scheduled to launch in 2006. Kepler would succeed by doing its observing from above the blurring effects of Earth's atmosphere. Other researchers are working to stretch ground-based observation techniques beyond current limits to allow for the discovery of smaller planets and of large objects orbiting far from stars. The new discovery represents one of these efforts. Brown dwarfs generate enough heat to shine, but only dimly and in infrared light. The newly spotted brown dwarf was found using a relatively new technique called adaptive optics, which corrects for some of the blurring effects of Earth's atmosphere and allows faint objects to be photographed with resolution that can be 10 times better. Liu imaged the primary star HR 7672 (also called 15 Sge) last summer, and he noticed a dim spot of light next to it, described as being akin to a firefly next to a bright searchlight. Follow-up images, using adaptive optics, showed the faint object moved on the sky along with the primary star, proving that it was in fact a companion and not a background star. HR 7672 is slightly younger than our Sun, but otherwise is seen as a twin to the Sun. Liu said. The researchers are now looking for similar groupings of other stars and brown dwarfs.

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SPACE SHUTTLE

AN INSIDE LOOK

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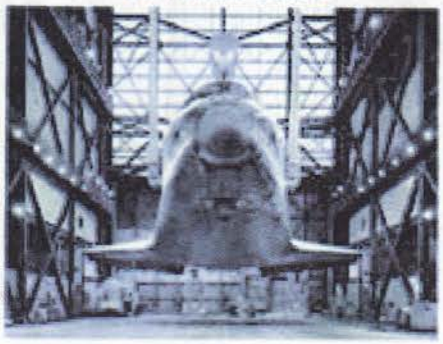
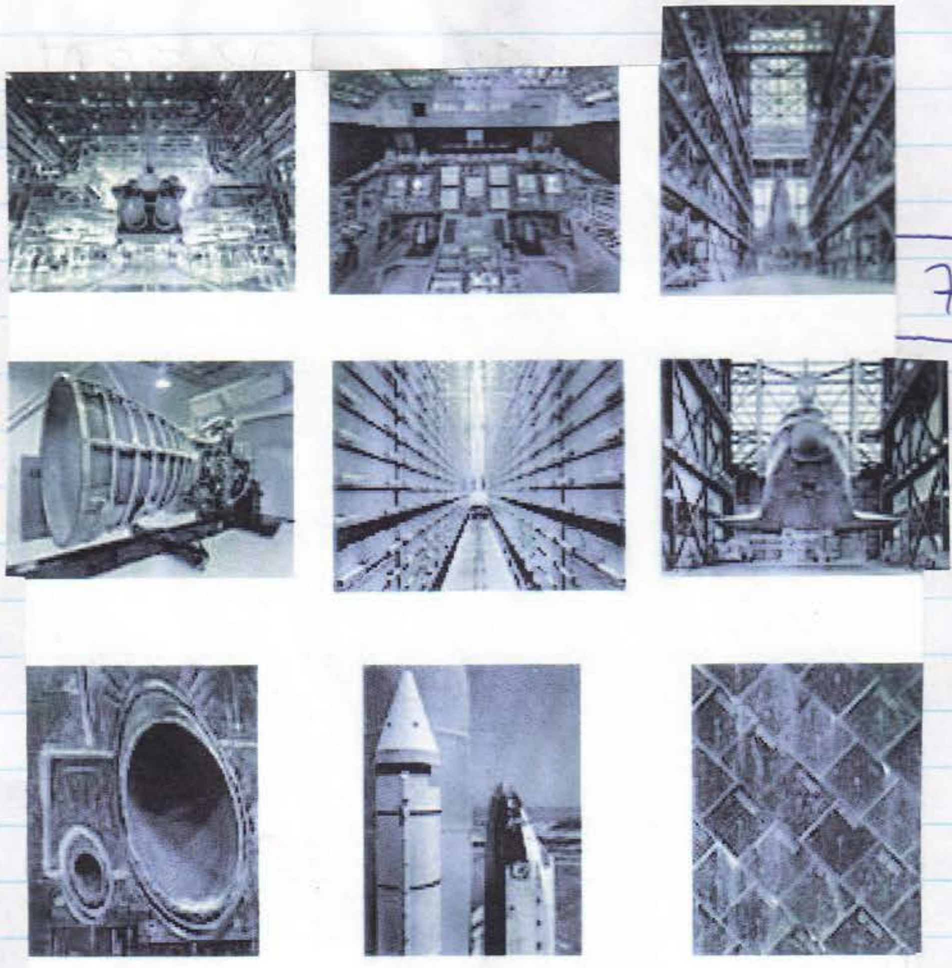


2002 CALENDAR

JOHN SEXTON



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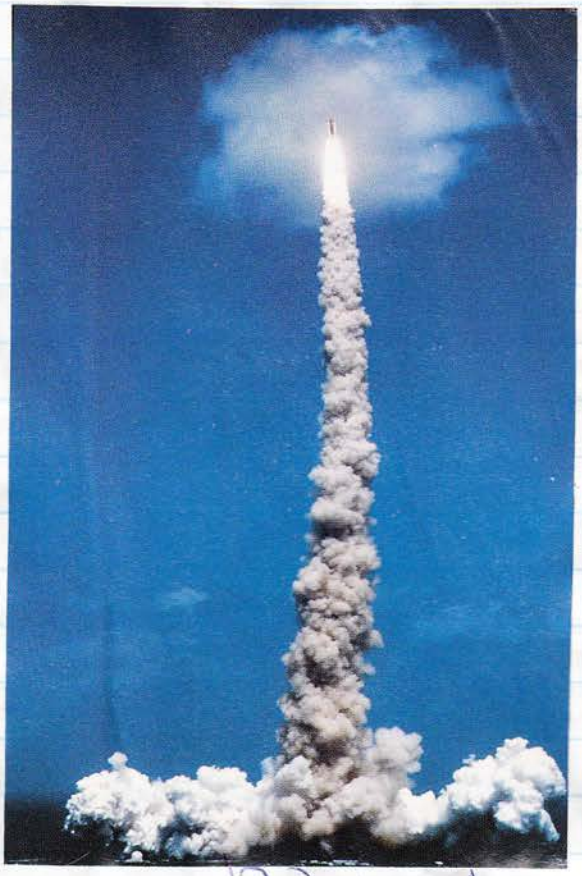

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Astronaut Frank Culbertson (bottom), Expedition Three commander, and cosmonaut Vladimir Dezhurov perform routine tasks in the Destiny laboratory on the Station.

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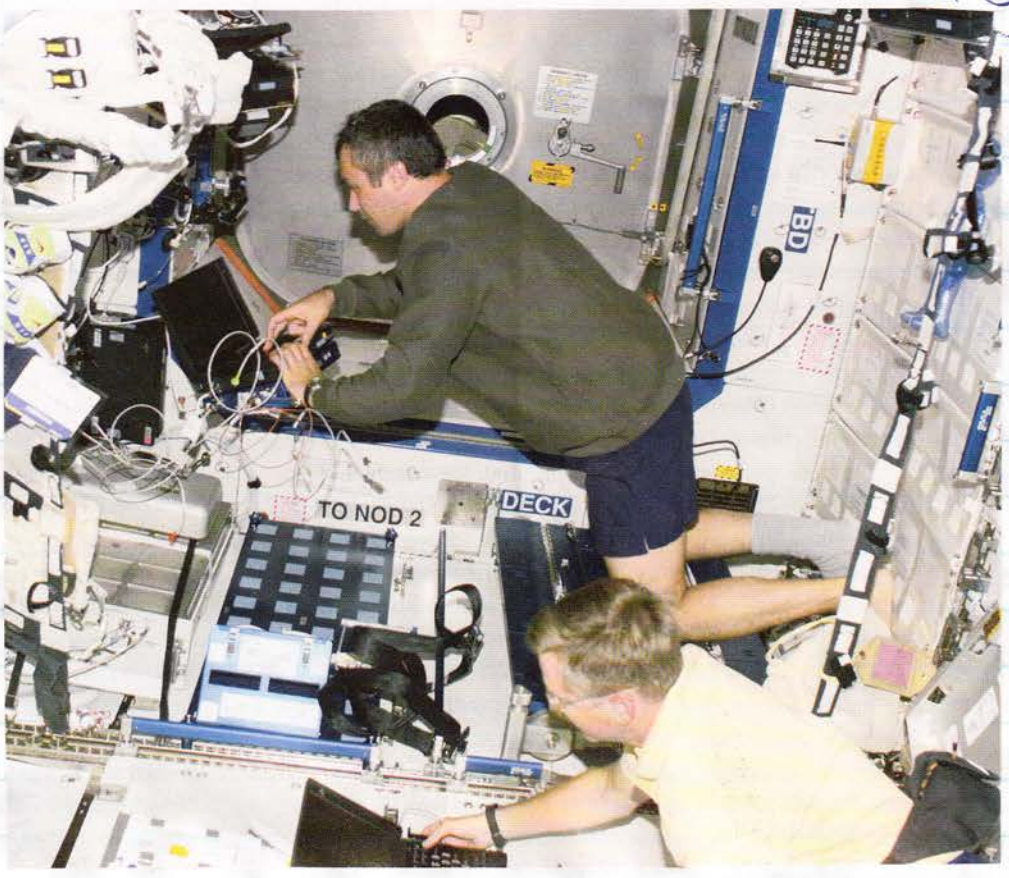

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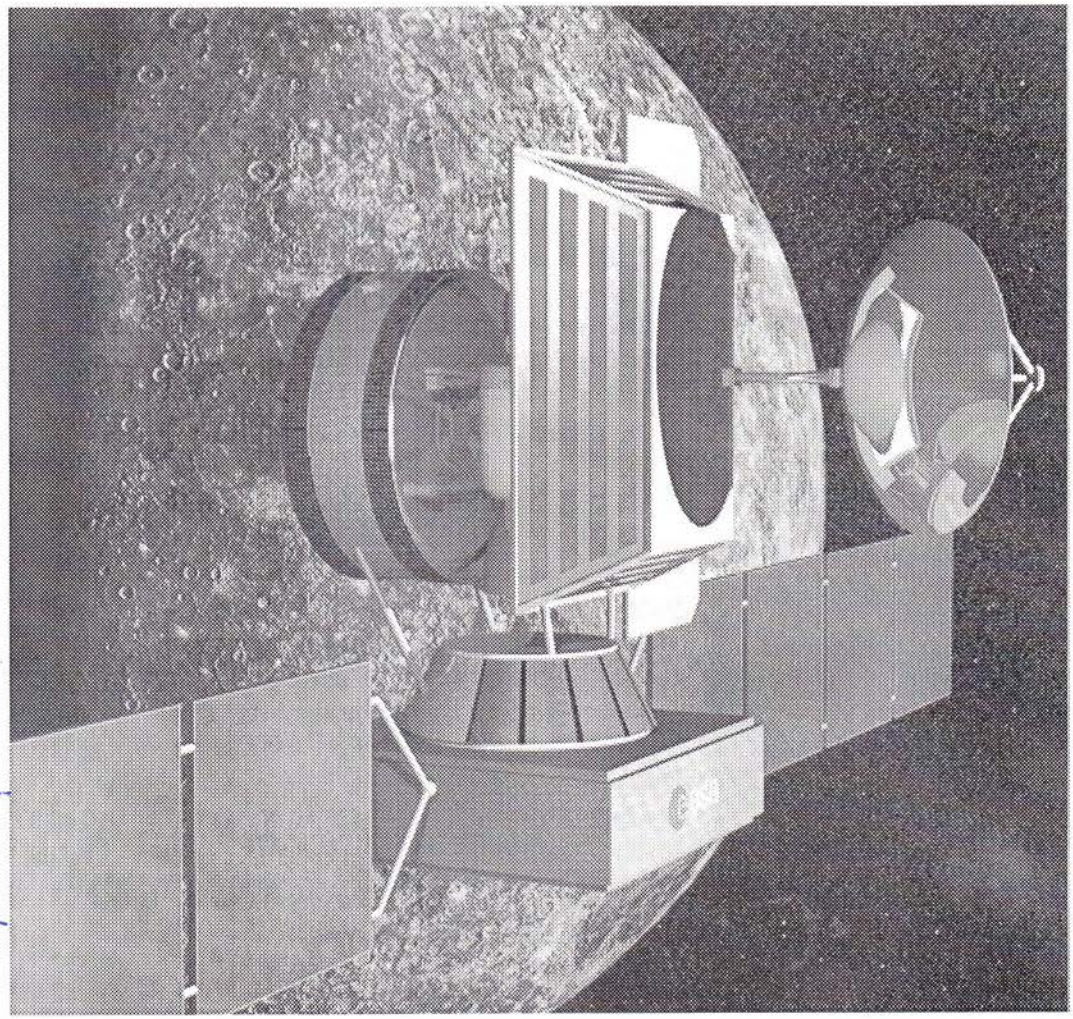
ESA gaat ruimtevaartuig naar Mercurius zenden



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Zo stelt ESA zich voor dat EpiColombo over enige tijd om planeet Mercurius zal draaien.

Tijdens een vergadering in oktober vorig jaar van alle lidstaten werden nieuwe toekomstige projecten bestudeerd. Welke zijn interessant genoeg om uit te voeren? Natuurlijk moesten ze financieel ook haalbaar zijn. Regelmatig komen wetenschappers wel met nieuwe plannen, die in de meeste gevallen alleszins de moeite waard zijn te bestuderen. De vraag is dan telkens of daarvoor voldoende belangstelling is van de lidstaten.

Een van de nieuw ingediende voorstellen was het in kaart brengen van Mercurius. Het is inmiddels al weer heel wat jaren geleden dat het Amerikaanse ruimtevaartuig Mariner 10 de eerste opnames van het oppervlak overseinde. Uiteindelijk werd de halve planeet in kaart gebracht. Andere instrumenten zorgden voor de eerste onderzoeken. Daar bleef het verder bij.

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En nu willen ESA-wetenschappers veel betere en uitvoerigere studies van deze binnenplaneet uitvoeren. Vanaf de aarde is dat nauwelijks mogelijk; de planeet staat te dicht bij de zon. In het gunstigste geval staat Mercurius 28 gr. van de zon, hetgeen betekent dat hij als een klein lichtpuntje zo'n twee uur vóór zonsopkomst of na zonsondergang te zien is. Vanuit de ruimte is het een riskante zaak om de Hubble ruimtetelescoop op de planeet te richten. Mocht het zonlicht in de telescoop vallen, dan zullen de gevoelige instrumenten zeker het loodje leggen. Daarentegen is het wel mogelijk een ruimtevaartuig in een baan om Mercurius te schieten. En dat is wat ESA-wetenschappers nu juist willen. Op die manier kan deze planeet goed bestudeerd worden.

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Dit hele project heeft de naam ***BepiColombo*** gekregen. Het bestaat uit twee orbiters die om de planeet gaan draaien en een lander die zacht op het oppervlak moet neerdalen.

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* Orbiter A, de Mercury Planetary Orbiter (MPO) zal vanuit een lage omloopbaan het oppervlak in kaart brengen en bestuderen.
* Orbiter B, de Mercury Magnetospheric Orbiter (MMO) moet in een sterk ellipsvormige baan om de planeet terecht komen om dit gebied te onderzoeken, de magnetosfeer dus.
* De lander heeft tot taak de wetenschappers meer te vertellen over de samenstelling van het oppervlak.

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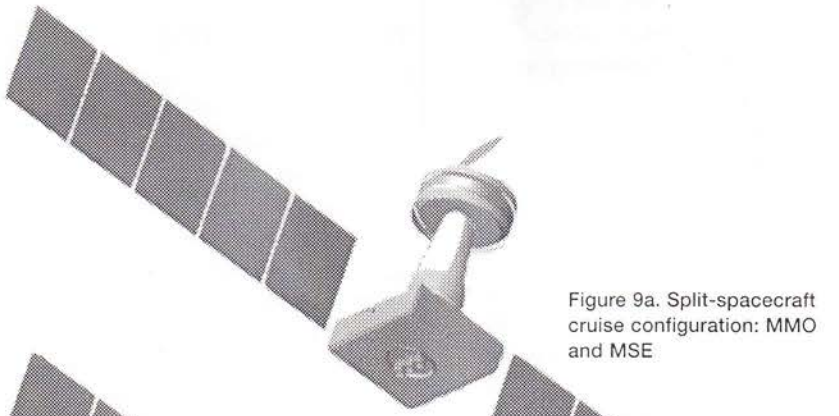


Figure 9a. Split-spacecraft cruise configuration: MMO and MSE

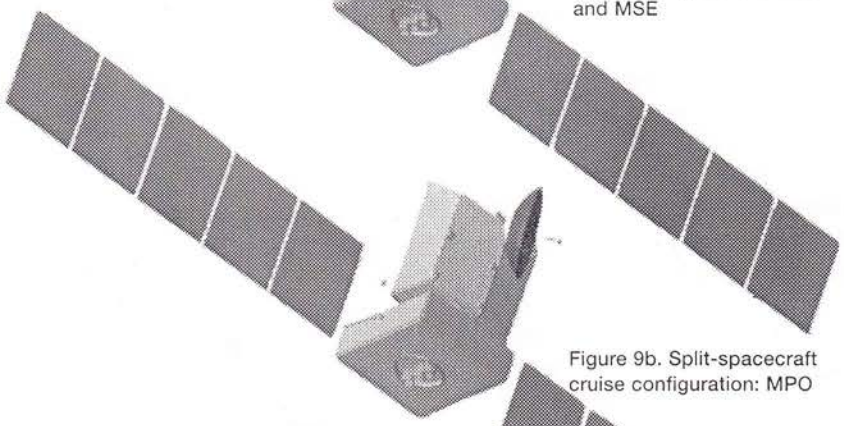
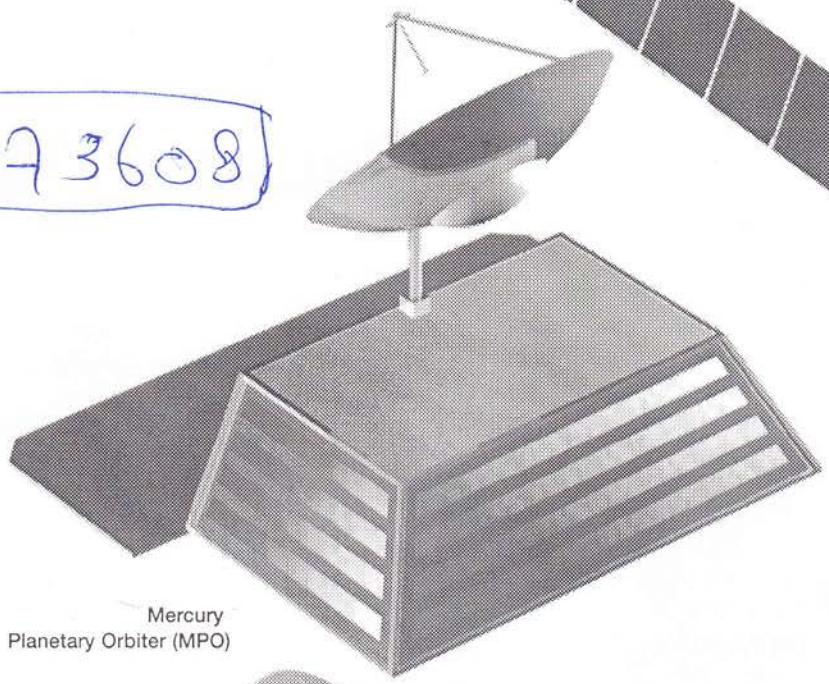
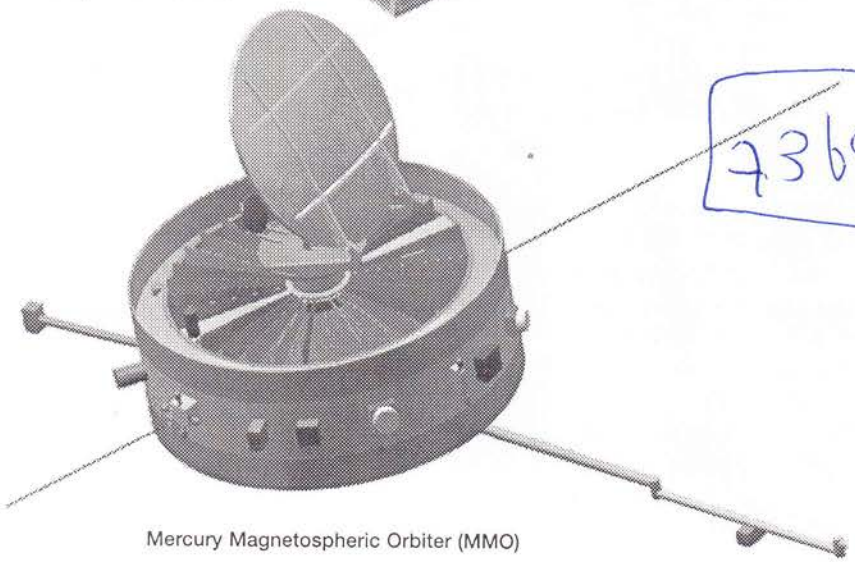


Figure 9b. Split-spacecraft cruise configuration: MPO



Mercury Planetary Orbiter (MPO)



Mercury Magnetospheric Orbiter (MMO)

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De lancering

Hoe de lancering in zijn werk zal gaan, is nog niet bekend. Er zijn twee mogelijkheden.

1. Alle drie voertuigen worden in één keer gelanceerd. Hiervoor is een grote raket nodig en daarbij moet men denken aan een Ariane 5.

2. Het naar Mercurius schieten van drie vaartuigen geschiedt met twee kleinere raketten. In dit geval de Sojoez-Fregat.

De bestudering van de planeet

* Het in kaart brengen van de gehele planeet.
Nog niet eens de helft van Mercurius is tot dusver gefotografeerd. En dat gebeurde door de Amerikaanse Mariner 10 in de zestiger jaren. Die opnames zijn te vergelijken met de foto's die door aardse telescopen van de maan werden genomen in diezelfde tijd. Die zijn intussen vele malen krachtiger geworden, vooral die instrumenten in de ruimte. Het wordt dan ook hoog tijd Mercurius met de beste apparatuur opnieuw in kaart te bren gen. Bovendien zijn er maar van één zijde van deze planeet beelden overgeseind. Van de andere zijde is dus geen enkele opname. We weten dat de voor- en achterkant van onze maan heel sterk met elkaar verschillen. Misschien is dat bij Mercurius ook wel het geval. Wie weet krijgen we wel met (hele) grote verrassingen te maken!

* Hoe ziet het oppervlak eruit?
Net als bij onze maan is het oppervlak bezaaid met kraters. Vlakkere gebieden, op enkele kleine na, komen er niet voor. Een vergelijking met de achterkant van de maan is veel meer op zijn plaats.
Tot zo'n vier miljard jaar van zijn bestaan bepaalden vulkanen het uiterlijk van de planeet De vijfhonderd miljoen jaren erna, waren het de stenen uit de ruimte die het huidige pokdadige gezicht vormden.

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Door zijn sterk ellipsvormige baan om de zon ontstond en ontstaat grote spanning onder het oppervlak. Het kan niet anders of de planeet is tectonisch actief. Vandaar de vele breuklijnen die duidelijk zichtbaar zijn.
Mascons moeten er zeker voorkomen en dus ook verschillen in aantrekkingskracht. Nieuwe missies zijn nodig om hierover uitsluitsel te verschaffen.

* Waaruit bestaat het oppervlak?

Wat de samenstelling van het oppervlak van Mercurius betreft, weten we nauwelijks iets. Welke elementen en mineralen komen er voor? Vaststaat dat veel zonlicht door de planeet wordt gereflecteerd. Rijst onmiddellijk de vraag wat hiervoor verantwoordelijk is.
Ook weten we dat de dichtheid van Mercurius heel groot is. Zou dat te maken kunnen hebben met de aanwezigheid van (heel) veel ijzer? De zon bakt er verschrikkelijk op los, maar wat voor invloed heeft die hitte in het begin gehad op de stollingsfase? Heeft dat geleid tot het (grotendeels) verdwijnen van bepaalde elementen?

* Bezit de planeet een vloeibare kern?

De grote dichtheid suggereert een ijzeren kern, welke 70% tot 80% van de massa behelst. Tussen die kern en het oppervlak is het mogelijk vloeibaar. Dat is weer een verklaring voor de aanwezigheid van zwavel (1 tot 5%).

* Het ontstaan van het magnetisch veld.

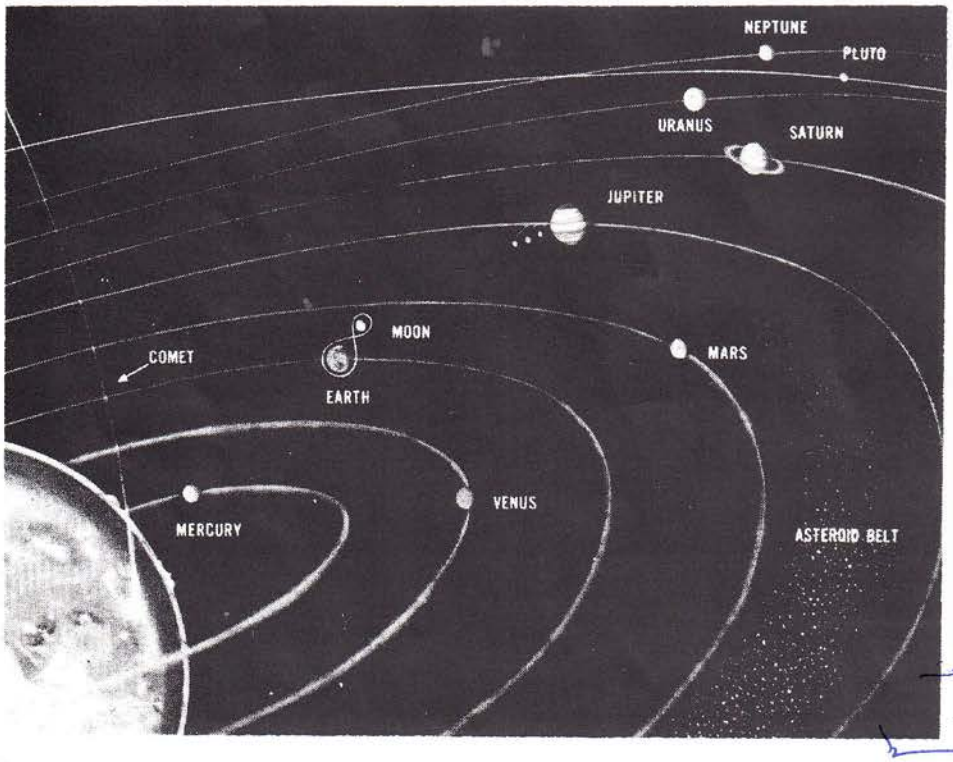
Mariner 10 ontdekte destijds een magnetisch veld rond Mercurius. Zij het wel erg zwak (éénhonderdste van die bij de aardse evenaar) en daarom des te verrassender. Dat zou dus wijzen op bewegingen van tectonische platen. Mogelijk ligt onder de 500 kilometer dikke korst vloeibaar gesteente. Wekken die het magnetische veld op?

* Een atmosfeer.

In de volksmond heet het dat er op Mercurius een dampkring ontbreekt oftewel het is er luchtledig. In wetenschapstermen is dat niet zo. De zonnewind heeft grote invloed op deze planeet omdat de afstand tot de zon zo klein is. Vele elektrisch geladen deeltjes, atomen enz. bombarderen het oppervlak. Het is dus beter te spreken over 'bijna luchtledig'.

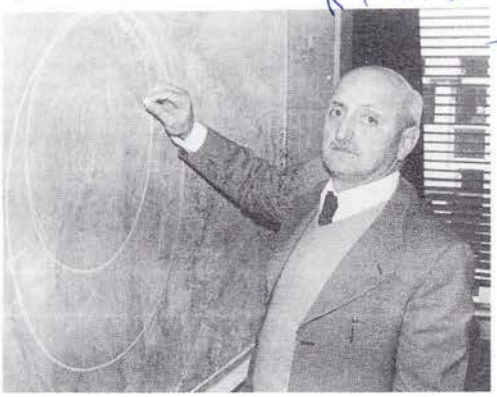
* Waterijs op de polen?

Uit waarnemingen met radar in 1992 meenden wetenschappers waterijs op de polen te ontdekken. Niet uitgesloten, want ook op het oppervlak van Mercurius zijn heel wat kometen terecht gekomen. Het meeste ijs verdampte meteen en verdween in het heelal. Het zou best kunnen zijn dat een klein deel op de polen is neergeslagen en in kraters terecht kwam, waarin geen zonlicht kan doordringen. De temperatuur in de nachtzijde bedraagt zeker 175 graden Celsius onder nul. Gebieden die in het volle zonlicht baden, kunnen te maken krijgen met een hitte van 425 gr. C.



Wie was Giuseppe Colombo?

Dit hele ESA project is vernoemd naar de Italiaanse wetenschapper Giuseppe (Bepi) Colombo. Hij was werkzaam aan de universiteit van Padua en leefde van 1920 - 1984.
Deze Italiaanse wetenschapper (wiskundige en ingenieur) was enorm geïnteresseerd in planeet Mercurius. Hij adviseerde NASA destijds in welke baan de Mariner 10 geplaatst moest worden om het toestel driemaal er langs te laten vliegen in de periode tussen 1974 en 1975.



De ruimtevaartuigen

Het hele BepiColombo project zal uit drie ruimtevaartuigen bestaan: twee orbiters om de planeet en één die op het oppervlak zacht moet terecht komen.

De Mercury Planetary Orbiter MPO

Op een hoogte van 400 tot 1500 kilometer zal het iedere 2,3 uur een baan om Mercurius beschrijven. In die tijd zal

het o.a. de planeet in kaart brengen, onderzoek van het oppervlak uitvoeren en op zoek gaan naar de aanwezigheid van waterijs. De orbiter zal waarschijnlijk ook uitgerust zijn met een 20-cm telescoop.
Het gewicht zal 360 kg bedragen.

Mercury Magnetospheric Orbiter MMO

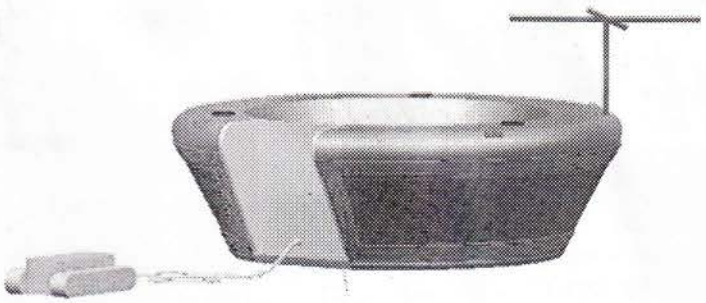
De MMO zal in een nog veel sterkere ellipsvormige baan om de planeet gaan draaien: 400 tot 12.000 km. De bestudering van de magnetosfeer en wat er mee te maken heeft, behoort tot zijn taken.
Gewicht: 160 kg.
Beide orbiters hebben een geschatte levensduur van een jaar. Ze zijn 5,1 meter hoog en hebben een spanwijdte van 32,8 meter.

De lander

Er zijn twee mogelijkheden: eentje voor een hardere landing en een voor een zachte. Een keuze is nog niet gemaakt.
De lander voor de hardere uitvoering zal uitgerust zijn met een penetrator die meteen zo diep mogelijk de grond in moet. Dit toestel zal beschikken over een motor werkend op vast brandstof. Zonder stuwstof zal het geheel 50 tot 70 kg wegen. In gewicht verschilt het toestel niet met die dat een zachte landing dient uit te voeren. Na het neerkomen zal een penetrator (mogelijk een soort boor) langzaam de grond in boren.
Naar verwachting zal de lander een week in bedrijf blijven.

De lancering

Gevuld met stuwstof zullen de drie vaartuigen 2500 tot 2800 kg wegen op het moment dat ze gelanceerd worden. Daarvoor is een grote raket nodig van het type Ariane 5. Een tweetal Starsem-Sojoez raketten zijn ook in staat die klus te klaren.
Wat de vliegroute betreft daarover zijn de wetenschappers het nog niet eens. Gebruik



De lander voor het zacht neerkomen op de planeet

maken van de aantrekkingskrachten van de maan en Venus behoort tot de mogelijkheden. Dat zal zeker gebeuren wanneer de Starsem - Sojoez raketten ingezet worden.
Het jaar 2009 staat als lanceerjaar gepland.
Met de komst van deze ESA-bezoekers zal Mercurius aardig wat geheimen prijs moeten geven.

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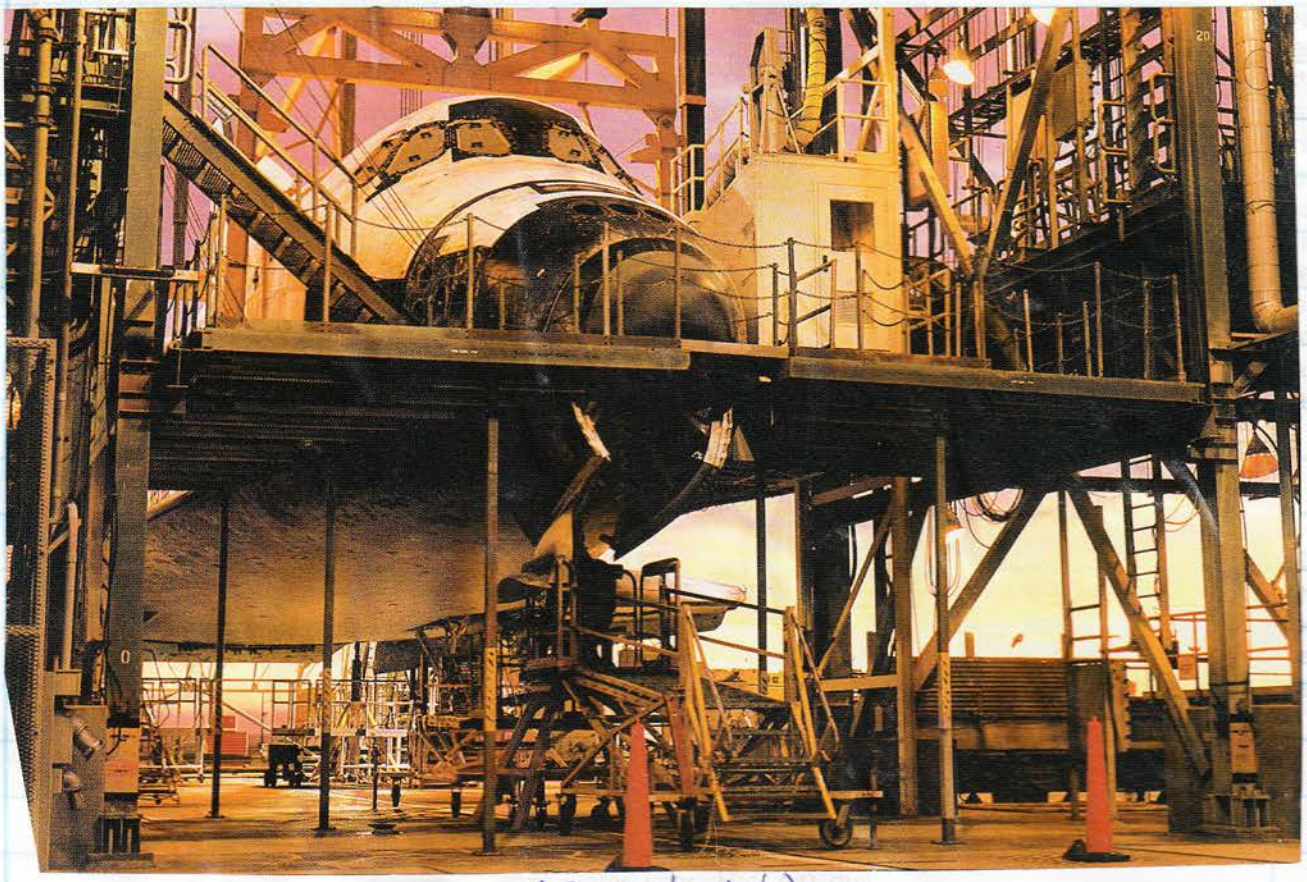

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UNIVERSITY OF MICHIGAN NEWS RELEASE : 11 JANUARI 2002.

ASTRONOMERS FIND EVIDENCE OF "MISSING LINK" IN BLACK HOLES.

In the last decade or so, supermassive black holes at the centers of galaxies have become an accepted part of the astronomical landscape, as have the small, stellar-mass black holes found farther from the center. Missing has been any solid evidence of an intermediate mass black hole, an entirely new astronomical object that would be, according to University of Michigan astronomer Joel Bregman, "the missing link in the black hole chain." Intermediate mass black holes may produce the brilliant X-ray light seen from sources in the disks of galaxies and finding their optical counterparts is a crucial step. Bregman and his colleagues, Jifeng Liu and Patrick Seitzer, also at the U-M, have found such optical counterparts and they presented their report this week to the American Astronomical Society meeting in Washington, D.C. Like many other astronomical bodies, black holes can only be studied indirectly, through the force they exert on nearby objects and from the light given off by material before it falls into the hole. X-rays are particularly useful in locating binary systems such as black holes with companion stars so close that they are slowly being eaten by the black hole. As the two objects orbit around each other the black hole pulls gas off the surface of the nearby star and this material spins around the black hole, spiraling in toward the center and emitting X-rays. The maximum brightness of the X-ray light is proportional to the black hole mass. The Michigan researchers' discovery centers on the enigmatic Ultraluminous X-ray sources (ULX), which have been causing great excitement in the high energy community for several years. Various theories have been devised to explain these objects, which have luminosities 10 times greater than the brightest X-ray point sources in the Milky Way. The high X-ray luminosity suggests a black hole mass at least 30 to 1,000 times the mass of the sun. This would make them 10-100 times larger than stellar black holes, but a million times smaller than the supermassive black holes found at the center of galaxies. "For years, these mysterious X-ray sources had no optical counterpart, so we were not positive that they were binary star systems," said Bregman, "but by combining the power of the Chandra X-Ray Observatory and the Hubble Space Telescope, we thought that we could find the star that is being eaten." The researchers devised a method for overlaying the high-resolution X-ray images from the Chandra X-Ray Observatory on top of the optical imagery from the Hubble Space Telescope (HST). "Overlaying these two images to very high precision was a technical challenge," said. Liu. This problem was overcome by aligning the two images by objects common to both, such as background Active Galactic Nuclei. Bregman notes that selecting the right targets can also be tricky, but eventually the team came up with five good ones, two in M51 and one each in M81, NGC6946, and NGC4559. "Each of the targets appears to be close to spiral arms, which is already an exciting result. It suggests that they are associated with young high-mass stars," he said.

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SPACEFLIGHT NOW : 17 JANUARI 2002.

NEW DISCOVERIES RAISE HOPES, QUESTIONS ABOUT LIFE ON MARS.

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Two separate studies published Thursday both provided new evidence that life could exist on the planet Mars while raising questions about the validity of some of the evidence presented for Martian life. One paper, published in the latest issue of the journal Nature, discussed the discovery of a microbe living deep within the Earth in conditions that resemble those below the surface of Mars. The microbe, found 200 meters below the surface in the mountains of Idaho, are completely cut off from the Earth's ecosystem, thriving in conditions like those on the early Earth, and perhaps within Mars or other worlds. "The microbial community we found in Idaho is unlike any previously described on Earth," said Derek Lovley, head of the microbiology department at the University of Massachusetts, Amherst, and one of the authors of the Nature paper. "This is as close as we have come to finding life on Earth under geological conditions most like those expected below the surface of Mars." Unlike other subterranean life, which survives on organic material carried underground by groundwater seepage, the microbes discovered in Idaho instead exist by combining hydrogen and carbon dioxide gasses dissolved in water to produce methane, releasing energy needed to sustain life. The microbes don't require organic carbon or sunlight to survive. Such "Archaean" microbes were likely commonplace on the Earth early in its history, when hydrogen was commonplace but other organic compounds were not. The existence of the microbes also raises the possibility that such life forms could exist on other worlds, in similar conditions. "On Mars and other planets or moons in our solar system on which life might exist, liquid water is only available below the surface where there is no sunlight," said Lovley. "So, if there is life, it must sustain itself with alternative energy sources. This study demonstrates, for the first time, that certain microorganisms can thrive in the absence of sunlight by using hydrogen gas released from deep in the Earth's surface as their energy source." Mars is the most likely world in the solar system, other than the Earth, where life could have taken root and might still exist today. One controversial piece of evidence for past life on Mars were carbonates found in Martian meteorite ALH84001, first reported over five years ago. However, a separate paper published in Nature suggests that those carbonates may not have an organic origin. Studies by European astronomers, using ESA's Infrared Space Observatory, have turned up evidence of carbonates in two nebulae formed by dying stars. Those carbonates, astronomers say, could not be formed by water, as scientists previously believed was the only way to create them. "The amount of carbonates we find is equivalent to at least 30 Earth masses, far too large to be the relic of a hypothetical planetary system present before the star became a planetary nebula," said Ciska Kemper of the University of Amsterdam. "On the other hand, the age of the dust shell in the nebula is about ten thousand years, which is too short for a new planetary system to form." This implies that the carbonates were formed by another method, although scientists haven't determined what that could be. It does mean that the existence of carbonates is alone not evidence of water, so the discovery of carbonates in a meteorite does not mean that it has been exposed to water, as was assumed for ALH84001. It may also mean that earlier beliefs that liquid water was available within 20 million years of the solar system's formation, based on the discovery of carbonates in other meteorites, may have to be reexamined.

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CNN : 08 JANUARI 2002.

COSMIC DUST GENERATED NEAR NASCENT SUPERNOVA.

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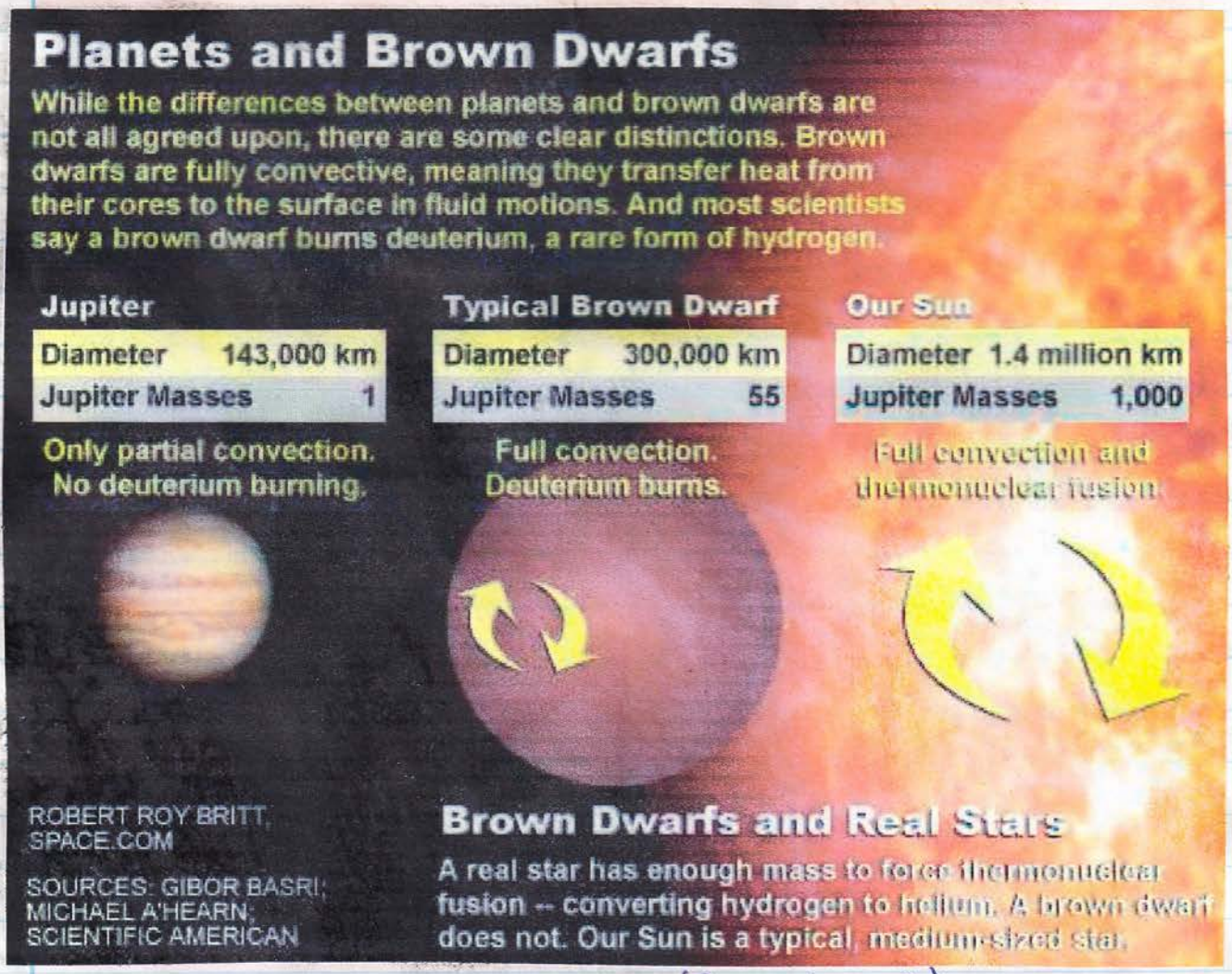
WASHINGTON - Dust in space often hides in cold, dark regions, but astronomers said they found cosmic dust forming in a hot spot around a big bright star that will someday explode into a supernova. The scientists saw space dust forming and then being blown away in a system of two big bright stars about 4,500 light-years from Earth in the constellation Cygnus. A light year is about 6 trillion miles (10 trillion kms), the distance light travels in a year. One of the stars was destined to explode as a supernova, scientists said Monday at a briefing at the annual meeting of the Astronomical Society in Washington. Astronomers are used to finding cosmic dust in cold, dark molecular clouds, but not near a hot star. As the two stars swirl around each other, they produce winds, much as our sun produces a solar wind. Because the two stars are so close together, the winds they produce collide, and dust accumulates and then is spat out at the place of the collision, astronomers said. The two-star system ejects enough dust to make up the mass of the Earth's moon every eight years or so, the scientists said. Scientists from the Harvard-Smithsonian Center for Astrophysics and NASA's Goddard Space Flight Center near Washington presented the findings.



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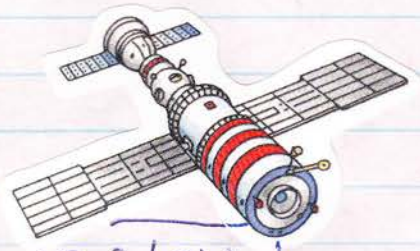

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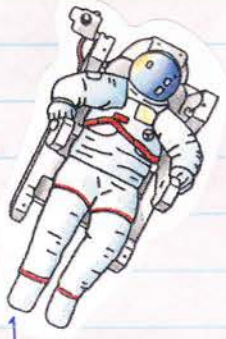

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SPACE.COM : 13 JANUARI 2002.

WATER BLAMED IN JULY ARIANE 5 FAILURE.

PARIS - The presence of water in the upper-stage engine has been identified as the probable cause of an Ariane 5 heavy-lift rocket failure in July, investigators have concluded. The failure caused the loss of one satellite, degraded the operational life of a second and forced a shutdown of Ariane 5 operations. The exact cause of the failure had engineers stumped for months. But recent tests of the engine in Lampoldshausen, Germany, showed that it exhibits the same defects when small amounts of water are added as it did in the July failure, said Jean-Yves Le Gall, chief operating officer of Arianespace, the European consortiuum that operates the vehicle. "The characteristics of the engine ignition when water is introduced are very, very similar to what we saw during the July launch," Le Gall said Jan. 8. He said the apparent discovery of such a simple cause for the failure has bolstered Arianespace's confidence that it can return the rocket to flight in late February. The Ariane 5's upper-stage engine is routinely filled with water during hydraulic tests before it is delivered for final integration into the vehicle. Le Gall said the engine used in the July launch apparently was not dried out thoroughly. "What we have found in the past few weeks is that this engine is extremely sensitive to the presence of water," Le Gall said. "So in addition to smoothing out the ignition sequence as part of the modifications we are adopting, we will ensure that the engines are fully dried after the hydraulic tests."

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Solar-Electric Power To Enable Double Planetoid Mission

FRANK MORRING, JR./**WASHINGTON**

Xenon-fueled solar-electric thrusters will give a newly selected NASA spacecraft enough maneuverability to explore two large protoplanets in the Asteroid Belt. The probe could answer questions about the processes that formed Earth and the other inner planets and perhaps supply data that can be used in the search for planets around other stars.

One of two Discovery missions chosen from 26 proposals last month, the Dawn spacecraft will survey Ceres, the largest asteroid, and Vesta, the third largest and second most massive of the bodies that lie between Mars and Jupiter. Astronomers believe Jupiter's powerful gravity disrupted the planet-forming process in the region after about 10 million years as the solar system formed some 4.6 billion years ago, leaving Ceres and Vesta in a state of arrested development while the Earth kept growing by accretion from smaller bodies crashing together.

"If we say that the Earth formed in the beginning of the solar system, then these objects formed in about one-fifth of the time of the Earth," said Christopher T. Russell, a professor of geophysics at the University of California in Los Angeles and the principal investigator on the Dawn project. "And we believe they all started at the same time, so this object stopped evolving a good 40 million years before the Earth stopped growing."

RUSSELL'S TEAM, which includes the Jet Propulsion Laboratory (JPL), the German Aerospace Center (DLR) and Orbital Sciences Corp., will take advantage of the ion propulsion techniques pioneered on NASA's Deep Space 1 technology mission to reach the two targets. Following a Delta II launch in May 2006, the spacecraft will spend about four years using the gentle thrust—about ⅓₀ lb.—of its ion engine to nudge its orbit out to a rendezvous with Vesta. Using small hydrazine thrusters, it will go into orbit around the 320-mi.-dia. object and spend almost a year studying it.

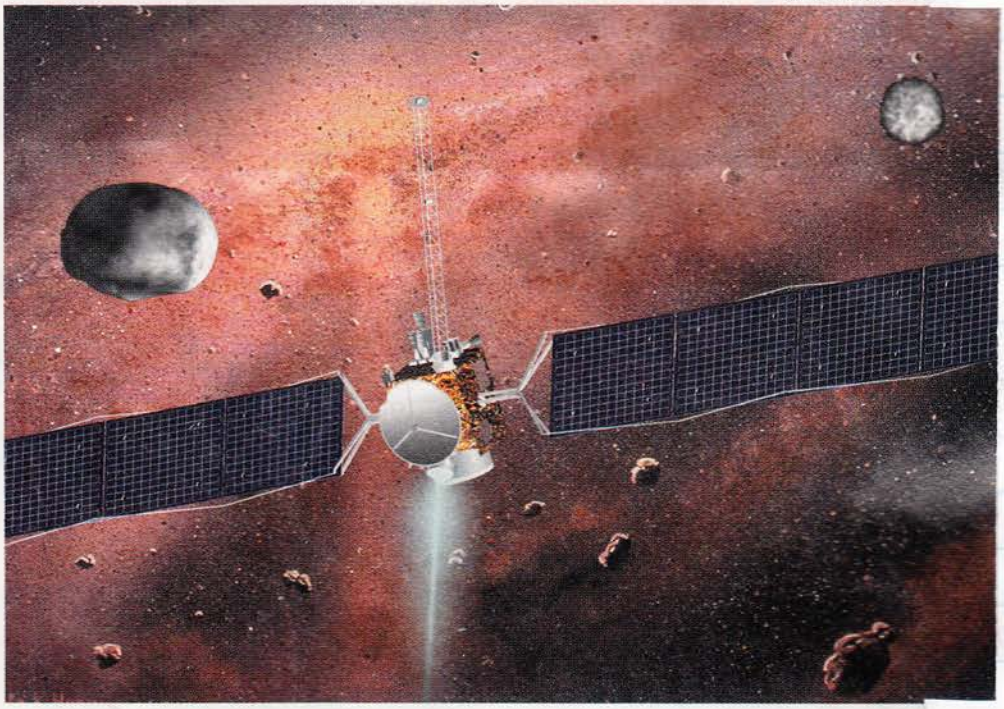
In July 2011, the probe will kick itself out of Vesta orbit and use ion propulsion to move farther from the sun for a rendezvous and orbital insertion with Ceres in August 2014. Its nominal mission is to end there in July 2015.

"The neat thing about ion propulsion now that NASA feels confident in it is that it uses the on-board fuel a factor of 10 more efficiently than chemical," said Russell, who unsuccessfully proposed using solar-electric propulsion to explore the Moon and a comet in the first round of Discovery bidding (*AW&ST* Dec. 5, 1994, p. 40). "That enables us to do a lot of maneuvering in space where we couldn't before. We're going to a body, orbiting it, then we're leaving that body and going to another body and orbiting it. We could not have done that chemically."

Russell said the Dawn mission will consume all of the $299 million maximum allowed for Discovery projects, plus about $1 million more NASA has authorized for additional reviews. The team picked Orbital Sciences for an $80-million contract to develop the spacecraft because it has experience in both long-lived spacecraft (in communications satellites) and in the pointing technology needed for remote sensing with its Orbview satellites.

The three redundant solar-electric thrusters, which use electrons generated by the spacecraft's twin 7.5-kw. end-of-life gallium arsenide solar arrays to send xenon ions through a charged exhaust grid, will be developed and tested at JPL. DLR and Italy's Institute for Astrophysics in Space will build the framing camera and mapping spectrometer, while Los Alamos National Laboratory will supply the gamma ray and neutron spectrometer. NASA's Goddard Space Flight Center will deliver a laser altimeter, and UCLA will supply a magnetometer.

WILLIAM K. HARTMANN



Dawn spacecraft is depicted with asteroids Vesta (left) and Ceres, positioned against an artist's conception of the primordial solar nebula that spawned them.

The instruments are designed to generate full-surface imagery of both bodies, along with three bands of mapping spectrometry, topographic profiles and maps of the two bodies' gravity and magnetic fields. The results should be quite different at each object, since Vesta is a "dry" asteroid with a basaltic surface formed by lava flows while Ceres is probably "wet," with a high water content that may be the result of its greater distance from the sun when it was formed.

Planetary scientists believe many frag-

ments of Vesta have reached Earth as meteorites, but none are known to have arrived from Ceres. Its primitive surface may be a clay, and there is a chance it has an atmosphere that Russell said would most likely be water vapor. The spacecraft should be able to settle the issue, he said. Scientists will also be able to use its gravity and other measurements to determine the size and thermal history of the objects' cores, which should answer questions about how such cores develop. Knowledge gained from the mission could be applicable, not just to the early history of Earth's solar system, but to the search for other solar systems as well, Russell said.

"ANOTHER IMPORTANT reason for doing this mission, especially at this time, is our growing interest outside the solar system where we're taking a look at the formation of solar systems around other stars," he said. "This will help us get a little bit of ground truth for those other observations. If we can learn about the first 10 million years in our own solar system, then maybe when we're looking at the first 10 million years in another solar system, it will help us understand what we're seeing in those telescopes."

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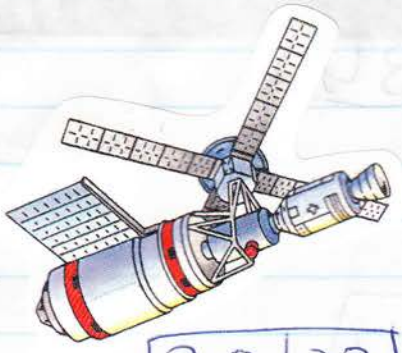

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NASA Goes Planet-Hunting

MICHAEL MECHAM/**SAN FRANCISCO**

NASA has funded a mid-decade Earth-trailing satellite that will carry a unique telescope to employ "transit signature" photography in a search for planets capable of sustaining life.

Named for Johannes Kepler, the German astronomer who described the motion of the planets in our solar system, the $299-million study is part of NASA's Discovery mission series and is scheduled for launch on board a Delta II in 2006. Scott Hubbard, deputy director for research at the Ames Research Center at Moffett Field, Calif., calls the mission "a cornerstone in our effort to search for evidence of life in the universe" that "will pave the way for future, more complex space projects."

The 903-kg. (1,987-lb.) spacecraft will be developed by Ball Aerospace & Technologies Corp. of Boulder, Colo., with a single instrument in mind, a photometric telescope with a 1.4-meter-(4.6-ft.-) dia. primary mirror designed by Principal Investigator William Borucki at Ames.

THE SEARCH for other planetary systems is one of astronomy's great quests, and in recent years, astronomers have identified about 80 planets outside the solar system. All are large gaseous planets, most likely composed of hydrogen and helium, that are similar to Jupiter. They are 30-600 times the size of Earth and lack solid surfaces and/or water, so they are unlikely to sustain life.

Until now, detection methods have not been available to spot smaller, Earth-like planets that might lend themselves to support life. That is the goal of the Kepler Mission.

Borucki has been working for about a decade on an approach using a transit-signature method for spotting such planets. A transit occurs whenever a planet crosses the line of sight between its parent star and the observer. That crossing causes a barely perceptible dimming of the light from the star. While only a few parts per 100,000 in the star's light output, it's enough to signal the presence of a planet orbiting the star. Borucki's detection method is to use a set of charged coupled devices to look for any of these so-called transit signatures. Once astronomers know where to look, they can use repeated observations to verify that a planet is present and to measure its size and orbit.

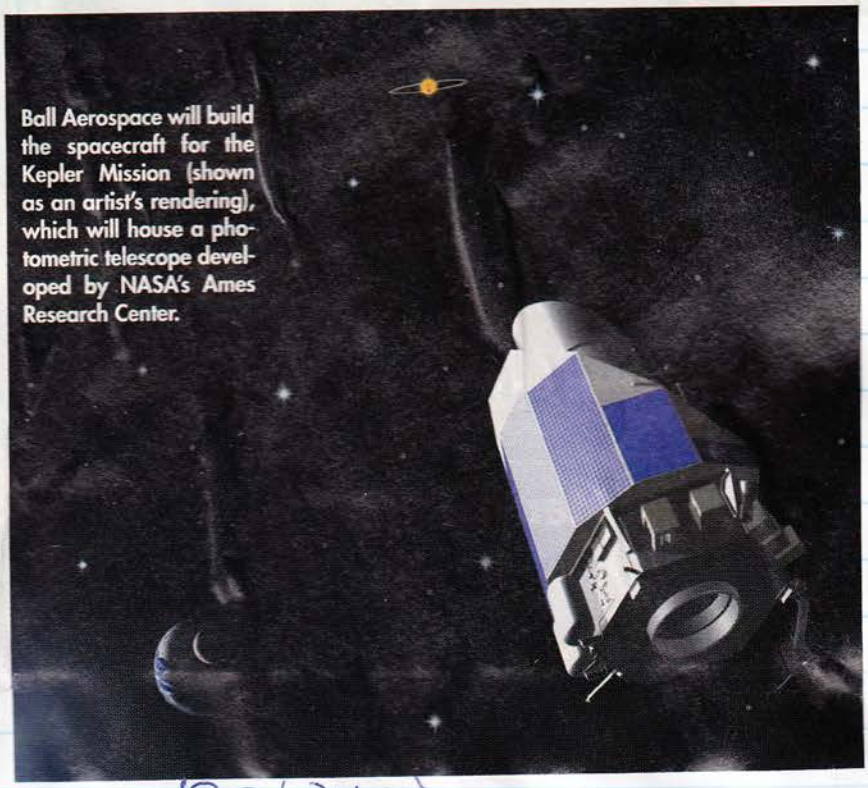
"The Kepler Mission will, for the first time, enable humans to search our galaxy for Earth-size or even smaller planets," Borucki said.

The spacecraft will trail the Earth by one astronomical unit (the distance from the Earth to the Sun) in a heliocentric orbit and monitor the same field of about 100,000 stars for four years.

The chance of any one planet being aligned along the telescope's line of sight is slight—only about 0.5%—so the spacecraft will need to monitor thousands of stars simultaneously. Three transits of a star, all with consistent periods, brightness changes and duration, will provide sufficient evidence of the presence of a planet and its orbital period. The measured orbit of the planet is important to determine whether it is in a "habital zone," one that is far enough from the star for liquid water to exist on its surface.

DAVID KOCH, the mission's deputy principal investigator, said the four-year monitoring period is expected to produce hundreds of terrestrial-type planets. Once a useful target is established, it can be checked over time to confirm a detection and establish an orbital period for planets.

The mission's cost includes a 30% reserve for science studies and $164 million for hardware. Initial funding in the current budget will be minimal; the bulk of the funding is expected in Fiscals 2004-05.



Ball Aerospace will build the spacecraft for the Kepler Mission (shown as an artist's rendering), which will house a photometric telescope developed by NASA's Ames Research Center.

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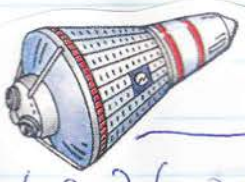

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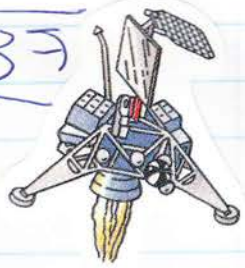

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Delta IV - a new giant

by Gerard van de Haar

Joel Powell/Boeing

In 1995 the US Government started the initiative for a new generation of unmanned launchers, called Expendable Evolved Launch Vehicle (EELV), to cope with the future user needs both military and commercial. Based on its Atlas family of launchers, Lockheed-Martin began development of the Atlas 5, and Boeing started developing the comparable Delta IV as the next step in the Delta launcher series. Both are now racing to perform the first test launch in spring 2002, with Delta IV now planned a week before Atlas 5. This article is based on a visit to the Delta IV production and launch facilities

Developing the Delta IV

The Delta IV philosophy is based on a revolutionary new main engine, the RS-68, and a modular design of its large new first stage.

Engine testing at both Rocketdyne (California) and NASA Stennis Space Center (Mississippi) started in 1998 and mid-2001 the test programme was concluded after approximately 150 test firings, lasting total 13,000 secs; on several tests the engine thrust was 105 percent at a max burn time of seven mins.

In 2000 the 120,000 m² large new Delta IV production facility in Decatur (Alabama) had produced the first stage test article, called Common Booster Core (CBC), which was shipped to Stennis and arrived on 29 October for a series of testfires; the first firing of this 41 m long first stage precursor was performed on 15 March 2001 lasting 15 sec, but the one on 29 April lasted for the nominal duration of five mins as did the final testfire on 6 May, thus qualifying the CBC.

As the upper stage uses the well-known RL-10, already used on Atlas 2 and Delta III, the Delta IV basic design was now ready for further testing at the launch site in Florida.

The first stage of the Boeing Delta IV is on its way to Cape Canaveral Air Force Station, Florida, in preparation for its first launch. Joel Powell/Boeing

Space Launch Complex 37B

Boeing chose a historic launch pad for its Delta IV launch operations. Cape Canaveral's pad 37B, located between the former Apollo and Titan pads 34 and 40, was already used in the sixties to launch a total of eight Saturn 1 or 1Bs, including the first Saturn 1 into Earth orbit on 29 January 1964, the first Apollo boilerplate launch on 28 May 1964 and the first launch of the Lunar Module (Apollo-5/LM-1) on 22 January 1968. Closed for operations in 1972, Boeing started rebuilding the site on 11 September 2000 for an amount of $250 million, with completion by mid-2001.

Delta IV comparison

	Delta IV	Atlas 5	Ariane 5	Titan IV	Proton
Produced in	US	US	Europe	US	Russia
Payload (LEO), max.	23 t	ca. 20 t	21 t	23 t	19.8 t
Payload (GTO), max.	13 t	8.7 t	6.2-12 t	6 t	4.9 t

In the meantime Boeing had developed a special vessel, called the Delta Mariner, to transport up to three Delta IV core stages over water from Alabama to Florida or the Vandenberg launch site in California. The Delta Mariner was delivered on 16 December 1999, set sail on 19 October 2000 to pick up the CBC at Decatur and bring it to Stennis; after the CBC test series in Stennis, the vessel brought the CBC to Florida where it arrived on 29 May. The CBC was first taken to the Horizontal Integration Facility (HIF) at pad 37B. The HIF is a 2100 m² building which can process two Delta IV's at the same time; from the HIF the completed booster is driven horizontally to the nearby launch tower where the rocket is erected and the payload can be put on top in a matter of days before launch. The CBC proved the soundness of this procedure when it was erected for the first time on 22 August.

Configurations

Delta IV will come in several versions. The basic configuration has only one first stage core, but small strap-on boosters can be added to increase the payload capacity; by combining three core stages the capacity is maximised (see Table below). The Decatur factory has the capability to produce up to ten Delta IVs a year, so a possible total of 30 booster cores annually.

The Delta launcher family

	Delta IV	Delta III	Delta II
Length m	61-72	39	38
Thrust mln kg	0.3-1	0.5	0.4
Payload (LEO) t	8.1-23	8.3	2.7-6
Payload (GTO) t	4.2-13.1	3.8	0.9-2.1

Planning

After the first flight-rated RS-68 was tested at Stennis, it was brought to Decatur and attached to the first flight core booster; this first Delta IV was shipped by the Delta Mariner to Florida and arrived on 4 October. The planning foresees erection at pad 37B for a Flight Readiness Firing early 2002. As the launch date of 30 April nears, the first Delta IV payload, a Eutelsat telecommunications satellite, will be transported from Astrotech, where the satellite's final servicing has taken place in its new 5000 m² building, to the pad. By late 2001 Boeing had signed 18 firm launch orders and 42 options for its new rocket.

Peering at Io, Galileo Finds No Magnetic Field

MICHAEL A. DORNHEIM/**LOS ANGELES**

Jupiter's moon Io does not have its own magnetic field despite the presence of a molten iron core, according to the latest measurements by the Jet Propulsion Laboratory's Galileo spacecraft.

Galileo made a close flyby of Io's south pole on Oct. 16, which, combined with an earlier flyby of the north pole, provided the data needed for scientists to conclude there is no intrinsic field (*AW&ST* Aug. 13, 2001, p. 20). The recent 114-mi. flyby also returned good visual and infrared images of the moon, and measurements of the 10-fold increase in charged particles in its vicinity.

Circulation of the Earth's molten iron interior generates its magnetic field, but Io's interior apparently doesn't move the same way. The accepted theory is that the Earth is internally heated at the boundary between the solid core and the fluid shell by the latent heat of condensation as the molten shell condenses to a solid, says Margaret G. Kivelson, the principal investigator for Galileo's magnetometer.

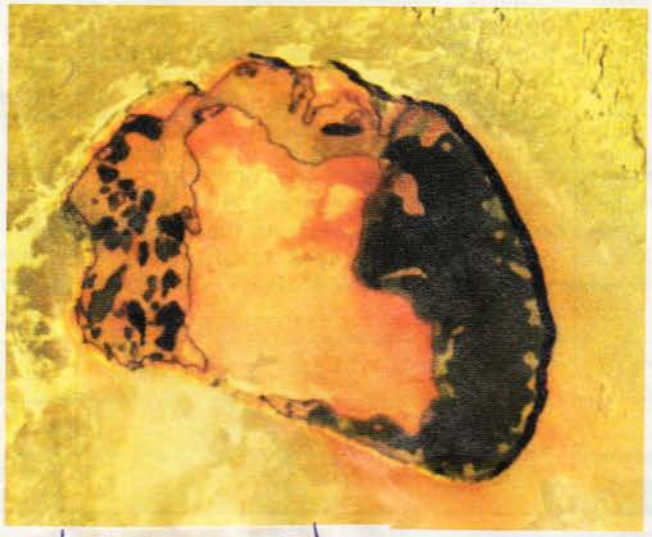
But Io's interior is heated externally by tidal flexing from Jupiter's strong gravity, and scientists were not sure whether this would produce a magnetic field. The lack of a field "shows that Io's heat source does not drive a magnetic dynamo and thereby limits the types of heating that produce internal planetary fields," Kivelson says.

However, local measurements show electrical currents flowing along magnetic field lines near two areas of volcanic activity. "If this is the mechanism that's producing the currents, it may help us in the search for active plumes," Kivelson says.

Pictures taken during the Oct. 16 flyby include the Tupan Patera volcanic area, which is seen in good detail for the first time at 440-ft./pixel resolution. The volcanic depression is colorful, with reds, yellows, greens and blacks that are believed to be mixtures of lava and forms of sulfur. Intermingled patches of lava and sulfur may be caused by warm lava locally boiling away the sulfur.

The spacecraft's camera had been erratic and missing some pictures, probably due to radiation damage, but a software fix made before the October encounter appears to have solved the problem—all of the pictures worked, says Galileo project manager Eileen Theilig.

Galileo is set to make its final flyby of Io on Jan. 17 and then encounter the tiny moon Amalthea in November, followed by crashing into Jupiter in September 2003.



Tupan Patera volcanic depression on Io is about 47 mi. across, surrounded by cliffs about 3,000 ft. tall. The dark material is lava, and colors are forms of sulfur. Sunlight illumination is from upper right.

73643

NASA PRESS RELEASE : 15 JANUARI 2002.

FAREWELL, IO / GALILEO PAYING LAST VISIT TO A RESTLESS MOON

NASA'S GALILEO ORBITER WILL DART PAST JUPITER'S MOON IO ON THURSDAY IN THE VETERAN SPACECRAFT'S LAST AND CLOSEST FLYBY OF ANY OF THE GIANT PLANET'S FOUR MAJOR MOONS. IO'S VOLCANOES HAVE PRESENTED MANY SURPRISES SINCE THEY WERE FIRST SEEN IN 1979 BY NASA'S VOYAGER SPACECRAFT AND ESPECIALLY DURING THE SIX YEARS THAT GALILEO HAS BEEN ORBITING JUPITER. SCIENTISTS HOPE THIS WEEK'S ENCOUNTER WILL REVEAL HOW SEVERAL REGIONS OF IO HAVE CHANGED OVER THE YEARS."GALILEO'S DAYS ARE NUMBERED NOW, SO IT'S ESPECIALLY EXCITING TO VISIT IO ONE LAST TIME," SAID DR. EILENE THEILIG, GALILEO PROJECT MANAGER AT NASA'S JET PROPULSION LABORATORY (JPL), PASADENA, CALIF. "AN ORBITAL MISSION LIKE GALILEO GIVES YOU THE ADVANTAGE OF GETTING TO EXAMINE INTERESTING PLACES REPEATEDLY OVER A PERIOD OF TIME. THAT'S BEEN GREAT FOR STUDYING IO, SINCE IT KEEPS CHANGING SO MUCH." THE GALILEO FLIGHT TEAM AT JPL AIMED THE ORBITER TO SKIM JUST 100 KILOMETERS (62 MILES) ABOVE IO'S MULTICOLORED SURFACE AT 9:09 A.M. EST ON JAN. 17. "THE REASON WE'RE GOING SO CLOSE IS TO PUT GALILEO ON A BALLISTIC TRAJECTORY FOR IMPACT INTO JUPITER IN SEPTEMBER 2003," THEILIG SAID. GALILEO HAS OPERATED IN ORBIT MORE THAN THREE TIMES LONGER THAN ITS ORIGINALLY PLANNED MISSION. THE RESILIENT SPACECRAFT HAS SURVIVED ABOUT THREE AND A HALF TIMES AS MUCH EXPOSURE TO RADIATION FROM JUPITER'S RADIATION BELTS AS IT WAS DESIGNED TO WITHSTAND. IN ITS 33 LOOPS AROUND JUPITER, IT HAS FLOWN NEAR IO SIX TIMES PREVIOUSLY AND NEAR THE OTHER THREE OF JUPITER'S PLANET-SIZED MOONS - EUROPA, GANYMEDE AND CALLISTO - A TOTAL OF 27 TIMES.

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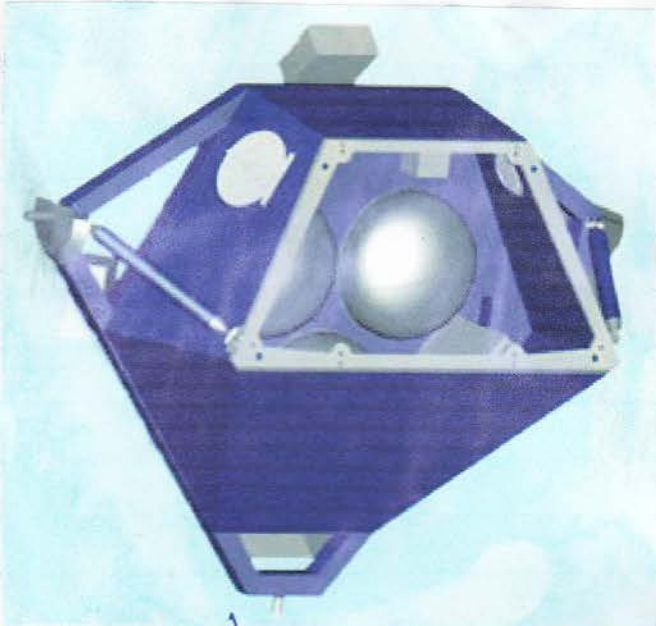

(73646)

HOUSTON CHRONICLE : 16 JANUARI 2002.

NASA AWAITS LAST PHOTOGRAPHS FROM JUPITER PROBE'S LONG TRIP.

LOS ANGELES - Since 1989, the camera on NASA's Galileo spacecraft has captured a comet slamming into Jupiter, volcanoes erupting on one of its moons and the first known moon orbiting an asteroid. On Thursday, the camera will snap its last pictures. Galileo will make its final flyby of one of Jupiter's major moons when it sweeps within 62 miles of Io. The mission budget does not cover any further pictures. Galileo will continue making other scientific observations until September 2003, when the $1.4 billion spacecraft is expected to slam into Jupiter in a spectacular finale. But the 70 photographs to be transmitted to Earth over the next three months will be the last. They will be a bittersweet reminder of a mission that was supposed to provide scientists -- and the world -- with motion picture-like images of Jupiter's vibrant atmosphere. Because of computer glitches and other problems, Galileo never did produce the movie-quality images, but it still provided stunning and scientifically valuable pictures. During 32 orbits of Jupiter, Galileo studied the planet-size moons Ganymede, Callisto, Europa and Io. Among its discoveries was evidence of liquid oceans beneath the surfaces of Europa and Callisto that could harbor life. The spacecraft also kept tabs on some of the dozens of hot, active volcanoes on Io. In all, Galileo has returned about 14,000 images to Earth. "It will be sad when we get to the end, but at the same time, looking back at its history, you can be quite proud of the mission," said Eilene Theilig, Galileo project manager at NASA's Jet Propulsion Laboratory. The spacecraft was launched in 1989 from the space shuttle Atlantis and arrived in orbit around Jupiter six years later. Originally, Galileo was to have used its high-gain antenna to zip data back to Earth at 134 kilobits per second -- more than twice the rate of a typical home dial-up modem. Scientists hoped to capture hundreds of thousands of images of Jupiter's atmosphere, stitching them together to create elaborate movies. Instead, the antenna jammed during its deployment in 1991, forcing scientists to rely on the probe's low-gain antenna and its pokey rate of 160 bits per second. The glitch was compounded by radiation damage to the camera and other spacecraft components. Still, the camera piled up the images. In 1993, Galileo captured the asteroid Ida at close range, allowing scientists to discover that the space rock had a tiny moon of its own, which they named Dactyl. A year later, Galileo watched as fragments of the comet Shoemaker-Levy 9 slammed into Jupiter and exploded in its atmosphere. During Thursday's flyby, Galileo will make its closest pass yet to any of Jupiter's moons. Its camera should be able to capture features on Io's surface as small as 33 feet across. It will also snatch the first peek at the moon's Jupiter-facing hemisphere since the Voyager mission in 1979.

(73647)

CNN : 17 JANUARI 2002.

DOOMED JUPITER PROBE GOES BLIND EARLY.

73648

Making its closet approach to one of Jupiter's moons, the aging Galileo spacecraft experienced a glitch and could not snap one final flurry of photographs. As the craft skimmed within 62 miles (100 km) of Io on Thursday, perilously close to the dangerous radiation belts of Jupiter, the NASA robot ship for unknown reasons went into safe mode, which automatically shut down onboard instruments. "We're not totally surprised, because Galileo has already outlived expectations and we knew that it might encounter additional difficulties from the high-radiation environment on this flyby," said Eilene Theilig, lead Galileo scientist at NASA's Jet Propulsion Laboratory in Pasadena, Califfornia. An inhabitant of the Jupiter system for six years, Galileo has already survived four years longer than expected and endured more than three times the radiation it was designed to withstand. Flight engineers hope to restore normal operations on the craft so it can resume scientific observations during the remainder of the Io encounter, expected to last until Sunday. The camera, however, which has weathered radiation problems in the past, will likely take no more photographs. The Io photo shoot was to be its last. The $1.4 billion orbiter did manage to keep to its intended course over Io. Using the gravity of the moon, the flyby was planned to boost Galileo into an orbital path that will eventually lead to its destruction. "The reason we're going so close is to put Galileo on a ballistic trajectory for impact into Jupiter," Theilig said. Launched in 1989, the robot ship has spotted an asteroid with a moon, a comet striking Jupiter and dozens of molten cauldrons on Io, the most volcanic body in the solar system. Galileo has taken more than 10,000 images, many documenting puzzling and stunning features on Io and the other major jovian moons, Ganymede, Callisto, Europa. Among its achievements, Galileo's observations offered evidence that Europa possesses a deep saltwater ocean under its frozen exterior. One year ago, the vessel took part in an unprecedented collaboration when it, and the Saturn-bound Cassini probe, conducted joint observations during the latter's brief stopover in the Jupiter system. Its camera shuttered, its fuel and mission budget nearly exhausted, Galileo will nonetheless keep taking other scientific readings. In November, it will make the first close flyby of Amalthea, a small, inner moon of Jupiter. The finale is expected in September 2003, when Galileo will plunge into the crushing atmosphere of Jupiter. The suicide run is to ensure the probe does not strike and contaminate Europa, which scientists speculate could harbor microbial life.

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SPACE.COM : 17 JANUARI 2001.

CAMERA ON GALILEO TO TAKE LAST PICS.

LOS ANGELES - Since 1989, the camera on NASA's Galileo spacecraft has captured a comet slamming into Jupiter, volcanoes erupting on one of its moons and the first known moon orbiting an asteroid. On Thursday, the camera will snap its last pictures. Galileo will make its final flyby of one of Jupiter's major moons when it sweeps within 62 miles of Io. The mission budget does not cover any further pictures. Galileo will continue making other scientific observations until September 2003, when the $1.4 billion spacecraft is expected to slam into Jupiter in a spectacular finale. But the 70 photographs to be transmitted to Earth over the next three months will be the last. They will be a bittersweet reminder of a mission that was supposed to provide scientists _ and the world _ with motion picture-like images of Jupiter's vibrant atmosphere. Because of computer glitches and other problems, Galileo never did produce the movie-quality images, but it still provided stunning and scientifically valuable pictures. During 32 orbits of Jupiter, Galileo studied the planet-size moons Ganymede, Callisto, Europa and Io. Among its discoveries was evidence of liquid oceans beneath the surfaces of Europa and Callisto that could harbor life. The spacecraft also kept tabs on some of the dozens of hot, active volcanoes on Io. In all, Galileo has returned about 14,000 images to Earth. ``It will be sad when we get to the end, but at the same time, looking back at its history, you can be quite proud of the mission,'' Eilene Theilig, Galileo project manager at NASA's Jet Propulsion Laboratory. The spacecraft was launched in 1989 from the space shuttle Atlantis and arrived in orbit around Jupiter six years later. Originally, Galileo was to have used its high-gain antenna to zip data back to Earth at 134 kilobits per second _ more than twice the rate of a typical home dial-up modem. Scientists hoped to capture hundreds of thousands of images of Jupiter's atmosphere, stitching them together to create elaborate movies. Instead, the antenna jammed during its deployment in 1991, forcing scientists to rely on the probe's low-gain antenna and its pokey rate of 160 bits per second. The glitch was compounded by radiation damage to the camera and other spacecraft components. Still, the camera piled up the images. In 1993, Galileo captured the asteroid Ida at close range, allowing scientists to discover that the space rock had a tiny moon of its own, which they named Dactyl. A year later, Galileo watched as fragments of the comet Shoemaker-Levy 9 slammed into Jupiter and exploded in its atmosphere. During Thursday's flyby, Galileo will make its closest pass yet to any of Jupiter's moons. Its camera should be able to capture features on Io's surface as small as 33 feet across. It will also snatch the first peek at the moon's Jupiter-facing hemisphere since the Voyager mission in 1979.

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SPACE.COM : 28 JANUARI 2002

REACHING FOR PLUTO – A RENDEZVOUS BETWEEN PLANETARY SCIENCE AND POLITICS.

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BOULDER, COLORADO - The White House, Congress, and NASA will soon seal the fate of a mission to the most distant planet known within our family of worlds: Pluto and its moon, Charon, the only planet-satellite system in our solar system that has not been visited by an interplanetary probe. An earlier Pluto spacecraft program was scrapped due to skyrocketing costs that forced NASA to cancel that Neffort in 2000. Last November, after a heated competition, NASA selected a new team for the job of getting to chilly Pluto. The Johns Hopkins University Applied Physical Laboratory (APL) in Laurel, Maryland and Southwest Research Institute (SwRI) in San Antonio, Texas were tapped to push forward on the first mission to explore the last known planet in the solar system and the Kuiper Belt region beyond that faraway world. The team also includes Ball Aerospace; Stanford University; NASA Goddard Space Flight Center; and other universities and research institutions. Title for the winning proposal, with the mission pegged at a cost of $488 million, said it all - New Horizons: Shedding Light on Frontier Worlds. If the proposed Pluto-Kuiper Belt (PKB) mission takes off in January 2006, obtaining a gravitational boost from Jupiter a year later, the craft would zip past Pluto between 2014 and 2018. That multi-year spread of prospective arrival dates depends on the launch vehicle NASA picks -- either a Delta 4 or Atlas 5 booster -- both of which are slated for first-time liftoffs this year. To date, Congress has coughed up a modest but welcomed $30 million for the PKB mission. Those monies became available against the wishes of the Bush Administration. That funding put money down on a launch vehicle and kick-starting final design work on the spacecraft and instruments. Thanks largely to behind-the-scenes and in your face political prodding by Senator Barbara Mikulski (D-Maryland), the home state of APL, the mission has moved forward on the bureaucratic game board that is the U.S. Congress. Even APL made note of her firm, resolute persona when announcing the selection in November of the New Horizons proposal. "We promise a rewarding mission for NASA and for avid space science supporters, such as Senator Barbara Mikulski and the Maryland delegation, who have done so much to advance science and technology in the state," said Richard Roca, APL's director. However no funding for subsequent years has been green-lighted and it must pass a NASA confirmation review. That appraisal will address just how real the PKB mission schedule is and what technical risks and must-meet milestones are ahead. Another key event is regulatory approval for launch of the mission's nuclear power source. Early next month, with the release of NASA's budget, the PKB mission team will learn of its financial footing and prospects for flying. In NASA's current environment of space station cost overruns, agency restructuring, an expensive menu of Mars exploration projects, as well as other space science agenda items, the near half-billion-dollar Pluto trek may be viewed as a costly and unwanted outing.Econo-class mission. "I'm a big optimist," says Alan Stern, director of Southwest Research Institute's Department of Space Studies here, and principal investigator for New Horizons.

19788

Complex Telescope To Probe IR Universe

WILLIAM B. SCOTT/**BOULDER, COLO.**

An innovative design and Earth-trailing orbit brought the SIRTF space-based infrared observatory to life

ON THE WEB
For more information onSIRTF, go to www.AviationNow.com/sirtf

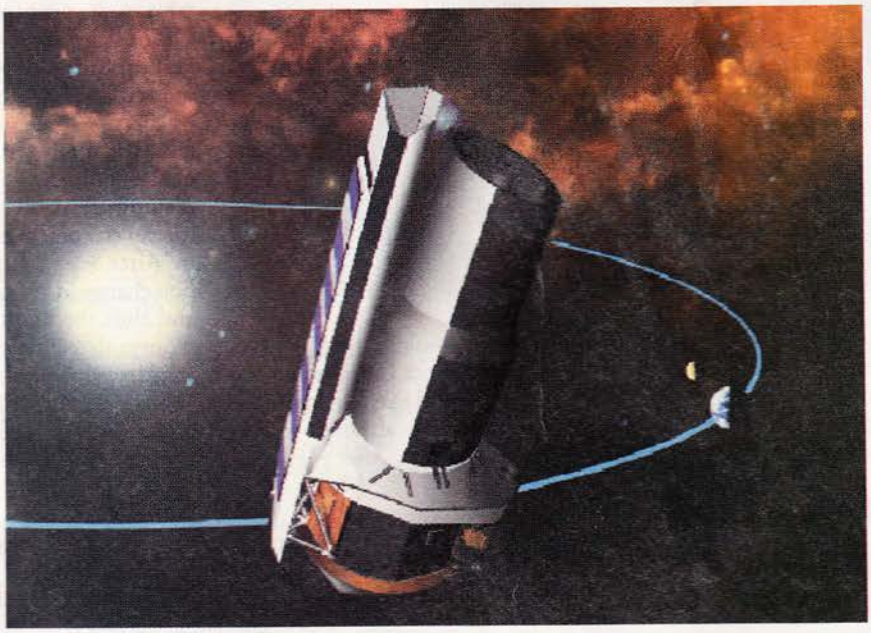
After waiting more than two decades, astronomers will move another step closer to exploring the infrared region of the universe when two major elements of the Space Infrared Telescope Facility (SIRTF) are joined this month.

NASA's Jet Propulsion Laboratory officially took delivery of the Cryogenic Telescope Assembly (CTA) from Ball Aerospace and Technologies Corp. last month. Containing an infrared telescope and three science instruments, the CTA is scheduled to arrive around Jan. 25 at Lockheed Martin Space Systems' Sunnyvale, Calif., plant, where it will be mated with a Lockheed Martin-built spacecraft bus.

Launch from Cape Canaveral on a Boeing Delta II 7920 booster will probably occur "late this year," said David B. Gallagher, JPL's SIRTF project manager. A firm date is being negotiated with NASA headquarters. Originally planned for launch in July 2002, SIRTF was plagued by difficulties in CTA development, slips in spacecraft hardware deliveries and "considerable delays in getting our flight software," he said.

A cryogenic observatory dedicated to space-based infrared astronomy, SIRTF is the last in NASA's four "Great Observatories Program," which includes the Hubble, Chandra X-Ray and Compton Gamma-Ray observatories. Together, the platforms will give scientists an unprecedented picture of the solar system and deep space, thanks to data from multiple bands of the electromagnetic spectrum.

In 1983, the Infrared Astronomical Satellite (IRAS) demonstrated the value of a cryogenically cooled IR telescope in space, well away from the thermal pollution of Earth. During 10 months, the spacecraft surveyed the entire sky and documented the universe in the 8-120-micron range.



The Space Infrared Telescope Facility will explore the near- and far-infrared universe, complementing the Hubble, Chandra and Compton observatories.

SIRTF differs from IRAS in that the new spacecraft is a "pointed observatory" fitted with an 85-cm. Ritchey-Chretien telescope, and will have a much longer mission lifetime—2.5 years for sure, and possibly five or more years. IRAS used about 60 discrete IR detectors, each with its own amplifier and cryogen supply. SIRTF will carry IR detector arrays having tens of thousands of pixels, enabling both imaging and spectroscopy.

The effort to develop and fly a space infrared observatory has undergone seismic shifts since it was first conceived in the 1970s. Originally it was to be a $2-billion-class mission, with a telescope launched by the space shuttle or a Titan rocket. For a variety of reasons, the program was scaled down substantially. NASA's "faster-better-cheaper" mantra also contributed to a rescoping of the program.

"Fifteen years ago, we were going to bury the telescope in the cryogen tank, as we did on IRAS," Gallagher said. "This time, we knew we couldn't do that on a low-cost program. We had to get the size down to fit on a smaller launch vehicle. The science team, in the early 1990s, decided we should separate the two—put the telescope outside the cryostat. That allowed us to use a much smaller cryostat, and from a systems point of view, allowed a lot of other good things to happen."

Driven by size and cost constraints, the SIRTF mission evolved to its present status:

- A compact spaceborne system developed for about $630 million to fly on a $60-million Delta II launch vehicle. Operations will run about $70 million per year, with approximately $40 million of that going to the science community.
- Use of an innovative Earth-trailing, heliocentric orbit. SIRTF will circle the Sun, following in Earth's wake.
- Launching "warm" and using the cold of space to cool the IR telescope to 40K.

"The trailing orbit is very innovative because it [largely] solves thermal problems," said Tim Kelly, SIRTF program manager for Ball Aerospace. The obser-

The heart of SIRTF is a Cryogenic Telescope Assembly, shown in a Ball Aerospace & Technologies test chamber. Low-conductivity struts thermally isolate the CTA from the spacecraft.

vatory is constructed in a way that keeps solar panels pointed toward the Sun, while also shielding much of the spacecraft, keeping the telescope cool as it looks into space. By not orbiting Earth, SIRTF also avoids blocked fields-of-view (FOV) and going in and out of the planet's shadow.

"A given object can be within SIRTF's [FOV] for at least 40 days. Over the course of six months, we can observe every point in the sky," Gallagher said. That greatly simplifies scheduling for scientists, and improves the observatory's efficiency—time of useful operation—to about 90%. Hubble's efficiency is roughly a third of that, because it orbits the Earth.

The in-space SIRTF observatory will cover a 3-180-micron wavelength band, enabling the study of cold objects in the outer solar system, as well as reaching the most distant objects in the universe. For example, it will be able to detect brown dwarfs, objects that don't have enough mass to ignite the fusion reactions of true stars, yet are larger and warmer than planets found in our solar system. SIRTF also will help determine the structure and composition of dust and gas disks.

By putting SIRTF in space, scientists will achieve "orders-of-magnitude gain in sensitivity over what's possible from [Earth]," said Michael W. Werner, JPL's project scientist for SIRTF. "This observatory has 'great discovery' potential, [thanks to that] sensitivity. The history of astroexploration tells us there's going to be some goodies out there. Our most exciting discoveries will be things I can't yet describe."

On Earth, the night sky is as thermally "bright" relative to the cold of space as "the sky at high noon" in the visible light spectrum, he said. An Earth-trailing orbit would distance SIRTF from the planet's heat—and allow designers to take advantage of space's thermal-radiative characteristics. Solar panels and a shield will shade the CTA from the Sun, while "keeping the panels power-positive at all times," Gallagher said.

Liquid helium cools science instruments in the CTA, but the telescope will be naturally chilled to ambient space temperatures, reducing the amount of cryogen needed.

Half of the CTA's outside surface is painted black and will face away from the Sun, radiating to the cold of space. The other side is reflective, yet protected most of the time by solar panels.

The Ball-built CTA is a highly complex system that comprises an 85-cm. telescope, outer shells and baffles, a dust cover, and a Multiple Instrument Chamber containing three science instruments—the Infrared Array Camera, Infrared Spectrograph and Multi-Imaging Photometer for SIRTF. The instrument chamber sits on top of a 360-liter (95-gal.) helium tank thermally isolated from the rest of the spacecraft. The entire system is dominated by thermal isolation shields and supports to keep the telescope and instruments cold.

POSITIONING IT OUTSIDE the cryostat did not eliminate a need to cool the telescope, though. Designers came up with a pragmatic approach—let the telescope radiate heat to the cold of space. That allows SIRTF to be launched "warm," and requires about 30 days for the telescope to passively cool to a temperature below 40K. Liquid helium will bring the telescope down to 5.5K. The three instruments will be cooled almost to absolute zero—1.4K. Not having to use helium to decrease telescope temperature more than 400K saves a tremendous amount of the cryogen, enabling at least a 2.5-year mission life.

"[SIRTF's] life is pretty much dictated by the exhaustion of helium," Gallagher said. "But even after the cryogen is gone and the telescope's temperature increases, there're still some detectors that can operate effectively, just with radiative cooling." After that, the orbit's geometry becomes a life-limiting factor. Still, scientists think they can squeeze two more years of work from SIRTF's "post-cryogen phase," Werner said.

But a "warm launch" approach, while saving weight and reducing SIRTF costs, makes it much harder to ensure alignment of the observatory's optics train. When all the critical components are cold at launch and change temperature uniformly, "you can lock the thing down [before liftoff] and know what the alignment will be on-orbit," Ball's Kelly said. "But here, we had to build and align 'warm,' then launch and go down to 5.5K and remain aligned. We understood that, but we didn't appreciate the complexity it would cause. We have different materials [at] joints and junctions."

A network of "flexures" and structural

members was used to control alignment with temperature changes. Where feasible, the same material was used in critical areas—such as beryllium for the mirrors and telescope—to minimize weight and ensure homogeneous changes with temperature.

"THE CTA IS ONE of the most complex mechanical items [Ball] has ever [developed], due to all the constraints—an innovative orbit, allowing temperatures to passively drop to 40K, and putting the three main systems together," Kelly said. "The overall structure has to be aligned, then the telescope and cryostat have to work together. CTA systems engineering was a long-pole in itself. It was a tough job."

JPL's Gallagher confirmed that view. "Ball took on a tremendous [challenge] with the CTA. It's a big deal. This is an extremely difficult task, and it hasn't been done before."

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Buried in the SIRTF cryostat and operating at 1.4K are three science instruments—two built by Ball and the third by NASA's Goddard Space Flight Center. Other organizations involved in instrument design and development include the Smithsonian Astrophysical Observatory, Cornell University and University of Arizona. A new SIRTF Science Center/Infrared Processing and Analysis Center is responsible for science operations.

NASA Goddard's Infrared Array Camera will cover the shortest IR wavelengths of about 3-10 microns, using four arrays. It is devoted primarily to imaging and mapping observations—good for "looking at stars in the distant, early universe," Werner said. When imaging, the camera can cover a 5 X 5-arc-min. patch of sky.

THE BALL-BUILT Multiband Imaging Photometer is a far-infrared or long-wavelength instrument covering the 24-160-micron band with three detector arrays. With a 5 X 5-arc-min. FOV, it will look for dust around a nearby star, which could indicate planetary system formation.

The Infrared Spectrograph, also fabricated by Ball, provides low and moderate spectral-resolution spectroscopy. Four separate optics modules span a wavelength range of 5-40 microns, overlapping somewhat with the other two instruments. Its forte is studying the composition of dust and ice near a star.

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Key to these instruments' sensitivities is their advanced detector arrays. "One thing that enabled SIRTF from the start was the quality and capability of dramatically better detector fabrication" as compared with those available in the 1980s. "SIRTF has benefited from substantial national investment by the defense community in infrared detectors," Gallagher declared.

AEROJET NEWS RELEASE : 26 JANUARI 2001.

AEROJET DELIVERS X-38 DEORBIT PROPULSION STAGE TO NASA.

73655

After three years of design, engineering and assembly, Aerojet on Friday delivered the Deorbit Propulsion Stage (DPS) for the X-38, NASA's full-scale prototype for the International Space Station emergency Crew Return Vehicle. The DPS was scheduled to make its "first flight" Friday to Johnson Space Center (JSC) in Houston aboard NASA's oversized Super Guppy plane. NASA officials loaded the crated DPS onto the Super Guppy -- via the plane's hinged nose -- at Mather Airport near Aerojet's Sacramento facility. At a ceremony at Aerojet, Matt Drutt, Aerojet X-38 program manager, commended the team's "dedication, patience and perseverance" in achieving this major milestone for Aerojet. He presented plaques to nearly 100 people who worked on the program. "The key to success was a fundamentally sounnd program plan," said Drutt. "This delivery is the latest addition to Aerojet's heritage of support to NASA, following programs such as the Space Shuttle OMS engines, which have had 100 percent flight success, and the NEAR propulsion system. Soon, we will add the MESSENGER program to the long historical line of successful products we have provided to NASA for space transportation." After the DPS is mated to the X-38 at JSC, NASA will conduct acceptance testing, followed by system integration, combined structural testing and other testing leading up to a flight test possibly in late 2004 or early 2005. For the flight test, a Space Shuttle will carry the X-38 into space. Part of the DPS structure is an interface to lock the vehicle in place in the Shuttle's cargo bay. At an altitude near the Space Station, the Shuttle's robotic arm will lift the X-38 out of the bay and release it. Except for a crash dummy named Edgar, the X-38 will be unmanned. (It's designed for seven passengers). Once the two spacecrafts are at a safe distance, the DPS will fire in a calculated deorbit burn to bring the X-38 out of orbit. The DPS will fire its eight thrusters for approximately 30-45 minutes during descent. When the X-38 begins to reenter the atmosphere, the DPS will jettison and burn up. The X-38, with Edgar at the helm, will glide to a remote-controlled parachute landing, possibly in Australia. Aerojet developed the DPS under a $23 million contract with NASA. The X-38 completed its highest, fastest and longest flight on Dec. 13, 2001, at NASA's Dryden Flight Research Center, Edwards, Calif. In the eighth large-scale flight test for the program, the X-38 was released from a NASA B-52 aircraft at an altitude of 45,000 feet and landed successfully. Aerojet, a GenCorp company, is a world-recognized aerospace and defense leader principally serving the missile and space propulsion, and defense and armaments markets.

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SPACE.COM : 05 JANUARI 2002.

STATION CREW GEARS UP FOR TWO JANUARY SPACEWALKS.

CAPE CANAVERAL - The U.S.-Russian crew aboard the International Space Station will step up work outside the orbital outpost this month, setting out on two spacewalks aimed at carrying out key assembly jobs at the 17-story complex. Station commander Yuri Onufrienko and flight engineer Carl Walz are scheduled to venture outside the outpost at 3:50 p.m. EST (2050 GMT) Jan. 14 on the first of the two excursions. The job at hand: Moving a Russian Strela cargo boom from a stowage point outside a conical U.S. docking port to the exterior of the station's Russian Zarya space tug, which doubles as an orbital warehouse at the outpost. James Hartsfield, a spokesman for NASA's Johnson Space Center in Houston, said the idea would be to place the crane within reach of a similar boom that was erected outside the station's Russian Pirs airlock late last year. Hefty cargoes as well as suited astronauts and cosmonauts then will be able to be moved from one crane to another during future construction and maintenance work outside the outpost, he said. The spacewalk is expected to take about six hours to complete and represents the first of two sorties the station crew plans to perform outside the outpost this month. Onufrienko and flight engineer Daniel Bursch will head outside the station Jan. 25 to set up ham radio and Russian television antennas on the outer hull of the outpost's Russian-built Zvezda crew quarters. Onufrienko and Bursch also will carry out several other chores during that excursion. Metal deflectors will be mounted next to Zvezda steering thrusters to prevent toxic rocket exhaust from damaging the exterior of the bus-sized module, and contamination monitors also will be set up in the same area. In addition, the pair will retrieve a materials science experiment that was set up outside the station during an earlier spacewalk. The two spacewalks will be the first of as many as eight such excursions that are tentatively planned at the station during the tenure of the Expedition Four crew. A visiting shuttle crew is slated to perform four spacewalks during an April mission to deliver and install the central segment of a huge station truss that will eventually stretch 356 feet (108 meters) from end to end. Once the shuttle crew departs, Busch and Walz are tentatively scheduled to carry out as many as two more spacewalks to finish outfitting the truss segment. Launched Dec. 5 aboard shuttle Endeavour, the Expedition Four crew boarded the station two days later, setting out on a five-and-a-half-month tour of duty. Much of their first month in orbit has been spent unloading a Russian Progress cargo carrier and starting up some of the 65 U.S. and Russian research experiments they plan to carry out onboard the outpost. The Progress cargo carrier will serve as a giant trashcan over the next two months before it is jettisoned from the station Feb. 27 and then sent on a destructive plunge back through Earth's atmosphere. A new Progress space freighter then is scheduled to arrive at the station three days later, hauling up food, water, clothing and station equipment to the crew. The crew's first visitors are scheduled to launch April 4 aboard shuttle Atlantis. The seven U.S. astronauts are to arrive at the station two days later with the central truss segment. A Russian Soyuz taxi crew then is slated to launch April 17 on an eight-day round-trip to the station. Headed by veteran cosmonaut Yuri Gidzenko, that crew will include European Space Agency astronaut Roberto Vittori and Mark Shuttlesworth, an Internet entrepreneur who is destined to become the first South African to fly in space. The Expedition Four crew now is scheduled to return to Earth May 13 aboard shuttle Endeavour, capping a 159-day stay in orbit. Their replacements - Russian cosmonauts Valeri Korzun and Sergei Treschev and U.S. astronaut Peggy Whitson - are to remain at the outpost until mid-September

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BERICHT UIT DE RUIMTE

Nummer 9 - 12.01.2002

Het International Space Station wordt nu bewoond door de Rus Yuri Onufrienko (commandant) en de Amerikanen Carl Walz en Daniel Bursch. Zij vormen samen de vierde stambemanning van het station en zullen tot mei 2002 in de ruimte blijven. De eerste week van het nieuwe jaar werd voornamelijk besteed aan het voorbereiden van de ruimtewandeling die op 14 januari zal plaatsvinden. Ook werd een experiment uitgevoerd waarin de groei van nierstenen bij ruimtevaarders in gewichtsloosheid wordt onderzocht.

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SPACE.COM : 13 JANUARI 2002.

STATION ASTRONAUT MISSES SIMPLE PLEASURES AMID "INCREDIBLE ADVENTURE".

CAPE CANAVERAL - In space for more than a month now, one of the U.S. astronauts aboard the International Space Station says he and his crewmates are in the midst of "an incredible adventure." At the same time, though, outpost flight engineer Daniel Bursch already misses some of the more simple pleasures on Earth -- such as being roused from bed by his kids or taking a breath of fresh air on a crisp winter morning. "My family is probably the Number One thing I miss -- whether it's waking up, with the kids coming into the room and waking me up, or going outside," Bursch said Thursday in a space-to-ground interview with a television reporter from his hometown, Vestal, N.Y. "And maybe just the different smells you get outside," he added. "It's just that the smell up here is just always the same. It's not bad. It just kind of never changes much." A married father of four, Bursch boarded the station in December along with Expedition Four commander Yuri Onufrienko and fellow flight engineer Carl Walz. The three are in the midst of a planned five-and-a-half-month tour aboard the international station. In the 35 days since they took the helm of the station, the three men already have started up many of the 65 U.S. and Russian science experiments they plan to carry out on the outpost, which is circling some 247 miles (395 kilometers) above Earth. They also have unpacked 1.5 tons of supplies and equipment from a Russian Progress cargo carrier, tested the station's $600 million Canadian robot arm and started upgrading the station's U.S. command and control computers. During the past week they've been busy gearing up for a spacewalk. "Every minute is filled with something," Bursch said. "It seems like there is never a dull moment up here." Bursch will be watching on from inside the station next Monday when Onufrienko and Walz venture outside the outpost on a spacewalk primarily aimed at moving a cargo boom into position on the exterior of the station's Russian airlock. A ham radio antenna also will be set up on the outer hull of the station's Russian-built crew quarters during the six-hour excursion, which is slated to begin about 3:50 p.m. EST (2050 GMT). The sortie will be the first of two planned at the outpost this month. The second will come Jan. 25 as Onufrienko and Bursch set up three other ham radio antennas at the rear end of the Zvezda crew module. Metal deflectors and contamination monitors also will be mounted next to Zvezda steering thrusters on that spacewalk, and the pair will retrieve a materials science experiment. Both spacewalks will be staged from the station's Russian-built Pirs airlock, and Russian Orlan spacesuits will be worn by the spacewalkers during both excursions. All in all, Bursch -- a U.S. Navy captain -- said his station tour to date has seemed somewhat like a lengthy deployment aboard an aircraft carrier. "But it's quite different. If you can think of kind of not being able to get out of your stateroom for the six months, it's different," he said. "All I can say is it's an incredible adventure." The food, meanwhile, apparently is just as good as meals served aboard Navy ships. "We have a mixture of Russian and U.S. food, and we really do have quite a variety," Bursch said. "And overall, it's excellent." But, he added: "It sure would be nice to get a pizza and beer sometimes." Launched Dec. 5, the Expedition Four crew will greet their first visitors in early April when shuttle Atlantis sets sail on a mission to deliver the central segment of the station's metallic truss. A Russian cosmonaut, a European astronaut and South African Internet entrepreneur Mark Shuttleworth then will fly to the station in late April to deliver a fresh lifeboat to the outpost. That flight likely will be pushed back to April 25 from April 17 to give Russian engineers more time to ready the Soyuz for flight, NASA officials said. As it stands, Bursch and his station crewmates remain scheduled to return to Earth aboard shuttle Endeavour in mid-May. Their replacements -- U.S. astronaut Peggy Whitson and Russian cosmonauts Valeri Korzun and Sergei Treschev -- will be ferried up to the station aboard Endeavour and then remain there until mid-September.

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FLORIDA TODAY : 13 JANUARI 2001.

ALPHA CREW TO MOVE RUSSIAN CRANE.

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CAPE CANAVERAL - Space station Alpha crewmates will use one Russian crane to help move another today during the seventh spacewalk from the outpost. The pair of Russian cranes, called Strela or "arrow," is central to maintaining the Russian half of the Alpha complex. A Canadian robotic arm performs the same role on the American side of the station. The hard part for Russian Yuri Onufrienko and astronaut Carl Walz will be maneuvering one of the cranes into place using its twin, said Daryl Schuk, lead spacewalk officer for the mission. Officials expect the two to emerge from Alpha's hatch at 3:56 p.m. The crane they will move was latched onto an American connecting tunnel in case of emergencies. The second crane was launched last summer with the Russian Pirs docking compartment. Onufrienko, making his seventh spacewalk, will take the controls of the boom on the Pirs module and attempt to extend it more than 45 feet alongside the station without bumping its flimsy solar panels. The boom will be within a foot of a solar panel on the Russian Zarya control module. The team practiced the tactic for months in a large water tank in Russia before traveling to Alpha last month. Ground controllers near Moscow send up clarifications before each spacewalk, but may not be eager to make any changes for today's work. "That's a fairly complex maneuver that needs to be orchestrated and executed properly and I don't anticipate they'll change anything with that," Schuk said. Walz, walking along Alpha's side like a mountain climber wary of his grip, will attach the second crane to the end of the first. Then Walz will get a good view of the Earth 200 miles below as he holds onto the end of Strela while Onufrienko retracts the boom and swings the second crane towards its new home. Relocating the crane is expected to take up most of the 5 1/2 hours scheduled for the spacewalk. They also will attach a HAM radio antenna during the work session. The spacewalk will be the first time the two will leave the 170-foot-long cylinder that makes up Alpha since they and astronaut Dan Bursch moved in a month ago. "Sometimes they do let us go outside," Bursch told reporters Thursday. Bursch will watch from inside Alpha, maneuvering the robot arm remotely to keep the spacewalkers in view with the arm's cameras. That will give ground controllers their best look at the work. Bursch will make a spacewalk with Onufrienko Jan. 25.

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TUESDAY, JANUARY 15, 2002

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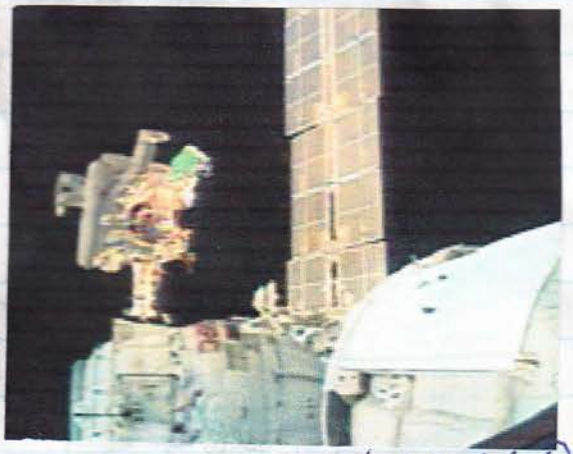
Commander Yury Onufrienko and Flight Engineer Carl Walz floated outside the International Space Station Monday on the first spacewalk of their expedition and finished installing a second Russian cargo boom, part of which had been delivered to the station two and a half years ago. With coordination help from inside the station by Flight Engineer Dan Bursch, the two space walkers also installed an amateur radio antenna on the Zvezda Service Module. The first space walk Expedition Four crew's five-month tour of duty began at 3:59 p.m. EST and ended at 10:02 p.m. EST, lasting a total of six hours, three minutes. Monday's spacewalk was the thirty-second in support of space station assembly, the seventh such excursion conducted from the station itself, and the sixth based out of the station's Russian segment. The total amount of time spent on space station-based spacewalks now stands at 29 hours, 04 minutes, and the total spacewalking time spent on station construction at 196 hours, 19 minutes. After exiting the station from the Russian Pirs docking compartment, Onufrienko and Walz assembled an extension for a Russian cargo boom that had been previously installed on Pirs. They used the operational cargo crane, called Strela 1 (Strela is the Russian word for arrow), to get into position to detach and relocate a similar crane temporarily stored on the outside of the Unity-to-Zarya connecting tunnel. Known as Strela 2, this second crane was moved back alongside Pirs and attached to a base point on the opposite side of the docking compartment and airlock at 7:31 p.m. EST. The first piece of Strela 2 had been delivered and installed in May 1999, and the second piece in May 2000. On future spacewalks, the two cranes may be used to maneuver equipment and spacewalkers. Onufrienko and Walz also installed an amateur radio antenna on a handrail at the end of the Zvezda service module. The antenna is one of four that eventually will allow space station crew members to make "ham" radio contacts from the comfort of their living quarters inside Zvezda. Currently, the amateur radio station is inside the Zarya module. The next spacewalk of the expedition - to be conducted by Onufrienko and Bursch - is targeted for Jan. 25. The plan for this spacewalk currently includes installation of the remaining three amateur radio antennae and thruster deflector shields on the end of Zvezda.



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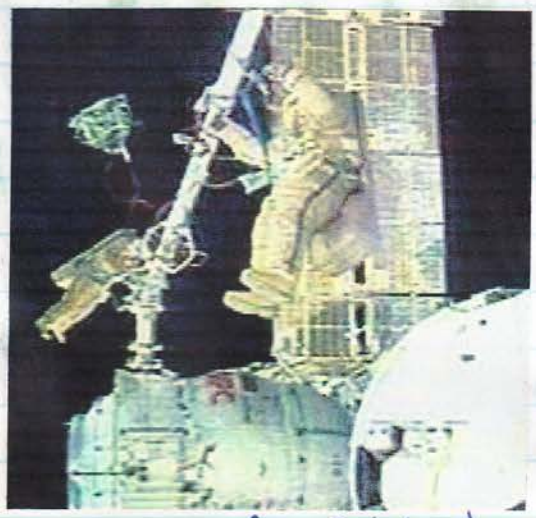

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CNN : 15 JANUARI 2002.

ALPHA CREW WRAPS UP SPACEWALK.

New residents of the international space station took their first stroll outside their orbiting home to relocate a Russian cargo crane and install a ham radio antenna. Cosmonaut Yuri Onufrienko and astronaut Carl Walz, wearing Russian Orlan spacesuits, completed the six-hour float about at 10 p.m. EST on Monday. The spacewalk was one of four planned during the crews five-month tour, which began in December. The first order of business was to move a 45-foot (13.6-meter) Russian crane from a temporary storage position outside a U.S. module to the docking compartment of the Russian control module, where an identical crane already is installed. The docking compartment air lock serves as the doorway for spacewalks conducted from the Russian side of the space station. In the future, the two cranes will be used together to move equipment and spacewalkers outside the 17-story orbiting complex. After that job, Onufrienko and Walz placed an amateur radio antenna on a handrail at the end of the Russian service module. Another spacewalk is set for later this month. On the January 25 excursion, the other Alpha resident, U.S. astronaut Dan Bursch, will accompany Onufrienko. Onufrienko, Walz and Bursch are the fourth crew to live in Alpha, which has been continuously occupied since November 2000. The unfinished station, a project of the United States, Russia, Europe, Canada and Japan, could cost upward of $100 billion if built as planned. But multibillion dollar cost overruns and shrinking federal budgets could force NASA, the primary organizer, to scale back further construction. Mondays spacewalk was the 32nd to help assemble the space station, the seventh from the station itself.

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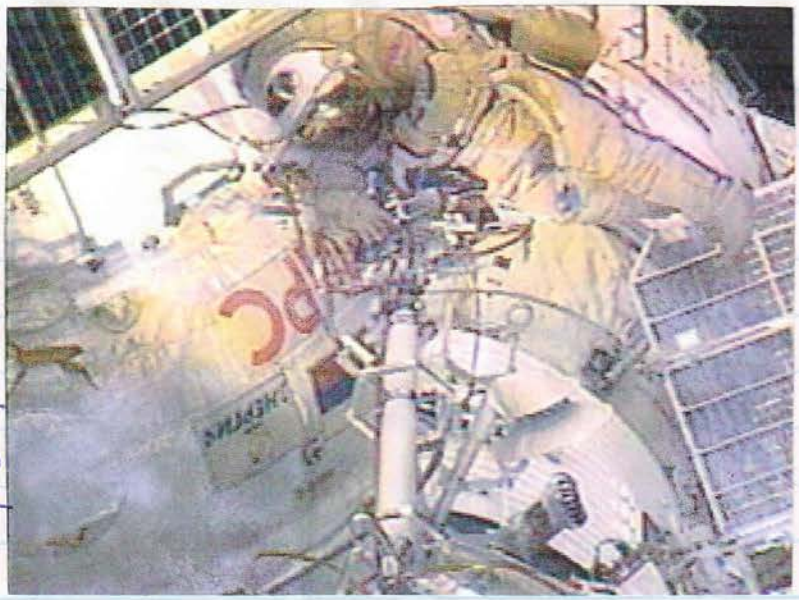

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Cosmonaut Yuri Onufriyenko and Astronaut Carl Walz installed a second Russian transfer crane and a ham radio antenna on the International Space Station during a 6-hr. extravehicular activity on Jan. 14, the first for the Expedition 4 crew and the seventh from ISS without a space shuttle present. Another EVA is set for Jan. 25, when Onufriyenko and Astronaut Dan Bursch are scheduled to install three more ham antennas and thruster deflector shields on the Zvezda module. Astronauts and cosmonauts often communicate with ham radio operators.

AWST:
21-01-2002

FLORIDA TODAY : 24 JANUARI 2001.

BURSCH TO MAKE FIRST SPACEWALK.

73672

CAPE CANAVERAL - The fourth crew of space station Alpha will make its second spacewalk in less than two weeks today to install thrust deflectors and a ham radio antenna on a Russian segment. It will be the first spacewalk for astronaut Dan Bursch. Bursch has twice helped fellow station resident Carl Walz suit up to go outside the shuttle and then the outpost. Russian commander Yuri Onufrienko will lead the 6-hour jaunt around the Russian Zvezda seervice module. It will be his eighth spacewalk and second on Alpha. The main task for the two is to lock simple aluminum grates to six sets of steering jets around Zvezda's hull. The jets give off a black residue when they are fired that collects around the nozzles and could get on spacewalkers' suits. Researchers do not want spacewalkers to accidentally brush against the material and bring it inside the station, where it could affect crewmembers' eyes or noses, Expedition Four manager Susan Brand said Thursday. "The substance will be more irritating than anything else," she said. "We do not see it as a toxic substance." Researchers have tried to recreate the material, but are not certain what it is except a byproduct of the chemical reaction that fires the thrusters. Spacewalk officer Daryl Schuck said Russian space officials called for the spacewalk after seeing similar residual buildup on the Mir space station. Onufrienko and Bursch will float out of Alpha's hatch at 10:35 Friday morning to begin the work. They will scale the sides of Zvezda, stopping occasionally to attach the deflectors. "Once you're at the work site, it's pretty fast," Schuk said. "The big task is getting out to the site and getting (the deflectors) separated from the others." It takes about ten minutes to plug each deflector into the nozzles. They are designed to confine any residue to the grates, leaving spacewalkers to mill around Zvezda with little concern in the future. The Russian and American will set up a plate of materials near the exhaust ports to see if the grates make a difference. A second ham radio antenna will complete the installation work for the two. Onufrienko and Alpha crewmate Carl Walz installed the first during their previous spacewalk.

19796

CNN : 25 JANUARI 2002.

SPACE STATION CREW STEPS OUT TO CATCH COSMIC RAYS.

Two crewmembers of the international space station stepped outside their orbiting home on Friday to install a ham radio antenna, thruster deflectors and a handful of cool experiments. Cosmonaut Yuri Onufrienko and astronaut Dan Bursch began the six-hour float from the Russian-built Pirs docking compartment shortly before 10:30 a.m. EST. Astronaut Carl Walz, who took part in a spacewalk with Onufrienko last week, remained inside to assist his crewmates by operating the space station's robotic arm. "The sunrise is beautiful," observed station skipper Onufrienko, minutes after venturing into space. Working on the Russian service module, Onufrienko and Bursch will position the second of four antennas, which will allow them to make contact with amateur radio operators more than 200 miles (322 km) below on Earth; and place six thruster plume deflectors, which should protect the exterior from harmful fuel exhaust. The deflectors are designed to block Alpha control thrusters from blasting onto parts of the station where spacewalkers must work. Station flight managers have expressed concern that residue might build up and cling to the suits of passing spacewalkers, posing a minor health risk when they return inside. The retired Russian space station Mir experienced a similar residue problem, which cosmonauts resolved by installing deflectors. The floating construction workers, both wearing Russian spacesuits, will also install a device that collects thruster contaminants for future study and a physics experiment designed to detect cosmic rays from the sun and beyond. The measurements could help improve procedures to protect Alpha and its hardware from intense space radiation. The spacewalk is the second of the crew, which began their five-month tour in December. The crew is the fourth to reside on Alpha. Walz and Bursch will conduct another one next month to prepare for an April space shuttle visit. The spacewalk is the 33rd in support of space station assembly and the eighth conducted from Alpha, a multi-billion dollar partnership of the United States, Russia, Europe, Canada and Japan. The spacewalk was Onufrienko's eighth and his second from Alpha. He conducted the others from the retired Russian space station Mir. The float was the first for Bursch.

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The Galileo spacecraft missed taking images on its final pass of Jupiter's moon Io on Jan. 17 (*AW&ST* Jan. 7, p. 61). The spacecraft detected a computer reset and automatically went into a standby mode that froze the scientific instruments, a process that is similar to prior events and is probably caused by radiation. Galileo in its extended mission has been exposed to 3.5 times the design amount of radiation. Controllers hoped last week to reactivate the systems before the Io encounter ended on Jan. 20.

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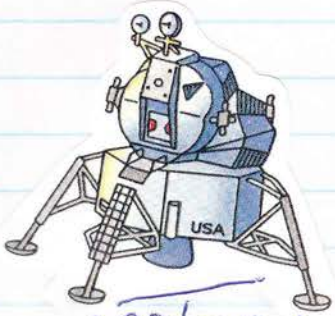
AWST: 21-02-'02



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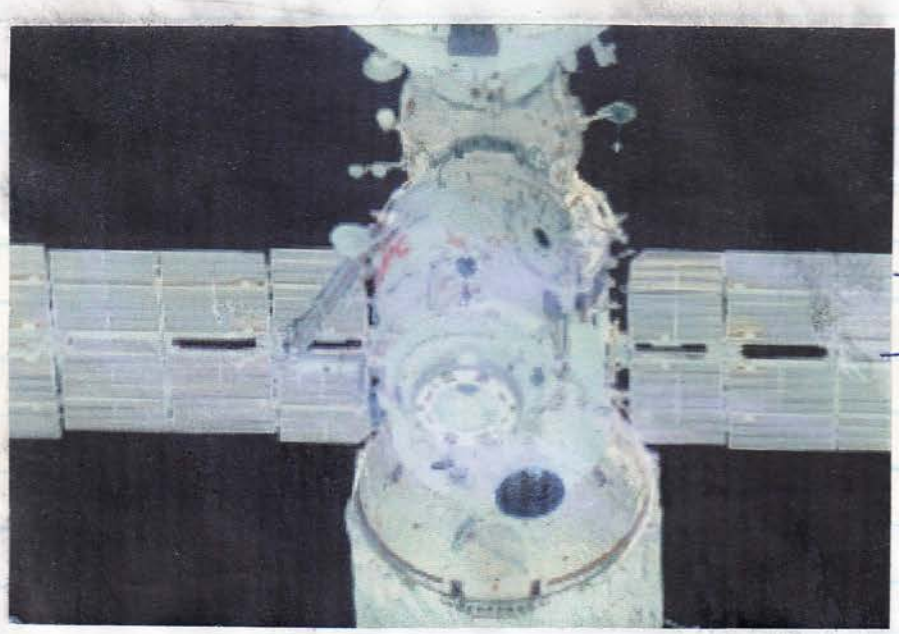

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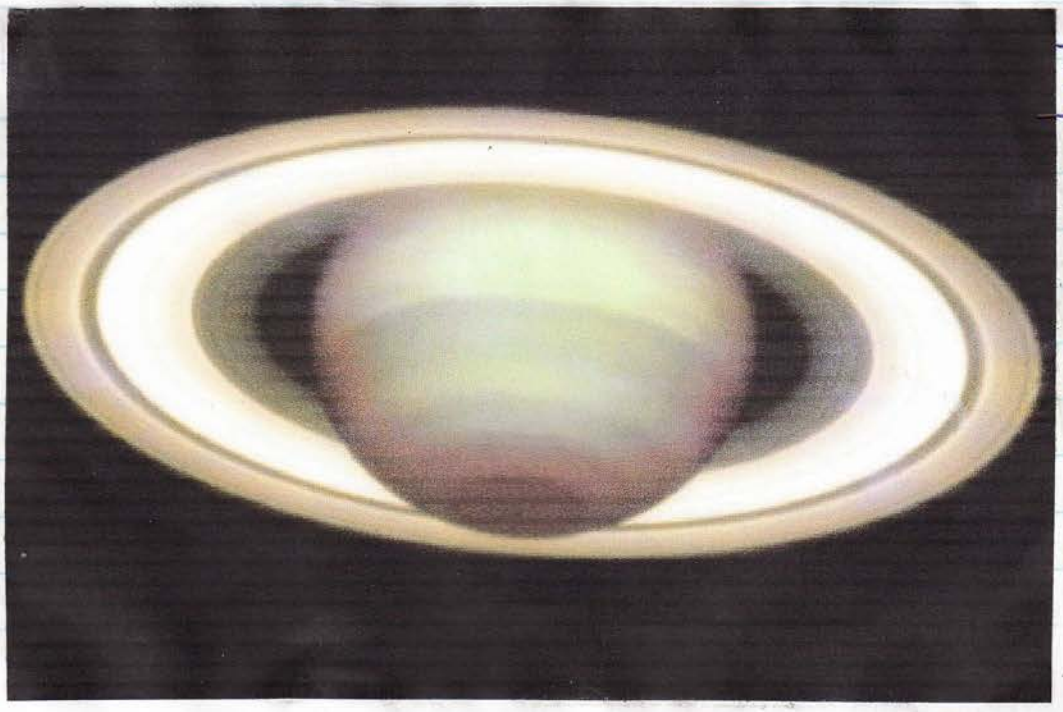

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HOUSTON CHRONICLE : 11 JANUARI 2002.

NASA'S MARS ODYSSEY COMPLETES AEROBRAKING, PUTTING IT CLOSER TO FINAL ORBIT.

PASADENA - NASA's 2001 Mars Odyssey spacecraft finished an aerobraking process Friday used to tighten its orbit around the Red Planet in preparation for mapping surface minerals and chemicals. The technique involved Odyssey dipping into the planet's atmosphere to get a drag effect on the spacecraft. By using Mars' atmosphere, scientists saved the expense of launching additional heavy fuel for rocket firings. Odyssey's thrusters will finish putting the spacecraft into its final, circular mapping orbit at an altitude of 249 miles later this month. Science observations will begin two or three weeks later. "The spacecraft has performed remarkably well," said Roger Gibbs, the mission's deputy project manager at NASA's Jet Propulsion Laboratory. Odyssey was launched on its $297 million mission April 7. It carries three science instruments. One of them, a radiation environment experiment, malfunctioned and was shut down in August. Troubleshooting to determine if it can be fixed will resume next month.

73684

Het Zonnestelsel in / Nummer 9 - 12.01.2002.

Op 28 december 2001 bevond de Mars Odyssey zich in een baan tussen 99 en 2951 kilometer boven het Marsoppervlak. De hoek van de baan met de Martiaanse equator bedroeg 93 graden, zodat de baan nagenoeg over de polen liep. Elke omloop, als de Odyssey de planeet het dichtst naderde (het zogenaamde periapsis), werd zij door de atmosferische weerstand iets afgeremd zodat het verste punt van de baan (apoapsis) steeds dichter bij Mars kwam te liggen. Op 11 januari lag dat verste punt op nog maar 500 kilometer boven het oppervlak. De Odyssey ontstak kleine raketten waardoor het periapsis boven de atmosfeer kwam te liggen. Na deze manoeuvre bevond de Odyssey zich in een baan tussen 201 en 500 kilometer, terwijl de hoek met de evenaar de gehele tijd dezelfde was gebleven. Door het luchtremmen heeft de sonde meer dan 200 kilogram brandstof bespaard. De komende maanden zal de Odyssey haar stuurraketten nog enkele malen ontsteken om in april haar definitieve observatiebaan op 400 kilometer hoogte te bereiken.

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SPACE.COM : 14 JANUARI 2002.

MARS ODYSSEY BRAKING COMPLETE, ARRIVES IN MAPPING ORBIT.

NASA's Mars Odyssey reached a major milestone Friday - the end of repeatedly dipping into the Martian atmosphere to slow down. The probe is now ready to begin its science mapping mission in late February. Odyssey completed weeks of delicate "aerobraking" maneuvers -- skimming through the upper reaches of the Martian atmosphere -- 332 times since its arrival at Mars. The craft was launched on April 7, 2001, crossing interplanetary space to reach Mars on October 23, 2001. The closest point in Odyssey's orbit, called the periapsis, is now 125 miles (201 kilometers) above the surface of the Red Planet. The farthest point in the orbit, labeled the apoapsis, is at an altitude of 311 miles (500 kilometers). Over the next few weeks, Odyssey's operators will refine the spacecraft's orbit until it reaches its final mapping altitude - a 249-mile (400-kilometer) circular orbit. During that time, the probe will be reconfigured to start the science mapping mission. "The successful completion of the aerobraking phase is a major milestone for the project. Aerobraking is the most complex phase of the entire mission and the team came through it without a hitch," said David A. Spencer, Odyssey's mission manager at the Jet Propulsion Laboratory (JPL) in Pasadena, California. JPL manages the 2001 Mars Odyssey mission for NASA's Office of Space Science in Washington, D.C. The mission's major goal is to map the amount and distribution of chemical elements and minerals that make up the Martian surface. Odyssey will especially look for hydrogen, most likely in the form of water ice, in the shallow subsurface of Mars.

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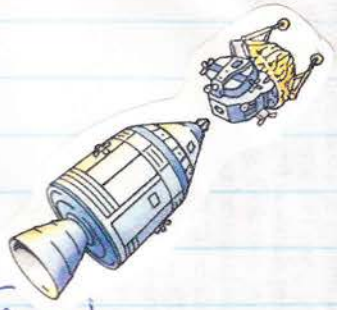

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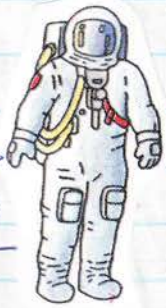

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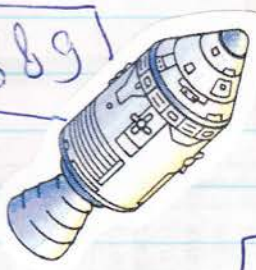

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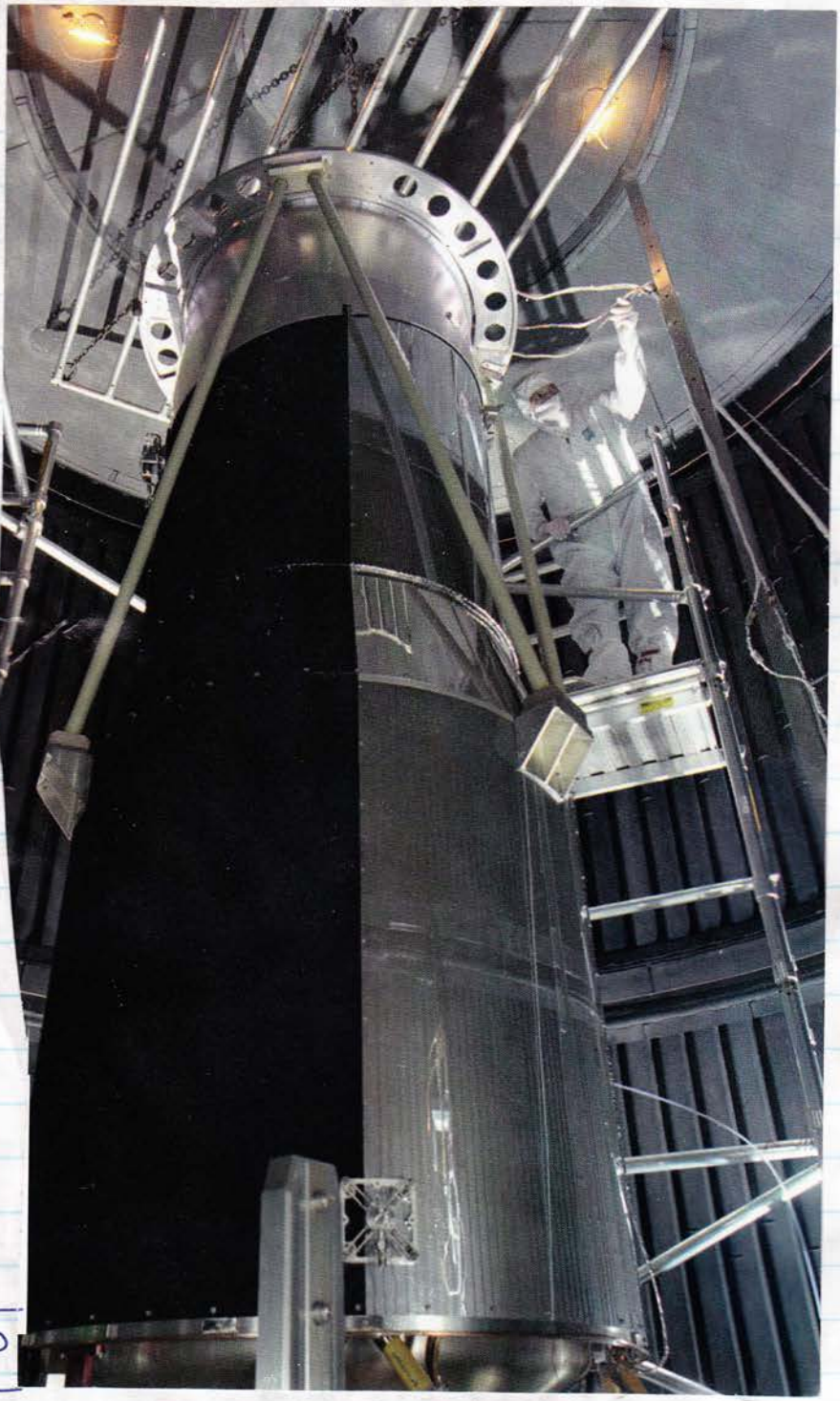


FLORIDA TODAY : 16 JANUARI 2002.

MARS ODYSSEY MANEUVERS DONE, SCIENCE WORK DELAYED.

73691

The 2001 Mars Odyssey spacecraft finished a tricky phase of its mission last week, but science mapping probably won't begin for another month. Mapping originally was supposed to begin in late January or early February. "They're just being very cautious and careful," said Mary Hardin, spokeswoman at NASA's Jet Propulsion Laboratory, where the spacecraft is controlled. "We're still on track." Last Friday, NASA's Odyssey concluded its aerobraking phase, where the probe drags across the upper reaches of the Martian atmosphere in oval orbits. This is done to slow down Odyssey so managers don't have to use extra fuel. The probe made 332 aerobraking orbits since arriving at Mars in October. Navigators made a few maneuvers this week and will keep refining the spacecraft's orbit until it gets into a more circular path 249 miles off the planet's surface. Odyssey launched from Cape Canaveral Air Force Station last April on a $297-million mission. The probe will map chemical elements and minerals on the surface, hunt for water in the subsurface and measure the radiation. NASA's last two missions to Mars, the Mars Polar Lander and Mars Climate Orbiter, failed in 1999. Much has been said about the need for this mission to succeed. NASA will check out some of Odyssey's larger scientific instruments early next month. Managers will deploy the dish-like high-gain antenna the first week in February. Late last month scientists got an early glimpse of what might be coming. When the neutron spectrometer instrument was turned on for one orbit, it saw what could be signs of hydrogen, one of the two elements in water. "We have a few glimpses at best that are extremely exciting," Mars program scientist Jim Garvin said earlier. "Whether that's water or not depends on more information."

19801

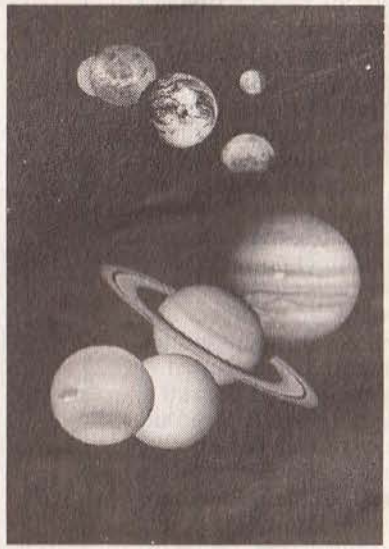
STERRENKIJKEN

STERREN KIJKEN IN 2002

De sterrenhemel heeft iets vertrouwds en verrassends tegelijk. Jaar in jaar uit trekt dezelfde processie van sterrenbeelden aan ons voorbij. Maar behalve regelmaat en routine heeft het firmament nog meer te bieden. De dans van de planeten bijvoorbeeld, fraaie samenstanden of voorbijflitsende meteoren. Zij doorbreken de sleur en houden de spanning erin. Wat heeft het firmament komend jaar voor ons in petto? Als het jaar nog in de luiers ligt houdt Orion de wacht. Het sterrenbeeld staat in het zuidoosten te pronken, met als visitekaartje het schuine rijtje van drie even heldere sterren. Linksonder Orion schittert Sirius, die alle andere sterren naar die loef steekt maar het desondanks moet afleggen tegen Jupiter. De koning onder de planeten, Orion (linksboven), is niet te missen. Meer naar het westen, dicht bij de oranjekleurige Aldebaran en rechtsboven Orion, houdt zich Jupiters kleinere broer Saturnus op. Aan de avondhemel bevinden zich nog meer planeten, zoals roestkleurige Mars, laag in het zuidwesten. Anders dan sterren hebben planeten geen vaste stek aan het firmament. Ze leiden een zwerversbestaan, zodat we ze volgend jaar niet meer op dezelfde plek kunnen terugverwachten. Het snelst beweegt de maan die voor een rondje om de hemel vier weken nodig heeft. Daarbij komt het geregeld tot nauwe ontmoetingen met planeten.

Een van de mooiste samenstanden van dit jaar is die van 26 januari, als Jupiter vlak onder de zuidelijke rand van de bijna-volle maan langs scheert. Soms is het rendez-vous zo intiem dat een planeet achter de maan schuil gaat. Dergelijke planeetbedekkingen zijn vrij zeldzaam, maar in 2002 hebben we er maar liefst twee die vanuit Nederland zijn te zien. In de vroege ochtend van 23 februari speelt Jupiter bijna vijftig minuten lang verstoppertje achter de aardse wachter en op 16 april verspert de maansikkel ons tijdelijk het zicht op Saturnus. Deze laatste bedekking is de mooiste. Door de verrekijker kun je zien hoe de zwak oplichtende donkere maanrand Saturnus langzaam verzwelgt.

Inmiddels heeft de sterrenrijkdom van de winter plaats gemaakt voor de schaars bevolkte



2002 kent talrijke fraaie samenstanden van planeten.
foto NASA

lentehemel. De enige heldere sterren zijn Regulus in het zuiden, de rossige Arcturus in het oosten en de blauwwite Spica laag in het zuidoosten. De hoofdrol is weggelegd voor de planeten. Mars, Jupiter en Saturnus vinden we 's avonds in het zuidwesten. Daar krijgen ze gezelschap van Venus, afgezien van de zon en de maan het meest opvallende licht aan het firmament. Tot in september zal zij de avondhemel luister bijzetten. Met al die planeten wordt het dringen geblazen, zeker als Mercurius zich begin mei bij hen voegt. Tussen 4 en 10 mei zijn er maar liefst drie nauwe samenstanden tussen Mars, Venus en Saturnus. Op de 7e staan de drie planeten samen in een cirkel, niet groter dan vijf keer de diameter van de volle maan. De aardse wachter, die van 14 tot 16 mei dit hemelgebied doorkruist, maakt het plaatje nog fotogenieker. Een maand later is het afgelopen met de planetenshow. Mercurius, Mars, Jupiter en Saturnus verdwijnen één voor één in de schemergloed. Venus heeft nu het rijk voor zich alleen.

Wat de sterren aangaat vertellen de heldere Wega, Deneb en Altaïr welk jaargetijde het is. Samen vormen ze de Zomerdriehoek. Dan laat ook de Melkweg zich van zijn beste kant zien, de zwakke band van licht die helaas in het dichtbevolkte Nederland steeds meer verstikt in de overvloedige nachtverlichting. Op zwoele augustusavonden schieten de Perseïden langs de hemel, 'vallende sterren' die allemaal lijken weg te vluchten uit het sterrenbeeld Perseus. Het grootste vuurwerk spaart de kosmos op voor november. Dan zouden de meteoren van de Leoniden ons om de oren kunnen gaan vliegen. Als de voorspellingen uitkomen zetten in de ochtend van 19 november duizenden 'vallende sterren' per uur de hemel in lichterlaaie. Diezelfde maand groeit Venus uit tot een spectaculaire ochtendverschijning. Vóór zonsopkomst staat ze in het zuidoosten te fonkelen. Mars houdt haar gezelschap, met op 6 december een mooie samenstand tussen beide planeten. Jupiter en Saturnus kwamen al eerder van achter de zon tevoorschijn. Aan het einde van het jaar vinden we ze laat op de avond in het oosten. Dan bestormt ook weer een oude bekende de hemel, Orion, die zoals altijd het oude jaar uitluidt en het nieuwe begroet.

Spits: 14-01-'02

73693

Miljoenen voor ruimtevaart

ESTEC in Noordwijk is fors uitgebreid

NOORDWIJK — Met de ingebruikname van drie nieuwe gebouwen van in totaal bijna 6000 vierkante meter krijgt het technische centrum ESTEC in Noordwijk nog meer ruimte om bij te dragen aan de internationale ruimtevaartontwikkeling. De uitbreiding, die € 10,7 miljoen (*f* 23,5 miljoen) heeft gekost, wordt overmorgen ingewijd door minister Jorritsma en Antonio Rodotá (directeur Generaal van ESA) en Gaele Winters (directeur ESTEC).

73695

De belangrijkste nieuwbouw betreft de uitbreiding van het testcentrum voor satellieten in Noordwijk, dat al jaren behoort tot de grootste en meest geavanceerde testcentra voor de ruimtevaart. Het gebouw voegt aan het complex een extra clean room en grote voorbereidingskamers toe. In de 19 meter hoge clean room worden satellieten op de verschillende testen voorbereid.

Satellieten weerstaan tijdens de lancering extreme belastingen. Met zware triltafels worden deze omstandigheden in de nieuwe testruimten nagebootst om zeker te stellen dat de satelliet deze belastingen kan doorstaan. Tijdens hun jarenlang verblijf in de ruimte ondergaan satellieten grote temperatuurschommelingen. In de Large Space Simulator worden ze hierop getest. Omdat satellieten in de ruimte in principe niet gerepareerd kunnen worden, is grondig testen voor de vlucht van groot belang.

Dankzij de nieuwe integratiehal kunnen in het testcentrum nu drie grote satellieten tegelijk voor testen worden gereedgemaakt.

Elders in het testcentrum zijn de Automated Transport Vehicle, de transportmodule voor het internationale ruimtestation, en de gammastralingstelescoop integral in ontwikkeling. Het nieuwe gebouw biedt ook onderdak aan de ingenieursteams van Europese ruimtevaartbedrijven die vaak maandenlang aan de testreeksen in Noordwijk werken.

Jorritsma: ESA moet efficiënter werken

NOORDWIJK — Het Europese Ruimtevaartagentschap ESA zal efficiënter moeten werken. Dat is een gevolg van de gekrompen budgetten die de landen van de Europese Unie voor ruimtevaart over hebben.

73694

Dat zei minister Jorritsma van Economische Zaken gisteren bij de opening van drie nieuwe gebouwen van het technisch centrum Estec in Noordwijk. „Het maken van pijnlijke keuzes zal soms onvermijdelijk zijn", aldus Jorritsma. De industrie doet er goed aan sociale toepassingen van vindingen die met de ruimtevaart zijn verbonden, duidelijk naar voren te brengen.

Spits: 17-01-2002.

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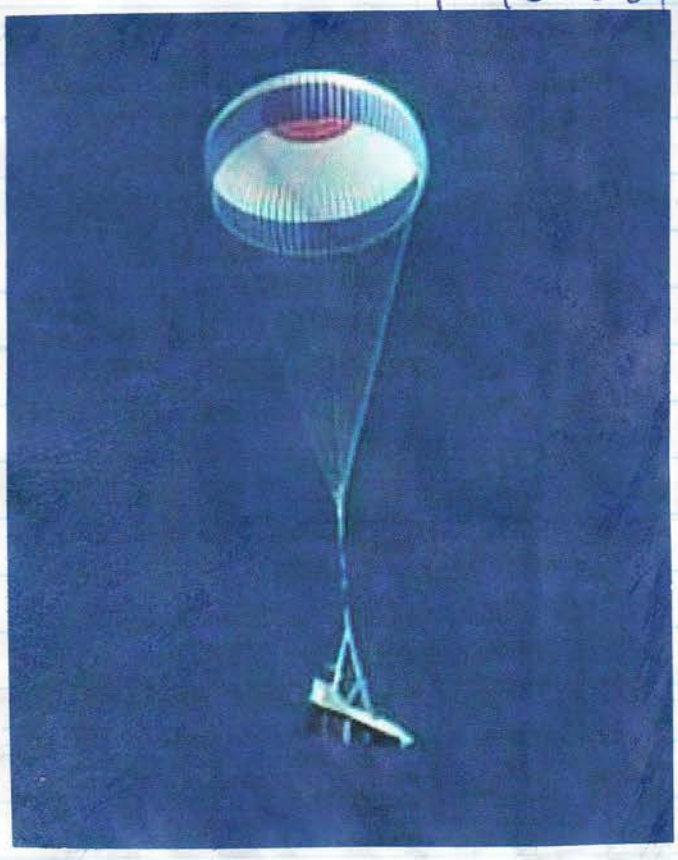

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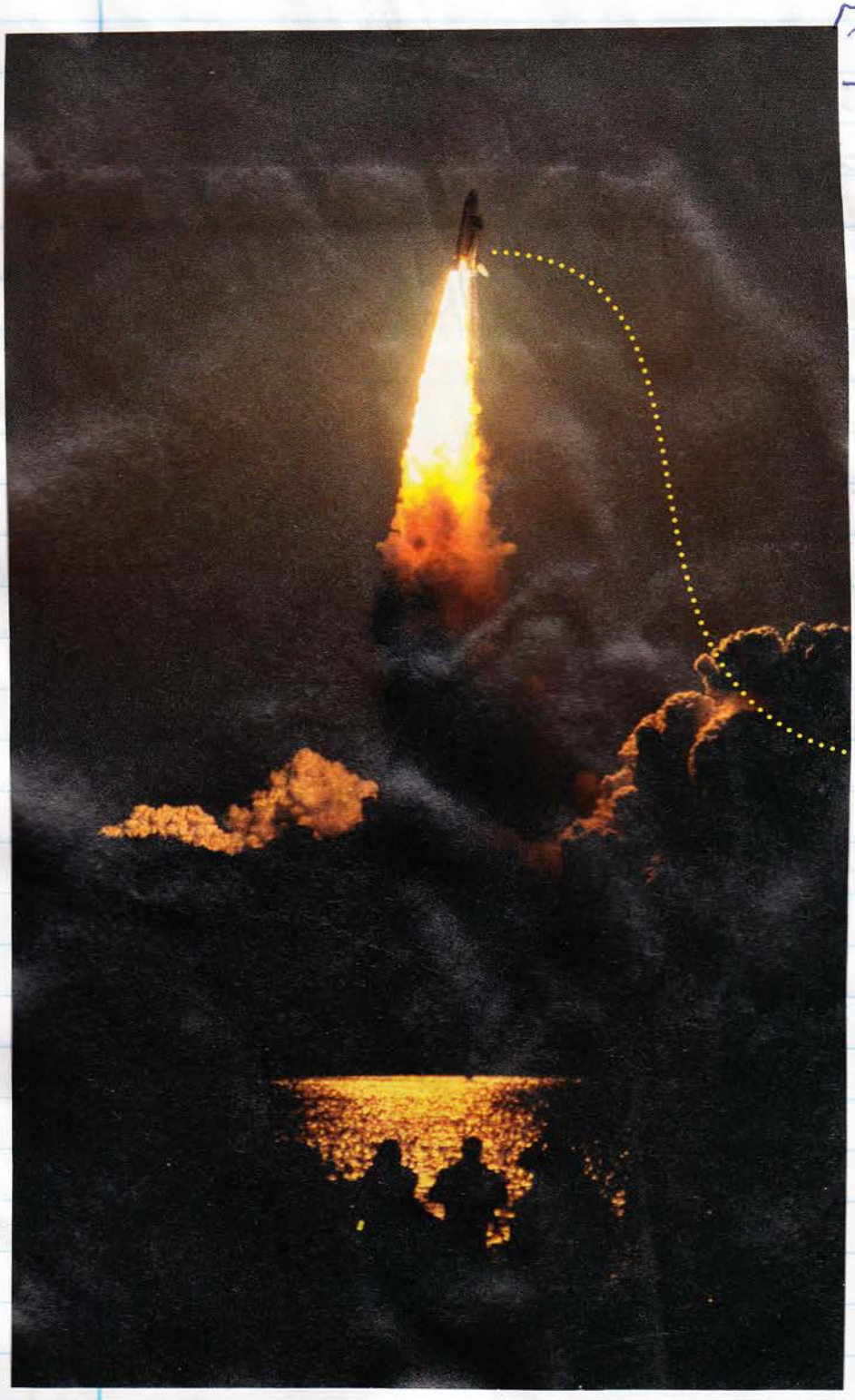

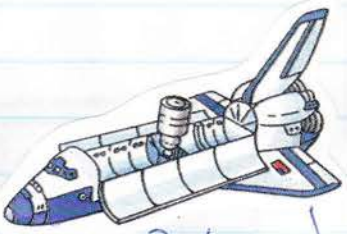

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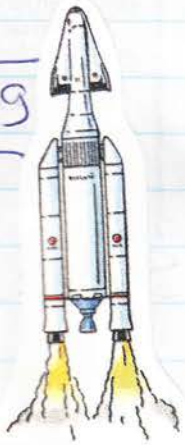

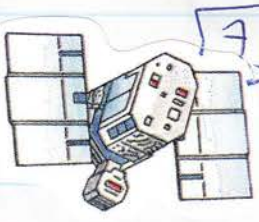

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STERRENKIJKEN

GIGANT ONDER DE STERREN

De kosmos is een wereld van extremen. Sommige sterren zijn niet groter dan een stad, andere zouden op de plaats van de zon neergezet de aarde verzwelgen. Tot die laatste categorie hoort Betelgeuze. De ster is zelfs zo groot dat we haar oppervlak kunnen fotograferen. Toch stelt een kolos als Betelgeuze minder voor dan je in eerste instantie zou denken.

Betelgeuze vormt de rechterschouder van het prachtige sterrenbeeld Orion, de mythologische jager die in winterse vriesnachten de zuidelijke hemel domineert. De ster ontleent haar naam aan yad al-Gauza, wat Hand van de Middelste betekent. Later is deze Arabische aanduiding in het westerse spraakgebruik verbasterd tot Betelgeuze. Om haar te vinden zoeken we eerst de gordel van Orion op, het rijtje van drie sterren in de taille van de jager.

Betelgeuze staat linksboven de gordelsterren. Let op de oranjerode kleur die al met het blote oog opvalt maar nog beter naar voren komt in de verrekijker. Bij sterren wijst een rode tint op een lage oppervlaktetemperatuur en met 3500 graden is Betelgeuze een stuk koeler dan de zon. De ster mag zich met recht een superreus noemen. Ze straalt even sterk als zestigduizend zonnen en haar diameter is 630 keer zo groot als die van onze eigen ster. Zet Betelgeuze op de plaats van de zon en voor de planeten binnen de baan van Jupiter blijft geen ruimte meer over. De ster is zelfs zo groot dat we haar oppervlak direct kunnen waarnemen. Bovendien staat ze met 425 lichtjaren niet al te ver bij ons uit de buurt.

In 1995 slaagde de Hubble ruimtetelescoop erin Betelgeuze als een minuscuul schijfje af te beelden, even groot als een eurocent op 45 kilometer afstand. Op een enkele uitzondering na is dit bij andere sterren nog niet gelukt. Zelfs in de krachtigste telescopen blijven het dimensieloze puntjes omdat ze niet groot genoeg zijn of te ver weg staan. De Hubble-foto van Betelgeuze laat een heldere vlek zien die minstens tweeduizend gaden heter is dan de rest van het steroppervlak. Over de

Betelgeuze, gezien door de Hubble ruimtetelescoop.
foto A. Dupree (CFA), R. Gilliland (STScI), NASA

aard van deze 'hete vlek' is nog niets bekend. Misschien wordt het gas ter plekke door sterke magneetvelden extra verhit. Superreuzen als Betelgeuze zijn zeldzaam, maar lijken desondanks ruim vertegenwoordigd aan de hemel. Dat komt door hun fabuleuze lichtkracht, waardoor we deze sterren tot op grote afstand kunnen zien. De veel talrijkere dwergsterren zoals de zon vallen door hun bescheiden lichtsterkte beduidend minder op. Toch moet uiterlijk vertoon verhullen wat Betelgeuze aan substantie tekort komt. Ook al bevat zij dertien keer zoveel gas als de zon, de superreus is op een kleine compacte kern na miljoenen keren ijler dan de aardse atmosfeer! Zelfs een zak met lucht heeft meer om het lijf. Daar komt nog bij dat de ster op haar laatste benen loopt. De brandstof is bijna op en in haar dichte, hete kern boort Betelgeuze nu de laatste energiereserves aan. Het naderende einde is de ster letterlijk van het gezicht te lezen. Toen de brandstof opraakte, zwol ze tot gigantische proporties op waarbij haar oppervlak sterk afkoelde. Vandaar de kolossale afmetingen en de rode kleur. Op haar oude dag kucht en proest Betelgeuze als een astmapatiënt. De helderheid verandert onregelmatig en het oppervlak deint voortdurend op en neer. Door deze pulsaties blaast de ster gaswolken de ruimte in en verliest zo in een half miljoen jaar het gewicht van de zon aan materie. Lang houdt de ster dat niet meer vol. Wanneer het einde komt, is niet precies bekend. Het kan al na duizend jaar afgelopen zijn of misschien pas na een miljoen jaar. Maar zodra het laatste restje brandstof verbruikt is, klapt de kern van Betelgeuze in elkaar.

De energie die daarbij vrijkomt, veroorzaakt vuurwerk van waarlijk kosmische proporties. In een gigantische explosie - sterrenkundige spreken over een supernova - gaat het grootste deel van de ster compleet aan flarden. Enkele maanden lang zien onze nazaten Betelgeuze even helder als de maan aan de hemel schijnen. Daarna zwakt de ster langzaam af. IJle gasslierten die de supernova achterlaat, getuigen nog enige tijd van de gewelddadige sterrendood. Uiteindelijk lossen ze op in de leegte van de ruimte. Alleen de compacte kern overleeft als neutronenster het inferno, maar de glans van Betelgeuze zal definitief tot het verleden behoren. Ga dus kijken, zolang het nog kan.

D.D.L. 15-01-2002

19805

BOEING NEWS RELEASE : 28 JANUARI 2002.

ROCKETDYNE RS-68 ENGINE CERTIFIED FOR BOEING DELTA 4.

The certification of the Rocketdyne RS-68 engine that will power Boeing's new Delta 4 launch vehicle brings to a close a remarkable development path for the first large liquid-fueled engine in the United States in nearly three decades. "What we have accomplished with the RS-68 is nothing less than the emergence of a new generation of American rocket engine designers and builders," said Byron Wood, vice president and general manager of the Rocketdyne Propulsion & Power business of The Boeing Co. "The men and women who took this engine from a blank sheet of paper to this certification and the beginning of full production of the RS-68 in record time have made their own mark in space history. A torch has been passed from the team that powered us to the moon and built the Space Shuttle Main Engine (SSME) to a new generation using new tools and techniques." The RS-68 is a liquid hydrogen-liquid oxygen booster engine that generates 650,000 lbs. of thrust. It was developed in less than five years in a program that was required to consider cost and cycle time variables in the design and manufacture of the engine. This RS-68 milestone is also the culmination of a development and certification test program that saw 183 hot-fire tests for a total of 18,645 seconds of test time. All verification objectives were achieved and the robustness of the engine was fully demonstrated. "We are very pleased with the exceptional job the entire RS-68 Engine team has done and the great industrial partnership that has been established between Boeing, Rocketdyne, and the U.S. Air Force," said Col. Bob Saxer, the U.S. Air Force EELV System program director. "The certification of the RS-68 engines marks the completion of a major Delta 4 program milestone and places us squarely on course for our first EELV Delta 4 launch in 2002." "The Boeing team at Rocketdyne has set a new standard in rocket engine design for the world," Wood said. "In the development of the RS-68, they achieved technical goals and met cost and cycle-time demands that have never been accomplished before. They have raised the bar in a way that is fitting for the successors of the generation of engineers that developed the F-1 and J-2 engines for Apollo and the SSME." This has been a year of achievement for the Boeing RS-68 team. In addition to the completion of certification, Boeing completed a series of hot-fire tests of the RS-68 integrated with the Delta 4 Common Booster Core. Five tests for a total of 555 seconds were completed at NASA's John C. Stennis Space Center in Mississippi. Boeing also completed acceptance testing and delivered the first flight RS-68 for Delta 4. That engine is scheduled to power the first launch of Delta 4 from Cape Canaveral Air Force Station during 2002. "The program did face a number of technical challenges on the road to development and certification, but very few compared to previous major rocket engine development programs," said Rick Baily, Rocketdyne chief engineer and former program manager for the RS-68 engine. "But each challenge was met and resolved and the solutions were tested to the satisfaction of the Air Force and exacting expectations of our team." Boeing Rocketdyne is a global leader in liquid-fueled propulsion. In addition to developing and manufacturing the SSME, the Boeing team at Rocketdyne also produces the RS-27A engine for Delta 2 and Delta 3.

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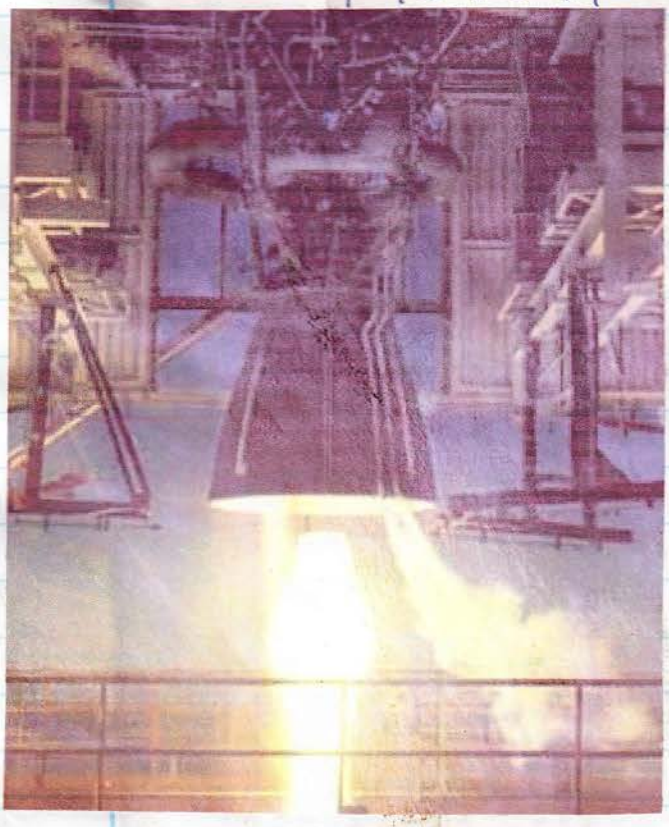
73704



73705

73706

DELTA IV DELAY

First launch of the Boeing Delta IV Evolved Expendable Launch Vehicle (EELV) will be delayed from Apr. 30 until mid-July at the request of Eutelsat, which has purchased the mission to launch a Eutelsat W communications satellite. Although Eutelsat requested the delay, first flight of the Delta IV already was on the verge of being postponed to allow Boeing to complete checkout of its new Launch Complex 37 at Cape Canaveral

AWST : 14-01-2002.

19806

SPACEFLIGHT NOW : 28 JANUARI 2002.

DELTA 4 ROCKET ASSEMBLED / NEXT STOP IS THE LAUNCH PAD.

The two stages of Boeing's inaugural Delta 4 rocket have been joined together inside a massive hangar at Cape Canaveral's newly refurbished Complex 37 as preparations continue for a targeted July 15 blastoff carrying a communications satellite for Eutelsat. With the help of a precision laser alignment system derived from Boeing's commercial aircraft production line, technicians mated the upper stage to the Common Booster Core first stage at the Horizontal Integration Facility last weekend. After a couple of weeks of electrical tests, the rocket will be rolled to the launch pad on a special transporter and erected upright by a hydraulic lifter. The milestone half-mile move to the pad is expected in mid-February, said Dave Herst, Boeing's director of Delta 4 launch sites. Once at the pad, the the twin strap-on solid boosters will be attached to the rocket as a three-month series of tests kick off to ready for the maiden flight of Delta 4. Activities will include countdown simulations, fueling exercises, tests with a dummy satellite cargo and an engine firing. A testing rocket, not built to fly, was used in pathfinder exercises at Complex 37 last summer, allowing engineers to ensure tools, handling equipment and other hardware worked with the Delta 4's Common Booster Core first stage. All five versions of the Delta 4 launch vehicle use the common core. In late August it was erected on the pad to verify the tower and service structure all fit together properly. But the test booster wasn't designed to be hooked up to the launch pad's fuel lines and other umbilicals. That's where the first flight rocket comes in. In the coming months technicians will mate the tail service mast and swing arm umbilicals to the rocket and conduct multiple fueling tests. The process will begin with partial loading of super-cold liquid oxygen and liquid hydrogen into the first and second stages. Ultimately, a complete countdown dress rehearsal, with the rocket fully fueled, will be performed to simulate launch day activities until just prior to engine ignition, Herst explained in a recent interview. A second countdown rehearsal, now slated for late May, will see the rocket fueled again, but this time the countdown clock will continue into the final seconds. The RS-68 main engine, the Rocketdyne-developed 650,000-pound thrust hydrogen/oxygen powerplant, will roar to life for a "Flight Readiness Firing," similar to tests performed on space shuttles before their maiden launches. After taking a few seconds to build up thrust, the engine will fire at full thrust for one second before shutting down. The rocket will be firmly bolted to the launch pad for the dramatic test. The purpose of the engine firing is to measure the acoustics and pressure levels at the new launch pad that will be experienced at liftoff. That is crucial to ensure engineers' predictions for such conditions are correct before bringing the Eutelsat payload to the pad for launch. Complex 37 has been intended as a "dry pad" with no water deluge flooding the flame trench to suppress the sound proceeded at launch like other pads. The plumbing is in place, however, to turn the water on if needed to ddampen the acoustics. The engine test will occur about six weeks prior to launch, allowing time to refurbish the pad, retest systems and mount the real Eutelsat spacecraft atop the rocket. Over the past couple of months the payload fairing -- rocket's nose cone -- and payload adapter for the first launch have been put through a pathfinder exercise with a dummy satellite at a military facility at the Cape. The pretend payload was attached to the adapter and then enclosed within the two-halves of the fairing. It is now ready to go to the pad for mating with the Delta 4, giving technicians a payload to practice lifting into the tower and attaching to the rocket before handling the real payload. The satellite simulator will remain atop the rocket through the engine firing test before being removed. The encapsulation work has been performed at a government site where an Air Force satellite will be processed for launch aboard the second Delta 4 flight this fall. "The government wants to make sure when we do that first payload encapsulation in the government facility we are ready," Herst said. Once the pad exercises with the dummy satellite are completed in a few months, it will be taken to the commercial AstroTech facility in nearby Titusville for removal of the fairing and detachment from the payload adapter, thus testing out both types of processing sites, Herst explained. The launch date for the first Delta 4 has been pushed back a couple of times by development delays. Most recently, the liftoff had been targeted for April 30. However, Eutelsat requested postponing the mission until mid-July. "The major driver for July 15 was the request from our first commercial customer," Herst said. "However, obviously that gives us additional time to do additional pad checkout as well as vehicle checkout. We did have some impacts from the base here due to all additional security that reduced the efficiency of our construction contractor testing systems." The exact identity of the Eutelsat payload has not been announced, but is rumored to be the repaired W1 satellite that was damaged a few years ago in a factory accident. The Delta 4 family has five different configurations, capable of launching between 9,300 to 29,000 pounds of cargo to geosynchronous transfer orbit. The first launch will use a Delta 4 Medium+ 4,2 -- which means it will have one Common Booster Core and upper stage, a four-meter payload fairing and two strap-on solid rocket motors. The second Delta 4 launch, with the Defense Satellite Communications System spacecraft for the Air Force using a plain Delta 4 Medium rocket with a four-meter fairing and no solid strap-on motors, is now targeted for around October 15. Boeing plans to spend about three months analyzing data from the maiden flight before launching the second Delta 4. The third and final Delta 4 of 2002 is targeted for November 20 when the Brazilian Estrela do Sul 1 communications satellite is launched for Loral. The rocket configuration for this launch will be the same as the inaugural flight.

(73707)

NASA PRESS RELEASE : 29 JANUARI 2002.

AGING NASA SPACECRAFT TO REENTER EARTH'S ATMOSPHERE.

73708

Engineers at NASA Goddard Space Flight Center in Greenbelt, Md., predict a 7,000-pound spacecraft could re- enter the Earth's atmosphere as early as 10 p.m. EST on Jan. 30 or as late as 7 a.m. EST on Jan. 31. NASA's Extreme Ultraviolet Explorer (EUVE) is currently 200 kilometers (124 miles) above the Earth with a descent rate of 25 kilometers (15.5 miles) a day. The estimated debris field is expected to be 800 to 1,000 kilometers (500-625 miles). "The probability of the few EUVE surviving pieces falling into a populated area and hurting someone is very small. It is more likely that the small pieces will fall into the ocean or fall harmlessly to the ground," said Ronald E. Mahmot, Project Manager for Space Science Mission Operations at Goddard. Unlike the Compton Gamma Ray Observatory, which was safely de-orbited June 4, 2000, EUVE does not have an on-board propulsion system to allow engineers to control its re-entry. Much of EUVE will burn up in the atmosphere before ever reaching the ground. However, estimates show that up to nine objects ranging from approximately four to 100 pounds may survive re-entry. Much of this debris is made of titanium and stainless steel. EUVE will start to break up when it falls to within 80 kilometers (50 miles) of the Earth. At this point, EUVE will have only four or five 90-minute orbits left before re- entering the Earth's atmosphere. Engineers will not know the re-entry point until approximately 12 hours prior to impact. EUVE is in a 28.5-degree orbit and could re-enter in any location within this orbit range. This ranges includes areas as far north as Orlando, Fla., and as far south as Brisbane, Australia. EUVE was launched on June 7, 1992. Science operations ended for the spacecraft in December 2001. During its early years, EUVE was operated from Goddard. In 1997, control of EUVE was transitioned from Goddard to the University of California, Berkeley and remained there until the program's termination in 2001. Slated for only three years, EUVE was operational for eight. NASA twice extended its scientific mission. During its eight years in orbit, EUVE successfully opened a new window on the cosmos and helped to bridge the gap in our understanding of the extreme ultraviolet spectrum. Rather than seeing about 24 nearby objects as many predicted, EUVE observed more than 1,000 nearby sources, including more than three dozen objects outside our galaxy.

19807

ORLANDO SENTINEL : 30 JANUARI 2002.

NASA: 3.5-TON SATELLITE TO FALL TO EARTH SOON.

WASHINGTON - A 7,000-pound science satellite will fall from the sky this week, and the National Aeronautics and Space Administration says a few pieces of metal could hit the Earth, although probably not in a populated area. The space agency announced Tuesday that the Extreme Ultraviolet Explorer is falling at the rate of 15 miles a day from an orbit of about 124 miles and should make a final plunge to Earth between 10 p.m. EST Wednesday and 7 a.m. on Thursday. Officials said the satellite will start breaking apart when it hits the upper edge of the atmosphere, about 50 miles high. It is expected to complete four or five more 90-minute orbits before its final descent. NMost of the spacecraft is expected to come apart and burn up in the atmosphere during its high-speed fall. NASA engineers, however, said it was possible that up to nine stainless steel and titanium pieces, weighing up to 100 pounds, will reach the Earth's surface. The satellite pieces, if they survive the fall, are expected to land in a debris field stretching some 625 miles under the orbital path. The re-entry point is expected to be determined about 12 hours before the final fall, NASA said. "The probability of the few ... surviving pieces falling into a populated area and hurting someone is very small," said Ronald E. Mahmot, project manager for Space Science Missions at the Goddard Space Flight Center in Greenbelt, Md. "It is more likely that the small pieces will fall into the ocean or fall harmlessly to the ground." In 2000, NASA engineers successfully directed a safe de-orbit of the 17-ton Compton Gamma Ray Observatory, using rockets aboard the satellite to bring it down in a remote part of the Pacific Ocean. The Extreme Ultraviolet Explorer, however, does not have the on-board rockets needed to direct the re-entry. As a result, it will fall uncontrolled within a belt around the middle of the Earth stretching as far north as Orlando, Fla., and as far south as Brisbane, Australia. This belt includes such highly populated areas as Mexico City, Bangkok and Miami. The largest uncontrolled re-entry by a NASA spacecraft was Skylab, a 78-ton abandoned space station that fell from orbit in 1979. Its debris dropped harmlessly into the Indian Ocean and across a remote section of western Australia. Launched in 1992, the Extreme Ultraviolet Explorer collected images of more than 1,000 celestial objects detected in the extreme ultraviolet part of the spectrum. The craft was designed to work for three years, but it was operational for eight. The observation program ended last year.

73709

NEWS CHANNEL 2000.COM : 29 JANUARI 2002.

7,000-POUND SATELLITE FALLING TO EARTH.

73710

WASHINGTON - A 7,000-pound satellite is falling from the sky this week. NASA said a few pieces of metal could hit the Earth, although probably not in a populated area. No one knows exactly where it will fall. The Extreme Ultraviolet Explorer is falling at the rate of 15 miles a day from an orbit of about 124 miles up in the sky. It's expected to come down Wednesday night or Thursday morning. It's going to start breaking apart when it hits the upper edge of the atmosphere, about 50 miles high. Most of the spacecraft is expected to burn up in the atmosphere. But NASA engineers said it's possible that up to nine stainless steel and titanium pieces -- weighing up to 100 pounds -- will reach the Earth's surface.

SPACE.COM : 30 JANUARI 2002.

NASA SPACECRAFT EXPECTED TO FALL TO EARTH.

73711

CAPE CANAVERAL - Heads up, another orbiting satellite is about to fall from the sky. This time it's NASA's Extreme Ultraviolet Explorer (EUVE) spacecraft that prompted the space agency Tuesday to issue a "Chicken Little" alert as the 7,000-pound (3,175-kilogram) telescope is expected to re-enter Earth's atmosphere between 10 p.m. EST Wednesday and 7 a.m. EST Thursday (0300 and 1200 GMT Thursday). Launched atop a Boeing Delta 2 rocket from Cape Canaveral in 1992, the satellite's orbit on Tuesday was said to be 124 miles (200 kilometers) high and decaying about 15.5 miles (25 kilometers) each day. By Thursday night it is expected to be broken up into small pieces and likely laying at the bottom of an ocean. "The probability of the few EUVE surviving pieces falling into a populated area and hurting someone is very small. It is more likely that the small pieces will fall into the ocean or fall harmlessly to the ground," said Ronald Mahmot, a NASA project manager Goddard Space Flight Center in Greenbelt, Md. Engineers predict that whatever does survive the fiery plunge through the atmosphere will be scattered along a debris field that is between 500 to 625 miles (800 to 1,000 kilometers) long. Estimates show that up to nine objects made of titanium and stainless steel -- ranging in weight from about four to 100 pounds (1.8 to 45 kilograms) -- may survive re-entry. Satellite re-entries are fairly common and despite the "sky is falling" reaction such events trigger in some people, the fact is that no human has ever been harmed by space debris, but part of the U.S. space station Skylab reportedly killed a cow in Australia when it fell to Earth in 1979. Massive spacecraft such as the Mir space station and the Compton Gamma Ray Observatory have been steered during their final orbits to help avoid striking civilization, but the much smaller EUVE does not have an on-board propulsion system to allow engineers to control its re-entry. According to a NASA statement, EUVE will start to break up when it falls to within 50 miles (80 kilometers) of Earth. At this point, EUVE will have only four or five 90-minute orbits left before re-entering the Earth's atmosphere. Engineers will not know the re-entry point until approximately 12 hours prior to impact. EUVE is in an orbit that could re-enter over any location between 28.5 degrees north latitude and 28.5 degrees south latitude. This ranges includes areas as far north as Orlando, Fla., and as far south as Brisbane, Australia. Designed to last about three years, the spacecraft remained operational for eight years, prompting NASA to twice extend EUVE's scientific mission, which was to observe nearby sources of extreme ultraviolet radation. Rather than seeing about 24 nearby objects as many scientists predicted, EUVE observed more than 1,000 nearby sources, including more than three dozen objects outside the Milky Way galaxy.

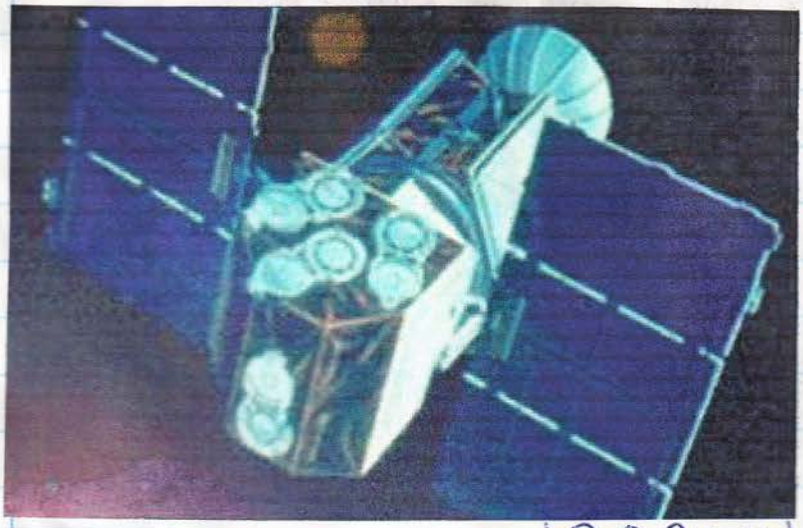
19808

BBC : 30 JANUARI 2002.

"MINIMAL" RISK FROM DEORBITING SPACECRAFT.

The American space agency's Extreme Ultraviolet Explorer (EUVE) spacecraft is due to re-enter the Earth's atmosphere and break-up sometime during the next 24 hours. Engineers at the Goddard Space Flight Center in Maryland, US, say the 3,100-kilogram (7,000-pound) spacecraft could come down as early as 0400 GMT on 31 January or as late as 1300 GMT that day. EUVE is currently 200 kilometres (120 miles) above the Earth with a descent rate of 25 km (15 miles) a day. Because EUVE is in a 28.5-degree orbit, it could re-enter in any location that much north or south of the equator. When it breaks up, the estimated debris field is expected to be 800 to 1,000 km (500-620 miles). Several large chunks will reach the ground but scientists say the danger is minimal. "The probability of the few EUVE surviving pieces falling into a populated area and hurting someone is very small," says Ronald Mahmot, Project Manager for Space Science Mission Operations at Goddard. "It is more likely that the small pieces will fall into the ocean or fall harmlessly to the ground." Uncertain impact zone Unlike the Compton Gamma Ray Observatory, which was safely de-orbited in June 2000, EUVE does not have an on-board propulsion system so engineers cannot control its re-entry. Based on past experience, much of EUVE will burn up in the atmosphere before ever reaching the ground. However, estimates show that up to nine objects ranging from approximately four to 450 kg (100 pounds) may survive re-entry. Much of this debris is made of titanium and stainless steel. EUVE will start to break up when it falls to within 80 km (50 miles) of the Earth. At this point, EUVE will have only four or five 90-minute orbits left before re-entering the Earth's atmosphere. Engineers will not know the re-entry point until just a few hours before impact. Scientists will be sad to see EUVE destroyed. Since it was launched in June 1992 until its science operations were ended in December 2001, it has opened a new window in the extreme ultraviolet region of the spectrum. Rather than seeing about 24 nearby objects as many astronomers had predicted, EUVE observed more than a thousand nearby sources, as well as more than three dozen objects outside our galaxy.

73712



73713

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73715

HOUSTON CHRONICLE : 31 JANUARI 2002.

EUVE SATELLITE PLUMMETS INTO PERSIAN GULF.

WASHINGTON - NASA scientists believe the debris from a 7,000-pound science satellite smacked into the Earth's atmosphere and rained down over the Persian Gulf -- a few thousand miles from where they first predicted it would plummet. As late as 10 p.m. Wednesday, the satellite remnants were expected to fall to Earth near the town of Belem, Brazil. Scientists changed their prediction just after 11 p.m. The satellite, the Extreme Ultraviolet Explorer, fell into lower and lower orbits through the day Wednesday, said NASA spokeswoman Dolores Beasley. She said the impact was predicted for "the northeast side of the Persian Gulf" sometime around midnight, EST, but she did not know whether it would be in international waters or if any of the expected impact area extended onto land. The impact region is near the coasts of Iraq, Iran and Kuwait. Ronald E. Mahmot, project manager for Space Science Missions at the Goddard Space Flight Center in Greenbelt, Md., said earlier that the chances of anyone being hurt from falling debris from the satellite are "very small." He put the odds at about 1 in 11,000. The falling satellite was being tracked by radar by the North American Aerospace Defense Command, the Air Force command known as NORAD that monitors space satellites. Beasley said NORAD would not confirm that the satellite had fallen until at least eight hours following impact. "They need at least three orbits to confirm that it is down," she said. It was expected that the satellite would start breaking apart as it entered the atmosphere, about 50 miles high. Most of the craft was expected to come apart and burn up in the atmosphere during its high-speed fall. NASA engineers, however, said that up to nine stainless steel and titanium pieces, weighing up to 100 pounds, would reach the Earth's surface. The satellite pieces, if they survive the fall, were expected to land in a debris field stretching some 625 miles under the orbital path. Beasley said she did not know if this anticipated debris field extended onto land in the Persian Gulf. In 2000, NASA engineers successfully directed a safe de-orbit of the 17-ton Compton Gamma Ray Observatory, using rockets aboard the satellite to bring it down in a remote part of the Pacific Ocean. The Extreme Ultraviolet Explorer, however, does not have the onboard rockets needed to direct the re-entry. As a result, it was expected to fall somewhere in a belt around the middle of the Earth stretching as far north as Orlando, Fla., and as far south as Brisbane, Australia. The belt included such highly populated areas as Mexico City, Bangkok and Miami. The largest uncontrolled re-entry by a NASA spacecraft was Skylab, a 78-ton abandoned space station that fell from orbit in 1979. Its debris dropped harmlessly into the Indian Ocean and across a remote section of western Australia. Launched in 1992, the Extreme Ultraviolet Explorer collected images of more than 1,000 celestial objects detected in the extreme ultraviolet part of the spectrum. The craft was designed to work for three years, but it was operational for eight. The observation program ended last year.

19809

Laserpulsen meten afstand naar maan

De maan bestoken met laserstralen, het lijkt op een computerspelletje, maar Tom Murphy van de Universiteit van Washington gaat het echt doen. Op die manier hoopt hij de afstand tot de maan te bepalen met een nauwkeurigheid van een millimeter.

De maan staat gemiddeld op 384.400 kilometer van de aarde, gemeten van middelpunt tot middelpunt. Maar de maanbaan is excentrisch en verandert bovendien voortdurend een beetje van vorm. De werkelijke afstand schommelt zodoende tussen de 356.000 en 407.000 kilometer.

73716

Door de reistijd van een laserpuls te meten, kan de afstand tot de maan bepaald worden tot op een centimeter of twee. Murphy wil die precisie vertwintigvoudigen door extreem korte laserpulsen van een tienmiljardste seconde op de maan af te vuren.

De laserpulsen worden gericht op spiegels die dertig jaar geleden onder anderen door de Apolloastronauten op de maan zijn achtergelaten. Van elke afgevuurde laserpuls hoopt Murphy een paar seconden later tien gereflecteerde fotonen op te vangen met een gevoelige detector.

Het laserproject, dat wordt gefinancierd door NASA, moet over een jaar van start gaan. Murphy en zijn collega's maken gebruik van de 3,5-meter telescoop op Apache Point in New Mexico. De metingen moeten bovendien leiden tot een extreem nauwkeurige test van Einsteins relativiteitstheorie en een beter begrip van de zwaartekracht.

Aarde, vanaf de maan. FOTO NASA

73717

Volkskrant:

19-01-2002.

CNN : 20 JANUARI 2001

DEEP SPACE PROBE HEADS TOWARD COMET

73718

A NASA spacecraft has performed a critical course change in deep space, positioning itself for a rendezvous with a comet from which it will gather samples to return to Earth. The Stardust probe fired its thrusters for nearly two minutes this month, quickening its speed for an approach to comet Wild 2. After examining communication signals with the craft, mission scientists announced last week that it had completed the task successfully. "This is the maneuver that sets us up for the bigger maneuver," said Robert Ryan, Stardust manager at NASA's Jet Propulsion Laboratory in Pasadena, California, in a statement. "It's a combination of increasing the speed of the spacecraft and at the same time putting it on the path to reach Wild 2. "It's like the setup pass in a basketball game. Now we're ready to shoot the basket." The robot ship should fly near Wild 2 in January 2004, collecting a thimble worth of particles from the dusty halo surrounding the comet's nucleus. Stardust has overcome numerous difficulties since its 1999 launch, including blurry vision in its navigation camera and a mysterious case of excessive thruster firing. The $200 million mission is the first designed to bring back physical specimens from beyond the moon. Scientists have said they expect Stardust's catch to shed light on many cosmic mysteries, including whether comets provided the water and organic material necessary to form life. Comets, possibly the oldest bodies in the solar system, could contain a record of the original material that formed the sun and planets 4.5 billion years ago. The refrigerator-size, solar-powered craft also has been assigned the job of gathering interstellar dust particles streaming into our solar system. The probe should return to Earth with samples of both in January 2006, landing via parachute in the Utah desert. Currently, Stardust is more than 245 million miles (305 million kilometers) away from the sun.

19810

HST Spectra Shows Planet

FRANK MORRING, JR./**WASHINGTON**

Artist's conception of extra-solar "hot-Jupiter"-type planet detected by Hubble Telescope spectrograph.

Clever use of the spectrograph on the Hubble Space Telescope has paved the way for study of the atmospheres around extra-solar planets far earlier than anticipated, possibly advancing the search for signs of life elsewhere in the galaxy.

Scientists who used the Space Telescope Imaging Spectrograph (STIS) to detect sodium in the atmosphere of the planet HD 209458b, about 150 light years from Earth, predict the discovery and study of similar "hot Jupiter"-type planets with the Hubble in the next few years. But beginning with the Next Generation Space Telescope (NGST), now set for launch in 2009, astronomers may be able to look for planets more like Earth.

"NGST has the advantage of being in the infrared, and a lot of the most interesting [spectrographic] lines are in the infrared," said Anne Kinney, director of NASA's Astronomy and Physics Div.

Hubble made the first direct detection of an extra-solar planetary atmosphere by measuring the added influence of sodium in the planet's atmosphere as it passed between Earth and the star HD 209458, which is also rich in sodium.

The observation was made possible because the planet makes a transit of its star that can be seen from Earth every 3.5 days. As it passes in front of the star, light passing through its atmosphere is absorbed by atomic sodium to the extent that it can be detected by STIS. In future observations, the research team hopes to detect other chemicals the same way.

David Charbonneau of the California Institute of Technology, lead investigator on the observation, said statistics suggest about one in 10 of the hot Jupiters—gas giants heated to 1,000C by their proximity to their stars—will have a transit that can be seen from Earth. To date, about 15 of the stars have been identified among the 70 or so extra-solar planets found, and Charbonneau said it should be relatively easy to find more by watching large numbers of stars for planet-induced wobbles.

The lower than expected level of sodium in the planet's spectrograph suggests clouds high in the atmosphere may be blocking some of the light from the star behind it. Future observations of the planet as it passes behind and emerges from behind the star may test that theory.

"AS IT PASSES BEHIND the star, then it would appear as a full moon," Charbonneau said. "It would then go behind the star and be out of view, and then it would appear as a full moon again. By measuring that on-off-on signal, we could learn about the brightness and therefore the reflectivity and therefore the chemical composition of that atmosphere."

NASA has planned a series of space observatories designed to look for ozone, carbon dioxide, water and methane that may suggest the presence of life on an extra-solar planet if they are present in unusual levels. But with the transit technique demonstrated on the Hubble, instruments like NGST that were not specifically designed for the job may be able to join in the search.

"The same technique can be used to find hundreds of Earth-like planets," said Alan P. Boss of the Carnegie Institution.

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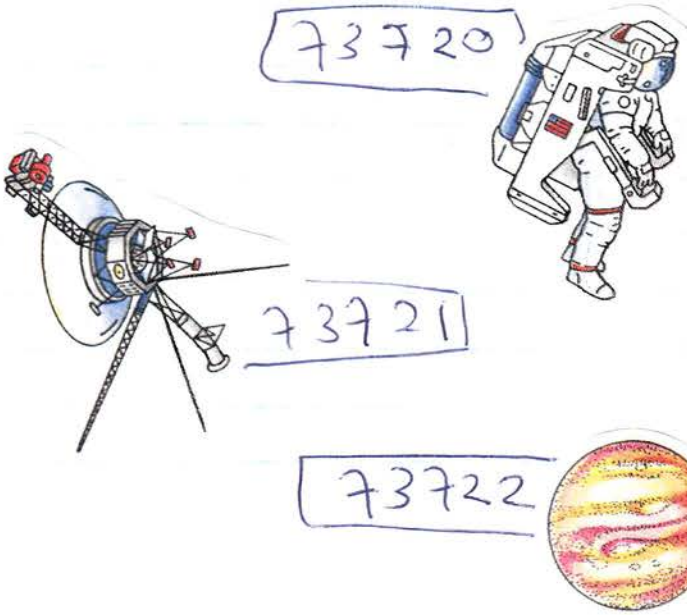

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AWST: 14-01-2002

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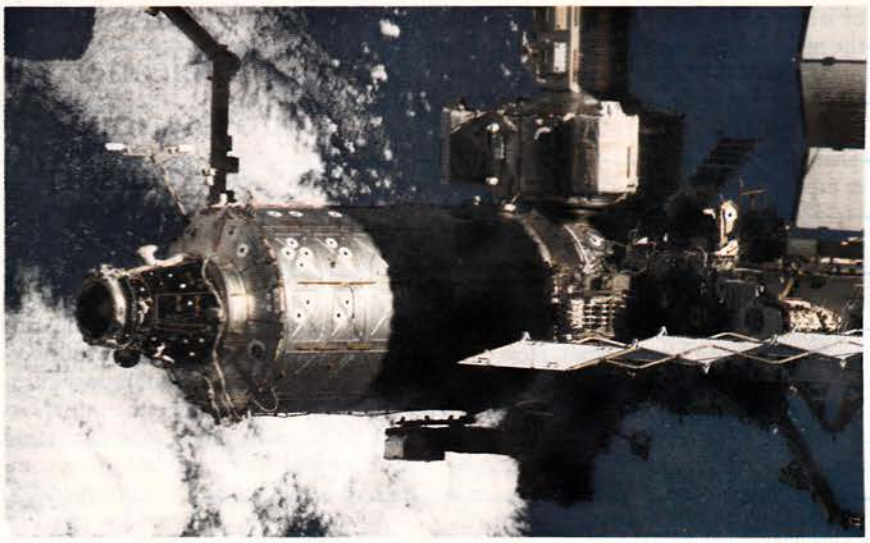
O'Keefe Seeks Closer Military/NASA Links

Fixing ISS overruns is the first order of business for O'Keefe, who is making a top-to-bottom review of the agency to trim inefficiency.

FRANK MORRING, JR./**WASHINGTON**



NASA Administrator Sean O'Keefe wants to initiate much closer cooperation between his agency and the Pentagon, with a possible resumption of classified space shuttle flights on military missions and perhaps a new White House space policy that orders joint NASA/Pentagon efforts across the board.

While he still must come to grips with a $4.8-billion-funding shortfall on the International Space Station (ISS), O'Keefe said NASA spending on aeronautics—relentlessly cut under predecessor Daniel S. Goldin—will increase in Fiscal 2003. That move, too, would push the sort of "leap-ahead" technology O'Keefe said he believes NASA should develop for all users—commercial as well as civil and military.

"I don't think we have a choice," he said regarding cooperation with the military. "I think it's imperative that we have more of a direct association for the purpose of sharing technology, sharing the capacity and the capability to do some things that couldn't otherwise be done."

SPEAKING TO REPORTERS Jan. 9 O'Keefe said it was his "hope" that President Bush will adopt a new national space policy growing from "an interagency process" that is not limited to launch vehicles, as was the Clinton-era document. Coming from a stint as No. 2 at the White House Office of Management and Budget, O'Keefe presented himself as a "public administrator" in the vein of his Apollo-era predecessor James Webb, who had been White House budget director. He termed the problems facing NASA as "manageable" through coordinated efforts like those that would be addressed in a new presidential policy, and with rigorous internal prioritizing.

"We've got finite resources, finite capability, finite capacity for doing a range of things, so we need to be more selective about how we utilize that capacity," he said. "And to the extent that there are things that we know how to do. . . that appropriately belong in other venues [NASA should] be selective."

O'Keefe said he would build on work started under Goldin to replace NASA's financial management system with one that can give an accurate reading on the true cost of programs, starting with the ISS. He said he would also continue the Strategic Resources Review (SRR) that aims to identify duplication of effort within NASA, a process that has raised fears on Capitol Hill of field-center closings and job cuts. To familiarize himself with the agency O'Keefe will visit all the field centers, and he plans to view his first shuttle launch at the end of February when Columbia lifts off on a mission to service the Hubble Space Telescope.

That flight will typify the kind of non-ISS mission that O'Keefe said would allow NASA to boost the shuttle flight rate above the four per year recommended by the independent panel headed by former Lockheed Martin executive Thomas Young (*AW&ST* Nov. 5, 2001, p. 38). As part of the SRR, NASA is also working on what O'Keefe termed "options" to privatize the shuttle (*AW&ST* Dec. 24/31, 2001, p. 36). The thrust of that effort, O'Keefe said, would be to boost competitive sourcing in shuttle support as outlined in President Bush's "Management Agenda" (see www.whitehouse.gov/omb/budget/fy2002/mgmt.pdf).

O'Keefe, who helped write the document when he was at the White House, said the payoffs in competitive sourcing are "the technology advances or the process changes that get you multiples in terms of productivity changes" when private contractors are allowed to deliver an end result without being told exactly how to get there. But he concedes that the approach was "less than satisfactory" when he tried to apply it to warship refitting as secretary of the Navy in the early 1990s.

"It's such a closed industry, and boy, they all do the same damn things the same way, and they've been doing it that way since the Vikings started in the shipbuilding business," he said.

O'KEEFE INDICATED the Young panel's recommendations would largely guide his approach to meeting the ISS shortfalls at the "strategic" level, although "tactical" details remain to be worked out. He was careful to stress that he believes the space station should be completed in a way that meets agreements with NASA's international partners, who are worried that Young's recommendation to trim the station crew to three would leave them out (*AW&ST* Nov. 12, 2001, p. 28).

"Our objective we set for ourselves is to try to look at a configuration that we've agreed to with all the partners through the year 2006," he said. "We've got time."

While the ISS is already up and operating, NASA's Space Launch Initiative is more in keeping with the type of work O'Keefe believes NASA should be doing in advancing technology beyond the "incremental" improvements typical of private industry. The $4.8-billion effort aims at creating technology that industry can apply to replacing the shuttle. "What I want to fight against is the propensity to say 'let's do some derivation of what it is we already know how to do,'" he said.

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19812

Shuttle Privatization Raises Safety Issues

CRAIG COVAULT/KENNEDY SPACE CENTER

CIA and Energy Dept. models offer guidance on course toward privatizing human spaceflight, first with shuttle and then with ISS

Endeavour returns to Kennedy with the ISS Expedition 3 crew after launching Expedition 4. Shuttle privatization would include astronaut corps.

In early 2002, NASA plans to lay the foundation for privatizing the space shuttle by 2004-06, a complex management, cost and safety challenge for the agency and its contractors.

Many NASA shuttle managers believe safety would be threatened by any delay in privatization, because the experienced NASA civil-service shuttle workforce is nearing retirement. Others, including some astronauts, view privatization as a potential risk to safety and overall program capability. This is more out of a concern that any shift should maintain extremely tight, independent and effective safety oversight—although that would be the intent of any privatization. And some managers and astronauts are worried that privatization might inherently squeeze the flight rate, short-change national manned space capability or stymie international teamwork.

The Johnson Space Center has completed an initial privatization assessment involving a large team from the NASA field centers, United Space Alliance and other shuttle contractors. The 60-page report says some of the shuttle privatization models being examined include concepts pioneered by the CIA and Energy Dept. The report's view is that there's greater risk to shuttle safety by maintaining the status quo with heavy NASA civil-service involvement, than by privatizing.

"CONTINUED CONTRACT consolidation utilizing the existing approach will result in a serious threat to safety and mission success," according to the Johnson team assessment.

"It is critical to take advantage of the existing shuttle program expertise before further erosion affects the ability to plan and safely implement privatization," the report said. This is because "the continuing [contract consolidation] combined with continuing loss of NASA skills and experience will result in the serious erosion of checks and balances critical to safety and mission success."

Over the last five years, United Space Alliance, the current shuttle prime contractor, has (in connection with NASA) consolidated numerous major shuttle operations contracts except for the main engine, solid motor and external tank awards. Although the report cites broad concerns about the aging NASA workforce, United Space Alliance with thousands of employees has maintained a solid safety record and saved more than $1 billion over the course of the nearly 30 flights under its stewardship.

Nobody has ever privatized a winged hypersonic space transport with $3.2 billion in annual operating costs, $10 billion in reusable flight hardware and $6 billion in ground test and processing facilities—in need of $600-900 million in refurbishment over the next 10 years.

MULTIPLE PRIVATIZATION options are being examined, according to Ron Dittemore, shuttle program manager. But he declined to be any more specific. Whatever is done is more likely to be the largest ever aerospace merger between the government and commercial sector, rather than a purchase arrangement. "Anything less than a full merger . . . results in a continued threat to safety," the report said.

The winning company's expected leading role in privatization of the U.S. share of the International Space Station is part of the broader equation, as would be its exploitation of NASA's expansive new commercial space policy (*AW&ST* Sept. 24, p. 64). In addition to a privatization challenge, 2002 will also be a major shuttle operations challenge.

Although downstream space station cost cuts could reduce annual shuttle flights to four, the NASA changes to curtail ISS cost overruns will not affect the shuttle schedule next year.

During 2002, NASA plans to launch six flights to add 50 tons of new structure to the International Space Station and install important new instruments in the Hubble Space Telescope. Four of those six missions are squeezed into the first seven months of 2002.

Six flights were also flown this year, the last completed on

Dec. 17 with the landing of Endeavour returning the Expedition 3 crew from the ISS.

STS-108 commander Navy Capt. Dom Gorie and copilot Navy Lt. Cdr. Mark Kelly landed Endeavour on Kennedy Runway 15 at 12:55 p.m. EST. The reentry was approved after the Johnson Spaceflight Meteorology Group, Mission Control and Chief Astronaut Charlie Precourt, flying a Gulfstream Shuttle Training Aircraft here, determined that a dynamic cloud situation at 6,500 ft. would not hamper Gorie and Kelly's visual acquisition of the runway on the 21-deg. glideslope.

Kelly piloted Endeavour's undocking and a half-circuit flyaround of the station when the shuttle departed the ISS over Australia Dec. 15. Johnson controllers made a complex recalculation of Endeavour's reaction control system propellant margins to enable the 40-min. flyaround, even though the crew had to cut into Endeavour propellant margins for an unplanned boost of the ISS orbit the morning of undocking.

THE UNEXPECTED 1-MI. BOOST maneuver was done when Space Command tracking determined that an old Soviet rocket upper stage in orbit for nearly 30 years could intersect the ISS with as little as 3-naut.-mi. clearance. The avoidance maneuver, which also delayed undocking by about 90 min., increased the separation to a comfortable 40 naut. mi.

Station Expedition 3 commander astronaut Frank Culbertson and cosmonauts Vladimir Dezhurov and Mikhail Tyurin, returning after 129 days aloft, are readapting well to Earth's gravity under tight supervision of U.S. and Russian flight surgeons. They boosted ISS science operations, which are being continued by the new Expedition 4 crew in connection with Marshall Space Flight Center controllers.

Any eventual privatization also would involve the astronaut corps, which could possibly be reduced in size downstream to save costs. There are currently 131 U.S. astronauts and 17 new astronaut candidates about to be brought into the program.

Although part of a new corporate structure, the Astronaut Office would continue to maintain a lead role in shuttle safety assessments, as would independent safety reviews outside of whatever corporate structure might be selected. Johnson Mission Control Center staff would also become corporate employees under the changes envisioned. About 700-900 NASA employees would be shifted to any new commercial shuttle company.

THE AGENCY PLANS to request proposals from industry in early 2002 (*AW&ST* Dec. 10, p. 35). But it is likely a "request for information" will be issued first, followed by a formal request for proposals around the end of the first quarter.

United Space Alliance could be a bidder, but not necessarily. That's because it is half-owned by Boeing and Lockheed Martin. Individual bids from the two industry giants, as well as from Orbital Sciences, are also a possibility depending upon how concepts evolve between now and March.

But before any options are valid, NASA needs to know how much the shuttle program truly costs per year—a figure that might be different from the program's annual NASA budget line item. The Johnson team set a goal of understanding that cost figure by January, along with defining several other key elements of the early privatization equation. Those include:

- Cost breakdown. Managers are trying to determine the specifics of recurring and nonrecurring costs.
- Contracting options. The Johnson team, including the contractors, are trying to develop strategies and options for long-term shuttle business arrangements, including fixed-price versus cost-plus contract structure options.

The Johnson report also noted that a separate shuttle privatization study done by John Logsdon at George Washington University indicated that "the closest analog" to a potential privatized shuttle program is the formation of the U.S. Enrichment Corp. by the Energy Dept. to transition its uranium enrichment functions to the private sector.

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ON THE WEB
Read more about the space shuttle at www.AviationNow.com/shuttle

The Johnson report also noted similarities between what NASA wants to do and how the CIA created the In-Q-Tel nonprofit venture capitalist firm in 1999. In-Q-Tel invests in, creates and helps companies enter markets, which can help the CIA tap into new technologies.

The team found privatized shuttle operations would have one of three likely company structures:

- A modification of the current NASA Space Flight Operations Contract arrangement that would utilize a single contract and contractor, but with increased contract consolidation and the merger of civil-service functions and employees.
- A government corporation.
- Expanded corporate competition beyond the current United Space Alliance arrangement that would leverage competition while expanding the number of participants in the process.

Shuttle asset management and ownership transfer is yet to be defined in any arrangement. According to the Johnson report, three options are being studied:

- Continued government ownership of the shuttle assets, but with private company "asset accountability and management."
- Partial government ownership with similar accountability.
- Complete transfer from government to the private sector.

The report says asset "transfer mechanisms that could be used include a facility contract, government-owned contractor-operated arrangement, lease, sale, license—or 'gift.'" Congress is likely to frown on the "gift" option for turning over shuttle assets, while potential corporate bidders might cringe at the Johnson report's assessment of commercial principles. "Shuttle privatization implementation needs to redirect the profit motive, allowing it to be a factor, but not the decisive influencing criteria," the report said.

"Existing contracts are structured such that contract length and terms significantly influence the contractor to make short-term profit-motivated decisions. An overemphasis on profit can result in program weakness with a reduction of critical skills," the report said. "Short-term cost reduction at the expense of long-term health will not be acceptable."

Astronauts strapped into any privatized shuttle would certainly agree with that.

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If Arianespace meets its best-case launch scenario this year, it could use up the last of its Ariane 4 medium-lift rockets. Seven to nine Ariane 4 and five Ariane 5 missions are scheduled.

ARIANESPACE

Sojus-Raketen in Kourou?

73729

Auch wenn die Fi[illegible]zierung noch den größten Streitpunkt darstellt, scheint doch festzustehen, dass in absehbarer Zeit auf dem europäischen Raumfahrtstartplatz Kourou in Französisch-Guyana eine Startrampe für Sojus-Raketen errichtet wird.

Diese können die Nutzlastpalette der Ariane-Familie nach unten abrunden. Jedoch sind die Russen derzeit nicht bereit, sich an den Kosten zu beteiligen, während Arianespace das Projekt nicht allein finanzieren will.

Flug Revue: januari 2002.

NASA NEWS RELEASE : 01 JANUARI 2002.

73730

SHUTTLE PROGRAM LOOKS TO RECORDSM CHALLENGES IN 2002.

On the heels of making space history in 2001 by completing the first phase of the International Space Station (ISS) assembly in orbit, the Space Shuttle will continue a string of space firsts during six missions planned for 2002. "In the past 12 months, we've completed some of the most challenging space flights in history," said Space Shuttle Program Manager Ron Dittemore. "In the next year those challenges will continue with missions just as complex. The team continues to excel safely and successfully, and 2002 promises to be just as rewarding as the past year." The coming year will be marked by the shuttle fleet matriarch Columbia's return to space on the first non-ISS Shuttle flight in more than two years. In addition, flights by Atlantis and Endeavour will haul more than 50 tons of additional components to the ISS and more than three dozen new experiments and two new laboratory racks. Discovery will remain on the ground in 2002 for standard maintenance and inspections. In 2002, NASA plans to break a record set only last year for the most space walks ever conducted in a single year. From Space Shuttles alone, 15 space walks are planned coupled with seven space walks that are planned by crews from the International Space Station. In 2001, 18 total space walks were conducted -- 12 from the shuttle and six from the station. "Space walks will never become routine, but we have entered an era of space exploration now where they will continue to become more common," said Milt Heflin, Chief Flight Director. "But no matter how many or how often crews leave their spacecraft, each EVA remains just as exciting to prepare and conduct and just as rewarding to complete." Columbia will begin the new year with a flight to the Hubble Space Telescope on mission STS-109, the fourth mission to service the space telescope since its launch in 1990. Five space walks will be conducted during the flight to install an advanced new camera system, attempt to reactivate an existing infrared instrument system, install new solar arrays and install a new power controller. The mission will extend the lifetime and capabilities of the now-famous orbiting telescope. When Columbia launches it also will become the second Shuttle ever to fly with a new "glass cockpit," installed as part of maintenance and modifications completed in 2001. The new cockpit has 11 full-color, flat-panel displays that replace 32 gauges and electromechanical instruments and four cathode-ray tube monitors in the old cockpit. The new cockpit is lighter, uses less power and sets the stage for a future "smart cockpit" that will feature new, more intuitive displays to reduce pilots' workloads during critical periods.

In addition, the following flights are planned in 2002:

STS-110, mid spring: Atlantis will deliver to the ISS the first of three giant truss segments to be launched in 2002.

STS-111, late spring: Endeavour will carry to the ISS the fifth resident crew, the Leonardo logistics module filled with experiments and supplies, and a mobile base system -- the second part of the mobile platform for the station's innovative Canadarm2 robotic arm.

STS-107, mid-summer: Columbia will fly an international mission dedicated to microgravity science that will carry a double Spacehab module filled with 32 experiments involving 59 separate investigations.

STS-112, late summer: Atlantis will make its second visit of the year to the ISS carrying the first starboard side truss segment.

STS-113, early fall: Endeavour will deliver the sixth resident crew and a port side truss segment to the station, completing almost half the length of the final truss.

19815

FLORIDA TODAY : 11 JANUARI 2002.

SHUTTLE RARELY USED TO CAPTURE, FIX SATELLITES.

73731

CAPE CANAVERAL - The space shuttle fleet no longer may be -- and almost never was -- a viable option to fetch and repair stranded spacecraft. NASA and the government's reluctance to use the shuttle in such missions is revealed when considering only five of 108 missions were committed to retrieval and repair. It's not hard to understand given the $500 million cost to launch a $2 billion shuttle. But for several reasons, NASA officials now are less inclined: Satellites are far cheaper than a shuttle, and less expensive in general. The shuttle is unable to reach altitudes where spacecraft often fly. The government places tough restrictions on when a shuttle may be used. The statistical risk of a shuttle catastrophe, which is one in 450 launches. The need to conduct its core mission of supporting the International Space Station. The inherent risks to astronauts exposed to the harsh environment of space. "As a mainline operation, I think it is obsolete," said John Logsdon, director of the Space Policy Institute at George Washington University in Washington, D.C. This could mean fewer shuttle flights from the Space Coast. However, the rise of space-based missile defense could revive interest in the shuttle's one-of-a-kind capability. Originally designed to service space stations, the shuttle also offered the added benefit of being able to capture spacecraft in orbit for repair or retrieval. But during the 1970s, when the servicing of stations became more remote, NASA sold the shuttle's crew as on-call space repairmen. It didn't turn out that way. Crews retrieved six satellites during five of the 108 shuttle missions, not counting three repair flights to the Hubble Space Telescope and experimental satellites that were released from the shuttle and returned during the same mission. The four orbiters remain capable of snagging satellites out of orbit, but there are no customers for the unique service. "It's useful in principle, should you ever want to go retrieve a satellite that was somehow stranded in a low orbit," Logsdon said. Guidelines set out after the Challenger disaster limited shuttle missions heavily, allowing flights that only an orbiter and astronauts can perform. "NASA looks at opportunities on a case-by-case basis," agency spokeswoman Kirsten Larsen said. Richard Blomberg, a member of NASA's Aerospace Safety Advisory Panel, said the shuttle can resurrect its retrieval duties if Congress and the White House liift restrictions on missions. Satellites for the budding missile shield President Bush has proposed may be an opportunity for the shuttle as the machines are built and tested. Astronauts could install experimental components on test satellites already in orbit, for example. Later in the program, the shuttle could refuel the satellites. "It sure would be nice to service some of those satellites since they will be high-value assets in orbits the shuttle can reach," Blomberg said. Retrieval flights easily and safely could bulk up the number of shuttle flights, which is stacked only with space station missions and occasional Hubble repair flights. "If the shuttle is privatized, then that's the kind of thing they should look at," he said. The last satellite retrieval was in January 1996, when Endeavour grabbed the Japanese Space Flyer Unit that had been launched 10 months earlier on a Japanese rocket. Three spacewalkers performed the most dramatic retrieval mission in 1992, when they manhandled the Intelsat 6 satellite into the cargo bay after the satellite was stranded two years earlier by a Titan rocket. A new rocket stage was bolted onto the satellite, and it was launched out of Endeavour. The satellite lacked the rod and baseplate device the shuttle arm grabs, so spacewalkers had to risk their lives to grab with their gloved hands in an improvised technique. Commercial space analysts said businesses rarely consider shuttle rescues of their satellites, and never add the grapple fixture to their spacecraft so the shuttle's robot arm could capture it in an emergency. "It just doesn't make business sense," said Phil McAlister, director of the Space and Telecommunications Industry Analysis Division for Maryland-based Futron Corp. "The (low Earth orbit) satellites are small, and there's a question of why send an expensive, high-value spacecraft like the shuttle to get a low-value satellite." Neither the Pentagon nor NASA are keen about such attachments, either. The Next Generation Space Telescope, designed to replace the Hubble Space Telescope launched in 1990, will not have a knob for the shuttle's robot arm to grab. The new observatory, slated for launch around 2010, will orbit far out of reach of the shuttle. Modern spy satellites are complex and expensive enough to justify a rescue mission, but they are not built with that in mind, Logsdon said. Only the Hubble Space Telescope has been repaired by the shuttle since 1992. A team of astronauts will make NASA's fourth visit to the observatory late next month for a service mission. "If Hubble had been a perfect instrument from the start, the shuttle-serviceable orbit would have been a detriment," Logsdon said. "It turns out that shuttle was its salvation." The space telescope was launched in 1990 with an imperfect mirror that returned blurred images to anxious astronomers. Endeavour was launched three years later to install a device that corrected the problem. Had the $2 billion telescope been launched any higher, the repair would not have been possible.

ISS

Dave Böskes

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Het verblijf van Frank Culbertson, Vladimir Dezhurov en Mikhail Tyurin, de derde stambemanning die in de ISS verblijft, loopt ten einde. Op 22 november werd het oude vrachtschip Progress M-45 losgemaakt van het ruimtestation om diezelfde dag nog te verbranden in de atmosfeer boven de Grote Oceaan. Vier dagen later werd Progress M1-7 gelanceerd met voorraden bedoeld voor de vierde expeditie die in december zijn intrek nam in het ruimtestation.

Op 26 november koppelde de Progress M1-7 aan het achterste koppelpoort van de Zvezda module, maar men slaagde er niet in een hechte verbinding tussen het vrachtschip en de ISS tot stand te brengen. Vermoedelijk werd dit veroorzaakt door een vreemd voorwerp dat in het koppelingsmechanisme was terecht gekomen. Beelden opgenomen door de naderende Progress toonden inderdaad een stuk kabel aan met een lengte van ongeveer een halve meter voor de achterste koppelingspoort van de Zvezda module. Hierdoor besloten de vluchtleiders de lancering van shuttle Endeavour uit te stellen tot 30 november.

Tijdens een ruimtewandeling op 3 december van Dezhurov en Tyurin werd het vreemde voorwerp verwijderd en kon de Progress goed aan de ISS vastmaken.

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In 1987 was er een soortgelijk probleem toen de wetenschappelijke module Kvant-1 aan de Mir werd gekoppeld. Ook toen kon er geen hechte binding tot stand komen. Twee kosmonauten voerden vervolgens een ruimtewandeling uit en ontdekten een stuk isolatiemateriaal dat in het koppelingsmechanisme terecht was gekomen. Nadat deze verwijderd was, kon de koppeling alsnog tot stand worden gebracht.

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Teams bid for Next Generation Space Telescope

Lockheed Martin and TRW-Ball Aerospace, the industry teams bidding to build NASA's Next Generation Space Telescope (NGST), have submitted their proposals to the space agency's Goddard Spaceflight Centre, Maryland.

The $500 million contract for the 5400 kg NGST compares with the $2 billion-plus cost of the Hubble Space Telescope (HST), reflecting not only the austere times for NASA but also the technological improvements that have been made in lightweight, advanced technologies.

These include the cryogenic mirrors which are a vital component of the primarily infrared space telescope. Other technologies include cryogenic acuators and detectors.

The original maximum size of any single mirror system was 8 m but this was reduced to 6 m for cost reasons by NASA.

Lockheed has opted for the conservative approach of a monlithic 6 m diameter deployable mirror, while the TRW/Ball team propose a deployable mirror consisting of six hexagonal petals that deploy in orbit.

The primarily infrared observations will enable the NGST to study objects 400 times fainter than those seen by infrared spacecraft and Earth-bound telescopes, while at the same time matching or even surpassing the image sharpness - spatial resolution - of the Lockheed-built Hubble Space Telescope.

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One of the designs for the Next Generation Space Telescope. Ball Aerospace

Astronomers think that they have a good idea of what the universe is like today by looking 10 to 12 billion light years into the past. In addition cosmic background radiation measurements indicate the early development to an age of one million years.

The unseen void between these distances is unexplored and astronomers hope that the NGST will fill this gap, observing stars and possibly galaxies being formed, helping to answer fundamental questions about the evolution of galaxies, stars and planetary systems and life cycles of matter in the universe, and the nature of dark matter.

The NGST is a NASA Origins programme and will involve the European Space Agency, Canadian Space Agency and the Space Telescope Science Institute.

The telescope will be launched in December 2008-June 2009 after the HST has been retired and is likely to be preceded by a 0.5 m to 2 m diameter mirror technology demonstration orbital mission.

However, as long as HST is working well which it is likely to continue to do for many years, NASA will not want to spend too much money too early, so the scheduled launch dates should be regarded with caution.

Spaceflight: februari 2002.

LockMart Bets Launch Future on Atlas V

73735

CRAIG COVAULT/**CAPE CANAVERAL**

Lockheed Martin faces the challenge of carrying the momentum gained through its Russian RD-180 powered Atlas III to the new, more cost-effective Atlas V Evolved Expendable Launch Vehicle.

The Atlas V EELV is set for its first flight in May with a European Eutelsat Hot Bird payload.

Lockheed Martin and International Launch Services (ILS) must also take care to sustain an already strong global launch market position, while dealing with the higher risks inherent in a new booster.

Lockheed Martin's several hundred million dollars' worth of new Atlas V facilities here are far more focused on customer comfort and support than earlier vintage Atlas infrastructure. Managers at Lockheed Martin and ILS say they specifically want to improve upon the same type customer comfort and support services that Arianespace pioneered years ago at its Kourou, French Guiana, launch site.

Lockheed Martin's momentum from Atlas III to Atlas V must be reinforced by a second Atlas III/RD-180 mission set for liftoff here in January. That flight, carrying EchoStar 7, will be the second for the Energomash RD-180 oxygen/kerosene engine and the first for the new stretched Lockheed Martin/Pratt & Whitney Centaur upper stage. These first- and second-stage propulsion systems will be the mainstays of the new Atlas V.

If successful, Lockheed Martin will have flight tested 85% of the critical propulsion and electronics hardware to be used on its EELV, said Adrian Laffitte, director of Atlas launch operations. After the At-

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las III/EchoStar mission, the only major elements of the new Atlas V that will not have been flown are its 106 X 12.5-ft. rigid-body common-core structure, new European Contraves composite payload fairings and GenCorp Aerojet solid rocket boosters for later flights. The first Atlas V is on schedule for liftoff on May 9 from its Launch Complex 41 facilities, but delays with such a new vehicle would not be unexpected.

THE 191-FT.-TALL EELV will be an Atlas V 401 vehicle. The 6,600-lb. Hot Bird is light enough that the first mission needs no SRBs, although the version can use 1-3 solids for geosynchronous transfer payloads up to 16,843 lb. With no solids, it can launch 10,913 lb. into transfer orbits.

The Atlas V 500 series with up to five solids can launch up to about 19,000 lb. into transfer orbit.

ILS so far has booked 10 commercial and seven Defense Dept. payloads on the Atlas V, said Greg Gilmore, ILS regional director for the Americas. It also has funding for perhaps an eighth near-term military payload.

Two Atlas Vs are set for launch in 2002 along with three Atlas IIIs. Up to six Atlas Vs and three Atlas IIIs are scheduled for 2003. Lockheed Martin will also continue to launch the older, smaller Atlas IIA and IIAS vehicle here until 2003, with Atlas IIIs continuing through about 2007.

The ILS partner arrangement with the Russian Khrunichev Proton, in place since the mid-1990s, will provide backup schedule assurance in connection with Atlas V.

In addition to the $500 million provided by the U.S. Air Force to each EELV contractor, Lockheed Martin has spent about $1 billion of its own money on the Atlas V development and facilities. The vehicle design, with hundreds of fewer parts and new manufacturing efficiencies, are key to the program (*AW&ST* Dec. 13, 1999, p. 54).

Lockheed Martin Atlas V EELV first stage undergoes final processing in Cape Canaveral's Atlas Spaceflight Operations Center. Russian RD-180 engine has twin nozzles.

New Cape infrastructure is also an inherent part of the cost-saving and marketing equations for Lockheed Martin and ILS. Atlas V operations will utilize only three new facilities here, compared with 17 government and contractor facilities required to process Atlas IIAs. The reduction eventually will allow for a 25% cut in Atlas/Titan personnel here, who currently number 300-350. That move should further save costs. The new facilities are:

- Atlas V Spaceflight Operations Center (ASOC). This four-story, 30,000-sq.-ft. building consolidates vehicle checkout, the Launch Control Center (LCC) and customer support rooms linked to a common database. The ASOC is 4 mi. from Pad 41. Its launch control center alone replaces 13 older Atlas facilities.

Up to six Atlas Vs can be parallel-processed in the ASOC. Much of the same work with the old Atlas had to be done serially on the pad, where mission bottlenecks could occur. The ASOC is specifically designed to provide customers more schedule assurance, a factor just as important as the launch price in winning a contract. With most checkout now done at Lockheed Martin's Denver plant, as little as one day of work will be needed in the ASOC.

- Vertical Integration Facility (VIF). This 292-ft.-tall building 1,800 ft. from Complex 41 is where the Atlas V is stacked vertically on its mobile launcher platform nine days before rollout to the pad. Atlas core vehicles are towed horizontally from the ASOC to the VIF.

The mobile launcher platform on which the booster is stacked weighs 1.3 million lb. with a 184-ft. umbilical mast. Lockheed Martin believes the VIF will save processing time, and therefore costs, by allowing most of the vertical launcher work to be done indoors out of the weather (see front cover).

- Pad 41. Unlike the older Atlas, which spends weeks on the pad, the Atlas V will be towed from the VIF on its mobile launcher to Pad 41 just 12 hr. before liftoff. The company believes this will be an advantage over Boeing's Delta IV, which must spend at least eight days on the pad, where lightning and other weather factors can limit technician access.

Like the Ariane 5 pad at Kourou, the Atlas V uses a "clean pad" concept in which there is minimal expensive infrastructure to be destroyed in the event of an accident. All of Pad 41's original Titan 3/4 infrastructure except its 340-ft. lightning protection towers were removed to make way for Atlas V operations.

PATRICK H. CORKERY/LOCKHEED MARTIN

Atlas V Launch Control Center has amphitheater type seating for rocket and satellite customer management above firing room. Note large screens for data display.

(73736)

19818

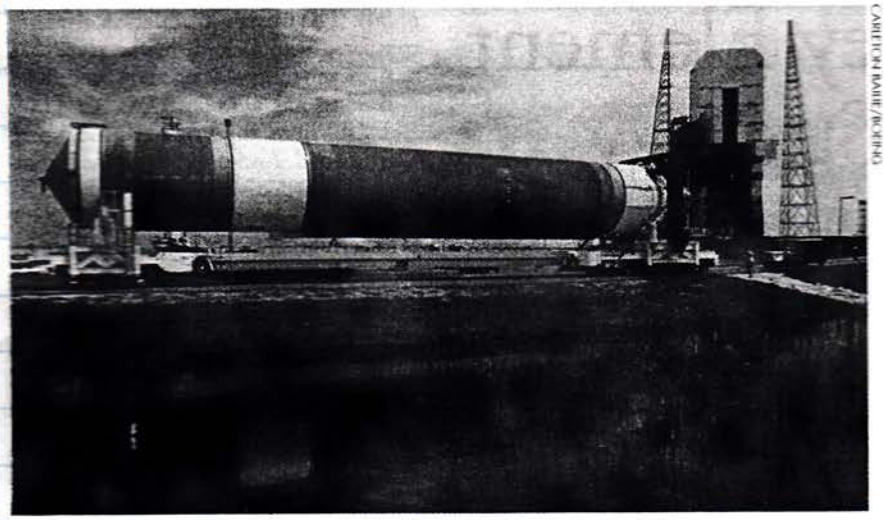
id motor and upper stage configurations.

The Delta IV Heavy version with three CBCs and three RS-68s can place 50,800 lb. into low-Earth orbit and up to 28,950 lb. into GTO. The 235-ft.-tall Heavy is to be flight tested on a USAF demonstration mission here in early 2003.

The Delta IVs RL10B-2 upper stage engine has been flight tested on the Delta III, as have the EELV's avionics.

Delta IV prices run from $80-160 million, but neither Boeing nor Lockheed Martin will be able to recoup their total development and facility investment for many years. As with Lockheed Martin, the Air Force provided $500 million in initial funding and Boeing has spent upwards of $1 billion of its own money on the program.

Three Cape Delta IV missions are set for 2002, while at least four or five Cape missions, including the Heavy demonstration flight, are set for 2003. But there are a total of six Delta IV launch slots possible at the Cape in 2003, and Boeing is poised to make new contract announcements in January that will likely boost that total.



CARLTON BAIRD/BOEING

Delta IV static test stage was moved to Pad 37 to check facilities. The flight vehicle will be on the pad by January for a flight-readiness firing in May.

As for ground infrastructure, there are major differences between Boeing's and Lockheed Martin's ground facilities. Lockheed Martin is placing more emphasis on customer comfort and dedicated customer facilities in its launch control center. In contrast, Boeing launch control facilities are more functional in scope and appearance. Boeing also believes it uses more cost-effective horizontal processing.

LIKE LOCKHEED Martin, Boeing has greatly reduced the number of its facilities compared with earlier operations. The processing of Delta II or III vehicles here requires operations in 43 separate sites. That has been reduced to only three primary facilities for Delta IV. They are:

- Delta Operations Center (DOC). Only 1.5 mi. from the pad, the DOC has the Launch Control Center with 17 consoles on its third floor and a Mission Directors Center with customer support areas on its fourth floor. Adjacent to the firing room is a somewhat similar Engineering Support Area with consoles used to monitor horizontal vehicle checkout. The DOC also contains Boeing offices and is used for Centaur engine nozzle preparation.
- Horizontal Integration Facility (HIF). The six-story, 350 X 250-ft. building is where virtually all post-factory vehicle testing is done. Up to six Medium or three Heavy Delta IVs can be processed in the HIF simultaneously. Most of Delta IV processing will be done with the vehicle horizontal, either at the factory or in the HIF, a factor that should reduce cost, personnel and schedule risk, said David Herst, Delta IV launch director and overall director of EELV launch sites.

For example, the older Delta II, a much smaller vehicle, needs to spend 3-4 weeks in the Cape's Delta Mission Checkout Facility. With the Delta IV, however, much of that DMCO type work will be done at the Decatur plant, and only two weeks of hands-on processing will be required in the Cape HIF. The combined efficiencies of the Cape's HIF and Decatur plant equate to a 54% reduction in off-pad processing time from Delta II and a 58% reduction in overall pad labor required.

- Launch Complex 37. Originally a Saturn 1B pad for Apollo, the site was totally stripped and rebuilt by Raytheon. The Florida Space Authority and Boeing are negotiating a possible $300-million deal in which Florida will provide financing for the pad and lease it back to Boeing so the company can remove the full cost of the pad from its books. The state worked out a similar $300-million deal with Lockheed Martin for the Atlas V pad.

While in the HIF, a large Launch Mate Unit fixture is attached to the Delta IV, allowing it to attach to the launch table at the pad. A Platform Transporter low-slung truck then carries the vehicle from the HIF to the pad's 26 X 95-ft. erector. This tilt-table hydraulically elevates the entire vehicle into the pad's 330-ft.-tall, 9-million-lb. mobile service tower (see front cover). Two 378-ft.-tall lightning rod towers protect the site. A crane will then raise the solid boosters and the payload, encapsulated in its shroud at Astrotech. Three large swing-arms will provide oxygen and hydrogen propellants and payload cooling.

The new vehicle will be only 8-10 days on the pad, compared with the older Delta II's 22-day minimum. The efficiencies mean that the Delta IV should be able to fly nearly 50% more missions from the Cape using one pad with reduced personnel, said Rich Murphy, Delta IV mission director and division director for Cape and Vandenberg launch operations.

Even though the vehicle will normally be on the pad just 8-10 days, for the first launch it will spend 4.5 months for propellant tests and the flight-readiness firing.

In contrast to Lockheed Martin, Boeing used a static test common booster core that had been fired five times at the Stennis Space Center in Mississippi to check out various mechanical interfaces at the Cape's HIF and pad. Those tests from August to October ran well and included erector demonstrations.

THE FLIGHT FIRST STAGE arrived from Decatur on the 312-ft.-long Boeing Delta Mariner transport ship in September, followed later by the road shipment of the upper stage. Later upper stage shipments also arrive on the boat.

The flight vehicle core and second stage have been undergoing final checkout in the HIF, where their avionics are performing well. The flight vehicle is to be erected on Pad 37 by mid-January. Tests will include separate, then combined oxygen and hydrogen fueling checks and demonstration countdowns leading to the FRF with a simulated payload and shroud atop the vehicle. The FRF with the first and second stages fully fueled will involve a full launch countdown leading to the RS-68 ignition sequence at T −5.5 sec. This will be followed by a pad abort cutoff after the engine has developed about 1 sec. of full thrust.

Another key facility, off site from the Cape but vital to both EELV competitors, is Astrotech's new $30-million, 50,000-sq.-ft. facility built specifically to check out Atlas V and Delta IV payloads and encapsulate them into launch shrouds up to 50 ft. tall.

The ASOC is the command center for all Atlas V operations. Its two-story high-bay launch control center with 12 system consoles supporting about 25 personnel has large wall screens with multimedia display capability—a major change from old Cape systems. Instead of firing room personnel being stuck in a blockhouse miles from management and engineers, they will now all be together in the business-like atmosphere of the ASOC.

The facility is unlike any other built for U.S. launch operations. Key management and engineering support rooms are in amphitheater seating behind glass on the second and third floors looking into the LCC and its big screens.

THE AMPHITHEATER sections include an Engineering Operations Center with 20 seats, computer displays and a line of sight to the big screens in the LCC. Similarly, there are several other management/engineer computer positions looking down into the LCC along with a separate Mission Operations Center section where launch management will be positioned.

Also on the second floor of the ASOC are five mission support rooms, each with its own large-screen display and six personal computer screens. At all of the positions is a "smart card" system programmed with what each individual is allowed to access from the Atlas V database. Boeing's facility, however, has no similar accommodations.

The smart card approach has allowed Atlas V to advance toward a paperless system. It also aids enforcement of International Traffic and Arms Transfer (ITAR) regulations for Russian RD-180 personnel and non-U.S. payload sponsors.

Unlike Boeing, Lockheed Martin has used its first Atlas V flight vehicle, designated AV-001, as a pathfinder. The vehicle was fully stacked in the VIF with a payload simulator in November and has now been moved back to the ASOC for installation of avionics and ordnance. It will be restacked in the VIF in January, then rolled out and back to Pad 41 in February, March and April for three fueled countdown rehearsals leading to the planned May launch.

Delta IV–Key Element In Boeing's Strategy

CRAIG COVAULT/**CAPE CANAVERAL**

Boeing Delta IV Evolved Expendable Launch Vehicle managers believe their strong early manifest will provide an immediate chance to demonstrate the reliability and long-term marketability of the Delta IV.

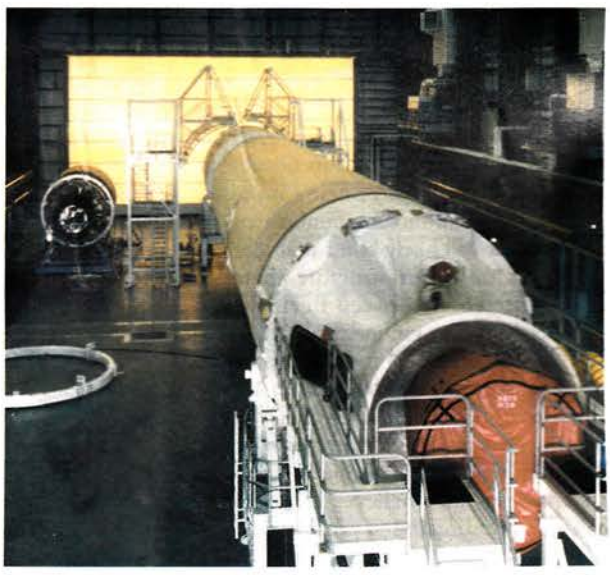
That's important, because the Delta IV has fewer major flight tested systems—but perhaps more early flights—than its Lockheed Martin competitor. What's not yet known, however, is how long the first flight of the 200-ft.-tall vehicle will be delayed by the checkout and verification of Boeing's massive Launch Complex 37. The mission is scheduled for Apr. 30, but Boeing knows it will be slipped until later in the spring, said Gale Schluter, vice president and general manager of expendable launch vehicles.

UNLIKE THE ATLAS V, the first Delta IV must undergo a flight-readiness firing (FRF) on the pad. That countdown software and engine test is now planned for no later than May, with the first flight to follow about six weeks later in the June time period.

"We, like Lockheed Martin, are seeing some reluctance in the commercial market to fly an unproven vehicle," Schluter said. "I think once we get three or four of these under our belt and demonstrate commercial stability, the market will be more responsive." Both companies agree the global outlook will remain flat at about 35 heavy geosynchronous satcoms per year, with perhaps some growth in military payloads.

Boeing's Sea Launch affiliate under the new Boeing Launch Services marketing organization will be a ready backup to the Delta IV for commercial missions (see p. 68). And Sea Launch—like the Atlas, Proton and Ariane—is already well positioned in the heavy-satcom market. But Delta is less established because of the smaller capability of the old Delta II and the failure of two of three new heavier Delta IIIs.

Compared with previous Deltas, Boeing's EELV is a far more powerful and modern launcher powered by the Boeing/Rocketdyne oxygen/hydrogen RS-68. Schluter believes the RS-68 will be cheaper to build than future Pratt & Whitney production of the Russian RD-180 for the Atlas V. Boeing also believes advanced processes used in its Decatur, Ala., plant will save money (*AW&ST* Dec. 13, 1999, p. 54). The overall production timeline compared with Delta II has been reduced by 45% and mission integration time, 20%.



Delta IV flight vehicle with its RS-68 oxygen/hydrogen engine is readied in Boeing Horizontal Integration Facility, where checkout is centered.

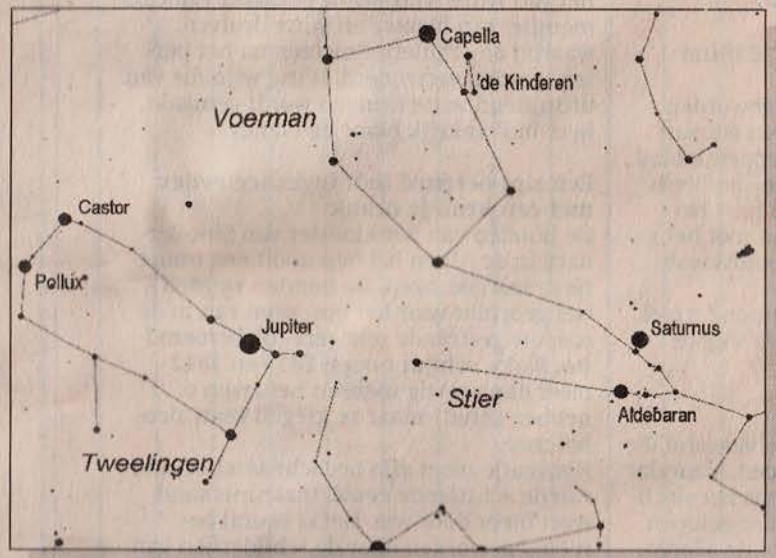
Boeing has won 22 U.S. Air Force EELV missions, three times the Lockheed Martin total. And only Boeing is initiating operations at Vandenberg AFB, Calif., with at least one mission set there in 2003. Overall, Boeing has more than 50 firm orders for Delta IVs out to 2007.

The Delta IV's first payload will be a Eutelsat W telecommunications satellite using the Delta IV "Medium Plus 4.2" configuration. That means the common booster core (CBC) with a 650,000-lb.-thrust RS-68 will fly with two solid rocket boosters along with a 4-meter (13-ft.) long RL10B-2 powered upper stage and 4-meter-long shroud. Different Medium versions can launch 9,285-14,475-lb. payloads into geosynchronous transfer orbit (GTO), depending on sol-

STERRENKIJKEN

EEN ZON IN HET KWADRAAT

Met haar goudgele verschijning lijkt ze als twee druppels water op de zon. Capella, de hoofdster van het sterrenbeeld Voerman schittert in hartje winter hoog aan de zuidelijke hemel, bijna recht boven ons hoofd. De ster heeft meer in petto dan je op het eerste gezicht zou denken.
Wie deze week de blik op de sterrenhemel richt, merkt allereerst Jupiter op. De planeet is momenteel het helderste sterachtige object aan de hemel en prijkt rond een uur of negen hoog in het zuidoosten. Jupiter bevindt zich in het sterrenbeeld Tweelingen, met Castor en Pollux als hoofdsterren. Een stuk naar rechts vinden we nog een planeet: Saturnus. Hij is zwakker dan Jupiter maar behoort nog altijd tot de helderste 'sterren' aan het firmament. De planeet vertoeft momenteel in de Stier, dichtbij de oranjekleurige ster Aldebaran.
De Voerman, de thuisbasis van Capella, vinden we boven de verbindingslijn tussen Jupiter en Saturnus. Meteen valt de vijfhoekige vorm van het sterrenbeeld op. De Assyriërs en later de Arabieren zagen in de Voerman een wagen met Capella als menner. De naam betekent 'geitje', want van oudsher werd de wagenmenner afgebeeld met een geit op zijn schouders. Rechtsonder Capella vinden we een kleine driehoekige sterrenconfiguratie die bekend staat als de 'kinderen van de geit'. In de verrekijker vallen de 'kinderen' op door hun contrasterende kleuren. De ster linksonder in de driehoek schijnt in zilverblauw licht, terwijl de rechter ster oranjeachtig is. Om iets van kleur te zien moet de hemelachtergrond wel goed donker zijn. De eerste paar dagen hebben we nog last van het schijnsel van de maan. Maar aan het einde van de week komt de aardse wachter pas later op de avond op en zal hij minder storen.
Capella neemt op de ranglijst van helderste sterren een eervolle zesde plaats in. Vanwege haar noordelijke positie gaat de ster nooit onder. Op heldere zomeravonden zien we haar laag in het noorden schitteren, maar 's winters staat Capella dicht bij het hoogste punt aan de hemel. Net als de zon straalt Capella voornamelijk in geel licht. De kleur van een ster zegt iets over de oppervlaktetemperatuur en dus is Capella ongeveer even heet als de zon. Maar daarmee houdt



iedere gelijkenis op. Capella is een zon in het kwadraat. Ze bestaat namelijk uit twee bijna identieke sterren die ook nog groter en zwaarder zijn dan de zon. De beide componenten cirkelen in 104 dagen om elkaar heen op een onderlinge afstand van honderd miljoen kilometer. Dat is slechts tweederde van de afstand aarde-zon. Omdat het Capella-stelsel 43 lichtjaar ver weg staat, kunnen zelfs grote telescopen de beide componenten alleen met behulp van speciale technieken afzonderlijk zien. Het zijn reuzensterren met een tien keer grotere diameter dan de zon en een tweeëneenhalf keer zo grote massa. De sterren ontlopen elkaar niet veel, maar toch zijn er kleine verschillen. De zwaarste van de twee, aangeduid als Capella a, is de grootste en koelste en straalt tachtig keer meer licht uit dan de zon. Capella b, de lichtste component, is net zo heet als de zon en overtreft haar lichtsterkte met 'slechts' vijftig keer. Het gaat hier om sterren die hun beste tijd er al op hebben zitten. Ze lijden aan acuut brandstofgebrek en zwellen langzaam maar zeker op.
Uit nauwkeurige analyse van het licht van Capella b blijkt dat deze ster in circa negen dagen om haar as draait. Voor een reuzenster is dat behoorlijk snel. Ook legt Capella b nogal wat activiteit aan de dag. De ster lijkt zich net zo te gedragen als de zon tijdens een zonnevlekkenmaximum. Iedere elf jaar raakt onze ster van slag. Haar oppervlak zit dan onder de donkere vlekken en in de zonneatmosfeer vinden hevige uitbarstingen plaats. Dat gebeurt ook op Capella b, maar dan nog veel heftiger. Na verloop van tijd komt de zon weer langzaam tot rust, maar Capella b lijkt last te hebben van permanente hyperactiviteit. Waarschijnlijk heeft dat iets te maken met de snelle rotatie van de ster. Die werkt als een dynamo, waardoor er bijzonder sterke magneetvelden worden opgewekt. Kijk maar naar Capella a. Zij draait minder snel om haar as en doet het een stuk rustiger aan.

Volgende week:
DE TOEGIFT VAN DE ZON

NEWS RELEASE : 05 FEBRUARI 2002.

KENNEDY SPACE CENTER TO PERFORM SHUTTLE MODIFICATIONS.

After completing detailed, independent cost and risk assessments, the agency has decided to perform Space Shuttle Orbiter Major Modifications (OMM) at NASA's Kennedy Space Center (KSC) in Florida.Since the inception of the Space Shuttle program, the Palmdale Manufacturing Facility in California has served as the manufacturing site for all orbiters, in addition to the primary location for performing periodic maintenance and safety upgrades. However, beginning immediately with the Space Shuttle Discovery, which is scheduled for its periodic structural inspection and maintenance period in early spring, the work will be moved to KSC. NASA Headquarters' Office of Space Flight made the decision following an extensive review. While it was determined that either KSC or Palmdale could support the current Space Shuttle launch schedule, keeping two modification facilities active to support four orbiters is no longer feasible in today's fiscal environment. Program managers believe significant infrastructure savings would be realized performing the major modifications in Florida. Shifting work to KSC would also minimize risk. "This decision reflects NASA's primary goal of maintaining safety as its primary objective and then evaluating cost savings and risks associated with that decision," NASA Administrator Sean O'Keefe said. "It is obvious that in the current fiscal environment, it makes more sense to perform this work at the launch site for the foreseeable future." The decision was reached after evaluating site selection criteria established by the Office of Space Flight, which included cost and risk, manifest impacts, shuttle flight schedule, management and workforce skills and experience, major modification performance in the past and present, facility utilization and centralization of operations. While both KSC and Palmdale could support the OMM, managers determined keeping both active to support four orbiters is no longer practical or feasible given the current shuttle manifest and budget environment.

737 40

SPACE.COM : 05 FEBRUARI 2002.

SHUTTLE OVERHAUL WORK HEADED TO FLORIDA FROM CALIFORNIA.

737 411

CAPE CANAVERAL - In a bid to save money in the face of dwindling budgets, NASA officials said Tuesday that future space shuttle overhaul work will be moved to Florida from the factory where the agency's four orbiters were built in California. Coming a day after President Bush unveiled a budget that will cut NASA human space flight programs in each of the next four years, the transfer of work will lead to the loss of some 240 jobs at a shuttle assembly plant in Palmdale, Calif. At the same time, the work force at NASA's Kennedy Space Center -- the agency's shuttle homeport -- is expected to grow by about 235 people. The estimated cost savings: $30 million per shuttle overhaul. Parker Counts, NASA's deputy associate administrator for the space shuttle program, said the decision -- which had been anticipated since last fall -- came down to simple economics in an era of serious budget limitations. The work forces in California and Florida both were deemed capable of doing the work safely, Counts told reporters in a late afternoon teleconference. But "with budget constraints," he said, "we just needed to centralize our activities in our work forces." Florida Gov. Jeb Bush lauded the move, saying that it "symbolizes the continuing partnership between Florida and the space industry." "The strategic relocation of the shuttle modifications to Florida is a testament to our economic strength," Bush said. "We are proud that NASA has chosen to expand its presence in the Sunshine State." There was little praise, however, coming out of California. U.S. Rep. Howard "Buck" McKeon, a California Republican whose district includes the Palmdale area, said the move marked "a sad day" for his community but added that he understood NASA's need to save money. Noting that "a savings of $30 million was simply too much to pass up" during difficult financial times, McKeon added that he still opposed the decision. "I believe the decision to be shortsighted and possibly harmful to the program in the long-term," McKeon said, adding that NASA stood to "lose the institutional memory of an experienced work force that cannot be replaced by training." "I fear that the damage done by this one step will be penny-wise but pound-foolish." NASA periodically sidelines one of its four orbiters for structural inspections and modifications, leaving its three other ships to carry out shuttle missions in the meantime. With the exception of one shuttle overhaul done at KSC in 1992, that work always has been done at a Boeing Co. plant in Palmdale and typically takes between 12 and 18 months. NASA officials, however, announced last year that the shuttle program was facing an anticipated budget shortfall of $800 million over the next five years. That situation prompted managers to consider moving the shuttle overhaul work to Florida to save money, and then last August, NASA gave its shuttle prime contractor -- United Space Alliance -- a go-ahead to hire new workers at KSC. The idea was to train additional workers in case a decision ultimately was made to move the work to Florida. NASA also agreed to reimburse the company for money spent if the work remained in California, so the move came as no huge surprise. The location of the work, meanwhile, has been a longstanding political football. NASA contemplated transferring the work to Florida around 1992. But members of the California congressional delegation threatened to vote against the agency's space station project, and the work remained in California. Two years later, NASA's own Inspector General conducted an investigation that showed the agency could save $30 million per shuttle overhaul by moving the work to Florida. But the agency once again decided to continue conducting inspections and modifications in Palmdale. At the time, NASA was flying six to eight shuttle missions per year, and officials said that the agency didn't want to tie up one of only three available shuttle hangars at KSC with orbiter modification work. The picture now, however, has changed dramatically. With a projected cost overrun of $5 billion, NASA's International Space Station program essentially has been put on probation by the Bush Administration, and as a result, the annual shuttle flight rate is expected to drop to four or five missions from 2003 through 2006. NASA officials, consequently, determined that the Florida work force could handle routine launch preparations as well as orbiter modification work, Counts said. Also a major factor: A new cost assessment that once again showed that NASA could save $30 million per shuttle overhaul by doing the modification work at KSC. Conducted at Johnson Space Center in Houston, the new study indicated NASA could save money on lower labor, energy and other operational costs in Florida. In addition, it typically costs NASA about $2 million to ferry a shuttle orbiter to California and back to Florida atop a modified 747 jumbo jet. The cost of NASA's last overhaul -- one carried out on shuttle Columbia -- was about $70 million. Some 400 workers were involved in that work at the Palmdale plant. Next up: sistership Discovery, which last flew on a mission to the space station last August. The overhaul will involve thorough inspections of Discovery's airframe and electrical wiring as well as modifications to the ship's various systems. The big-ticket item: Installing an advanced cockpit, work that NASA had considered scrapping due to its projected shuttle budget shortfall. NASA's fleet leader with 30 flights to date, Discovery is expected to return to the fleet in early 2004. The future of the Palmdale facility, meanwhile, might not be as bleak as it appears. The work force at the plant -- which is the only shuttle manufacturing facility in the world -- is expected to drop to 110 from the current payroll of 350, but Boeing officials said the company will try to place affected workers within other corporate divisions. Furthermore, the company said it has no plans to shut down the factory. Space shuttle components still are being manufactured at the plant, a shuttle parts warehouse still will be maintained and technicians there also work on ground support equipment for the company's Delta 4 rocket program. What's more, company officials think that there's still a chance that either future shuttle work -- or work on any spaceship the agency builds to replace the shuttle -- could end up being done in Palmdale. "The facility is not going to close. It's too important for the long-term work on the shuttle -- not just orbiter major modification but futuristic upgrades. We want to hedge our bets and keep it open," said Boeing spokesman Glenn Golightly. "I can't predict the future very well, but we think Palmdale is an important place for us, and it still has a future role to play in the shuttle program," he added. "We think it's still the best place to do any kind of orbiter work."

19822

Atlas and Delta test programmes completed

Testing of the engines for the new Delta IV and Atlas V engines has been completed.

Boeing's Rocketdyne division has finished the testing of the 2.9 MN thrust RS-68 engine which will boost the Delta IV fleet of satellite launchers, with a first flight scheduled for May 2002.

The now certified engine has been test fired 183 times for a total of 18,645 seconds.

Boeing has also completed five hot fire tests of the engine, integrated with the Delta IV Common Core Booster stage at NASA's Stennis Space Centre, Mississippi, lasting 55 seconds.

Lockheed Martin has announced that the final test firing of the joint US-Russian RD AMROSS, Pratt & Whitney-NPO Energomash RD-180 engine has been completed with a 350 s burn at 47 percent and 100 percent power levels at Khimky, Russia, and the engine is now fully qualified for Atlas V launches, which will start in May 2002, as the powerplant of the Common Core Booster.

The engine also powers the Atlas IIIA and B series. The five year development of the RD-180 started in November 1996 and involved 135 tests lasting 25,450 secs. The engine has also been used on the only Atlas III launch so far conducted in 2000.

737 42

737 43

NASA's Extreme Ultraviolet Explorer (EUVE) ended almost a decade in orbit Jan. 30, when it reentered the atmosphere over Egypt and apparently burned up. Launched on July 7, 1992, the 7,000-lb. spacecraft examined more than 1,000 objects for the first time in extreme UV wavelengths before its instruments were shut down in December 2000. The reentry was uncontrolled, but there were no early reports of surviving debris striking the surface.

AWST: 04-02-2002

Mars Odyssey Reaches Final Mapping Orbit

BRUCE A. SMITH/LOS ANGELES

NASA's Odyssey spacecraft has reached its final mapping orbit at Mars and is scheduled to be fully configured to begin its science mission by Feb. 20, according to project officials at Jet Propulsion Laboratory.

The spacecraft completed aerobraking Jan. 11, during which its initial elliptical orbit around the planet was reduced by making 332 passes through the upper fringes of the Martian atmosphere. As a result, the spacecraft's propellant requirement was decreased by 440 lb.

> "We charted a region of Mars' atmosphere which hadn't been explored before"

Since that date, controllers have been bringing the spacecraft closer to its mapping orbit and preparing for deployment of its high-gain antenna on Feb. 4. It is considered a critical maneuver since failure to deploy the antenna would require turning the spacecraft to position the antenna toward Earth every few orbits in order to return data.

David A. Spencer, Odyssey mission manager at Jet Propulsion Laboratory (JPL), said deployment of the 6-meter gamma ray spectrometer instrument boom is another critical move.

CONTROLLERS ON JAN. 11 raised the periapsis, the closest point in Odyssey's orbit to the surface of Mars, out of the atmosphere to about 200 km., stopping the aerobraking process. On Jan. 15, another maneuver was conducted to raise periapsis close to the mapping altitude of about 387 km., and to make a small adjustment in orbit inclination, which is 93.1 deg.

Two days later, a maneuver was completed to lower apoapsis, the farthest point of the orbit, to 450 km.

Spencer said the aerobraking process, the third time it has been tried by NASA, went smoothly. The initial aerobraking procedures were conducted by the Magellan spacecraft as an end-of-mission experiment at Venus, and then by the Mars Global Surveyor spacecraft. MGS experienced a structural problem with its solar array system and required an extended period of time to complete aerobraking.

"I think the aerobraking phase is the biggest technical challenge for the mission," Spencer said. "With [its] completion, we have retired a great deal of the mission risk." In fact, the aerobraking process on the Odyssey mission was completed a few days ahead of schedule.

Spencer said aerobraking data received from the MGS mission, as well as MGS operational techniques, were important to Odyssey project planners. Odyssey, however, flew through an unknown area of the Martian atmosphere—a region near the north pole with significant variations in atmospheric density.

"We charted out a region of the Mars atmosphere which really hadn't been explored before," Spencer said. "That will be very valuable to the next mission." He added that the fact Odyssey was able to maintain its flight plan during the aerobraking phase will increase confidence that aerobraking can be accomplished on time and on budget.

Mars Reconnaissance Orbiter, planned for launch in 2005, will use aerobraking down to a final mapping orbit about 200 km. above the surface of the planet.

Odyssey controllers initially were relatively conservative in their operations because of the predicted atmospheric variations in the north polar region, where density could double from one pass to the next. They became more aggressive, however, during aerobraking in areas where there was increased atmospheric uniformity, driving deeper into the atmosphere during each pass.

The Odyssey mission initially was going to use a technique called aerocapture, in which the spacecraft plunges deep into the atmosphere upon arrival at the planet to take out a large amount of energy at one time, and then maneuvers into an operational orbit. The mission was to be the first to use aerocapture, but project officials later decided to use the proven aerobraking technique instead.

737 44

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Meeliften op treeplank Ariane-raket

73745

Telegraaf
19-01-2002

LEIDEN — In oosterse landen is het een bekend tafereel: als de deuren van tram of trein zich hebben gesloten lift een aantal waaghalzen gratis mee op de treeplanken. In ons land gebeurt dat niet maar Nederlanders willen wel altijd graag voor een dubbeltje op de eerste rang zitten. Niet verwonderlijk dus dat juist het Nederlandse bedrijf Fokker Space (Leiden) een revolutionair meeliftidee presenteert: benut de lanceercapaciteit van de Europese Ariane-raket beter door vrijwel gratis een extra

73746

Die kunstmaan is in feite een aangepaste versie van de afgeknotte kegel die tussen de Ariane-raket en de mee te voeren satelliet(en) zit. Zo'n kegel heet in het Engels 'cone' en dus heet het project 'ConeExpress'.

Satellieten lanceren is duur, zeker als ze naar de typische baan voor communicatiekunstmanen moeten, op 36.000 kilometer boven de aarde. Een lancering kost wel € 100 miljoen. Gewoonlijk brengt de Ariane-5 twee satellieten tegelijk naar een overgangsbaan. Daar worden de kunstmanen losgelaten en met een eigen forse raketmotor vliegen ze naar de geostationaire baan boven de aardse evenaar. Daar hebben ze een omlooptijd van 24 uur en draaien ze gelijk mee met de roterende aarde: ze blijven dus steeds boven hetzelfde punt hangen - een belangrijk vereiste voor communicatiekunstmanen.

Twee

Typische Ariane-satellieten wegen drie tot vier ton en de Ariane kan er zonder probleem twee meenemen. ConeExpress zal hooguit een ton wegen en kan makkelijk mee, omdat de konische adapter tussen satellieten en raket er toch al zit. Maar er moet natuurlijk wel wat voor betaald worden, daardoor wordt de concurrentiepositie van Ariane beter.

Resteert het probleem van de eigen motor van de kunstmaan, die nogal duur is. Fokker stelt daarom voor geen zware chemische motor te gebruiken, maar een ionenmotor die elektrisch geladen deeltjes uitstoot. „Zo'n motor heeft weinig stuwkracht en daardoor duurt het wel drie tot zes maanden voor de ConeExpress in zijn definitieve hoge baan is. Maar dat hoeft geen bezwaar te zijn. Het Franse bedrijf SEP levert dergelijke motoren, gebaseerd op Russische technologie", aldus dr. Jaap de Kam, projectleider bij Fokker Space.

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„We hebben al heel wat missievoorstellen uitgewerkt, bijvoorbeeld een wereldomspannend data-relay systeem gebaseerd op drie ConeExpress satellieten, gelijkelijk verdeeld over de geostationaire baan. Maar ook puur wetenschappelijke satellieten zijn mogelijk."

ConeExpress zal behalve een ionenmotor ook grote zonnepanelen nodig hebben. Maar dat is voor Fokker geen probleem: daarin is het bedrijf gespecialiseerd.

Bij ESA, de Europese ruimtevaartorganisatie, en Arianespace, die de Ariane-raketten verkoopt, is men zeer enthousiast over dit typisch Nederlandse idee, dat extra inkomsten belooft: een spierinkje uitgooien om een kabeljauw te vangen!

19824

CONE-EXPRESS NEEMT EXTRA SATELLIET BIJNA GRATIS MEE

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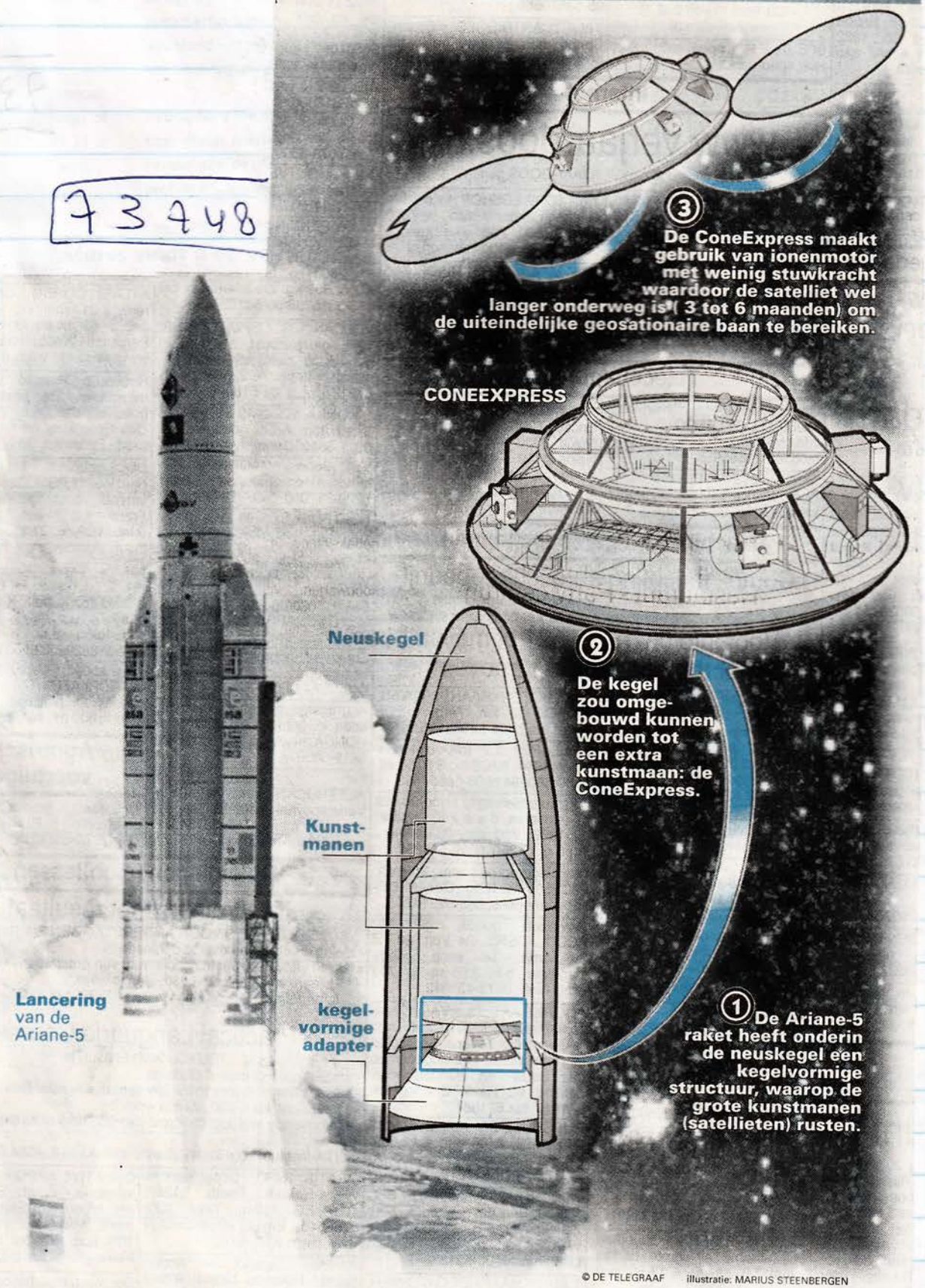

De Ariane-5 raket (links) heeft onderin de neuskegel een kegelvorige structuur, waarop de grote kunstmanen rusten (midden). Die kegel (rechtsonder) zou omgebouwd kunnen worden tot een extra kunstmaan (rechtsboven): de ConeExpress. (Fokker Space).

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Kalk groeit ook in de droogte

Overal waar kalk zich vormt, is vloeibaar water geweest, was tot dusver een onwrikbaar uitgangspunt. Maar een Amsterdamse sterrenkundige zag kalk in de ruimte op plaatsen waar geen water was.

SOMS MOET je een beetje op je tenen durven lopen, ook als promovenda. Ciska Kemper heeft er kennelijk weinig moeite mee. Donderdag 17 januari publiceerde ze een artikel in *Nature* over de vorming van kalk in het heelal. Volgens Kemper heb je daar niet per se vloeibaar water voor nodig, zoals tot nu toe altijd werd aangenomen. De standaardideeën over de rol van water in het zonnestelsel moeten misschien op de schop.

Geochemici zullen de wenkbrauwen wel fronsen, verwacht Kemper. De calciumcarbonaten op aarde – denk aan druipsteengrotten en ketelsteen – ontstaan allemaal onder invloed van water. 'Je ziet het voor je ogen gebeuren', aldus Kemper. 'Andere vormingsmechanismen liggen gewoon niet zo voor de hand, dus wetenschappers hebben zich hier een beetje op blind gestaard.'

De ontdekking van calciumcarbonaten in meteorieten – onder andere in de beroemde Marsmeteoriet ALH84001 – is dan ook altijd beschouwd als een sterke aanwijzing voor de aanwezigheid van vloeibaar water op het object van herkomst. Zo zijn meteorietdeskundigen tot de conclusie gekomen dat twintig miljoen jaar na de vorming van het zonnestelsel al grote hemellichamen waren samengeklonterd waarop vloeibaar water voorkwam. Kemper: 'Er moet nu eerst maar eens goed bekeken worden of die conclusies gerechtvaardigd zijn.'

Drs. Ciska Kemper (26) is sterrenkundige aan de Universiteit van Amsterdam. Komend najaar hoopt ze te promoveren op een onderzoek aan de vorming en evolutie van stofdeeltjes in het heelal. Kosmisch stof kan het best bestudeerd worden op infrarode golflengten. Dat moet dan wel vanuit de ruimte gebeuren, omdat de meeste infrarode straling uit het heelal wordt tegengehouden door de aardse dampkring.

Kemper maakt vooral gebruik van waarnemingen van ISO, het Europese Infrared Space Observatory. ISO deed van eind 1995 tot voorjaar 1998 onderzoek aan de infrarode straling uit het heelal. De infraroodspectra bevatten de unieke 'vingerafdrukken' van de mineralen waaruit het stof is opgebouwd, en door de ISO-metingen te vergelijken met laboratoriumspectra van bekende mineralen, kan de samenstelling van het ruimtestof worden achterhaald.

'Voor mijn promotie-onderzoek was ik op bezoek bij het astrofysisch lab van de universiteit van Jena in Duitsland', vertelt Kemper. 'Toevallig had ik de ISO-waarnemingen van twee nevels in handen gekregen, en in die spectra zat een ongeïdentificeerde bult, waar we aanvankelijk niets van konden maken. De laboratoriummetingen wezen echter uit dat het om carbonaten ging.'

De nevels in kwestie worden door astronomen aangeduid als de Vlindernevel en de Rode Spin-nevel, vanwege hun opmerkelijke vorm. Het zijn gaswolken die uitgestoten zijn door oude, stervende sterren. In de verre toekomst zal ook onze eigen zon op die manier aan haar eind komen.

In de binnendelen van de nevels zijn stofdeeltjes gecondenseerd, en daar werden de carbonaten aangetroffen. Over de aanwezigheid van calciumcarbonaat (calciet, $CaCO_3$) bestaat eigenlijk geen twijfel: de identificatie van calciummagnesiumcarbonaat (dolomiet, $CaMg(CO_3)_2$) is iets minder zeker.

'Deze ISO-waarnemingen zijn al twee jaar lang publiek', zegt Kemper. 'Andere onderzoekers hebben er ook naar gekeken, maar niemand heeft de juiste conclusie getrokken. Men wist gewoon niet wat het was.' Geen wonder als je ervan uit gaat dat die carbonaten alleen in planetenstelsels kunnen ontstaan onder invloed van vloeibaar water. Blijkbaar moet je de onbevangen houding van een promovendus hebben om onverwachte ontdekkingen te doen.

Zouden de carbonaten niet ontstaan kunnen zijn op grotere hemellichamen die in de stofwolken rond de stervende sterren zijn samengeklonterd? Onmogelijk, aldus Kemper. De nevels zijn hooguit een paar duizend jaar oud, en in zo'n korte periode kunnen zich geen grote objecten, zoals planeten, vormen, waarop vloeibaar water kan voorkomen. Ook kunnen de carbonaten niet afkomstig zijn van planeten die mogelijk ooit rond de ster hebben gedraaid; de totale hoeveelheid kalk bedraagt minstens dertig aardmassa's – veel te veel om uit een planetenstelsel afkomstig te kunnen zijn.

De conclusie is onvermijdelijk: kennelijk bestaan er ook 'droge' manieren om kalk te maken. Hoe dat dan precies in zijn werk gaat, is echter niet bekend. In het Nature-artikel beschrijven Kemper en haar collega's uit Nederland, Duitsland, België, de Verenigde Staten en Groot-Brittannië drie mogelijke ontstaanswijzen, maar alledrie hebben ze zo hun haken en ogen.

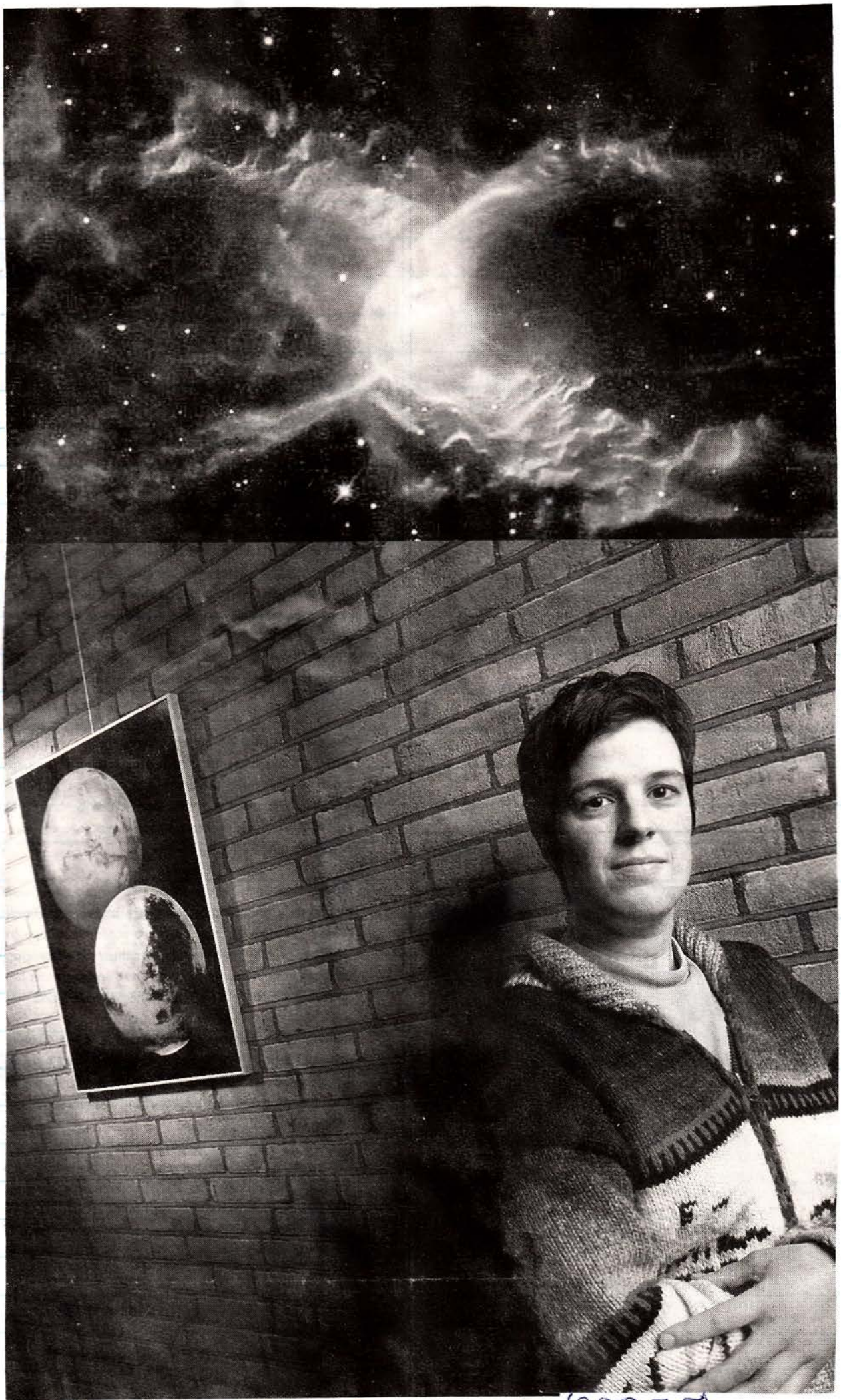
De eerste mogelijkheid is dat de kalkverbindingen ontstaan aan het oppervlak van stofdeeltjes die met een heel dun laagje ijs zijn bedekt. Waterijs- en koolzuurijsmoleculen zouden misschien verbindingen kunnen aangaan met calcium- en magnesiumionen in de stofdeeltjes. Het probleem is echter dat koolzuurijs bij een temperatuur van 120 graden onder nul al verdampt, en waterijsmoleculen bij zo'n lage temperatuur onvoldoende mobiliteit vertonen.

De tweede theorie is dat er chemische reacties plaatsvinden met water en koolzuur in de gasfase. Dan zouden er echter eerst gehydreerde silicaten moeten ontstaan, en daarvan blijkt niets in de ISO-spectra. Bovendien is niet bekend of dit proces wel kan optreden onder de omstandigheden die in deze nevels heersen.

De derde optie is dat de carbonaten direct condenseren uit een gaswolk die grote hoeveelheden koolzuur en magnesium- of calciumoxide bevat. 'Dat is in een laboratorium nog nooit onderzocht', zegt Kemper. Maar als er ook silicaten en metalen condenseren, zie ik niet in waarom er niet ook direct carbonaten gevormd kunnen worden.'

Hoe het ook zij, uit de ISO-waarnemingen blijkt zonneklaar dat je voor de vorming van carbonaten niet per se vloeibaar water nodig hebt. 'Natuurlijk gaat nu niet opeens alles op de helling', aldus Kemper. 'De kalkverbindingen op aarde zijn vrijwel allemaal onder invloed van water ontstaan: daar zijn vaak directe bewijzen voor. Maar of dat ook geldt voor calciumcarbonaten in meteorieten, moet nog maar blijken.'

Nu er in twee nevels kalk is gevonden, zal er ongetwijfeld ook in andere objecten naar worden gezocht. 'Het is zeker interessant om deze stoffen ook in andere fasen te bekijken', zegt Kemper. 'Maar het gaat om een relatief zwak signaal, en modelberekeningen van jongere sterren, die nog massa aan het verliezen zijn, wijzen uit dat de spectrale signatuur van de carbonaten daar gewoon niet te zien is.'



Drs. Ciska Kemper. Boven: de Rode Spin-nevel, waarin kalk is aangetoond.

(73755)

19827

Chandra Probes Stellar Violence

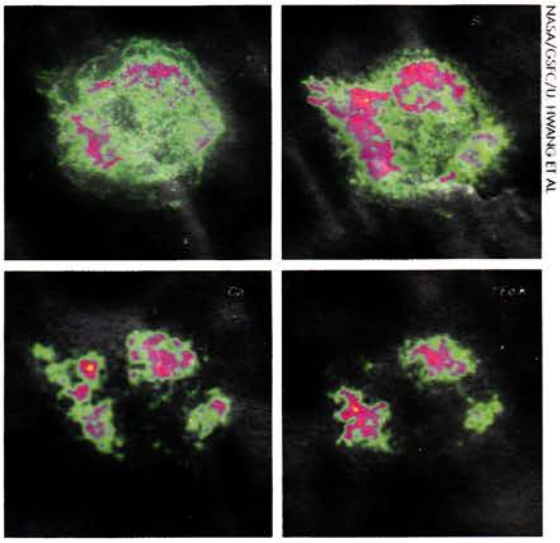
FRANK MORRING, JR./WASHINGTON

Astronomers are using NASA's Chandra X-Ray Observatory to investigate some of the most violent events in the cosmos, ranging from the explosive death of stars to eruptions at the center of galactic clusters that send out "bubbles" the size of the Milky Way galaxy that Chandra's instruments can resolve.

Since its launch on board the space shuttle Columbia in July 1999, Chandra has given scientists their best view yet of the X-ray universe, which pinpoints the high-temperature events that radiate in the X-ray portion of the electromagnetic spectrum. Papers presented at the recent American Astronomical Society (AAS) meeting here gave an overview of some of the results coming in.

One finding relates to the structure of galactic clusters, which are the largest objects in the universe. Measuring some 10 million light years across and composed of hundreds of galaxies, galactic clusters are extremely stable over time, but scientists aren't certain why that is so. Using Chandra, astronomer Brian McNamara of Ohio University has found evidence that suggests magnetism may rival gravity in shaping the structure of the clusters.

Clusters were among Chandra's first targets, and in the 100-millionC gas that Chandra "sees," huge bubbles were visible moving away from the supermassive black holes at the clusters' centers. In most cases, those holes contained radio emissions that were probably created by an explosion of high-energy particles. But in the galaxy Cluster designated Abell 2597, about 1 billion light years from Earth, McNamara found only faint radio emissions emanating from the bubbles as they rose through the cluster like carbon dioxide in a can of soda.



NASA/CSC/U. HWANG ET AL

X-ray spectroscopy allows the Chandra telescope to pinpoint elements in the ejecta from the Cassiopeia A supernova. The broadband image at top left is broken down into silicon (top right), calcium (bottom left) and iron.

"WE HAVE A GOOD IDEA that these radio sources last for a few million years, and we were able to compute . . . that it would take about 100 million years for them to rise out here, to the outer part of the galaxy cluster," McNamara said, indicating the "ghost cavity" on an image of Abell 2597. "So we inferred that they were probably created by a radio event that occurred about 100 million years ago, and that they rose outward like bubbles rising inside a Coke bottle."

Those bubbles are created continuously as more matter falls into the black hole and is sprayed back out with enormous explosive force, McNamara said. The magnetic energy contained in the bubbles may account for the magnetic structure associated with galactic clusters, which has been known but not understood for some 20 years.

"We believe that they probably erupt between 10 and 100 times during the lifetime of the cluster, and the amount of magnetic energy that they diffuse in the intracluster medium would be just about enough to explain the large magnetic field strengths that we see in the centers of clusters," he said. "This is very important in these clusters because it is one of the few environments in the universe where the forces due to magnetism compete with the forces that are due to gravity. We think now that magnetism has a lot to do with the structure that we see in this 100-millionC gas that Chandra observes."

THE ERUPTIONS THAT PRODUCE the giant bubbles rising from the centers of galactic clusters carry energy equivalent to about 1 million supernovae, or exploding stars. Chandra has also been able to shed new light on what happens when a star explodes, producing the first images of different elements being cast off as a star's core rips apart and blasts its outer layers deep into the surrounding space in a flare that sometimes can be seen with the unaided eye on Earth.

Chandra's strength is that it is able to analyze the X-rays from those enormously hot remnants spectroscopically, allowing astronomers to determine just what elements are producing the X-ray emissions. In an AAS lecture, Una Hwang of the University of Maryland presented views of the supernova Cassiopeia A showing images of silicon, calcium and iron blown out by the exploding star, as well as an overall X-ray image of the blast.

"At every point on this image, you're able to extract a spectrum," Hwang said.

By analyzing the shapes of the remnant clouds produced by the different elements, scientists are able to make inferences about the explosion that caused them. For example, the shape of the image for iron—the heaviest element measured—suggests that the stellar layers were overturned by the explosion or the events leading up to it.

Chandra carries four sets of mirrors carefully shaped so the high-energy X-rays entering them will ricochet toward the focal point as they strike them at a grazing angle, rather than go straight through as they would a conventional light-collecting mirror. At the focal plane, a high-resolution camera provides images of the X-ray sources, while the Advanced CCD Imaging Spectrometer (ACIS) gives a medium-resolution reading of the energy from each X-ray. Hwang and her colleagues used ACIS to produce the element images from Cassiopeia A.

Behind the mirrors are two different spectrometers able to produce high-resolution spectroscopy with hundreds of gold transmission gratings that diffract the X-rays before sending them on to the focal-plane instruments. One of the high-resolution spectrometers handles high-energy X-rays, while the other diffracts relatively low-energy X-rays. When in use, the high-resolution spectrometers are flipped into the path of the X-rays as they leave the mirrors.

Chandra is controlled from an operations center in Cambridge, Mass., where preplanned observation sequences are assembled based on peer-reviewed proposals from astronomers and uplinked to the telescope. Data collected are stored on board and dumped every 8 hr. through NASA's Deep Space Network.

Simple Fixes Put Ariane 5 Back on Pad

73757

MICHAEL A. TAVERNA/PARIS

Straightforward changes to ignition software and cleaning procedures are expected to allow the Ariane 5, sidelined since a launch failure last summer, to return to operational service on Feb. 28.

The Flight 142 failure, which led to the loss of Japan's BSAT-2b telecommunications satellite and compromised the European Space Agency's Artemis technology mission, was attributed to a malfunction in the upper-stage Aestus engine that caused it to shut down prematurely (*AW&ST* July 23, 2001, p. 38).

A report issued in early August traced the malfunction to a high-frequency instability condition during ignition, and recommended that engineers undertake more detailed digital modeling and extensive testing to ensure "softer" ignition (*AW&ST* Aug. 13, 2001, p. 32).

The test campaign was performed in mid-November and mid-December by Astrium, the Aestus prime contractor, at a German aerospace center DLR vacuum test facility in Lampoldshausen, Germany. The test rig had to be extensively modified for the purpose because the existing facility, for safety reasons, was not representative of altitude conditions. This was the primary reason the anomaly had heretofore gone undetected.

RIG RECONSTRUCTION and validation, completed in October, pushed back the Ariane 5's return to service from November, as had initially been planned, to early this year (*AW&ST* Nov. 5, p. 63, 2001; Jan. 14, p. 411).

A powerplant incident that knocked out the main vacuum pump slowed but did not seriously impede the effort, company executives said, because a priming pump, sufficient to ensure vacuum conditions during ignition, remained available.

Eighty-five altitude test firings and 151 ignition sequences were performed on the modified rig, using an Arta 3 powerplant that serves ESA's Arta technology-improvement-and-verification program.

Another 66 test firings were carried out on an Arta 3 engine under simulated altitude conditions but using a nonrepresentative fuel line configuration. A further 66 test firings were run on an Arta 2 powerplant under ground conditions, measuring the effect of differing monomethyl-hydrazine (MMH) flowrates, pressure and other parameters. Test conditions included excursions to the edge of the flight envelope.

The test campaign, combined with extensive digital modeling and other analyses, led to the following conclusions, Arianespace Executive Vice President Jean-Yves Le Gall said here last week:

- Under nominal operating conditions, the Aestus engine is stable in both steady-state and transient regimes.
- Backflow in the MMH or nitrogen tetroxide (N_2O_4) oxidizer lines ahead of the injector can lead to flow, pressure and temperature transients downstream.
- Under transient conditions, the engine is sensitive to abnormal, i.e., up to 40% above nominal, MMH flowrates.
- The presence of water in the MMH fuel lines feeding the combustion chamber—perhaps left over from hydraulic acceptance tests—can cause high-frequency instability during the ignition transient, or the first few milliseconds thereafter.

It was determined that the most likely scenario for the Flight 142 failure was "the presence of water in MMH lines, triggering HF instability on ignition, exacerbated by a low-pressure drop in the injector."

Le Gall acknowledged that replication was not perfect because it was impossible to simulate the engine degradation that had occurred as a result of the malfunction. However, he said it was "of the same nature," and, in any case, sufficient to base suitable modifications on.

The remedies devised are simple and involve no modifications to flight hardware, he indicated. One involves adopting cryogenic drying techniques, instead of the vacuum oven drying methods currently used. Introduction of the new techniques, already used for the HM7B upper-stage LOX/H2 engine on the Ariane 4, requires only a procedural change, and will not appreciably affect launch preparation time, he said.

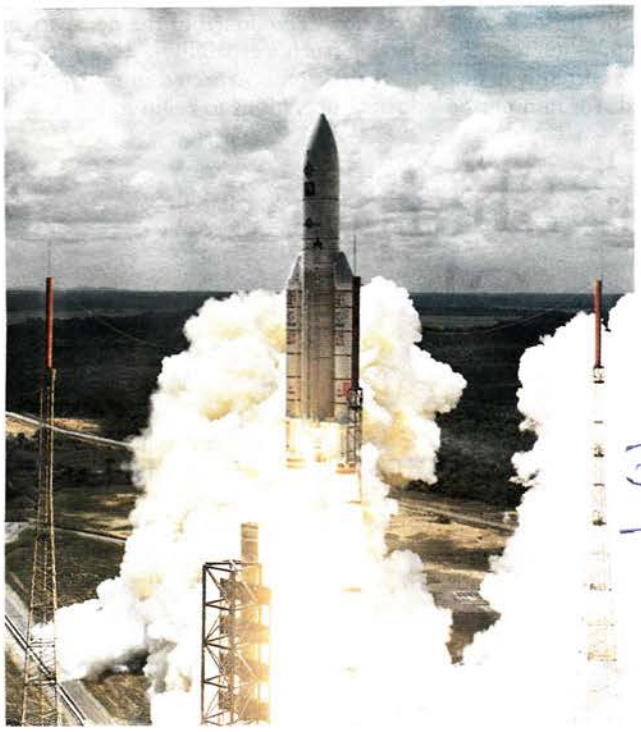
THE OTHER FIX WILL entail introducing a helium flush in the MMH lines leading to the combustion chamber prior to the beginning of fuel flow, and modifying the time period between opening of main valves. A helium line already exists to purge the lines before ignition, so only software changes will be involved, according to Le Gall.

These modifications were jointly approved by Arianespace, ESA and French space agency CNES early this month.

The engine for the next flight, due to orbit ESA's Envisat Earth-observing satellite, was installed on the bench in Lampoldshausen on Jan. 7. It will be subjected to 10 simulated altitude test firings under both nominal and degraded conditions, based on parameters identified in the Arta engine test campaign.

The engine is to be delivered to Astrium's Bremen, Germany, facility for mounting in the upper stage at the end of this week. The stage is to be shipped to Kourou for final integration later in the month.

In parallel, two test campaigns will be run on a pair of Arta 4 and Arta 5 engines to qualify the modification package. Each campaign will comprise 30 simulated altitude firings. Final qualification, based on test results, modeling and other analysis, is expected in mid-February.



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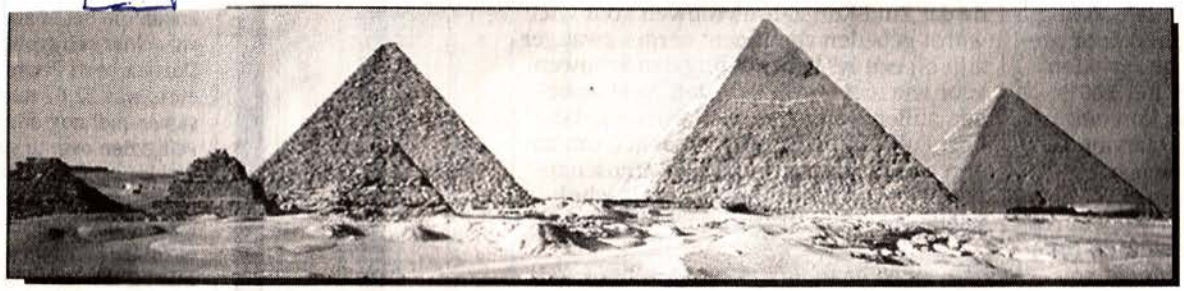
STERRENKIJKEN

ORION IN STEEN



De piramiden van Gizeh. *foto CMCC*

Vormen de piramiden van Gizeh in Egypte een getrouwe afspiegeling van het sterrenbeeld Orion? Volgens Robert Bauval hebben de oude Egyptenaren met hun indrukwekkende monumenten een stuk van de sterrenhemel afgebeeld. Het zoveelste hersenspinsel van een zweverige piramidefanaat of een serieus te nemen theorie? De egyptologen hebben zo hun bedenkingen.

Robert Bauval heeft niet zoveel op met egyptologen. Ze hebben geen benul van astronomie en bouwkunde, aldus de van oorsprong Belgische bouwkundig ingenieur, en sluiten hun ogen voor nieuwe, baanbrekende theorieën. Die vind je in zijn boek *The Orion Mystery* uit 1994, dat vele malen als basis diende voor documentaires over de geheimen van het oude Egypte. Op Discovery Channel zijn ze nog steeds met de regelmaat van de klok te zien. Op het eerste gezicht is de theorie nog niet zo gek. Orion vinden we op heldere januariavonden in het zuiden. Meteen vallen de drie gordelsterren op die net als de beroemde piramiden mooi op een rijtje staan. Wie goed kijkt ziet dat de ster rechtsboven iets zwakker is dan de overige twee en ook een beetje van de rechte lijn afwijkt. Dat komt mooi overeen met de afwijkende positie van de kleinste van de drie piramiden. Ook de rivier de Nijl, links van Gizeh, heeft zijn tegenhanger aan de hemel. Op dezelfde plaats ten opzichte van de gordel van Orion strekt zich namelijk de zwak oplichtende band van de Melkweg uit. Bauval gaat nog verder. Andere piramiden die net als die van Gizeh dateren uit ca. 2500 voor Christus, corresponderen met de posities van andere sterren in Orion en het naburige sterrenbeeld Stier. De piramide van Cheops, de grootste van de drie, heeft vier smalle schachten die van kamers binnenin de piramide naar buiten lopen. Twee van deze schachten waren ten tijde van de bouw precies gericht op de heldere ster Sirius en een van de gordelsterren van Orion. Voor de oude Egyptenaren stond Orion symbool voor de god Osiris. Zijn vrouw Isis werd aan de hemel vertegenwoordigd door Sirius. Volgens Bauval waren de 'luchtschachten' in werkelijkheid een soort pijplijnen waardoor de ziel van de overleden farao terugkeerde naar de sterren. Zijn meest opzienbarende conclusie is dat de piramiden van Gizeh niet de huidige sterrenhemel afbeelden, maar die van 10.500 voor Christus!

Momenteel hebben de Nijl en de piramiden niet dezelfde oriëntatie ten opzichte van de gordelsterren van Orion en de Melkweg. Maar dat is niet altijd zo geweest. Oorzaak is de precessie van onze planeet. Net als een tol schommelt de aardas met een periode van 26.000 jaar heen en weer, waardoor de stand van de sterren langzaam verandert. Honderd eeuwen voor Christus kwam de richting van de piramiden wel overeen met die van de gordel van Orion. Als Bauval gelijk heeft, zijn de piramiden gebouwd volgens een bouwplan dat al achtduizend jaar oud was. Volgens hem bestond toen een tot dusverre onbekende beschaving in Egypte, waarvan de sfinx een tastbaar overblijfsel zou zijn.
De egyptologen zijn niet onder de indruk. Voor het oog is de gelijkenis tussen de gordel van Orion en de piramiden treffend, maar dat zegt niet zo veel. Uit overgeleverde inscripties blijkt nergens dat de Egyptenaren het ook zo zagen. Als je het goed gaat onderzoeken, is de overeenstemming tussen de piramiden en de gordelsterren op zijn best matig te noemen. Zo is het verschil in afmetingen tussen de piramiden veel groter dan het helderheidsverschil tussen de sterren. En de afwijking van de rechte lijn van de drie piramides blijkt veel kleiner te zijn dan die bij de gordelsterren van Orion. Als je bovendien de kleinere piramides naast de drie grote meetelt, is er van een overeenkomst met Orion al helemaal niks meer te bespeuren. Ook de piramiden in de omgeving van Gizeh wijken behoorlijk af van de posities v de overige sterren van Orion de Stier. Verder valt ook de nauwkeurigheid waarmee d schachten van de piramide van Cheops in de richting van sommige sterren wijzen, bij nader inzien nogal tegen. Aanwijzingen dat de piramidebouwers op de hoogte waren van de precessiebeweging van de aarde ontbreken eveneens. En als ze die kennis wel hadden, hoe kon de herinnering daaraan tachtig eeuwen lang levend blijven, de eerste 7500 jaar zonder schrift? Hoe baanbrekend een theorie ook lijkt, soms is het oordeel van de wetenschap hard.

New Company Markets Services For Delta, Sea Launch Programs

BRUCE A. SMITH/LOS ANGELES

Boeing has taken a page from Lockheed Martin's book with the establishment of Boeing Launch Services (BLS), a wholly owned subsidiary which appears to mirror the operations of competitor International Launch Services (ILS).

Both ILS and BLS offer a new family of U.S. expendable launch vehicles as well as boosters with origins in the former Soviet Union. But while BLS focuses only on sales and marketing, ILS responsibilities include the management of launch services as well as sales functions.

BOEING AND SEA LAUNCH announced formation of BLS in September, with Will Trafton, former president and general manager of Sea Launch, named president. Sea Launch operates a Zenit-3SL booster from a floating platform positioned at the equator for launch.

While the BLS sales team now markets the Delta family of boosters and Sea Launch, the Delta and Sea Launch programs continue to operate as separate organizations.

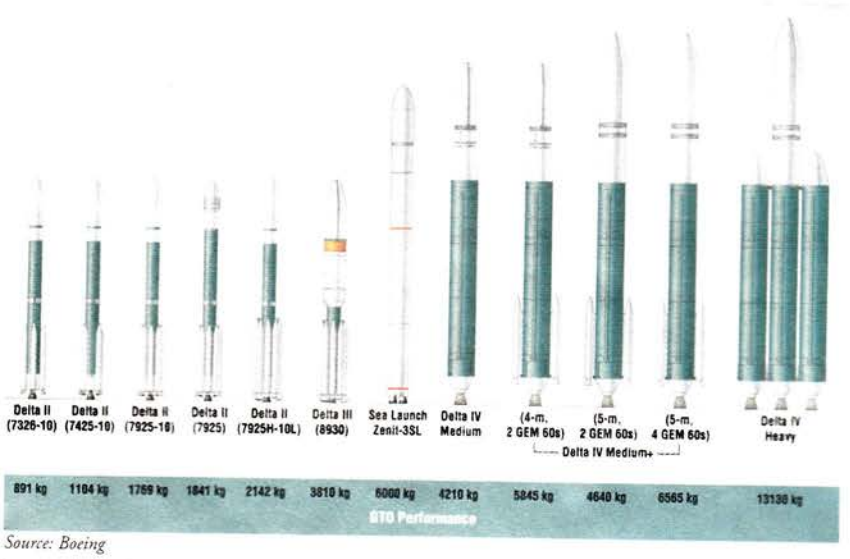
"We have marketing and sales people as well as customer relations, customer engineering and a business side," Trafton said of BLS, "but once it comes time to execute a contract, we hand off the contract to either Sea Launch or Delta, and they execute. There are no programs in BLS."

Boeing is a 40% partner in Sea Launch, while RSC-Energia has a 25% share, Kvaerner has a 20% share, and SDO Yuzhnoye/PO Yuzhmash has a 15% stake.

Jim Albaugh, president and CEO of Boeing Space and Communications, said Boeing has contracts with the other Sea Launch partners to provide launch services. "If you look at those contractual relationships we have, I think we've taken the joint marketing and sales about as far as we can and still preserve the foundation documents that were put together 6-7 years ago.

"I wanted to create BLS for the last couple years because I felt jointly marketing the two, rather than have the two compete with each other, was in the best interests of both Sea Launch and Delta," Albaugh said. "It just took awhile to get everybody comfortable" with the idea, he added.

Trafton formerly served as president of ILS, a joint venture of Lockheed Martin, Khrunichev and RSC Energia established in 1995—following the merger of Lockheed and Martin Marietta—to market Atlas and Proton boosters.



Source: Boeing

The Sea Launch Zenit-3SL booster and the Delta family of launchers have been combined for sales purposes with the establishment of Boeing Launch Services.

Lockheed had been offering the Proton booster through its Lockheed Khrunichev Energia International joint venture, while Martin Marietta was marketing Atlas after its purchase of General Dynamics Space Systems Div. and its Commercial Launch Services subsidiary. Now both within the ILS structure, the organizations serve as the contracting entities for executing Proton and Atlas launch contracts.

THE ESTABLISHMENT of BLS followed consolidation of the Delta II, III and IV programs by Boeing into a single organization last January, which in turn followed consolidation of production activities for the three programs in facilities at Decatur, Ala., and Pueblo, Colo.

A top priority for BLS is to increase its launch services market share by providing potential customers with a broader range of products—the Zenit-3SL and the Delta launch vehicles—through a single point of contact. The new organization is also intended to strengthen the previous backup arrangement between the as-yet unlaunched Delta IV family, with its all-new first stage, and the Sea Launch system, which has successfully completed five of six commercial satellite launch attempts.

"The bottom line, of course, is that we at BLS are going to go after increasing our market share," Trafton said. "We are very confident we can do that. The Sea Launch Zenit-3SL and Delta IV complement each other very nicely, and we have a Delta IV Heavy which our competition does not have."

All BLS sales personnel will represent Delta and Sea Launch, and there will be coordination between Delta and Sea Launch regarding future development activities. But Boeing officials said pricing and key technical data from one organization will be "fire walled" from the other.

The establishment of Boeing Launch Services will also provide for more efficient business development planning for the two launch programs, they added.

ILS acquires launch assets through its suppliers, Lockheed Martin and Khrunichev, and resells the services to customers. The organization has integrated account teams, which handle marketing, contracting, mission management, launch operations and regulatory issues for customers, whether they are signed up for Atlas or Proton missions.

"We were flattered when [Boeing] came out with Boeing Launch Services," according to Jim Rymarcsuk, ILS vice pres-

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ident for business development. "A lot of it was drawn to emulate what we have done at ILS."

Rymarcsuk said ILS has crafted a business proposition over time that the organization's customers appreciate. "We have been doing it for six years, and they have been doing it for a couple of months—heading in the same direction, but our goal is to stay ahead of them," he added.

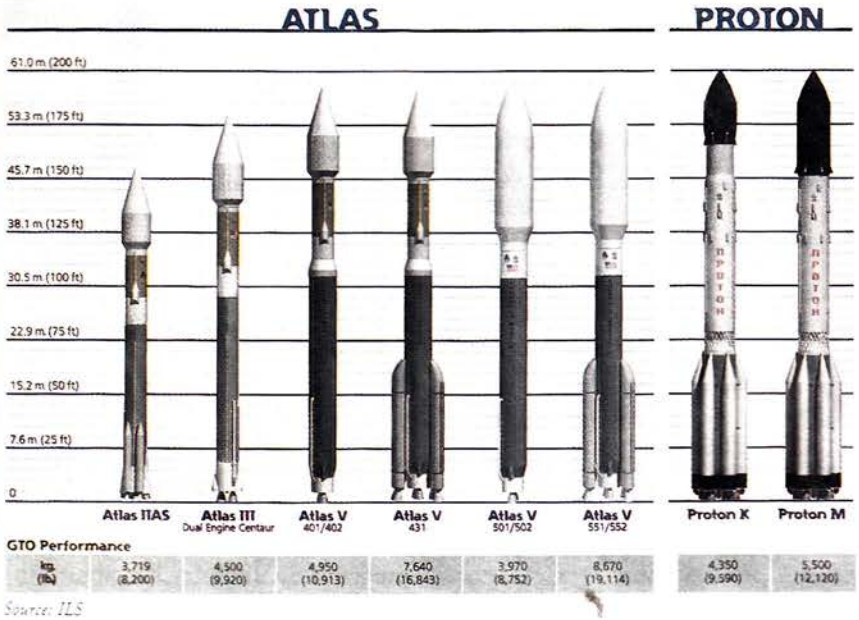
ILS has a firm order backlog of just under 40 launches with a value of about $3 billion in both commercial and U.S. government launches. About three-fourths of those launches are for commercial customers, and the commercial launches are roughly evenly split between Atlas and Proton boosters. The figure does not include seven designated Atlas V government launches.

Boeing U.S. government launches are handled through a separate organization within the company, also under Trafton, rather than through BLS.

ILS has conducted four Atlas and two Proton launches this year, a figure which would have been higher without satellite manufacturing delays. But even in a relatively slow year for ILS, Proton had an additional five Russian federal launches this year. Last year, Proton flew 14 times, including six missions for ILS.

ILS believes such a high flight rate is an important factor in preserving the opportunity to back up missions between the two programs.

James G. Maser, president and general manager of Sea Launch, said the niche for Zenit-3SL is in the 4,000-6,000-kg. (8,800-13,200-lb.) geosynchronous transfer orbit (GTO) market. The joint venture has plans in place to increase GTO capability of the system to the 6,000-kg. level by the end of 2002 through weight reduction and other system refinements. "Our plan is to be extremely competitive in the 4,500-6,000-kg. market," Maser said.



Atlas and Proton launchers team under the International Launch Services banner. A planned Angara booster series could achieve GTO capability by 2005.

Maser said Sea Launch has had only two launches this year due to slips in satellite delivery dates, although the lull is expected to end next year with an initial mission in the spring and four possible additional launches during the remainder of the year. Sea Launch anticipates 5-7 launches during 2003.

BOEING HAS primarily been a niche player in the launch services business with its Delta II booster. With introduction of the Delta IV, the company expects to significantly increase its market share, although it faces the challenge of a relatively flat market and stiff launch service competition.

The company continues to work on the lower end of its market, with refinements to the Delta II, due in part to development work conducted for the Delta III program.

Dan Collins, Boeing program manager for Delta launch vehicles, said the company plans to introduce a new Delta II variant, the Delta II Heavy, next year. The new model is essentially a Delta II with larger Delta III solid rocket motors for a 10-15% improvement in performance.

Initial launch for the derivative will be the Space Infrared Telescope Facility (SIRTF) mission for NASA, Collins said.

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CITIZENS IN SPACE

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Educator-in-space Barbara Morgan will probably get a flight assignment before the end of the year, according to NASA Administrator Sean O'Keefe, who saw his "vision" for the agency overshadowed by his announcement that the late Christa McAuliffe's backup was finally going into orbit. Morgan will be followed by other citizen-astronauts, O'Keefe says, but they'll have to contribute something to the mission and not just be tourists. For her part, Morgan says her first priority is just that, with her lesson plan growing out of the objectives for the mission to which she is assigned. It isn't clear whether O'Keefe intends to reactivate the journalist-in-space program that was shut down after the Challenger disaster. "For journalists, I have a very special program," O'Keefe joked. "The flight out is on me, and we'll negotiate the return."

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MENSEN IN DE RUIMTE

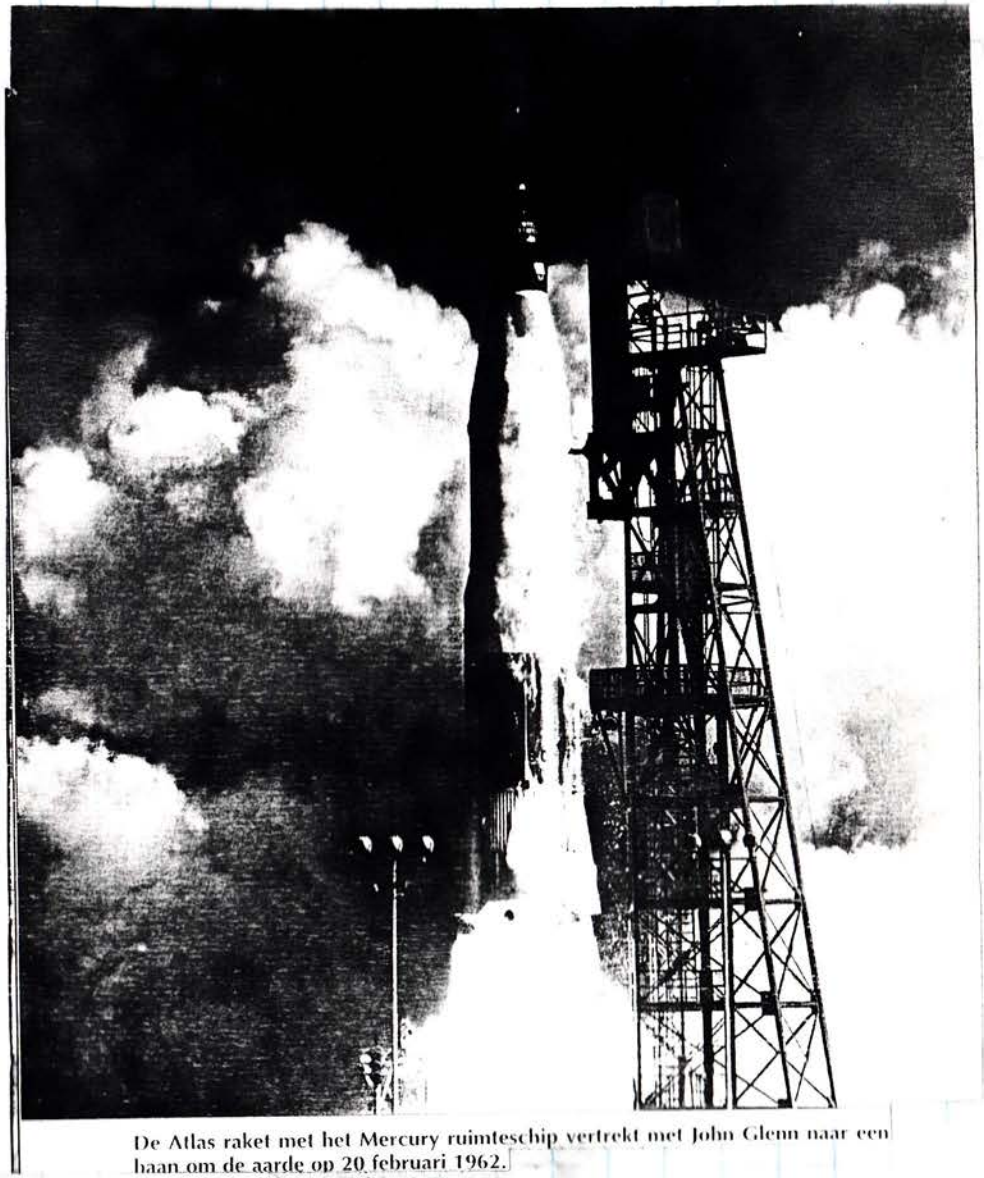
Einde Mir, ISS komt op gang

Op het eerste gezicht gaat het goed met het International Space Station. Shuttles en Russische ruimteschepen vliegen af en aan en technisch gesproken loopt alles voorspoedig. Maar niet alles is koek en ei. Het ruimtestation wordt veel duurder dan begroot en daarom zijn bezuinigingen aan de orde van de dag. Een kleine shuttle, die als reddingsboot zou moeten fungeren, is wegbezuinigd. Daarom zullen voor dit doel Russische Sojoezi gebruikt blijven worden. Maar veel erger is dat een Amerikaanse woonmodule voor drie tot vier personen niet doorgaat. De enige woonmodule blijft de Russische Zvjezda en daarom kunnen er niet meer dan drie mensen in het ruimtestation wonen.

Het ISS dreigt een puur Amerikaans- Russische show te worden en de Europeanen, Canadezen en Japanners, die ook aan het project deelnemen, staan voorlopig aan de zijlijn. Ten einde raad heeft de Europese ESA vijf vluchten bij de Russen gereserveerd, waarbij een Europese astronaut de plaats van een Rus mag innemen - tegen betaling natuurlijk.

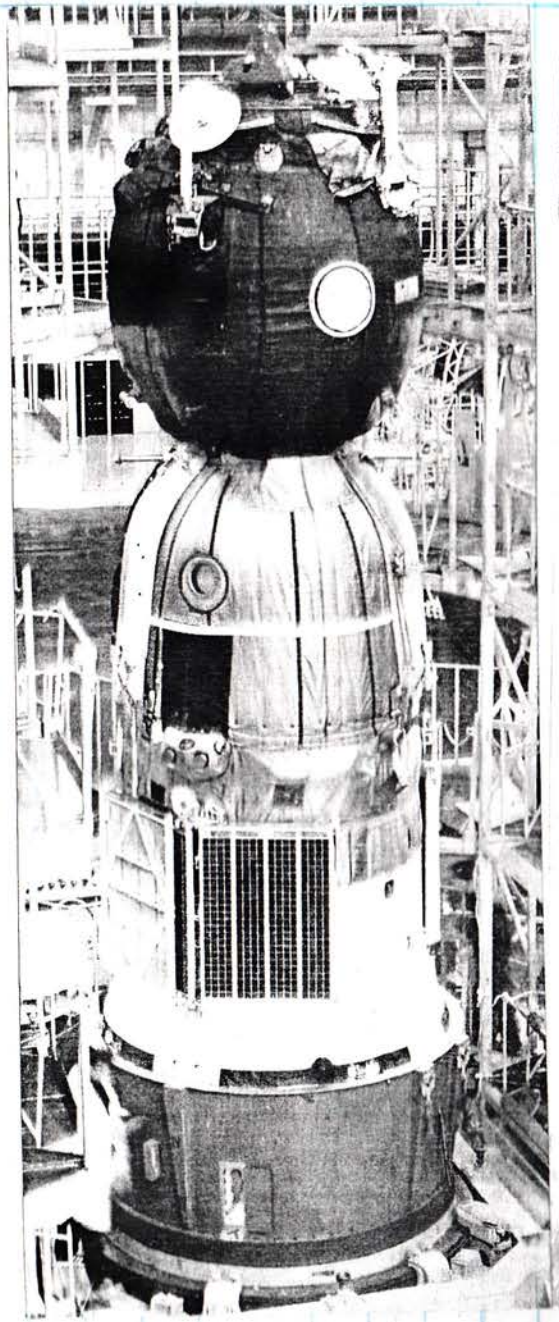
Op 12 juli 2000 werd een goed begin gemaakt met het bewoonbaar maken van het nieuwe ISS, dat tot dan toe nog maar uit twee modules bestond: "Zarja" (Dageraad) en "Unity" (Eenheid). Die dag ging - op een krachtige Proton K raket vanaf de basis Baikonoer - de module "Zvejzda" omhoog, sterk lijkend op de centrale leefmodule van de oude Mir. De module, bijna

Dit jaar is het veertig jaar geleden dat de eerste Amerikaan in de voetsporen van Joeri Gagarin trad: John Glenn beschreef op 20 februari 1962 drie banen om de aarde in het ruimteschip "Fiendship-7". (Foto NASA)

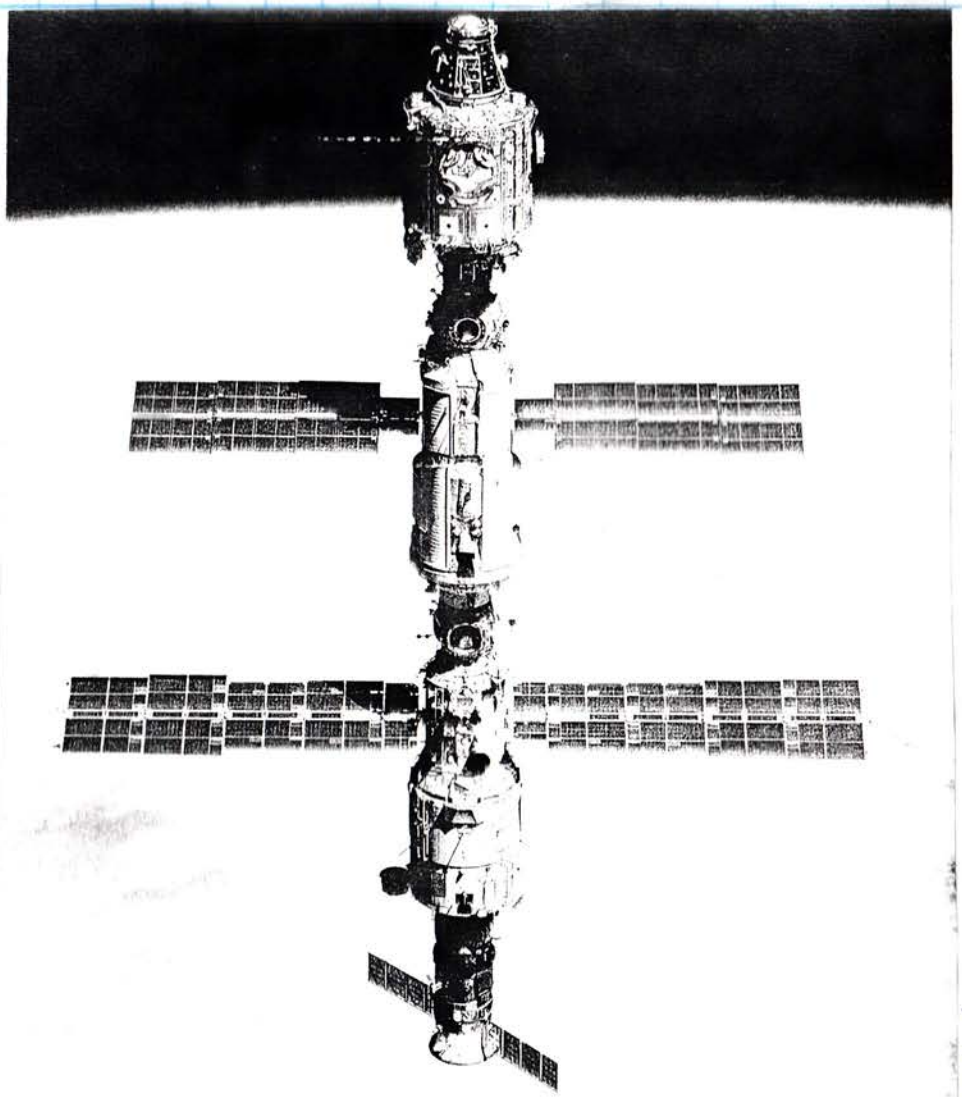


De Atlas raket met het Mercury ruimteschip vertrekt met John Glenn naar een baan om de aarde op 20 februari 1962.

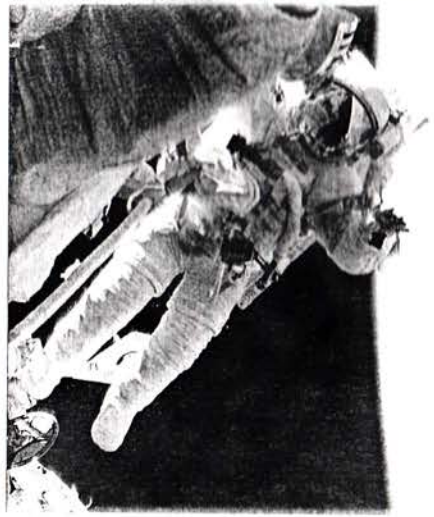
twintig ton zwaar, maakte na een reeks gecompliceerde manoeuvres, op 28 juli vast aan de achterkant van Zarja, de "hoeksteen" van het ISS.
Op 6 augustus vertrok het eerste vrachtschip naar het ruimtestation, Progress-M1 3. Aan boord daarvan waren brandstof, water, zuurstof, instrumenten en andere voorraden voor de eerste bemanning van de internationale ruimtebasis.
Die voorraden werden uitgeladen en op hun plaats gebracht door de astronauten van het ruimtevliegtuig Atlantis, die op 8 september in het kader van missie STS-106 naar het ISS vlogen. Aan boord van de Atlantis waren commandant Terence Wilcutt, piloot Scott Altman, Edward Lu, Richard Mastracchio, Daniel Burbank, Joeri Malentsjenko en Boris Moroekov.
De kwartiermakers kweten zich uitstekend van hun taak en de Atlantis keerde terug op 20 september.



Op de ruimtebasis Baikonoer wordt een Sojoez klaargemaakt voor de vlucht naar het ISS. (Foto Anatoli Dimitrovitsj Pavlov)

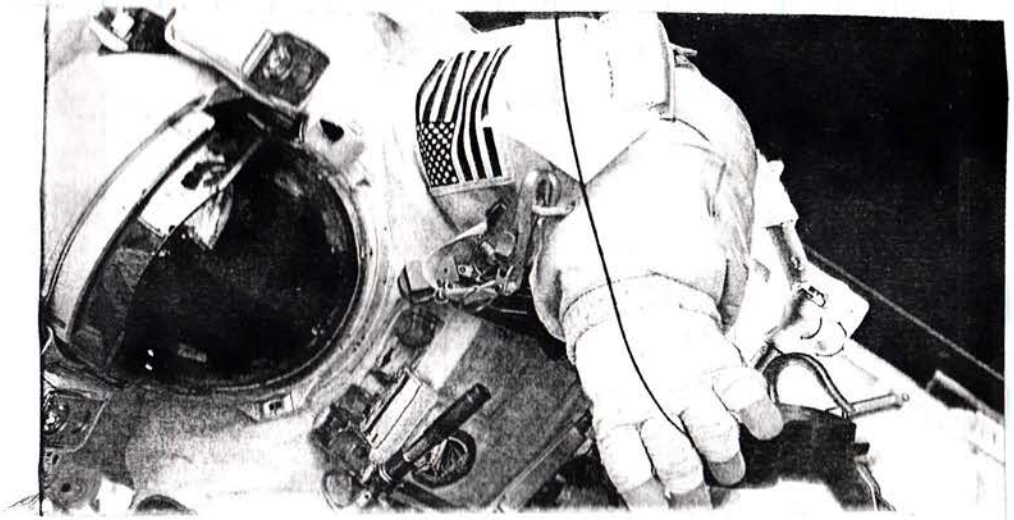


Het nog onbemande ISS in september 2000, gefotografeerd vanuit de space shuttle Atlantis. Van boven naar beneden: Unity, Zarja, Zvjezda en het Progress-M1 3 vrachtschip. (Foto ESA)



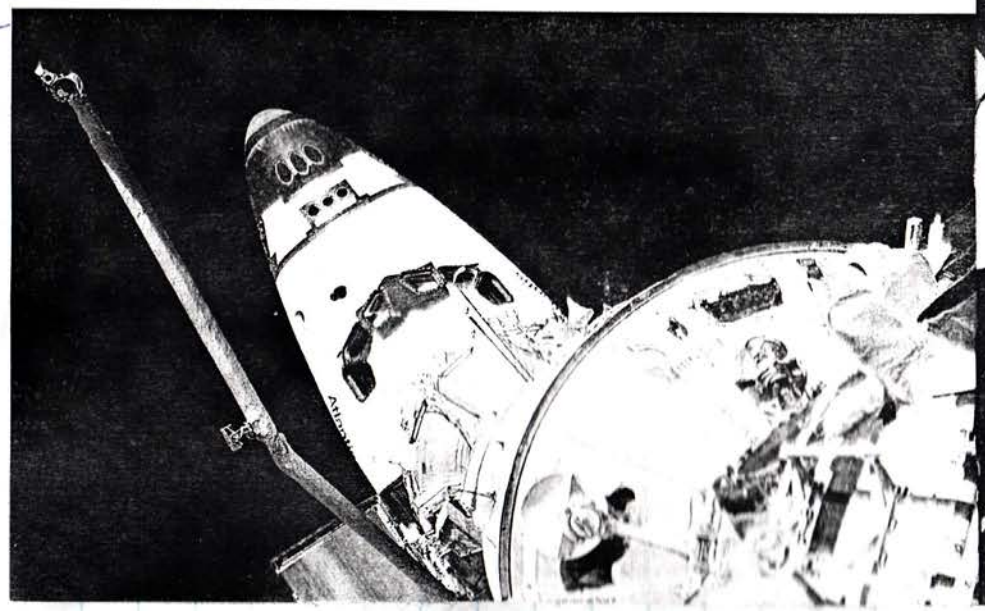
Links: De Russische kosmonaut Joeri Malentsjenko gedurende STS-106 aan het werk in de Amerikaanse Unity module. Rechts: Joeri Malentsjenko tijdens zijn zes uur durende ruimtewandeling gefotografeerd door astronaut Edward T. Lu. (Foto's NASA)

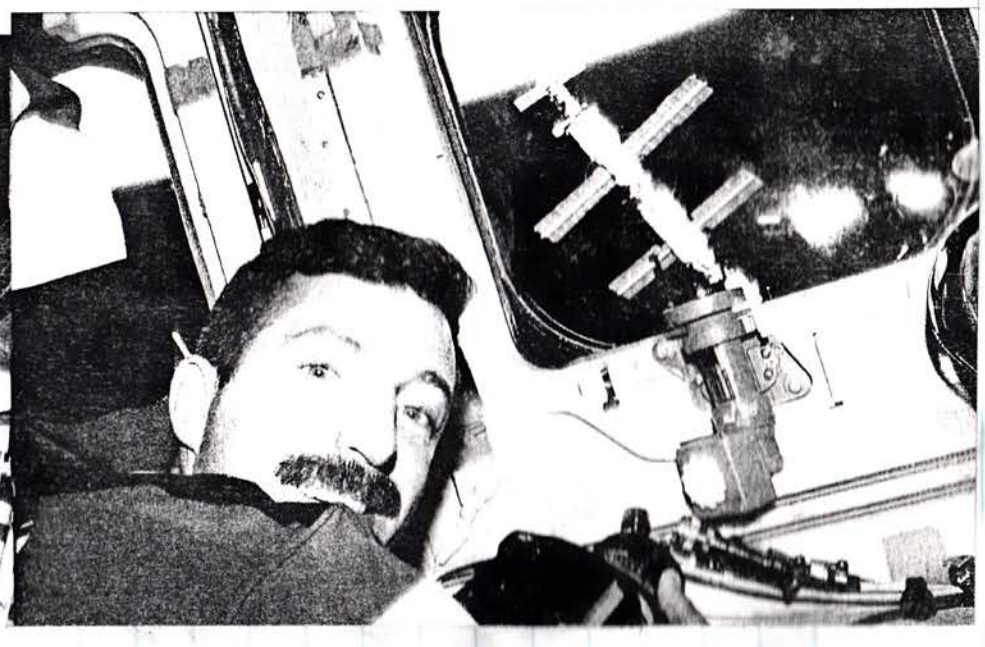
Gedurende hun ruimtewandeling fotografeerden de ruimtevaarders de Atlantis, gekoppeld aan het ISS. De manipulator van Atlantis, Canadarm-1, is duidelijk te zien. (Foto NASA)

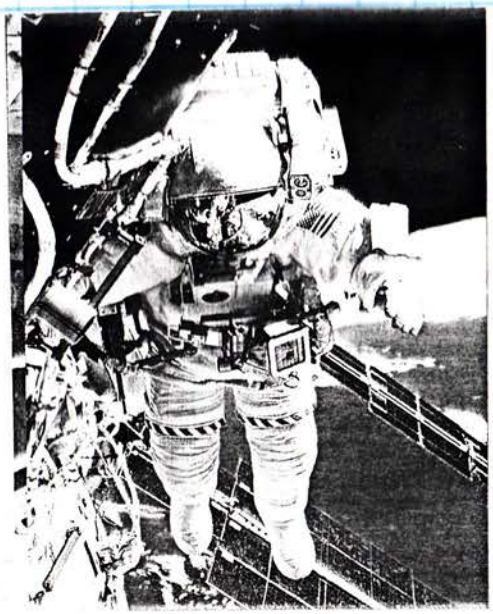


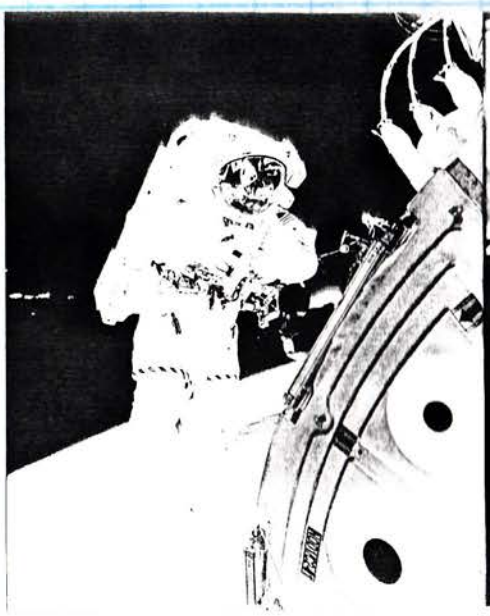
Astronaut Edward T. Lu, in beeld gebracht door kosmonaut Joeri Malentsjenko gedurende hun zes uur durende ruimtewandeling tijdens missie STS-106 op 11 september 2000. (Foto NASA)

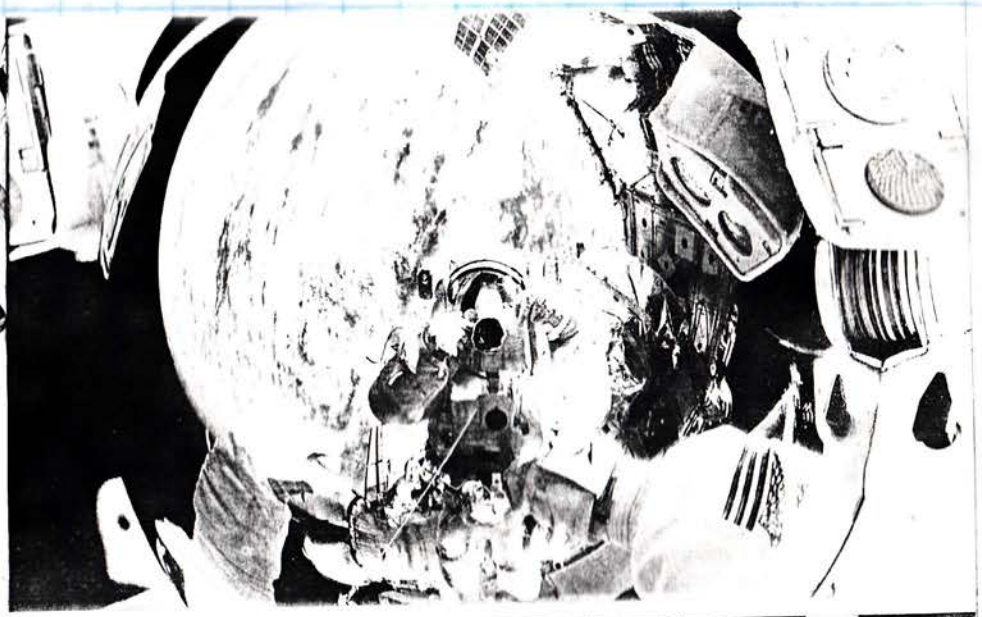
Afscheid van het ISS. Astronaut Daniel Burbank staat op het punt het ruimtestation te fotograferen door een van de raampjes van de shuttle Atlantis. (Foto NASA).











Links: Astronaut Michael Lopez-Alegria aan het werk buiten het ISS tijdens missie STS-92 in oktober 2000. Rechts: Michael Lopez-Alegria, vastgeketend aan de Amerikaanse Unity-module, staat op het punt enkele opnamen te maken met een kleine 35-mm camera. (Foto's NASA)

Foto's rechter pagina:
Boven: Astronaut Peter Wisoff brengt zichzelf in beeld, gereflecteerd in het vizier van astronaut Michael Lopez-Alegria. Linksonder: De volgepakte ruimte van de Russische module Zarja met op de achtergrond astronaut Lopez-Alegria. Rechtsonder: Het ruimtestation ISS, de space shuttle, de manipulator van het ruimteveer en astronaut William McArthur zijn te zien op deze opname, gemaakt tijdens STS-92. (Foto's NASA)

12 Oktober was het de beurt aan de space shuttle Discovery (missie STS-92). Dit was alweer de vijfde vlucht van een shuttle naar het ISS. De bemanning bestond uit commandant Brian Duffy, Pamela Melroy, Koichi Wakata, Leroy Chiao, Peter (Jeff) Wisoff, Michael Lopez-Allegria en William McArthur. Tijdens deze missie monteerden de astronauten aan de buitenkant van de Unity module een soort gigantisch evenwichtszintuig dat het hele complex in de juiste stand moet houden. Ook werd een nieuwe koppelmodule op Unity gemonteerd.

In de ochtendmist wordt Sojoez TM-31 geïnstalleerd op het lanceerplatform van Baikonoer, twee dagen voor de start van de eerste ISS bewoners. (Foto Piet Smolders)

Het aankleden van de ruimtevaarders Krikaljov (links), Shepherd en Gidzenko op de dag van hun lacering naar het ISS. (Foto Piet Smolders)

Klaar voor de reis! Van links naar rechts William Shepherd, Joeri Gidzenko en Sergei Krikaljov. Achter hen de reservebemanning: Ken Bowersox, Wladimir Dezjoerov en Michail Turin. (Foto NASA)

De Progress M-43 (nog van het oude type) startte op 16 oktober met aanvullende voorraden voor het ISS. Op 18 oktober koppelde het onbemande vrachtschip met 2174 kilo vracht aan boord.
Tenslotte vertrok op 31 oktober de Sojoez TM-31 naar het ISS met de eerste bemanning: De Amerikaan William Shepherd en de Russen Joeri Gidzenko en Sergei Krikaljov. Op aandringen van de Amerikanen was Shepherd tot commandant van het ISS benoemd, Gidzenko had de leiding in de Sojoez tot en met de koppeling aan het station.
Het was zoals gewoonlijk prachtig weer op de basis Baikonoer, maar al wel aardig koud. Twee dagen voor de start om zeven uur 's ochtends was de pers (waaronder de auteur) getuige van het uitrijden van de raket naar de lanceerplaats. Tijdens de traditionele persconferentie op die dag uitte Bill Shepherd zijn onvrede over het feit dat het ISS nog steeds geen naam had, terwijl de afzonderlijk gelanceerde modules wel van een naam werden en worden voorzien. De naam "Alpha" was immers al enige tijd in onbruik geraakt, naar verluidt omdat de Russen

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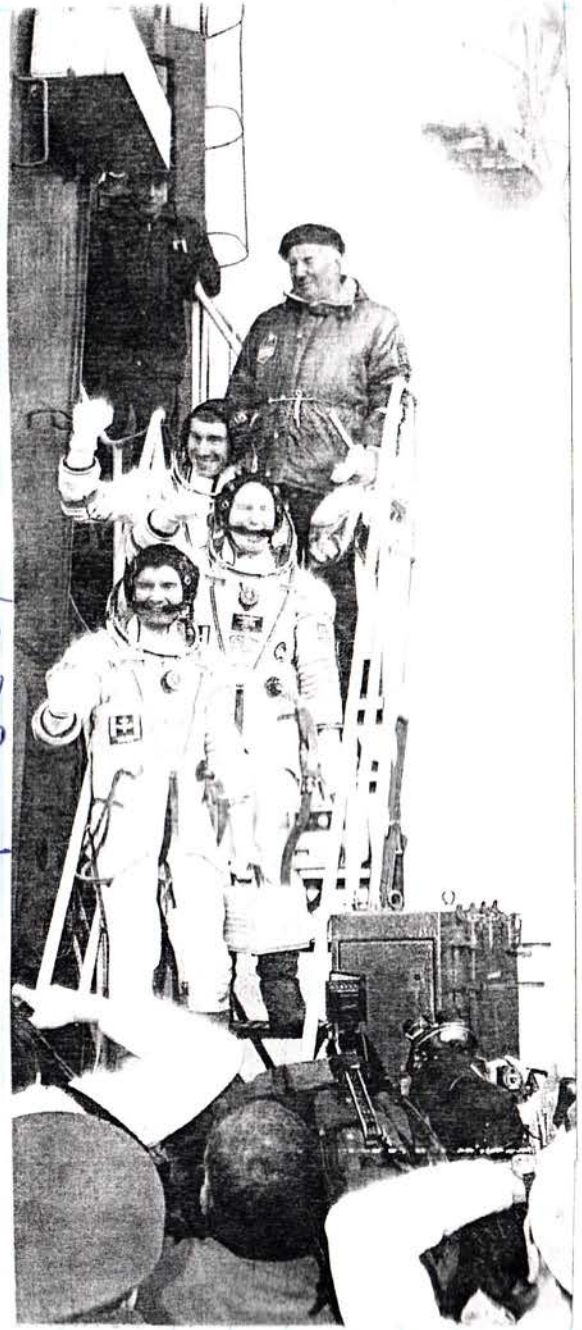


"Get those shuttles flying" roept William Shepherd, de eerste commandant van het ISS. Van voor naar achter: Gidzenko, Shepherd en Krikaliov.

die niet zo zagen zitten. De naam suggereerde dat het om het eerste ruimtestation ging, terwijl het ISS al vooraf werd gegaan door de Saljoets, Skylab en het ruimtestation Mir. "Vroeger had een schip altijd een mooie naam, waarvan verondersteld werd dat die de bemanning geluk zou brengen", aldus Shepherd.

Verder keek Shepherd met optimisme uit naar het gezamenlijke karwei dat voor de deur stond. "Wij hebben al vier jaar samen getraind en hebben aan een half woord voldoende, of dat nu Russisch of Amerikaans is", zei hij.

Vlak voor het drietal op dinsdag 31 oktober aan boord ging, riep Shepherd vanaf de trap de wachtenden toe: "Get those shuttles flying!"

Na de geslaagde start (om 9 uur plaatselijke tijd) in langzaam optrekkende mist was NASA baas Daniel Goldin, voorzien van een Texashoed, razend enthousiast:

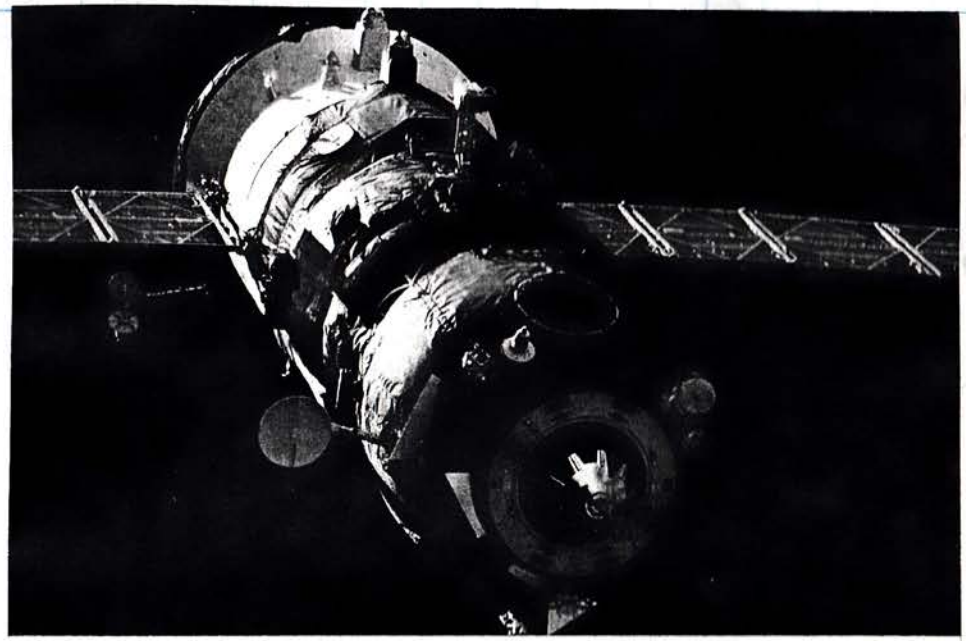
"Toen wij Amerikanen naar de maan gingen wilden we iets doen wat de Russen niet konden. En daar waren we trots op. Maar wat we nu doen is veel belangrijker: in plaats van raketten op elkaar te richten gaan we samen de ruimte in. Veel problemen zullen we nog tegenkomen, maar veel zullen we ook van elkaar leren. Ik heb Russen en Amerikanen zien veranderen. Wij vertrouwen het de Russen toe om onze mensen te lanceren en zij vertrouwen hun kosmonauten toe aan onze shuttles.

Generaal Valeri Grienj, voorzitter van de Staatscommissie voor Ruimtevaart, liep op Baikonoer nog duidelijk met gemengde gevoelens rond. "Dat Rusland aan dit programma mag deelnemen onderstreept onze rol in de bemande ruimtevaart. Maar ik geef toe: onze eigen Mir opgeven doet pijn." En ruimtevaartingenieur Anatoli Pavlov zei het aldus: "ISS is prima. Maar er gaat niets boven een eigen huis, zodat je zelf kunt beslissen wie je daar uitnodigt." Achteraf bleken zijn woorden bijna profetisch, gezien de problemen die er zouden rijzen met de eerste ruimtetoerist, Dennis Tito.

Communistenleider Gennady Zjoeganov keek op toen hij van ons hoorde dat het ruimtevaartbudget van Rusland net zo hoog was als dat van Nederland (250 miljoen gulden). " Dat is een situatie waar snel iets aan gedaan moet worden. We moeten de ruimtevaart in dit land werkelijk ondersteunen en we moeten een eigen lanceerbasis hebben." Daarmee doelde hij op het feit dat de basis Baikonoer tegenwoordig in het onafhankelijke Kazachstan ligt, met alle financiële en organisatorische problemen van dien.

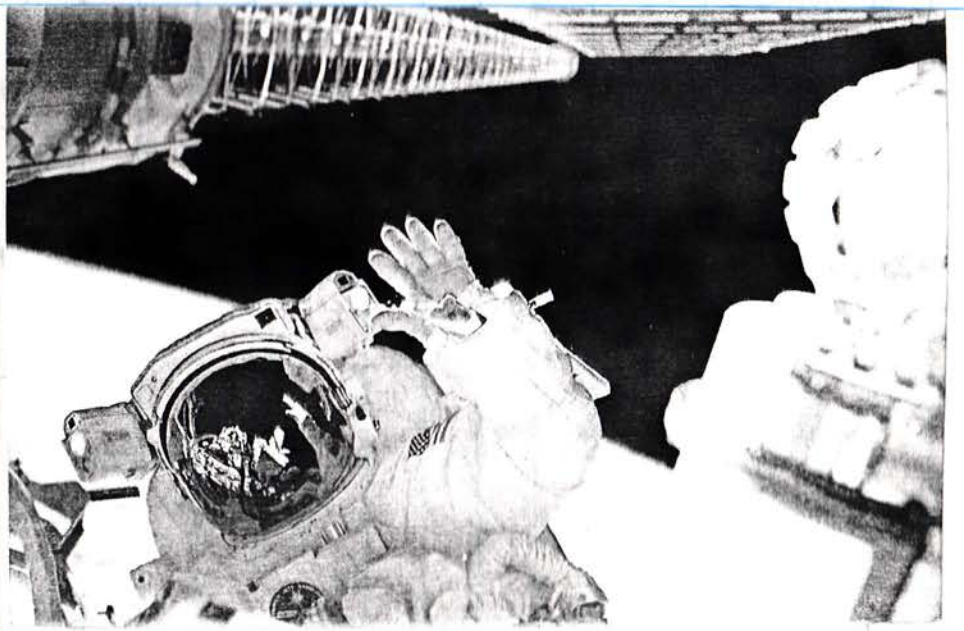
Bij het verlaten van de startplaats kwamen we oud-kosmonaut en Doema-lid Vitali Sewastjanov nog tegen. Net als zijn zielsverwant Zjoeganov hoopte hij op betere tijden: "Tien jaar lang hebben we de zaak hier verkwanseld en is het geld weggestroomd naar het buitenland. Maar het wordt beter. President Poetin is iemand die de zaak werkelijk aanpakt, daar ben ik van overtuigd. En dat moet ook zichtbaar worden in de bestorming van de kosmos!"

Twee dagen later, op donderdag 2 november, werd het ISS voor het eerst betrokken. Om 11.23 uur Nederlandse tijd openden Shepherd en zijn Russische collega's het luik tussen hun ruimtetaxi Sojoez TM-31 en de Zvjezda leefmodule. Gidzenko was de eerste die het nieuwe verblijf, bijna 100 kubieke meter groot, binnenzweefde. Shepherd maak-



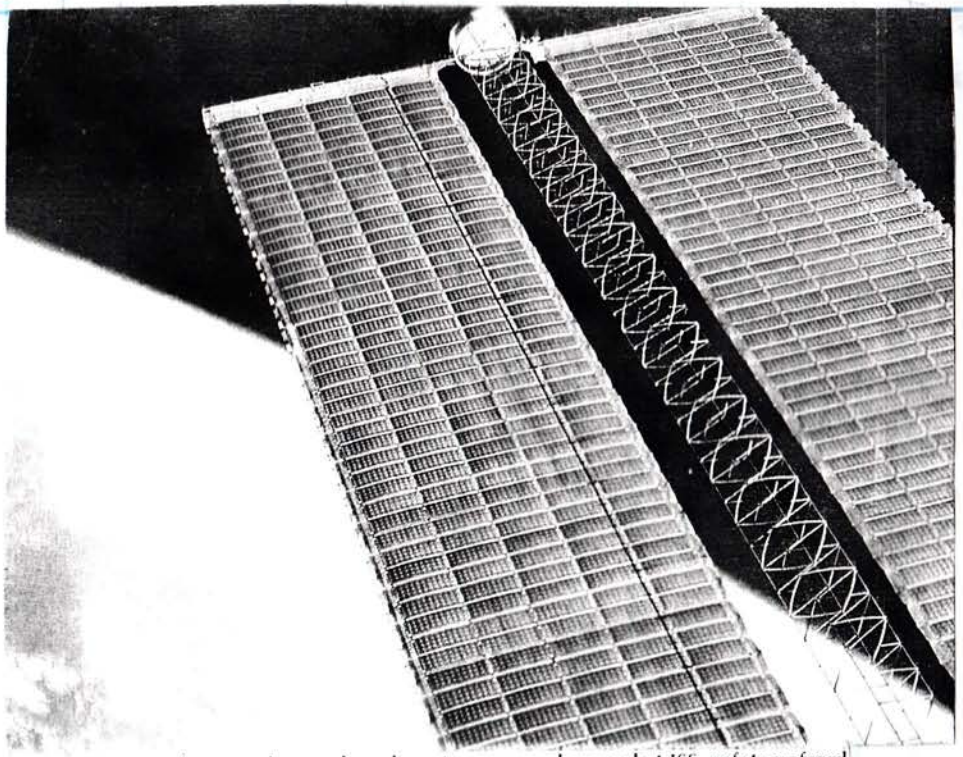
Op 18 november komt het vrachtschip Progress aan bij het ISS, in beeld gebracht door zijn eerste bewoners. De Progress bracht twee ton voedsel, kleding, instrumenten en kadootjes van de familie. (Foto NASA)

Een verse sinaasappel gaat er altijd in. Van links naar rechts Joeri Gidzenko, William Shepherd en Sergei Krikaljov aan boord van de ISS module Zvjezda. (Foto NASA)



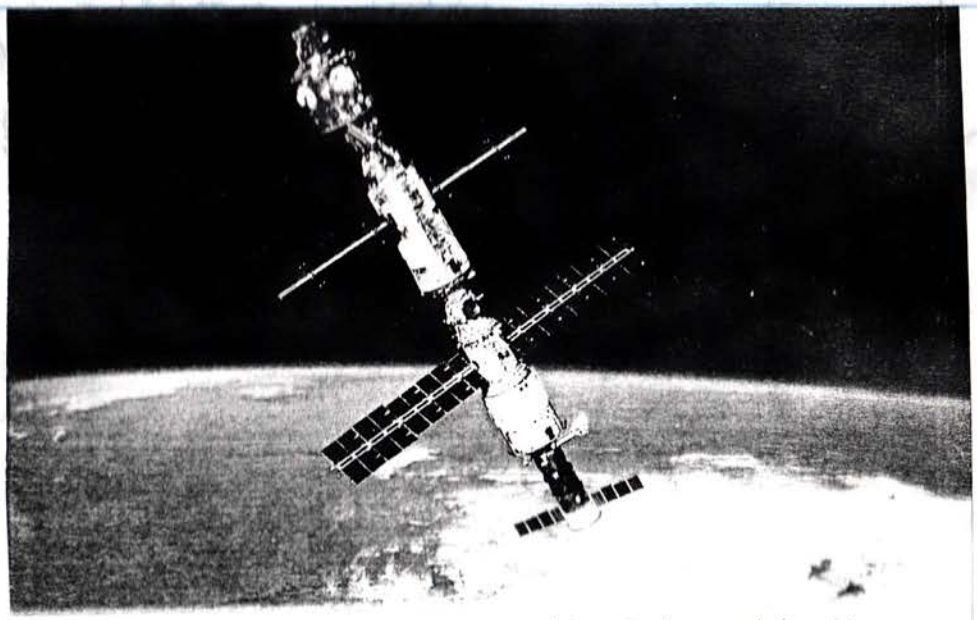
Astronaut Carlos Noriega zwaait naar de fotograaf, Joseph Tanner, tijdens de tweede ruimtewandeling van missie STS-97. Een deel van de nieuwe reusachtige zonnepanelen is boven hem te zien. (Foto NASA)

te meteen van de gelegenheid gebruik om zijn baas, Daniel Goldin, een sluw verzoek te doen wat hij - met andere autoriteiten gezeten in het vluchtleidingscentrum Tsoep - moeilijk kon weigeren. Shepherd vroeg hem namelijk of de bemanning vanaf dat historische moment de roepnaam "Alpha" mocht gebruiken.
"Oké, oké. Je mag die naam voorlopig gebruiken als je dat zo graag wilt". Goldin bulderde van het lachen.
Onmiddellijk ging de bemanning aan het werk om het ISS definitief klaar te maken voor bewoning (hun eerste zorg was het opstarten van het toilet!) en zich voor te bereiden op de komst van nieuwe onbemande en bemande ruimteschepen.
Aanvullende voorraden voor station en bemanning gingen op 16 november de ruimte in met Progress-M1 4. Na te zijn leeggehaald door de ruimtevaarders en te zijn volgestopt met dingen die niet meer nodig waren, werd de Progress op 1 december ontkoppeld.



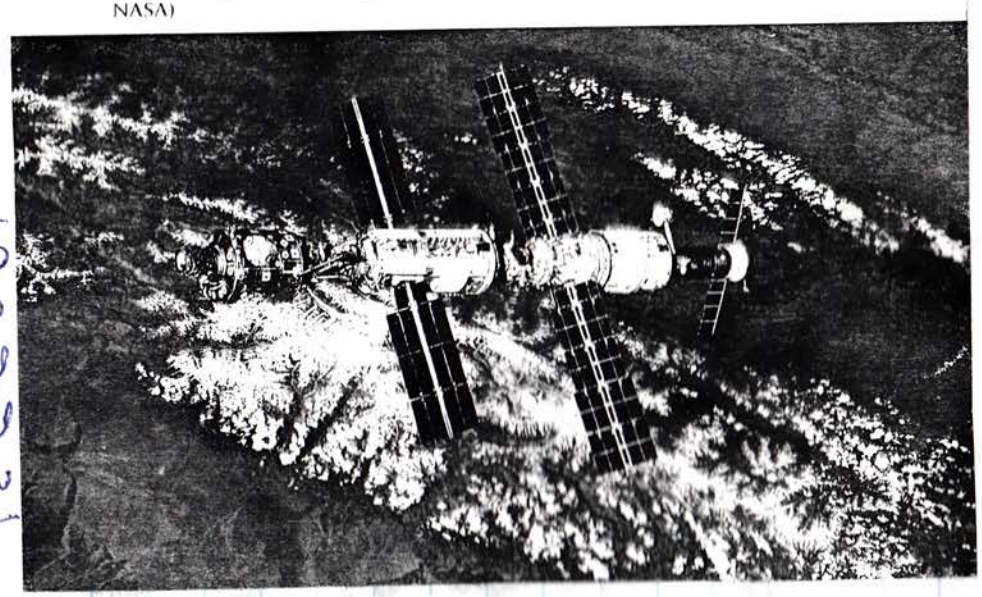
Een van de twee nieuwe vleugels met zonnepanelen van het ISS, gefotografeerd vanuit de space shuttle. (Foto NASA)

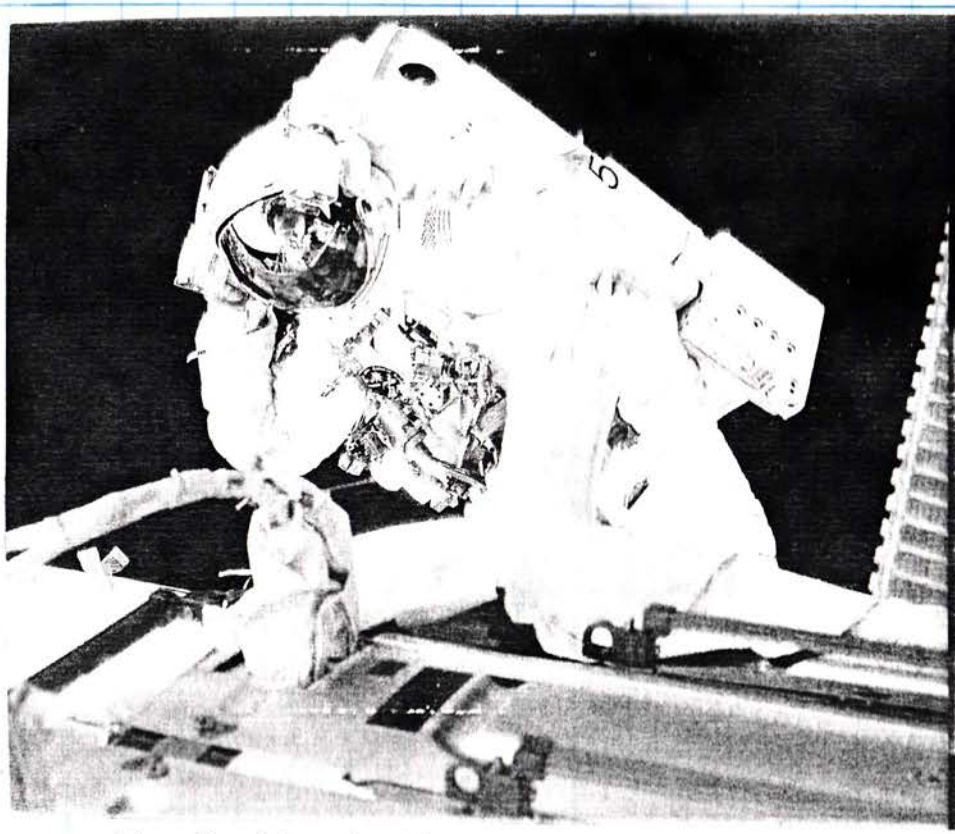
Gigantische zonnepanelen en koelradiatoren voor het voorspoedig groeiende ISS vertrokken op 1 december met de Endeavour in het kader van missie STS-97. De bemanning werd gevormd door Brent Jett, Michael Bloomfield, Joseph Tanner, Carlos Noriega en Marc Garneau. De grote zonnepanelen hadden, nadat ze eenmaal waren uitgevouwen, een spanwijdte van 73 meter. De koppeling met ISS vond plaats op 2 december.
Dankzij de nieuwe zonnepanelen werd de beschikbare elektrische energie voor het ISS vervijfvoudigd.
Twee dagen na de start van Endeavour tilde de Canadese astronaut Marc Garneau met behulp van de shuttle manipulator de tot een plat pakket opgevouwen en zeventien ton wegende zonnepanelen uit het



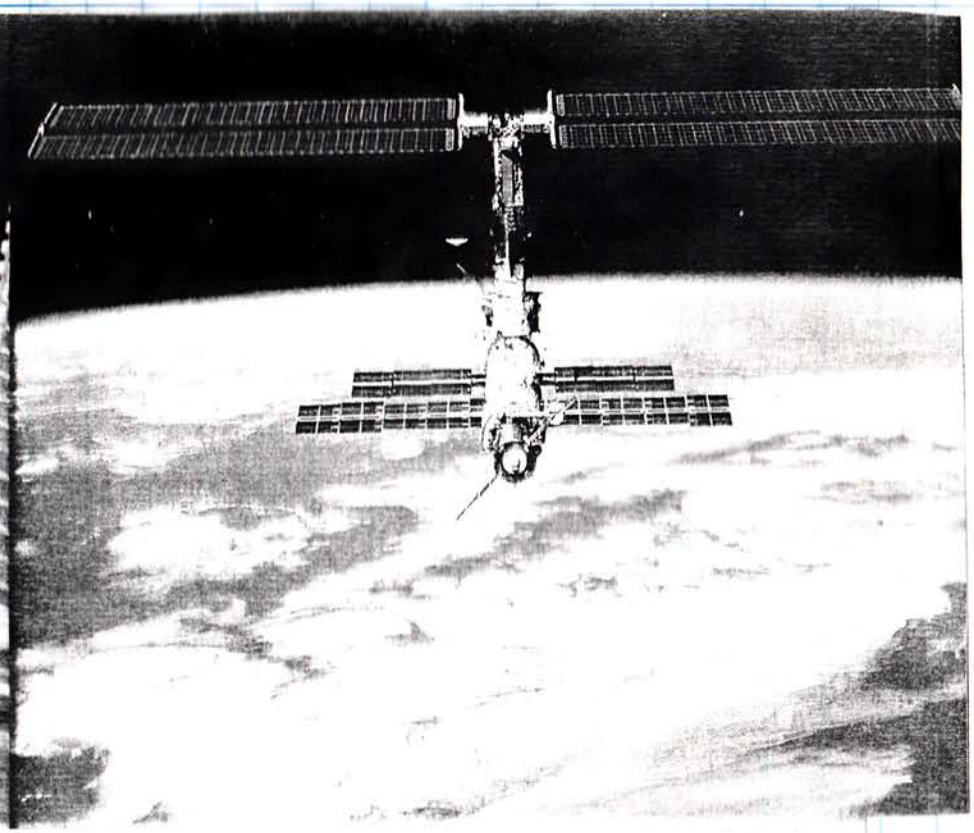
Terwijl de Atlantis in september 2000 rond het ISS vloog werd deze foto gemaakt. (Foto NASA).

Het ISS vliegt boven de bergen en Lake Issyk-Koel ten zuiden van Alma-Ata. (Foto NASA)





Astronaut Jopseh Tanner in actie buiten het ISS, gezien vanuit de space shuttle. (Foto NASA)

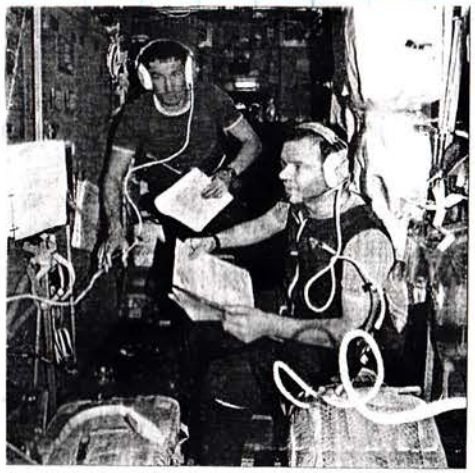


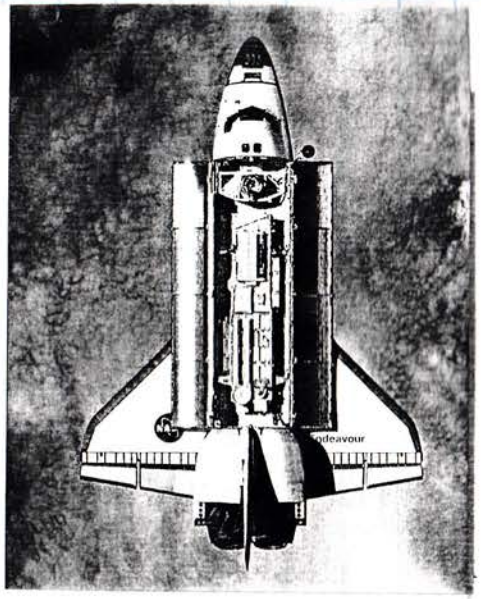
Het ISS met zijn nieuwe zonnepanelen, na de ontkoppeling van de shuttle op 9 december 2000. (Foto NASA)

laadruim van de space shuttle, zodat ze alvast konden opwarmen. Een dag later begonnen de astronauten Joe Tanner en Carlos Noriega tijdens hun eerste ruimtewandeling met het montagewerk, geassisteerd door Marc Garneau, die het pakket in de juiste positie bracht en vastdrukte op een frame dat tijdens de vorige shuttlevlucht al was aangebracht. Tanner en Noriega verwijderden daarna klampen die het pakket bijeen hielden en maakten de nodige elektrische aansluitingen. Op een commando vanuit Endeavour werd het pakket vervolgens ontplooid. Later bleek dat een van de panelen zich niet helemaal vlak had ontvouwd, maar dat probleem kon door de astronauten handmatig worden verholpen.

Tijdens een tweede ruimtewandeling monteerden Tanner en Noriega nog een antenne en maakten het station klaar voor de ontvangst van de Amerikaanse laboratoriummodule Destiny, begin 2001.

Pas op de zevende dag van hun missie gingen de Endeavour-astronauten het ISS binnen om nog twee dagen met de vaste bewoners van het station samen te werken. Endeavour keerde op 11 december terug op het Kennedy Space Center.





Links: Sergei Krikaljov (links) en Joeri Gidzenko aan het werk in het ISS. Rechts: De space shuttle Endeavour (STS-97) gezien vanuit het ruimtestation. (Foto's NASA)

De bemanningen van het ISS en missie STS-97 broederlijk bijeen. Vooraan van links naar rechts Brent Jett (commandant STS-97), William Shepherd (commandant Expeditie 1) en Joseph Tanner. Op de tweede rij van links naar rechts kosmonaut Sergei Krikaljov, astronaut Carlos Noriega, kosmonaut Joeri Gidzenko en astronaut Michal Bloomfield. Achteraan de Canadees Marc Garneau. (Foto NASA)

Chinese kosmonauten op komst

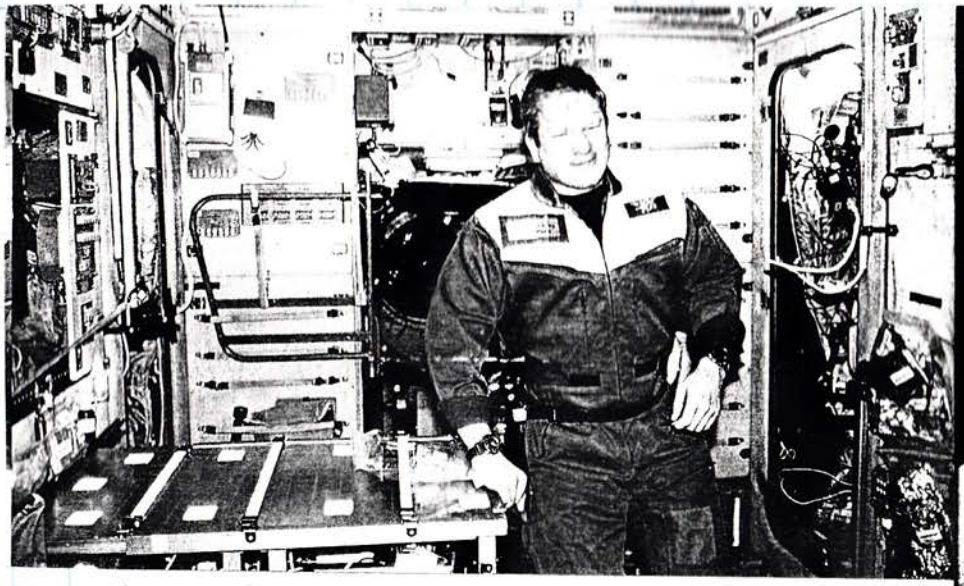
Aan het begin van het nieuwe jaar deden ook de Chinezen weer van zich spreken op het terrein van de bemande ruimtevaart, al verscheen er nog geen landgenoot in de ruimte.

Op 9 januari 2001 startte voor de tweede keer een bemanbaar Chinees ruimteschip: de Shen Zou 2. Het werd gelanceerd vanaf de basis Juiquan op een CZ-2F raket. Een Shen Zou (Godenschip) werd voor het eerst gelanceerd op 19 november 1999. Die vlucht verliep goed, tot en met de landing een dag later.

Bij de tweede vlucht had de Shen Zou wel een aantal passagiers aan boord: een aap, een hond, een konijn en een aantal slakken. Nog dezelfde dag landde de capsule van het ruimteschip. Weliswaar iets te hard omdat een parachutestrop afbrak. Maar de levende have zou de klap toch hebben overleefd. De landing vond plaats op de droge vlakten van Binnen Mongolië.

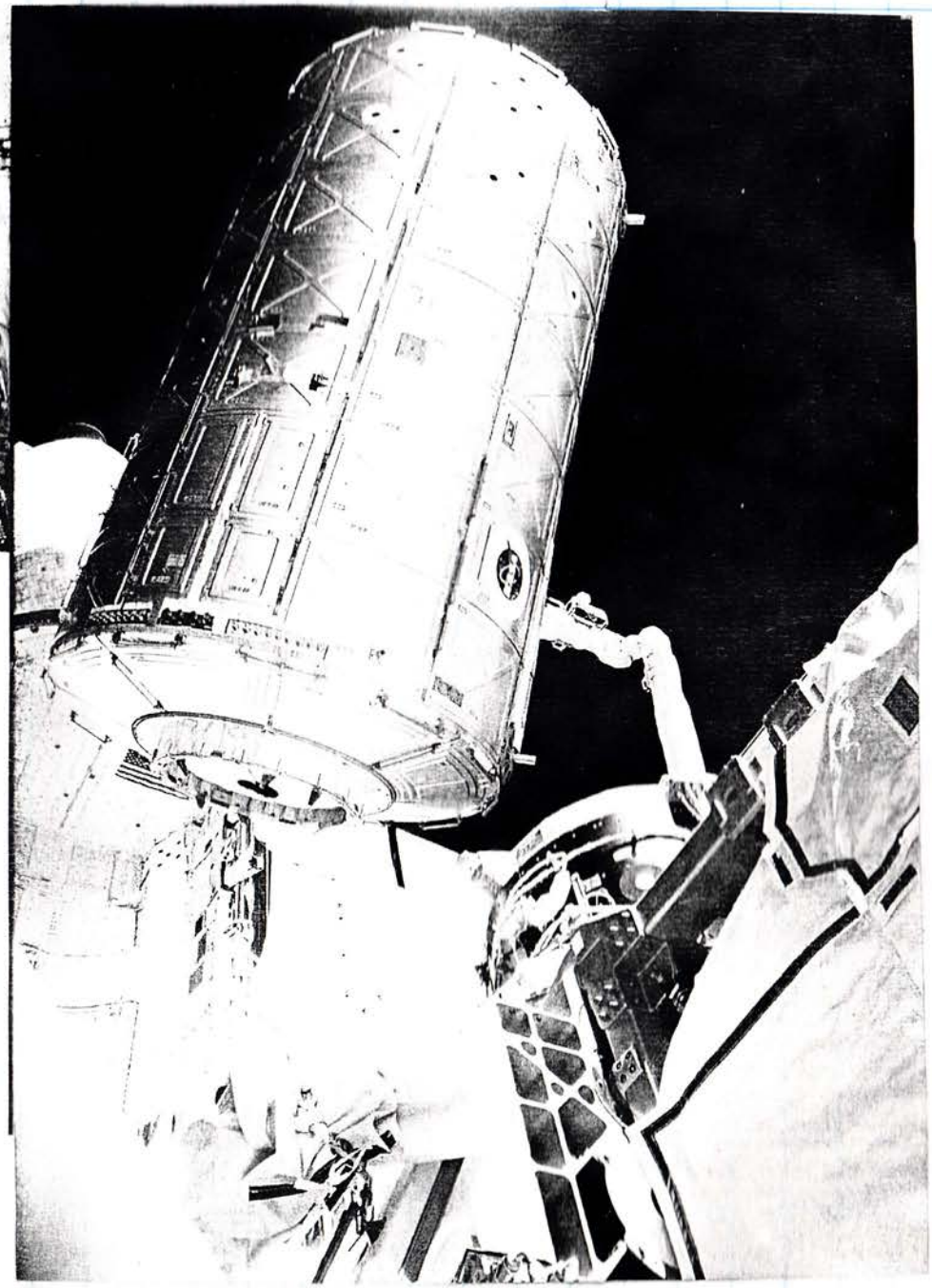
Een artistieke impressie van het Chinese ruimteschip Shen Zou 2 in zijn baan om de aarde. Bovenaan de cilindrische leefmodule. (Foto Space.com)

De Shen Zou lijkt sterk op het beproefde Russische ruimteschip Sojoez, het is gebaseerd op dezelfde technologie. De motorsectie en de bemanningscabine zijn vrijwel identiek aan die van de Sojoez, maar de orbitale- of leefmodule is anders. Zij is niet eivormig zoals bij de Sojoez, maar cilindrisch en belangrijk groter. Deze module is net als de motorsectie voorzien van zonnepanelen en is duidelijk berekend op een langer verblijf in de ruimte. De module is zelfs voorzien van internationale koppelapparatuur, zoals die ook gebruikt wordt bij het koppelen van de shuttle aan het International Space Station. Het ligt nu in de verwachting dat spoedig twee of drie Chinezen, opgeleid in Sterrendorp bij Moskou, in de ruimte zullen verschijnen. Een eigen Chinees ruimtestation zou op den duur ook wel eens werkelijkheid kunnen worden.



Astronaut William Shepherd in de leefmodule Zvjezda van het International Space Station. (Foto NASA)

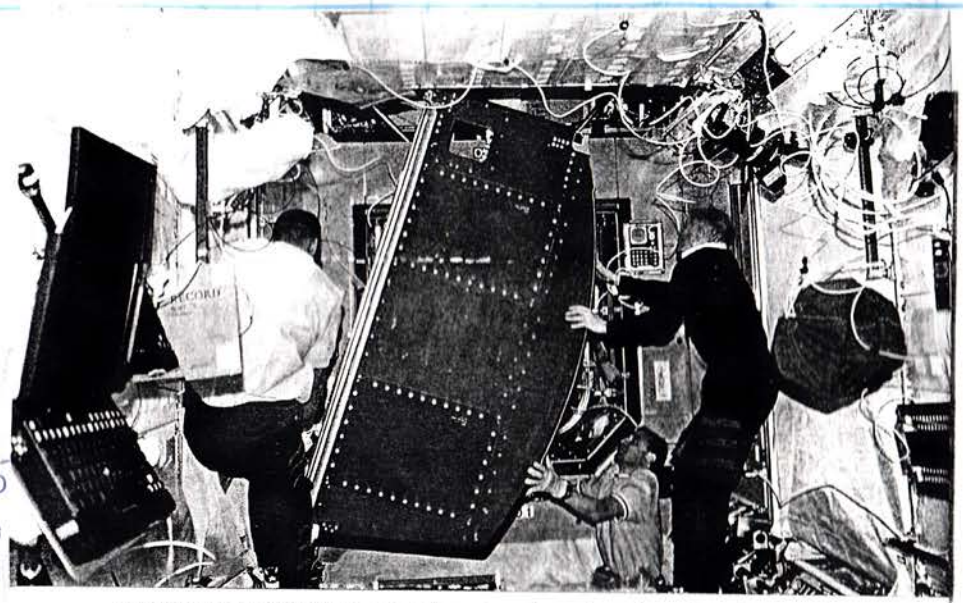
Foto rechter pagina:
De nieuwe Amerikaanse laboratoriummodule Destiny wordt met behulp van de robotarm uit het laadruim van de space shuttle getild om te worden vastgemaakt aan het ISS. De foto werd gemaakt door Thomas Jones, die op dat moment samen met astronaut Robert Curbeam een ruimtewandeling maakte. (Foto NASA)



Mir en ISS

De aloude Mir kwam weer even in beeld op 24 januari 2001, toen de Progress-M1 5 werd gelanceerd op een Sojoez-U raket vanaf Baikonoer. De koppeling aan de Kwant Module, aan de achterkant van Mir, vond plaats op 27 januari. Deze Progress had liefst 2677 kilo brandstof aan boord, bedoeld om de Mir af te remmen voor de terugkeer naar de aarde.

Het eerste onderzoekslaboratorium voor ISS ging omhoog in het vrachtruim van het ruimteveer Atlantis op 7 februari: de eerste space shuttlevlucht van de nieuwe eeuw en de zevende naar het ISS. Aan boord waren vijf astronauten: Ken Cockrell (commandant), Mark Polanksy (piloot), Robert Curbeam, Marsha Ivins en Tomas Jones. Atlantis arriveerde bij het ISS op 9 februari en vertrok weer op 16

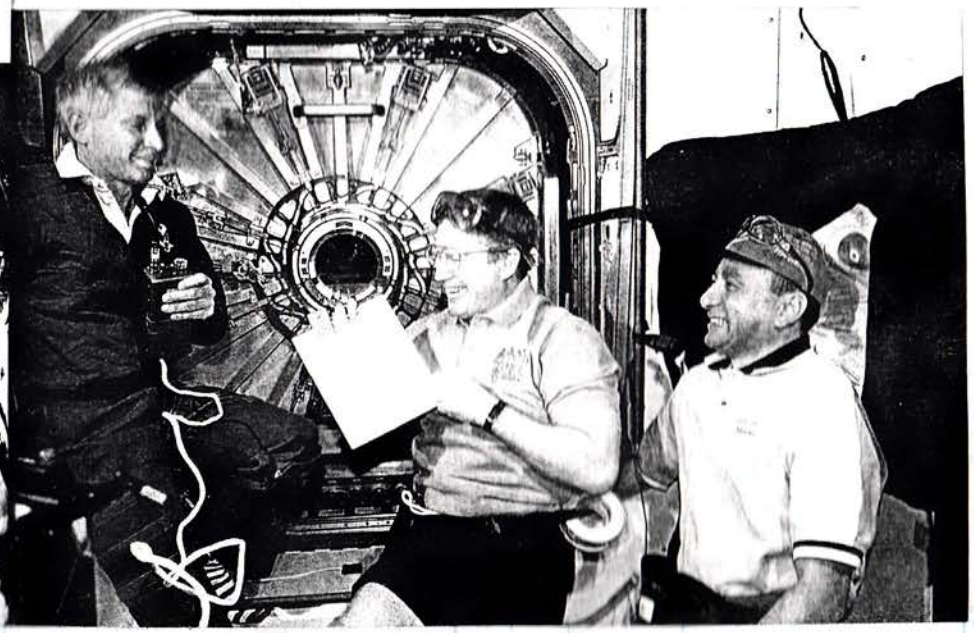


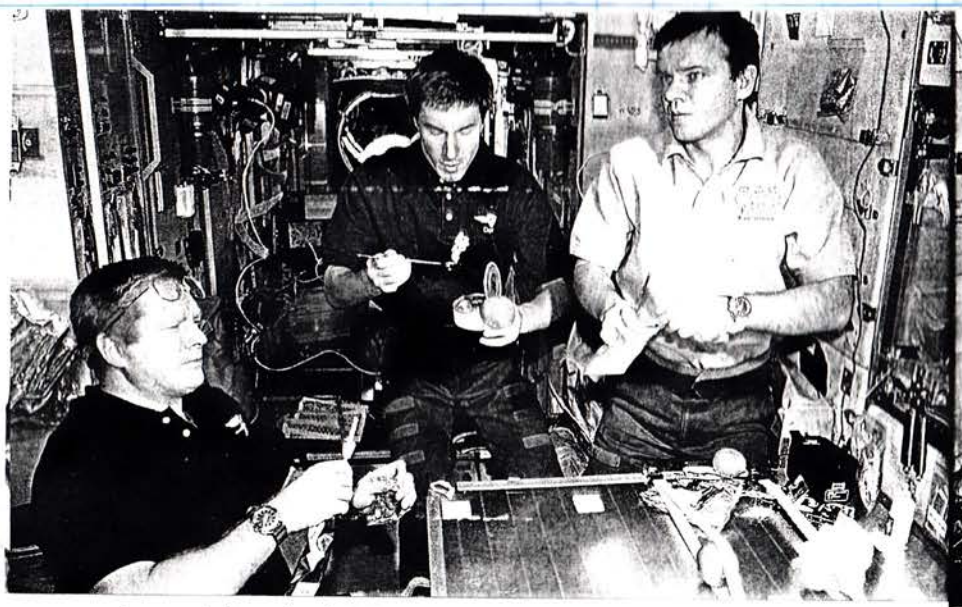
Astronauten installeren een experimentenrek aan boord van het nieuwe ruimtelab Destiny. (Foto NASA)

Astronaute Marsha Invins, Kenneth Cockrell en Mark Polansky kijken door een raampje van het vliegdek van de space shuttle Atlantis naar hun ruimtewandelende collega's. (Foto NASA)

februari, het nieuwe Amerikaanse ruimtelab Destiny op het complex achterlatend. Atlantis keerde op 20 februari terug op aarde.
Tijdens de vlucht werden drie ruimtewandelingen uitgevoerd om aansluitingen te maken tussen Destiny en de rest van het ruimtestation.
Destiny zit gekoppeld aan de voorkant van de kleine Unity module.
Het ruimtelaboratorium is bijna tien meter lang en heeft een massa van zestien ton. Anders dan de Russische modules Zarja en Zvjezda is Destiny speciaal ingericht voor het doen van wetenschappelijke experimenten. Tevens zal het fungeren als commandocentrum voor het groeiende ISS, dat in zijn uiteindelijke vorm ongeveer 200 miljard gulden zal hebben gekost.
Inwendig kan Destiny worden voorzien van maximaal 23 experimenteerrekken, die door shuttlebemanningen kunnen worden gewisseld, afhankelijk van de geplande experimenten. Die zullen vooral betrekking hebben op het onderzoek van materialen en levende materie onder invloed van langdurige gewichtloosheid.
Over enkele jaren moeten ook nog een Europees en een Japans ruimtelab aan het ISS worden gekoppeld.

Commandant William Shepherd krijgt het document van overdracht van de Destiny module, die op de achtergrond zichtbaar is. Links Kenneth Cockrell en rechts Mark Polanksy. (Foto NASA)

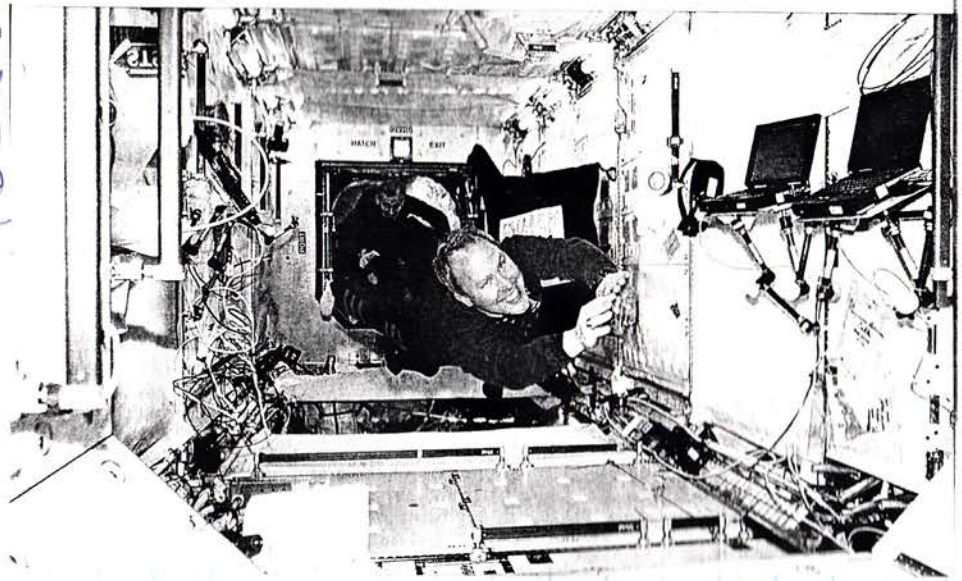




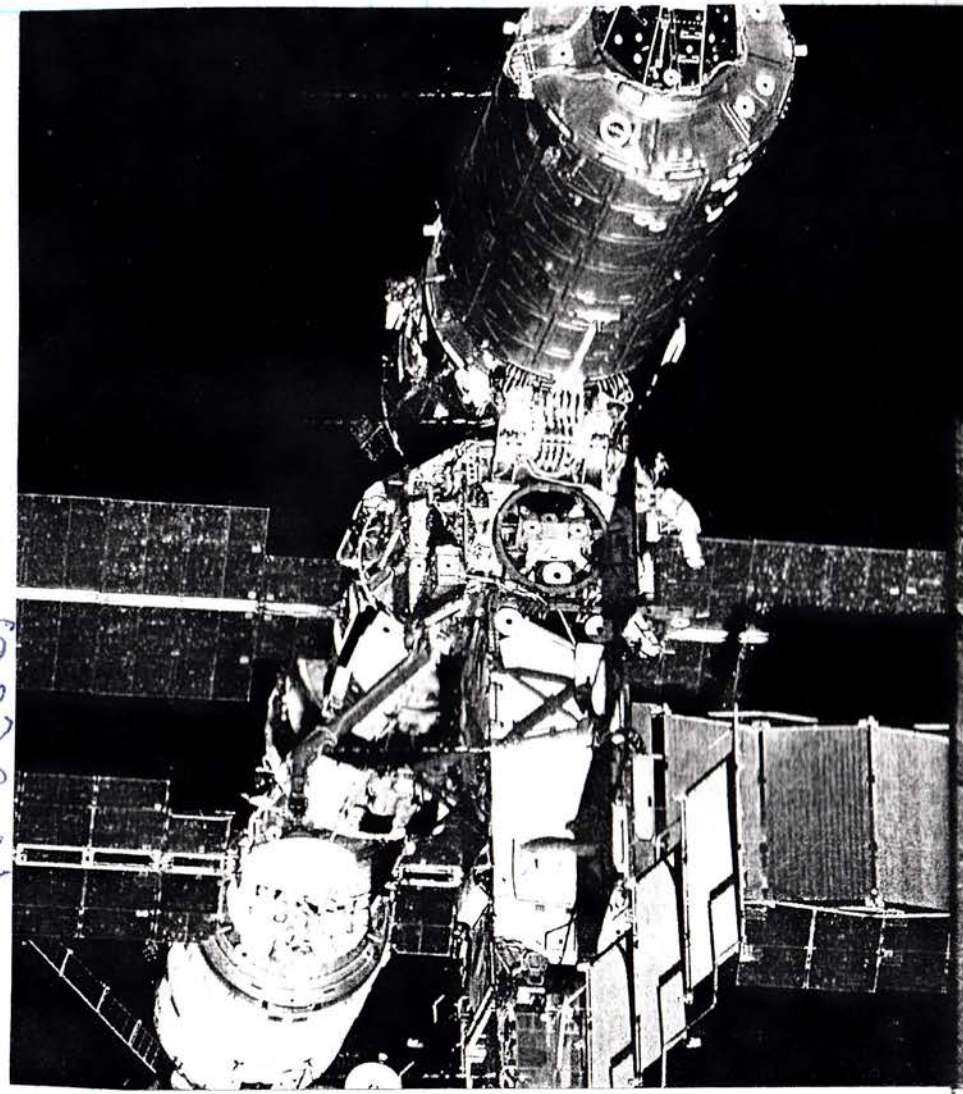
Een van de bezoekende STS-98 astronauten maakte deze foto van de dinerende hoofdbewoners van het ISS. Van links naar rechts William Shepherd, Sergei Krikaljov en Joeri Gidzenko. (Foto NASA)

De eerste bemanning van het ISS, samen met de astronauten van shuttle missie STS-98. Op de voorgrond van links naar rechts Sergei Krikaljov, Bill Shepherd en Joeri Gidzenko. Achter hen van links naar rechts Mark Polansky, Kenneth Cockrell, Marsha Ivins, Robert Curbeam en Thomas Jones. (Foto NASA)

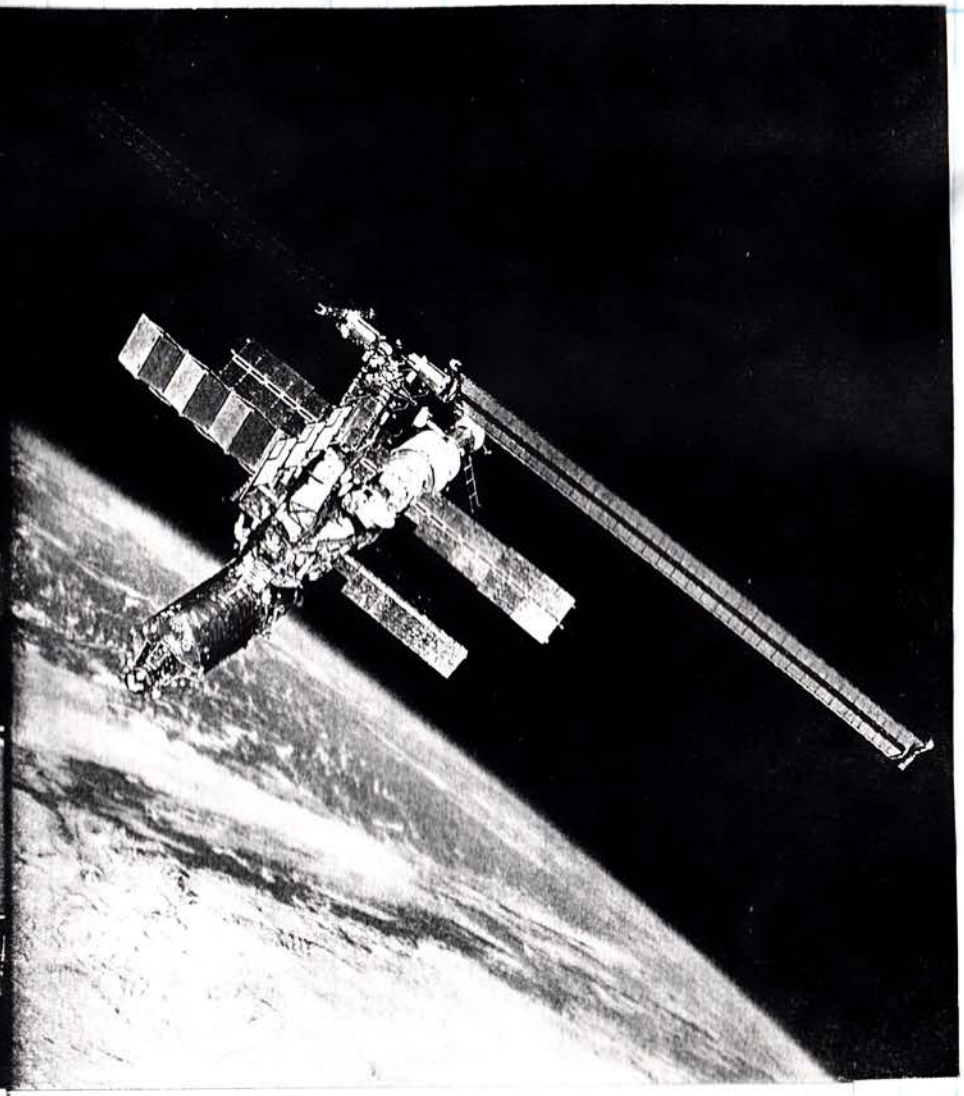
De astronauten Thomas Jones (voorgrond) en Kenneth Cockrell zweven het nieuwe Destiny binnen. (Foto NASA)



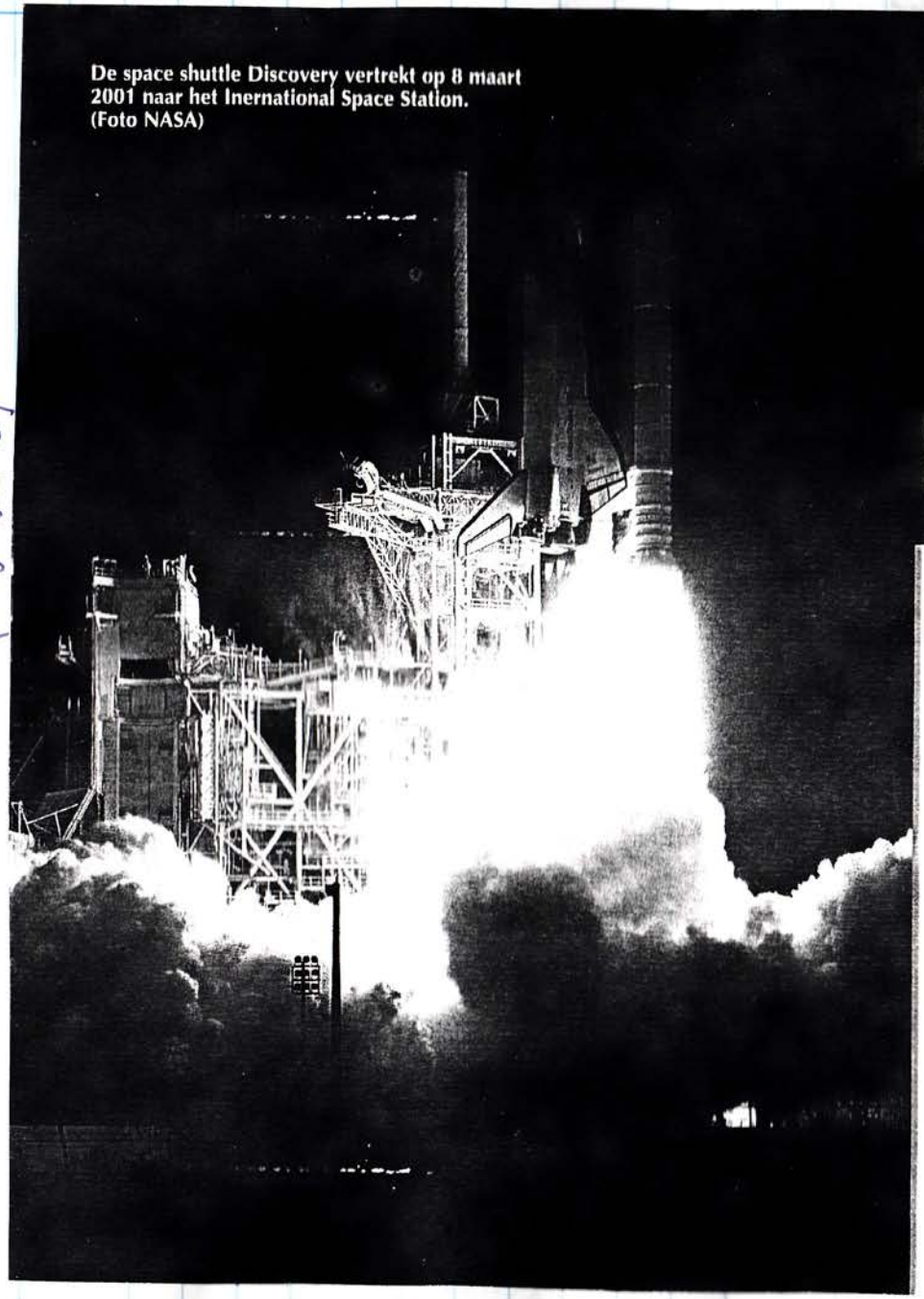
Op 26 februari werd weer een onbemand vrachtschip gelanceerd vanuit Kazachstan: Progress M-44. De vrachtvaarder koppelde zonder problemen op 28 februari aan de achterkant van de Russische Zvejzda, de woonmodule van het ISS.
Op 8 maart vertrok de space shuttle Discovery vanaf het Kennedy Space Center voor missie STS-102 naar het International Space Station. Zeven astronauten waren aan boord: James Wetherbee (commandant), James Kelly (piloot), Andrew Thomas, Paul Richards, Joeri Oesatsjov, James Voss en Susan Helms. De laatste drie - zeer ervaren - ruimtevaarders vormden de tweede bemanning van het ISS.
Aan boord van Discovery was een Italiaanse container - Leonardo genaamd - vol met uitwisselbare instrumentrekken voor het ISS. De rekken werden na de koppeling uitgeladen en Leonardo (genoemd naar Leonardo da Vinci) ging leeg mee terug met Discovery. Op 31 maart keerde Discovery behouden terug op aarde met onder andere



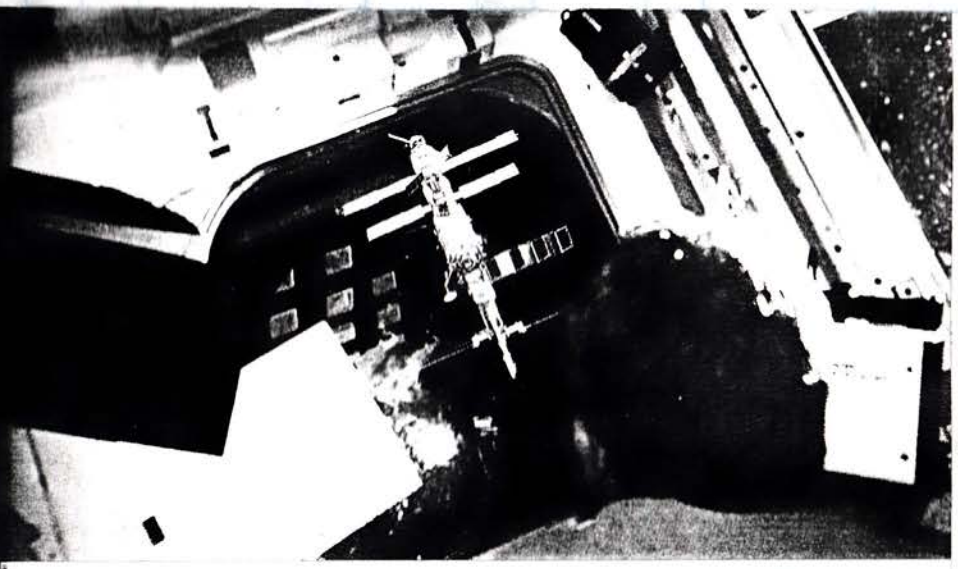
Het ISS in beeld gebracht vanuit de ontkoppelde space shuttle Atlantis, op 16 februari 2001. Op de voorgrond het nieuwe ruimtelab Destiny, dat tijdens de STS-98 vlucht werd geïnstalleerd. (Foto NASA)



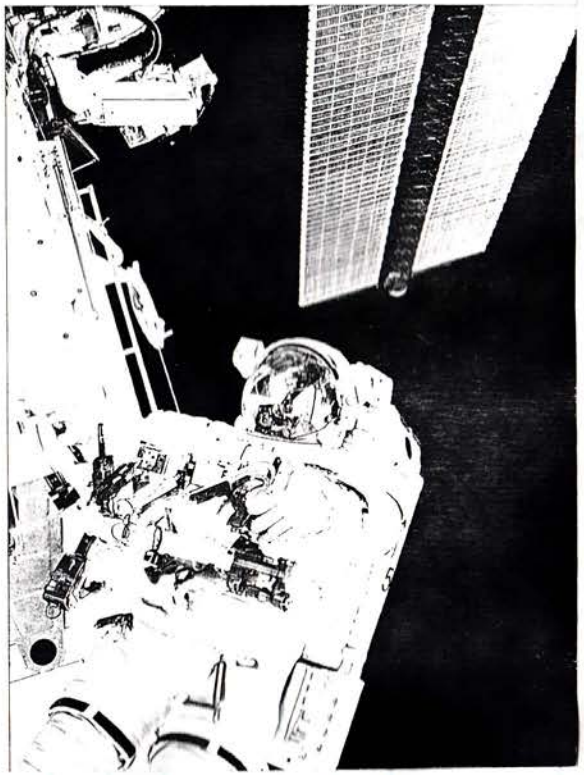
Voor de Atlantis terugkeerde naar de aarde keken de astronauten nog een keer terug naar het International Space Station, tegen de achtergrond van onze blauwe planeet.



De space shuttle Discovery vertrekt op 8 maart 2001 naar het Inernational Space Station. (Foto NASA)



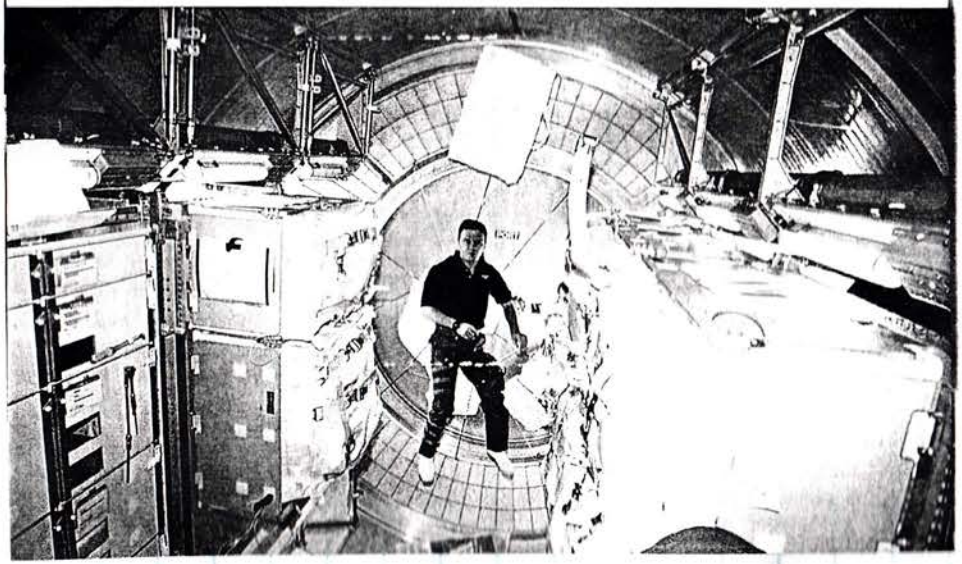
Door het raampje van Discovery kijkt een van de astronauten op 10 maart naar het ISS dat langzaam dichterbij komt. (Foto NASA)



Astronaut Andrew Thomas tijdens een ruimtewandeling (samen met Paul Richards) terwijl de shuttle Discovery gekoppeld zit aan het ISS. Er werden tijdens deze STS-102 vlucht twee ruimtewandelingen uitgevoerd. (Foto NASA)

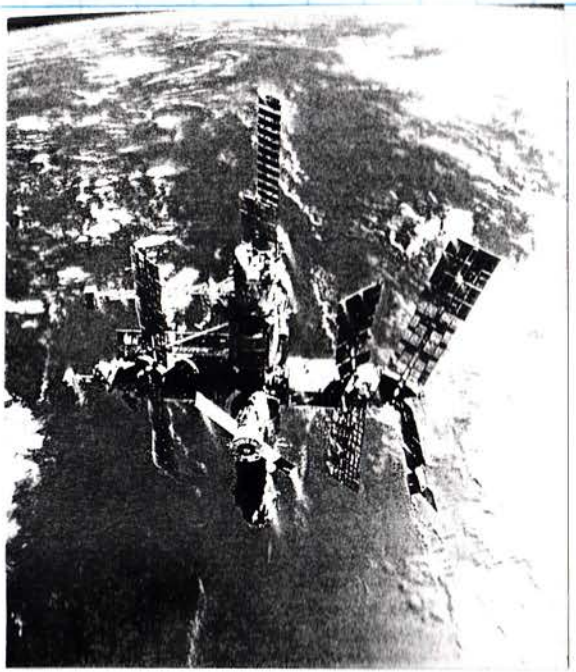
Twee van de nieuwe bewoners van het ISS: De Amerikaan James Voss (links) en de Rus Joeri Oesatsjov. Het derde lid van Expeditie 2, Susan Helms, is buiten beeld. (Foto NASA)

Expeditie-1 lid Joeri Gidzenko aan het werk in Leonardo, de in Italië gebouwde transportmodule. De apparatuur hier is voornamelijk bestemd voor de onderzoeksmodule Destiny. (Foto NASA)



Voor de terugkeer naar de aarde in de space shuttle Discovery: vijf astronauten en een Russische kosmonaut. Links Sergei Krikaljov, Bill Shepherd (beneden). Verder van links naar rechts James Kelly, Andrew Thomas, Paul Richards en James Wertherbee. Joeri Gidzenko, het derde lid van Expeditie 1, is buiten beeld. (Foto NASA)

Bill Shepherd, Joeri Gidzenko en Sergei Krikaljov, de eerste hoofdbewoners van het ISS.
Intussen was er op 23 maart tenslotte een einde gekomen aan het befaamde en veelbesproken ruimtestation Mir. Ondanks allerlei opwindende verhalen maakte het enorme complex een gecontroleerde terugkeer in de aardse dampkring.
Het afgedankte ruimtestation vlamde die ochtend nog één keer toen zijn zes grote modules als schitterende sterren langs de hemel trokken boven het eiland Fiji in de Stille Oceaan, op weg naar het "ruimtevaartkerkhof" tussen Nieuw Zeeland en Chili. Om een minuut voor zeven onze tijd doken de smeulende resten in zee, precies in het geplande doelgebied. Mir was geschiedenis.
De vluchtleiders van het centrum Tsoep in Koroljov bij Moskou hadden gedaan wat ze beloofd hadden: zonder iemand schade te berokkenen was het 15 jaar oude ruimtestation aan zijn vurige einde gekomen.



De Mir begint op te gloeien bij zijn intrede in de hoogste lagen van de atmosfeer. Korte tijd later komt er een einde aan het veelbesproken Russische ruimtestation, de voorloper van het ISS. (Animatie Mark Spoelstra)

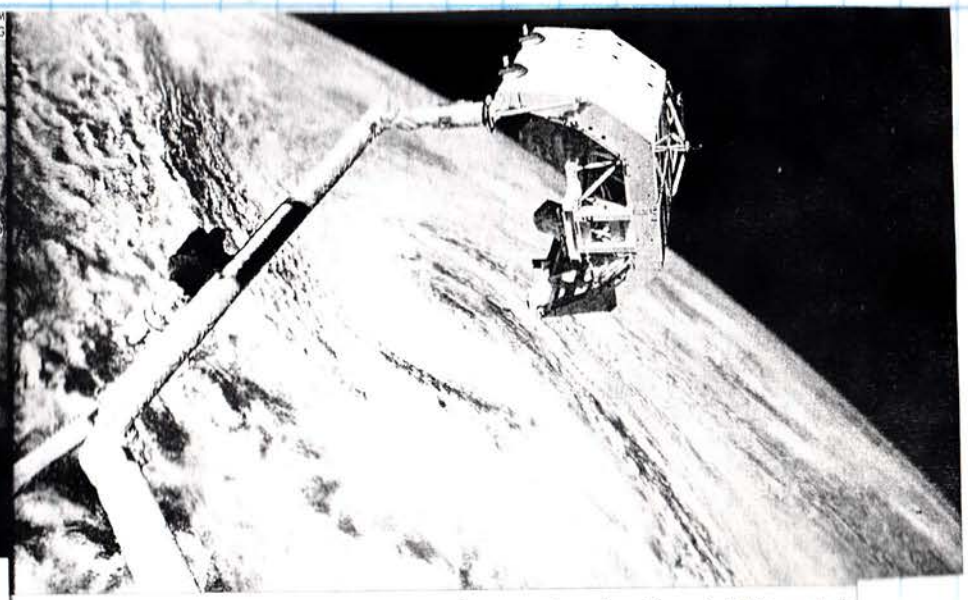
De Russische ingenieur-kosmonaut Sergei Krikaljov heeft zowel aan de Russische als aan de Amerikaanse kant van de ruimtevaart veel ervaring opgedaan: hij vloog in de Mir (links) , in de Amerikaanse space shuttle en werd een van de eerste drie hoofdbewoners van het nieuwe International Space Station (rechts). (Foto's RKK Energia, NASA)

Na gedurende twee eerdere omlopen al te zijn afgeremd door de stuurraketten van de aangekoppelde Progress kreeg het 140 ton wegende complex de finale stoot van de Progress hoofdmotor, die boven West Afrika werd ontstoken en twintig minuten lang werkte. De dalende Mir vloog over Rusland en Siberië, een televisiecamera aan boord toonde het statig voorbij glijdende aardoppervlak. De Mir koerste nog op veilige hoogte over het zuidelijkste puntje van Japan en dook boven de Stille Oceaan de dampkring in om te worden gecremeerd.

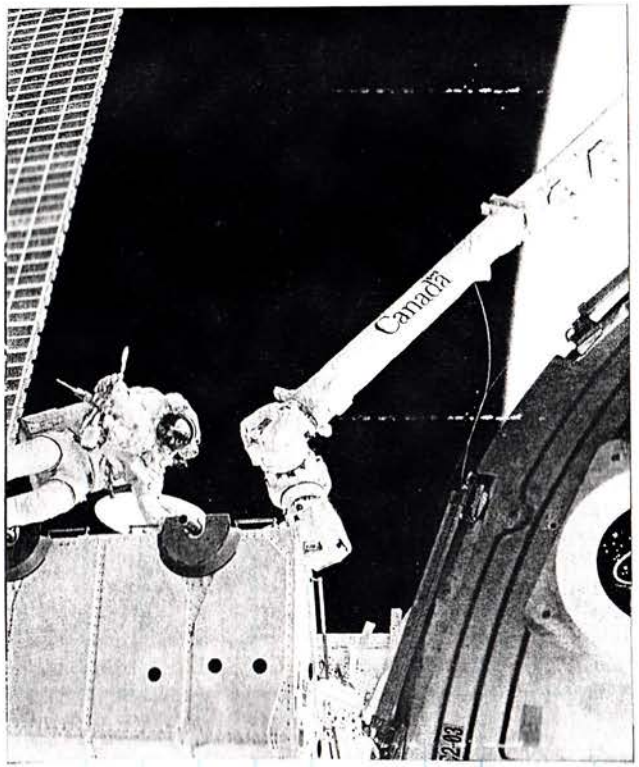
In Tsoep hadden de tientallen vluchtleiders en kosmonauten gemengde gevoelens: enerzijds tevredenheid over de geslaagde operatie, anderzijds droefenis omdat Rusland's zelfstandige rol in de bemande ruimtevaart nu verleden tijd was. Ruimtevaartbaas Joeri Koptjev en hoofdconstructeur Joeri Semjonov bedankten iedereen die de afgelopen vijftien jaar aan het project had gewerkt en spraken de hoop uit dat Russen, Amerikanen, Europeanen, Canadezen en Japanners nu verder eendrachtig samen zouden werken aan het nieuwe International Space Station.

Op 21 april 2001 vertrok de space shuttle Endeavour naar het ISS voor missie STS-100 met de astronauten Kent Orminger (commandant), Jeffrey Ashby (piloot), Chris Hadfield (uit Canada) Scott Parazynski,

Joeri Oesatsjov spreekt met radioamateurs op de aarde, daarbij gadegeslagen door Joeri Lontsjakov, die even op bezoek kwam in het kader van shuttle-missie STS-100. (Foto NASA)



Handdruk in de ruimte: De nieuwe ruimtearm Canadarm-2, op het ISS, geeft de "wieg" waarin hij in de shuttle zat opgeborgen, over aan Canadarm-1 op de space shuttle Endeavour. Canadarm-2 zal worden gebruikt bij de verdere uitbouw en andere operaties op het ISS. (Foto NASA)

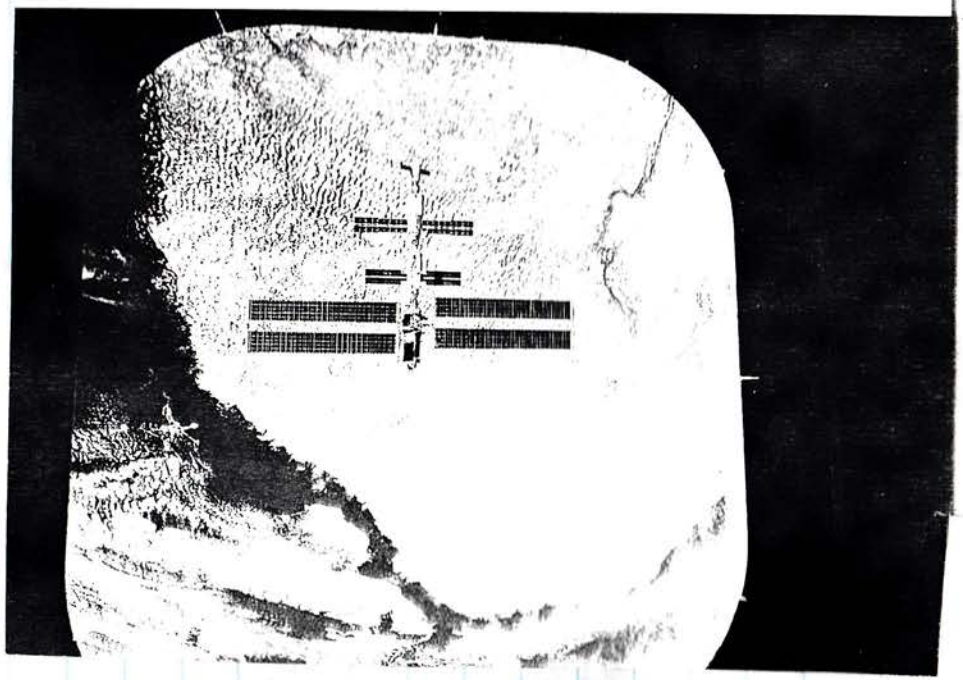


De Canadese astronaut Chris Hadfield bereidt zich voor op de eerste van twee ruimtewandelingen, uitgevoerd vanuit de shuttle Endeavour, buiten het ISS. (Foto NASA)

Chris Hadfield (Canada), bij de in zijn land gemaakte Canadarm-2, die nieuwe grote manipulator op het ISS. De foto werd gemaakt door de Amerikaan Scott Parazynski die samen met Hadfield twee ruimtewandelingen maakte om de nieuwe arm te installeren. (Foto NASA)

John Philips, Umberto Guidoni (ESA) en Joeri Lontsjakov (Rusland). De voornaamste opdracht van de astronauten was het installeren van een grote ruimtekraan op het ISS ("Canadarm"). Ook werden nieuwe experiment-rekken aangevoerd met de Italiaanse container Rafaello. De koppeling vond plaats op 22 april en de ontkoppeling op 29 april. Op 1 mei landde Endeavour op Edwards Air Force Base in Californië. Op 30 april ging de eerste ruimtetoerist eindelijk omhoog: de Amerikaan Dennis Tito (60). Hij had ongeveer 40 miljoen gulden voor zijn vlucht betaald. De Sojoez TM-31 ging de ruimte in met Tito, Talgat Moesabajev en Joeri Batoerin. De Amerikanen en de Europeanen waren fel gekant tegen deze vlucht, maar de Russen hielden voet bij stuk: zij konden het geld goed gebruiken en meenden dat zij zelf wel konden beslissen wie er in hun Sojoez kwam te zitten.
Toen Tito boven kwam en overgestapt was in het ISS voelde hij al gauw dat hij niet al te welkom was. Bovendien hadden de Amerikanen hem verboden in de Amerikaanse modules te komen. Maar Tito liet

Chris Hatfield tijdens een van zijn twee ruimtewandelingen buiten het ISS. De foto werd gemaakt door zijn collega Scott Parazynski. (Foto NASA)



Afscheid van ISS: terwijl de Endeavour op 29 april 2001 langzaam wegdrijft is door een raampje de internationale ruimtebasis te zien. (Foto NASA)

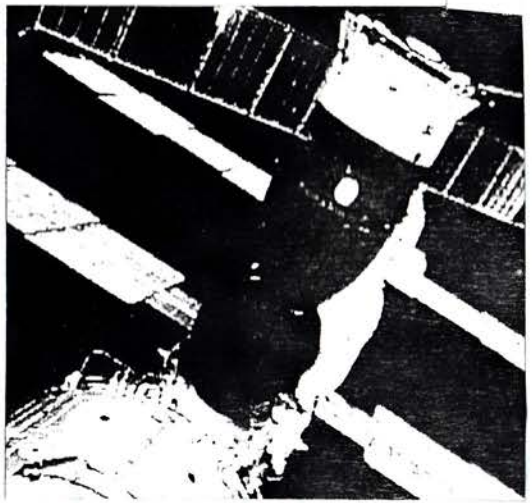
zich niet van de wijs brengen. "I love space", riep hij uit toen hij goed en wel aan boord was. De bedoeling van de vlucht was eenvoudig: het uitwisselen van de Sojoez reddingsboot van het ISS. Te allen tijde moet er een Sojoez aan het ruimtestation vast zitten om de ruimtevaarders in geval van nood een ontsnappingsmogelijk te bieden. Maar de Sojoez is maar goedgekeurd voor een half jaar, dus moet er ongeveer elke zes maanden een nieuwe Sojoez omhoog, waarna de bemanning na een week met de oude Sojoez terugkeert naar de aarde.

Tito had daarboven de tijd van zijn leven. Hij keek naar de aarde, genoot van de gewichtloosheid, maakte foto- en videoopnamen en hielp de ISS-bewoners een beetje als dat zo uitkwam.

Op 6 mei maakten de moedige Amerikaan en zijn beide Russische begeleiders in de Sojoez-TM 31een zachte landing op de steppe in de buurt van de stad Arkalyk in Kazachstan

Dennis Tito op de Russische basis Baikonoer in gesprek met de auteur, een dag voor de lancering van de eerste bemanning van het ISS, eind oktober 2000. Tito wist toen nog niet of hij naar de Mir of naar het ISS zou vliegen, of helemaal niet. (Foto Jan Reijnoudt)

Het ruimteschip Sojoez, waarmee Dennis Tito naar het ISS is gevlogen, gekoppeld aan het ruimtestation. (Foto NASA)



Dennis Tito zweeft de Zvjezda module van het ISS binnen, geassisteerd door commandant Joeri Oesatsjov (links) en Talgat Moesabajev. (Foto Internet)

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"It was paradise!" aldus Tito, "de vlucht van mijn leven!". De drie kosmonauten werden verwelkomd door Narsoeltan Nazarbajev, de president van Kazachstan. Al eerder had Tito vanuit het ISS laten weten dat een ruimtevlucht "een fluitje van een cent" is. Hij spoorde iedereen aan zijn voorbeeld te volgen.
Tito ging zich na zijn vlucht bezighouden met het promoten van vakantiereisjes naar de ruimte voor mensen die de vooralsnog hoge prijs kunnen opbrengen.
Aan het eind van dit verslagjaar vertrok op 20 mei de Progress-M1 6 naar het International Space Station, ter verdere bevoorrading. In de vroege ochtend van 23 mei koppelde de Progress zonder problemen aan de achterkant van de Zvjezda module. Deze Progress werd als eerste gelanceerd met een verbeterde versie van de Sojoez raket, de Sojoez-FG. Deze raket is uitgerust met nieuwe boosters en een verbeterde tweede trap.

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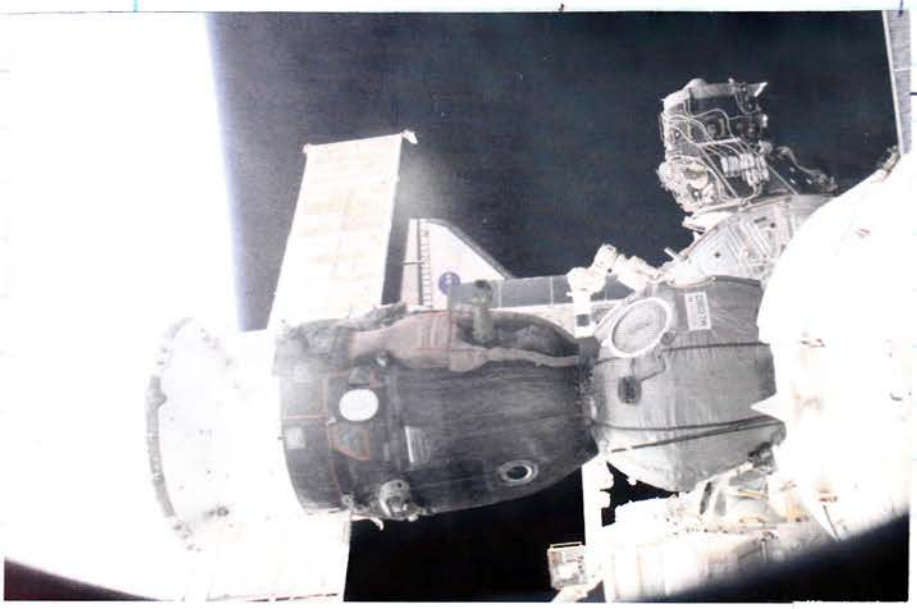

A Soyuz vehicle docked to the Space Station. A portion of Endeavour is visible in the background.

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Record spacewalks planned for 2002

NASA plans to conduct 15 EVAs from the Space Shuttle and seven from the International Space Station (ISS) during 2002, compared with the 18 conducted in 2001.

Five EVAs will be made by the crew of the first Space Shuttle to be launched in 2002, not to the ISS but on the fourth Hubble Space Telescope servicing mission scheduled for launch in late February.

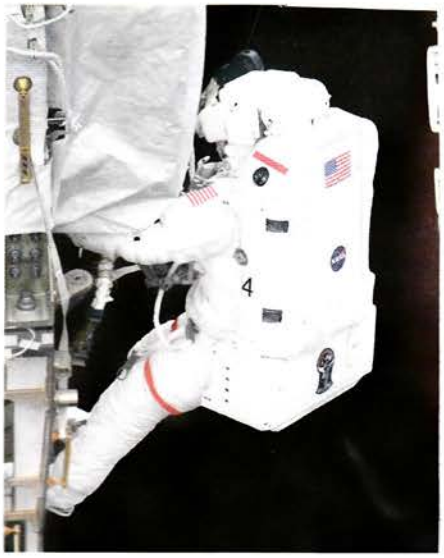
The Columbia STS-109 crew will attempt to reactivate an infrared instrument, install an advanced camera, new solar arrays, a power controller and reaction control system gyro to replace one of the four attitude control system units on the telescope which failed in November.

STS-110 Atlantis, which is scheduled for an April launch to the ISS, carrying three truss segments was delayed from March to 4 April after a decision to remove at least one of the Orbital Manoeuvring Systems pods to verify stress integrity of an attach point after bore scope checks indicated the dimensions of the attach point's fittings may not meet flight requirements.

STS-111 Endeavour will deliver the Expedition Crew 5 and return the fourth crew now aboard the ISS, on a logistics mission which will also add further components to the Canadian Space Station Remote Manipulator System.

The launch is scheduled for May and will be followed by a Columbia mission, STS-107 in July, on a solo science mission equipped with 32 experiments in a Spacehab double-module.

The first starboard side truss segment will be attached to the ISS during the STS-112 Atlantis mission in late August and will be followed by the delivery of the Expedition Six Crew and the return of the fifth crew in late September on the STS-113 Endeavour mission, which will also add a port side truss segment, completing almost half the length of the final truss structure.



Michael Gernhardt, STS-104 mission specialists, works on the Space Station's Quest airlock during his July 2001 EVA. NASA

USAF, NASA Eye Cooperation On Next Reusable Launcher

ROBERT WALL/**WASHINGTON**

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The Pentagon's growing interest in conducting military operations through space is prompting the Air Force and NASA to try to form a common development program for the next generation of reusable launch vehicles.

But finding a way to combine the civil space and military requirements won't be easy. Already, analysts assessing the two constituencies' needs are finding that they don't coalesce in several areas.

The activity to bring NASA and the Air Force together is being led by a group, called the One Team, that is undertaking a four-month RLV assessment. The goal is to devise a program that would build on funding from both government departments and could see first flight of a prototype system around 2007.

Although there is overlap in many mission areas, or at least not outright conflict, there are also areas of divergence that could be difficult to accommodate in a single design. For instance, the Air Force wants a highly responsive vehicle that could be launched within 12-48 hr.—a capability military officials believe is important to ensure the spaceplane would be available as a global strike system or for space control. However, NASA's operational demands are not as strenuous, since civil space missions would be planned and have long lead times.

SIMILARLY, THE AIR FORCE expects to require high sortie rates for a future system, while NASA doesn't. USAF objectives call for up to 20 missions in a two-week time period on a sustained basis. The need for a responsive system also drives the Air Force to require a system capable of being launched in strong winds, precipitation and wider temperature ranges than NASA would demand.

"We've got to be honest about it, our needs don't totally line up with the Air Force needs. We've got human space flight, and they don't," said Dan Dumbacher, who leads NASA's portion of the study. Nevertheless, "there is a lot of commonality," he added.

The team is looking at a broad spectrum of RLV technology options. Among the near-term alternatives are two-stage-to-orbit RLV systems, an air-launched reusable system and a hybrid of expendable boosters with a reusable upper stage. Single-stage-to-orbit technologies, which suffered a setback with NASA's and Lockheed Martin's X-33, are only being considered for far-term application.

NASA is far ahead of the Air Force in its planning for a future RLV, mainly through its space launch initiative (SLI). Whether a joint NASA/USAF program would be managed through SLI or lead to a new structure hasn't been resolved. The One Team study was supposed to look at SLI and determine if there are ways to field a capability earlier than called for in the NASA-only assessment. Similarly, it is supposed to attempt to harmonize technology work and particularly focus on military spaceplane needs.

Dumbacher noted that SLI was set up to be adjustable, in part with the Air Force in mind. However, senior NASA and Air Force officials will have to decide how to proceed. That decision needs to be made soon since NASA has key SLI milestones on the horizon, including a system requirements review later this year.

Getting a flying prototype by 2007 would require the government to start funding a project this year and involve "significant technical [and] programmatic risk," government officials told potential contractors. However, it could provide the Pentagon with a residual operational capability and represent a limited operational system for NASA even before the final design is available.

A notional program plan would have the Air Force and NASA developments combine in the near terms, with the two organizations likely to part ways again after 2007 to build their tailored systems. NASA would pursue a crew vehicle, while the Air Force would continue working on an unmanned spaceplane capable of carrying cargo. Early assumptions being made for the Air Force system is being able to lift 15,000-25,000 lb. into a 100-naut.-mi. circular orbit. The NASA vehicle would carry 45,000 lb. or more into a similar orbit inclined 28 deg. to the equator.

One notional RLV concept Boeing has put forward to help define the technologies that need to be pursued in NASA's space launch initiative is this two-stage-to-orbit design.

NASA and the Defense Dept.'s last attempt to meld their RLV requirements produced less-than-satisfactory results on both sides. During development of the partially reusable space shuttle, the two organizations repeatedly butted heads. Furthermore, an expensive launch complex was built at Vandenberg AFB, Calif., to satisfy the military. Yet the shuttle never flew from it, as the Pentagon all but abandoned the vehicle after the Challenger accident.

Officials involved in the process are well aware of the checkered past. As part of the study, the two bureaucracies are looking at what problems were encountered in the past and where things worked. Moreover, Dumbacher hopes by resolving USAF requirements issues early, problems down

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the road can be avoided. Furthermore, the joint study should help foster a relationship that could smooth cooperation later.

"Fiscal constraints are out there, and it behooves the two agencies to work together as much as possible to continue down the path of solving the access to space issue from a reliability, safety and cost standpoint," Dumbacher added.

A conceptual operational architecture for a fleet of military spaceplanes calls for 10 vehicles to be based at four different locations in the continental U.S. Two of those would be launch-ready at any moment.

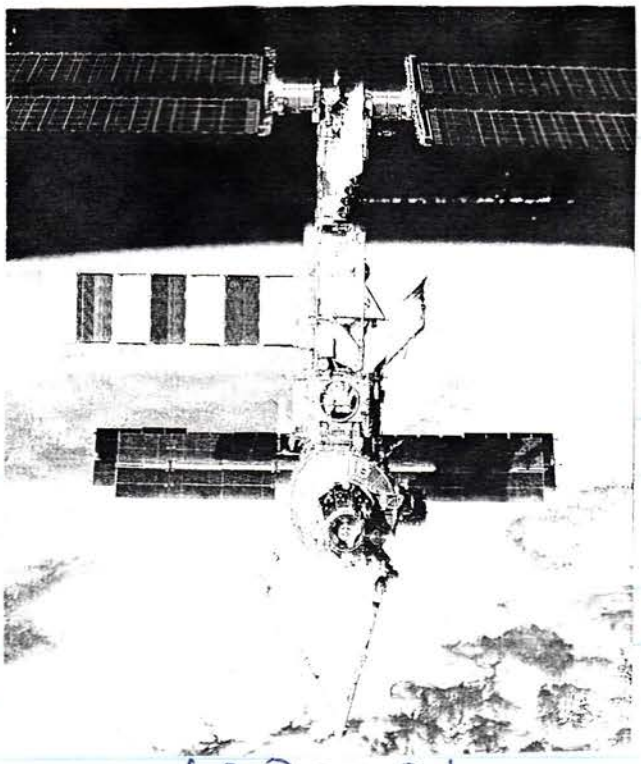
A DRAFT WHITE PAPER on the operational utility of such a spacecraft developed by the One Team outlines a military spaceplane's usefulness beyond 2010. For instance, the team argues that new and emerging long-range air defenses could prevent airborne intelligence gathering aircraft, such as RC-135 Rivet Joint, E-8C Joint-STARS or unmanned aircraft from flying close to the front lines and being effective. Moreover, advances in bi-static and millimeter wave radar could undermine the viability of stealth aircraft designs.

Those problems could potentially be offset by an RLV. "A military spaceplane armed with a variety of weapons payloads will be able to precisely attack and destroy a considerable number of targets while satisfying the requirement for precise weapons (i.e., circular error probably [CEP] of less than or equal to 3 meters)."

USAF's Air Combat Command appears to be embracing the spaceplane concept. The command's advanced program's division said last month that "we see the potential combat capability for [an RLV] with [intelligence, surveillance and reconnaissance] and precision engagement" features.

The white paper also tries to outline the application of such a system using an Afghanistan scenario. It would take 35 min. from launch in the U.S. for the system to be able to deliver munitions in Afghanistan. "Potential strikes include the use of hypersonic deep-Earth penetrators to take out Al Qaeda forces hiding in caves; the use of small-diameter bombs to take out Taliban troop concentrations, or even the use of low-cost autonomous attack systems [Locaas] to take out an Al Qaeda leader driving between cities," the study hypothesized.

The military spaceplane would use largely the same munitions employed by strike aircraft. They would be delivered using a system called the Common Aero Vehicle (CAV), essentially a guided shroud that protects the ordnance during hypersonic reentry and dispenses it over a target area. One advantage of this approach would be that the Air Force doesn't have to seek overflight rights over other countries since the CAV could reenter directly over a target.



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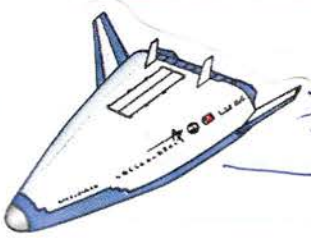

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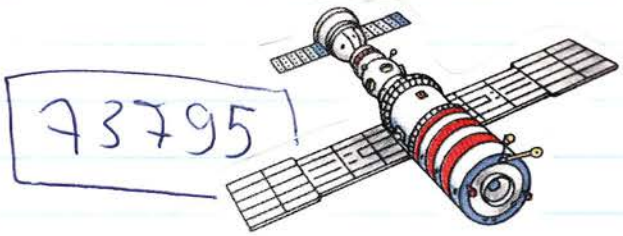

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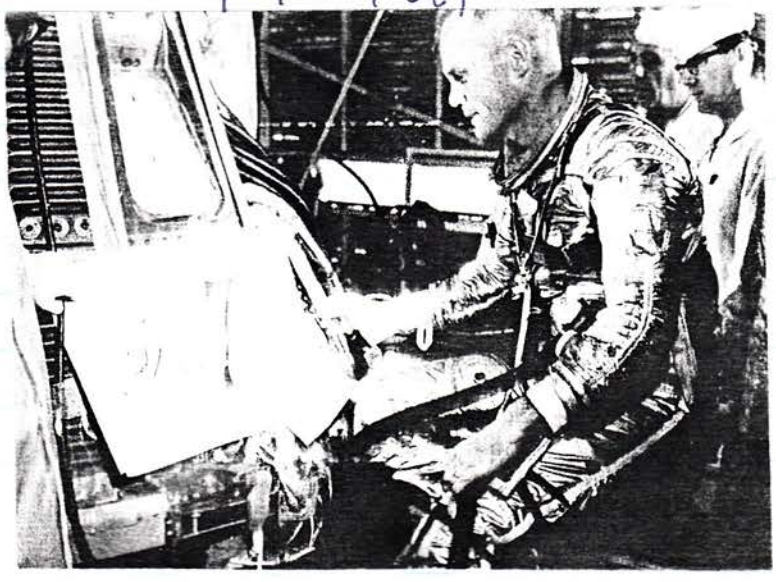

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FLORIDA TODAY : 04 FEBRUARI 2002.

PROPULSION RESEARCH TO OFFSET OTHER CUTS IN SPACE SCIENCE.

CAPE CANAVERAL - A mission to Pluto died again, but new propulsion systems got a boost in NASA's fiscal year 2003 budget, unveiled Monday. NASA cut its Outer Planets program, which includes the Europa Orbiter and New Horizons Pluto-Kuiper Belt. Both missions were under development and slated to fly in 2008 and 2006, respectively. NASA tried to kill the Pluto mission last year only to see Congress revive the project under a new name. O'Keefe said he will fight efforts by Congress to restore funding for the effort again. "My fondest hope is that the logic will be persuasive as well as the analysis we put into this," O'Keefe said. Pluto is the only planet in the solar system that has never been visited by a spacecraft. Late last year, Congress breathed new life into the Pluto program. However, Congress only provided $30 million while NASA said over $400 million more was needed to finish the mission. NASA axed the orbiting mission to Jupiter's icy moon Europa, citing ballooning costs. Instead, NASA's new administrator Sean O'Keefe said NASA should focus on a more efficient way to get to these distant places before spending money to develop the missions. "We are limited strictly by our cap to get from here to there in a span of time that is considered reasonable," O'Keefe told NASA employees. If NASA sent a probe today, O'Keefe said, it would take 11 years to get to tiny Pluto. Even then, the spacecraft would not orbit; it would just fly by and provide a few weeks worth of pictures and information. In response, the Department of Energy and NASA announced the Nuclear Systems Initiative in this budget request. As a part of this, NASA requested $46.5 million for nuclear electric propulsion and $79 million for nuclear electrical power-generation systems. "To me, this is NASA at its best, we're pioneering the future," said Ed Weiler, NASA associate administrator for space science. Safety will be a top concern for the nuclear effort, but Weiler emphasized NASA has already invented power modules that withstand any disaster. NASA has flown about 20 missions, including Viking and Voyager, using nuclear technology. The Casini mission to Saturn drew substantial protests for its use of a radioactive power plant. But many of the current missions accelerate for only a short time after getting into space. The spacecraft usually reaches its destination by coasting the rest of the way using that initial boost and occasionally swinging around planets to gain momentum. "That's exploring the west by going in covered wagons," Weiler said. He said NASA needs the equivalent of steam engines to get to their destinations faster. "It is welcome and positive news that despite the setback to the Pluto and Europa missions, the proposed budget is supportive of planetary exploration," Planetary Society President Wesley T. Huntress said. "With all the pressures on the NASA budget, especially in the troubled space station program, we take heart with the commitment to the established planetary exploration programs." A recent survey conducted by the nonprofit Planetary Society showed people most want to see NASA send missions to Mars, Earth's moon, Europa, Pluto and Jupiter's volcanic moon Io, in that order.

737 97

FLORIDA TODAY : 05 FEBRUARI 2002.

FOUR SITES CONSIDERED FOR LANDERS.

737 98

CAPE CANAVERAL - When two little robots fly to Mars in 2003, they won't just plop down on any old plot of red dirt. NASA takes years to plan the landing sites for its rover missions. A committee has whittled down the number of potential landing sites for the pair of rovers from 200 to four. In late March, NASA's landing site steering committee will make its recommendation for two sites, and in May, NASA headquarters will put its stamp of approval on the sites. The $700 million Mars Exploration Rovers will launch from Cape Canaveral Air Station in May and June 2003. NASA's last successfully landed on Mars in 1997 with the Pathfinder lander and Sojourner rover. For that mission, the space agency asked the science and engineering community their opinions on where to land. The Mars Exploration Rovers are taking even more community input. "We don't want it to be in a smoke-filled room," said Matt Golombek, Mars exploration program landing site scientist at NASA's Jet Propulsion Laboratory in Pasadena, Calif. NASA's plan calls for the rovers to find evidence of past water because that could show whether the area was ever suitable for life. "If we see a huge fossil, we'll take a picture of that, but the likelihood of that is pretty small," said Joy Crisp, project scientist for the rovers. In 1999, the Mars Global Surveyor spotted what may be gulleys along a slope. The gulleys may have been caused by recent water flows. This would seem like an ideal spot to study, but the rovers will never see it. First of all, it is too dangerous. Second, the rovers will only move 1 kilometer (six-tenths of a mile) in their lifetime, so if they land far away from the gulley, there's a chance they could never see them. In no particular order, here's a peek at what the next pair of rovers might feast their mechanical eyes on:

Hematite in Terra Meridiani:

Mars Global Surveyor, now orbiting Mars, has indicated that this southern highlands region might be populated with coarse-grained hematite material. Hematite typically forms after being deposited by water in a sedimentary process.

Gusev crater:

Scientists have studied this crater for years. A single channel, perhaps formed by water, enters into the crater. Another channel goes out. The crater floor appears to be smooth from materials deposited, by what might be water.

Melas Chasma:

This chasma sits inside one of Mars' most distinctive features, the Valles Marineris canyon system. Walls of the canyon are about six miles high. The Mars landers can't land on a dime. Planners map out ovals 60 miles long by 12 miles wide that the spacecraft will land on. "The ellipse fits nicely inside there so there's no worry about hitting the (canyon) walls," Golombek said.

Isidis Planetia:

The landing ellipse sits on the edge of an ancient impact basin, so it's smooth and flat. Nearby mountains stretch up for miles. If there was water, it would have drained off the mountains and deposited material in this region. However, this area tends to be rockier than the others, which could be a problem for the bouncy landing.

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Meteorieten van Mars gevonden

Wetenschappers hebben op de zuidpool en in woestijngebieden vijf meteorieten gevonden die afkomstig zijn van Mars. De stenen spreken tot de verbeelding omdat hun chemische samenstelling iets kan verklaren over de geschiedenis van de Rode Planeet. Ook kunnen deskundigen de mogelijkheid onderzoeken of er in een ver verleden water en leven waren op Mars.

Het gaat eigenlijk om zes stenen, maar aangenomen wordt dat twee daarvan van dezelfde meteoriet afkomstig zijn. Een daarvan weegt 13,7 kilo en is daarmee de op een na zwaarste Marsmeteoriet die ooit is gevonden. De stenen lagen op Antarctica en in de woestijnen van de Sahara en Oman. Hun donkere kleur is in sneeuw en zandvlaktes makkelijker te zien.
De stenen zijn vermoedelijk van Mars afgeraakt toen daar lang geleden een komeet te pletter sloeg, zo denken wetenschappers. Na hun reis door de ruimte kwamen ze op aarde terecht. Onderzoekers maken uit de structuur en massa van de stenen op dat ze van Mars moeten komen. De stenen zijn vermoedelijk anderhalf miljard jaar oud. Dat is betrekkelijk jong in vergelijking met andere meteorieten, die voor het merendeel rond de 4,5 miljard jaar oud zijn.

Jaarlijks kruisen 20.000 meteorieten de baan van de aarde en veel daarvan verbranden in de dampkring. Het aantal nu bekende meteorieten dat van Mars afkomstig is, is nu 24.

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D.D.L.
05-02-2002.

APNEWS : 06 FEBRUARI 2002.

NASA'S MARS ODYSSEY SACECRAFT DEPLOYS MAIN ANTENNA.

73800

PASADENA -The Mars Odyssey spacecraft successfully extended the main communications antenna it will use to send science data to Earth, NASA officials said Wednesday. Engineers received confirmation late Tuesday that the boom holding the 4.3-foot wide dish had deployed. The spacecraft will use the parabolic antenna to transmit the scientific data it gathers, including images, back to Earth at 110,000 bits per second. In later years, the satellite will use the antenna to relay to Earth data gathered by other probes both in orbit around Mars and operating on its surface. Odyssey, which started its $297 million journey on April 7, will map the mineral and chemical makeup of the surface of Mars and hunt for large deposits of water when its science work begins later this month.

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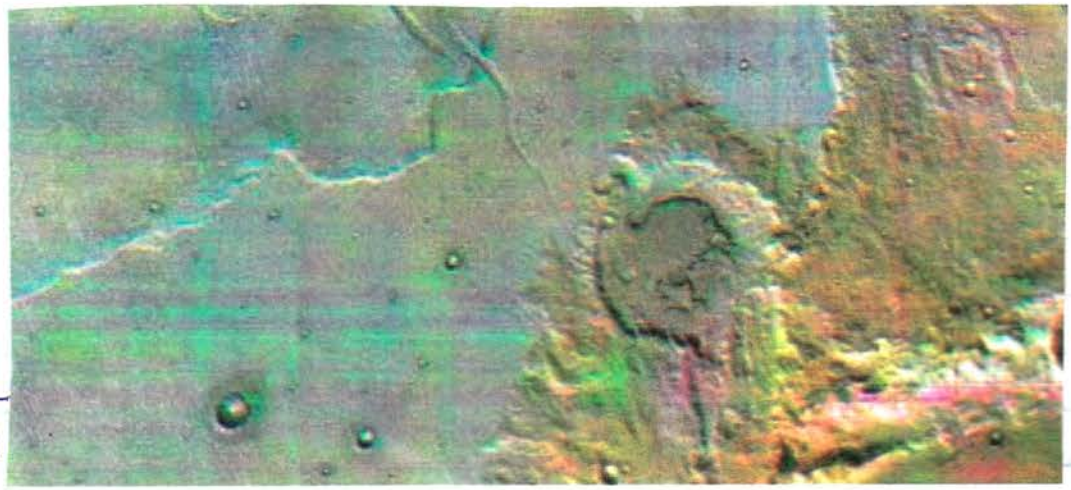

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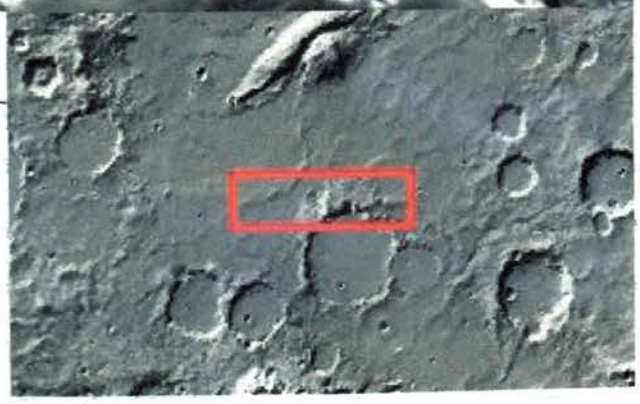

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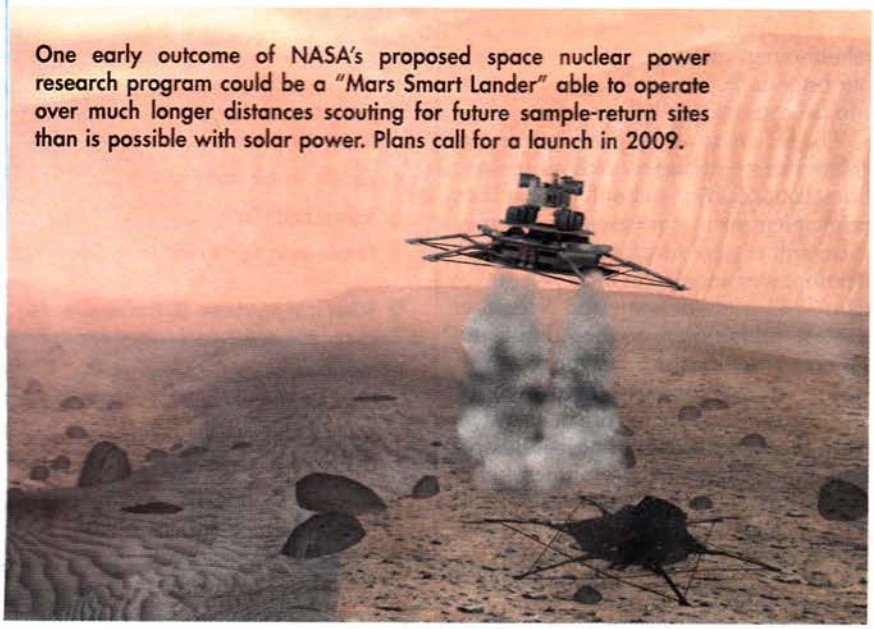
NASA Dodges Bullet In Fiscal '03 Budget

FRANK MORRING, JR./**WASHINGTON**



One early outcome of NASA's proposed space nuclear power research program could be a "Mars Smart Lander" able to operate over much longer distances scouting for future sample-return sites than is possible with solar power. Plans call for a launch in 2009.

NASA's $15-billion Fiscal 2003 budget request marks a second chance from White House managers for an agency that still can't say for certain just how much it will cost to complete even a truncated version of the International Space Station.

Although the Bush Administration didn't give NASA a funding increase, it didn't whack away at it either, as some had predicted with the war on terrorism driving the federal budget deeper into the red.

"THEY WERE LUCKY, given the environment overall nationally," said one congressional staffer who tracks space issues.

Instead, NASA received a five-year, $950-million down payment on a space nuclear power research program that could enable much more ambitious planetary science missions than are possible with today's chemical rockets. And its faltering program to study the outer planets was replaced with a "New Frontiers" program—based on the faster-better-cheaper Discovery and Explorer missions—that caps future planetary probes at a relatively generous $650 million each.

That is more than the $500-million cap imposed on the "New Horizons" mission to Pluto and the Kuiper Belt. The White House does not support that mission, but it has won some funding on Capitol Hill. NASA officials said last week that if Congress pulls the plug the mission could be resurrected as a "New Frontiers" effort, or restructured to utilize nuclear power developments later in the decade.

The first real Bush budget request for civil space reflects the Administration's focus on management and commercialization. The ISS must meet as-yet-unspecified metrics to grow beyond 2004, and the space shuttle fleet is still down for privatization, although details of how that will happen also are unspecified. Beyond that, the Bush space policy so far doesn't seem all that different from Clinton's.

"In a $15-billion portfolio our task is to explore and discover, based on a science and technology agenda that reflects a series of targeted priorities," said Administrator Sean O'Keefe in his first public NASA budget briefing. Those priorities include getting the ISS to a three-person "core complete" configuration in a fashion that will allow expansion to a larger crew later; identifying and tackling "technological limitations" on what NASA can do with programs like the space nuclear power effort, and meeting President Bush's management reform objectives.

O'Keefe, who has taught public administration when not serving in Republican governments, likes to point out that Bush is the first president with an advanced business degree. As a White House Office of Management and Budget (OMB) official, the new NASA administrator helped draft the management agenda Bush is enforcing across the federal government, and the Fiscal Year 2003 NASA budget suggests how that agenda will be applied in the civil space program.

Taking a "scorecard" approach to federal programs, the Bush White House rated only one NASA initiative as "effective"—the competitively awarded, cost-capped Discovery planetary exploration and Explorer astronomy/astrophysics missions. But the agency's outer planets effort was rated "ineffective" because of cost overruns and schedule slips. The New Frontiers program will follow the Discovery/Explorer model for planetary missions, with the $650-million cost cap. The outer planets effort was killed.

ALSO RATED "INEFFECTIVE" were the ISS program, which is suffering from a funding shortfall of at least $4.8 billion, and the program to develop safety upgrades for the space shuttle fleet, which has also suffered overruns and delays. As expected, O'Keefe will adopt many recommendations of the independent panel headed by former Lockheed Martin executive A. Thomas Young to straighten out the station program, including an overhaul of NASA's accounting structure to get an accurate understanding of just what it will cost to complete the station.

"This is an integrated activity for everything we do, and it has implications for lots of what we pursue," O'Keefe said. "We have an obligation to make sure we get it right, and to make sure the baseline is well established."

O'Keefe has also adopted the Young-panel recommendation that the number of shuttle flights be cut to four a year to support ISS. Other flights may be possible to meet the agency's scientific requirements, like the upcoming mission to service the Hubble Space Telescope. Despite the poor performance rating for the effort, budget documents stated shuttle safety upgrades work would be accelerated. But congressional Democrats cautioned the budget's details may not support that effort.

A quick-reaction study by the Democratic staff of the House Science Committee reported funding for shuttle safety and supportability cut by about $500 million in the next five years, with $300 million shifted from orbiter upgrades to upgrading and maintaining ground facilities. An expected $1-billion funding shortfall in shuttle accounts in the next five years was not addressed directly, with the shuttle privatization initiative held out as a possible bailout, according to the Democrats.

The budget left congressional staffers on both sides of the aisle scrambling for understanding, since it shifts some accounts from the programs where they have traditionally resided and incorporates institutional support costs that previously were listed separately. However, last week's budget briefings gave plenty of detail on the new nuclear power effort, which is designed to develop nuclear power sources for operations and propulsion in space.

IN FISCAL 2003 THE AGENCY, working with the Energy Dept. would spend $46.5 million for nuclear electric propulsion and $79 million for nuclear electric-power generation. According to Ed Weiler, associate administrator for space science, that money will be a down payment on a 10-year effort that will consume some $950 million over the five-year extended budget. The goal is to reactivate production of radioisotope thermoelectric generators (RTGs), which convert heat from the radioactive decay of plutonium 238 into electricity, and to start working on fission reactors for use in space.

There is one fueled RTG left in the U.S. inventory, a spare built for the Cassini mission to Saturn. One unfueled RTG also remains, and the parts for a third. Under the new program, the Energy Dept. would buy Pu-238 from Russia to fuel new RTGs, which have long been used for space probes that operate where solar energy is too weak for useful exploitation. The Fiscal Year 2003 budget calls for their use on a "Mars Smart Lander" to be launched in 2009 as a scout for future sample return missions, possibly operating for years instead of the months afforded by solar cells that eventually are obscured by dust from the planet's atmosphere.

The RTG research, to be managed at the Cleveland-based Glenn Research Center, will also examine Stirling cycle generators, which produce more power but have moving parts that may impact reliability in the long haul even though a Stirling generator has operated for eight years on the ground. Fission reactor research will be aimed at producing "tens of kilowatts" of power for a high specific impulse ion drive that would speed deep space probes to their targets much quicker than existing chemical systems. Use of such systems would allow orbital missions at the outer planets as well as faster trips to them, a factor that may influence the pending New Horizons Pluto mission.

Presently operating on an unrequested $30-million appropriation, the mission to fly by Pluto, Charon and a few Kuiper Belt objects could be resurrected as a New Frontiers mission if Congress drops the funding for it. Without nuclear power it must be launched in 2006 to take advantage of a gravity assist from Jupiter, and the timing will be close. Weiler said the first New Frontiers contract won't be awarded until next year, while the appropriated funds for New Horizons will run out before this fiscal year ends Sept. 30.

OVERALL THE BUSH BUDGET request would fund NASA at $15 billion in Fiscal Year 2002, plus another $117 million in federal retirees' costs. Human space flight, including ISS, the shuttle and expendable launch vehicles, would drop to $6.131 billion from the Fiscal Year 2002 level of $6.830 billion. Science, aeronautics and technology would go up to $8.844 billion, from $8.047 billion, with most of the growth in the Space Launch Initiative (SLI) effort to develop technology for an eventual shuttle replacement.

In a possible White House policy shift, the budget calls for cooperation between the X-38 program to develop a crew rescue vehicle (CRV) for ISS, and the SLI effort to build a new Crew Transfer Vehicle (CTV) that would take humans to and from orbit. When the station shortfall was detected the White House ordered NASA to fix it within the human spaceflight account, and specifically directed that the CRV effort be killed when funding ran out. Allowing the remaining CRV funds to be used in conjunction with previously off-limits SLI funding could lead to continued work on the CRV, which would be necessary to expand the station beyond the three-person crew now on board.

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Telescoop kijkt door kosmische stofdeeltjes

Britse astronomen hebben opnamen vrijgegeven van een telescoop die speciaal is ontworpen om door kosmische stofdeeltjes heen te kijken. De telescoop Gemini South staat op een berg in Chili op 2715 meter hoogte.

De telescoop kan tot in detail sterren waarnemen die zich achter kosmische wolken schuilhouden. Hij kan infrarood licht opsporen, net als de Gemeni North, die op Hawaii is gebouwd. De telescopen staan aan weerszijden van de evenaar en kunnen samen een soort panoramabeeld geven van de hemel in het noordelijk en zuidelijk halfrond.
De Gemini's hebben spiegels van acht meter doorsnee en kunnen lichtsignalen opvangen van melkwegen die miljarden lichtjaren van ons verwijderd zijn. De spiegels van de telescopen zijn ruim drie keer zo groot als die van de Hubbletelescoop, die zich in de ruimte bevindt en niet wordt gehinderd door het weer hier op aarde.

Een Britse onderzoeker noemde de eerste beelden van de Gemini South niet teleurstellend. Het ging onder meer om opnames van de melkweg Seyfert en van de regio Scorpius, waar sterren in ontwikkeling zijn. Nog nooit is dat deel van het heelal zo gedetailleerd in beeld gebracht. De Britten hebben toegang tot de telescoop in Chili omdat ze medefinancier zijn, zo meldt *The Independent*.

D.D.L. 22-01-2002.

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Composite Wings Readied For Installation on X-37

Michael A. Dornheim/Los Angeles

Boeing's Phantom Works has completed the wings for the X-37 experimental spaceplane, and transported them to the company's High Desert Assembly Integration & Test Facility in Palmdale, Calif.

The X-37 is to be placed in orbit by the space shuttle or another launcher and return to Earth to test spaceplane technologies such as thermal tiles and reentry profiles. Other technologies to be demonstrated include warm structure, open architecture avionics hardware and software, fault-tolerant autonomous operations, high-energy-density rechargeable batteries, calculated air data system and phase change brakes.

The wings are made of graphite fibers in a bismaleimide matrix, and the composite is usable at 450F, about 100F greater than the aluminum structure of the shuttle, which means that the thermal tiles can have lower insulation properties. The 15-ft.-span wings were made at the Phantom Works' Huntington Beach, Calif., facility. The 27.5-ft.-long fuselage was made in St. Louis and had already been shipped to Palmdale.

The X-37 is a cooperative project involving NASA, Boeing and the Air Force. Managers sought extra funding from NASA's Space Launch Initiative and the Air Force Space Command's Space Operations Vehicle efforts, but were rejected by both organizations (*AW&ST* Sept. 10, 2001, p. 36). The project is about 2.5 years behind the original schedule set in 1999, which had a drop test from a NASA B-52 at the end of 2001 and space flight in 2002. A number of changes hit the project, and now the drop test is set for the beginning of 2004; the space flight is undetermined (*AW&ST* Aug. 6, 2001, p. 57).

X-37 wings have been completed and sent to Palmdale, Calif., for assembly with the fuselage (above). Artist's concept shows the X-37 conducting experiments in orbit before reentry (right). A flight date has not yet been chosen.

STERRENKIJKEN

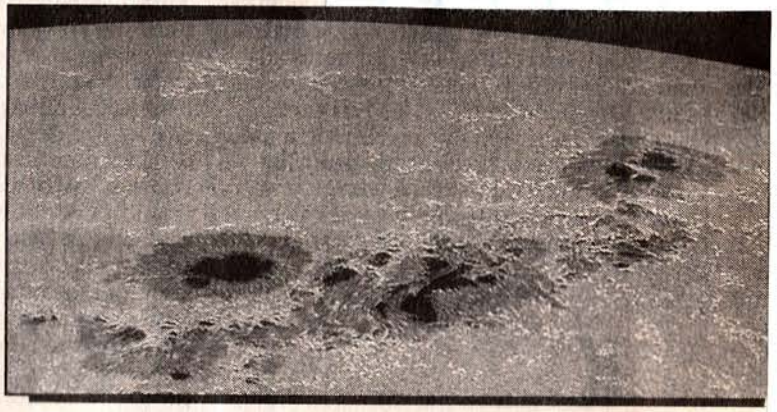
DE TOEGIFT VAN DE ZON

Onze dagster heeft het op de heupen. Na enkele woelige jaren leek de zon eindelijk wat gas terug te nemen, maar de rust bleek van korte duur. Sinds kort bruist ze weer van de energie en beleeft de zonneactiviteit een tweede piek. Wat de oorzaak ook moge zijn, dankzij de nieuwe oprispingen kunnen we weer uitkijken naar poollicht.

Eens in de elf jaar raakt de zon van slag. Donkere vlekken tekenen haar gelaat en hevige uitbarstingen in de zonneatmosfeer laten zelfs de aarde niet onberoerd. Al die tomeloze energie vindt zijn oorsprong diep in het inwendige van de zon. Door het samensmelten van atoomkernen wordt daar iedere seconde vijf miljoen ton aan waterstof omgezet in licht en warmte. Al die energie baant zich een weg naar het oppervlak, een moeizame reis van zevenhonderdduizend kilometer. In de buitenste tweehonderdduizend kilometer, de zogeheten convectiezone, verloopt het energietransport chaotisch. Hete gasbellen borrelen naar boven, terwijl op andere plekken koelere materie naar beneden stroomt. Het kolkende gas wekt krachtige magneetvelden op die lokaal het warmtetransport van onderop blokkeren. Er ontstaan dan zonnevlekken: koele gebieden die vanwege hun lagere temperatuur donker afsteken tegen de omgeving. Magneetvelden die op het ziedende zonsoppervlak in elkaar verstrikt raken, kunnen gigantische erupties van elektrisch geladen deeltjes veroorzaken. Met honderden kilometers per seconde worden ze de ruimte in geblazen en bereiken, mits de deeltjes in de goede richting worden weggeschoten, na een paar dagen de aarde. Daar aangekomen beuken ze op het magneetveld van onze planeet en dringen door tot de bovenste lagen van de dampkring. Luchtmoleculen worden tot gloeien gebracht en de bontgekleurde stralen en banden van het poollicht zetten de hemel in brand. Normaal beperkt het noorderlicht zich alleen tot de poolstreken, maar bij hevige zonne-erupties kan het ook tot gematigde breedten doordringen. Zo leek de lucht op 6 april 2000 ook boven Nederland in lichterlaaie te staan. Een jaar later, in de nacht van 11 op 12 april 2001, was het weer raak.

De activiteitscyclus van onze dagster laat zich aflezen aan het aantal zonnevlekken. Sinds medio jaren negentig van de vorige eeuw liep hun aantal gestaag op en bereikte in de zomer van 2000 een hoogtepunt. Daarna zette de daling in maar al gauw lieten tellingen van zonnevlekken weer een stijgende lijn zien. Eind vorig jaar werd een tweede maximum bereikt, met slechts enkele procenten minder zonnevlekken dan tijdens de eerste piek. Ook de toegenomen radiostraling van de zon wijst erop dat onze dagster nog geenszins van plan is het rustiger aan te doen.

Dubbele pieken rond het hoogtepunt van de zonnecyclus zijn niet ongebruikelijk. Ze traden ook op bij de twee vorige zonnevlekkenmaxima in 1979 en 1989, maar wel minder uitgesproken dan nu. Waaraan we deze toegift na het eerste maximum hebben te danken, is nog niet duidelijk. De zonnecyclus is geen mooie op- en neergaande lijn, maar verloopt met horten en stoten. Bovendien lopen meerdere cycli door elkaar. Zo is er een 27-daagse cyclus, veroorzaakt door de rotatie van de zon, en een tot dusverre onverklaarde periode van 155 dagen. Wel valt op dat de twee pieken rond de afgelopen drie maxima telkens achttien maanden uit elkaar liggen. De oorzaak daarvan ligt ergens in het turbulente binnenste van de zon verscholen. Gasstromen in de convectiezone veroorzaken trillingen op het zonsoppervlak die door satellieten in de ruimte met uiterste precisie worden geregistreerd. Net als geologen met behulp van aardschokken het inwendige van onze planeet peilen, zo gebruiken astronomen deze golven om tot in het binnenste van de zon door te dringen. Wat blijkt? Aan de basis van de convectiezone draait het gas met een andere snelheid rond de zon dan in de lagen direct daaronder. Bovendien schommelt de stroomsnelheid van de aangrenzende gaslagen in zestien maanden op en neer. Dat is ongeveer even lang als de tijd tussen de twee pieken rond een zonnevlekkenmaximum en dus lijkt er een verband tussen beide te bestaan. Hoe de vork precies in de steel zit is nog niet duidelijk, iets wat ook voor het ontstaan van de elfjarige zonnecyclus geldt. Mysterie of niet, iedereen die tot dusverre het poollicht heeft gemist kan dit jaar en in 2003 in de herkansing.



Een actief gebied met zonnevlekken. De totale lengte van het complex is tien keer de diameter van de aarde.
foto Dutch Open Telescope

FLORIDA TODAY : 19 FEBRUARI 2002.

PROBE SEES HYDROGEN IN PEEK AT MARS

CAPE CANAVERAL - NASA took the Mars Odyssey spacecraft for a test run Monday for five orbits' worth of science measurements. So far, results indicate hydrogen in the surface of the Martian southern hemisphere. "It's beautiful," said William Feldman, a scientist with Los Alamos National Laboratory who operates the neutron spectrometer instrument on Odyssey. "Everything is very preliminary because we don't have enough to make a map yet." A full map of Mars' surface elements will take about a week. Hydrogen is important because it is a key element in water, which is crucial for life. As long as everything went smoothly, NASA planned to start its official mapping phase Monday evening, Feldman said. Odyssey aims to get beyond the red dirt and figure out the chemical makeup of the Martian surface during 917 days of science mapping. Scientists expect there are vast, hidden stores of water below the dry, dusty surface. Odyssey left Earth on a $300 million mission from Cape Canaveral Air Force Station in April. It arrived at Mars in late October. The spacecraft has spent the past several months braking into the proper circular orbit and getting ready for the science operations to begin. On Thursday, the instrument took a peek at the planet for an orbit. Feldman found the area from about 60 degrees south latitude to the south pole appears to have hydrogen on or near the surface. "It looks like it's pretty loaded with hydrogen," he said. The instrument measures hydrogen only within three feet of the surface. Last fall, when the instrument was turned on for a single orbit, researchers thought they spotted hydrogen near the north pole. Now, the area around the north pole and down to 60 degrees north latitude appears to be covered with a carbon dioxide, or dry ice, frost. "Hydrogen can exist in many ways, but the most abundant on the Earth, anyway, is just plain old water," Feldman said. "It's not water, it's ice on Mars." Feldman said he will need data from other instruments on the spacecraft to confirm the early results. Scientists already know there is water on Mars -- in ice that caps the north pole, frost seen at high latitudes and wispy clouds crowding the planet's highest peaks. NASA's Mars program includes plans for advanced robotic rovers that will land and dig into the surface. Maps produced by Odyssey will guide those rovers to spots that appear rich in water today -- or that were soaked in the past. Odyssey's Thermal Emission Imaging System will turn on today and check its instruments. One of the imaging system's tasks during the next two to four weeks will be to collect data on four potential landing sites for NASA's 2003 Mars Exploration Rovers. NASA plans to pick two landing sites in May. The infrared instrument sniffs out minerals on the Mars surface. "The minerals leave a fingerprint of what's happened on the surface the first couple billion years," said Phil Christensen, who runs the instrument from Arizona State University. "If there were ever hot springs or lakes on Mars, the water is long gone, but they would have left behind tell-tale minerals of what was there." NASA planned to open the door for the probe's Gamma Ray Spectrometer instrument late Monday. If everything went well, the team would have to wait a few days for the instrument to cool down enough so it could be turned on, said William Boynton of Arizona State University. NASA plans to announce Odyssey's early findings during a March 1 news conference.

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Huygens communications test clears Titan mission

The vital "Doppler shift" communications test between the European Space Agency's Huygens Titan lander and NASA's Cassini Saturn orbiter has been successful, ensuring that data from the Saturnian-moon lander will be received by Cassini during its descent into Titan's atmosphere and for at least 15 minutes on the surface in early 2005. Earlier, it had been discovered that due to a design error, data from Huygens would have been lost due to the effect on the Doppler shift by the relative speeds of the two craft.

The Cassini-Huygens mission plan involved new communications paramaters being established for the two spacecraft. Last year, it was discovered that due to a serious oversight by the design team, there could have been a disastruous loss of communications between Huygens and its US Saturn-orbiter mothership, Cassini which will deploy Huygens to land on the moon, Titan. It was discovered that wrongly-estimated paramaters, communications between the two craft would break down due to the Doppler shift caused by the different speeds of the craft relative to each other. ESA-NASA teams at NASA's Goldstone station in California, the European Space Operations Centre in Darmstadt, Germany, and the Cassini mission operations centre at the Jet Propulsion Laboratory, California, will perform a communications dress rehearsal of the unique Huygens probe's mission.

Signals will be transmitted to the Huygens receiver on Cassini using a specially-developed programme. The probe's computers should format the decoded data and send it in packets to computers on Cassini for transmission to Earth. This will simulate the very small shift in frequency of the probe's signals that will be caused by the continuously changing positions of the two spacecraft and their relative speed - the Doppler shift.

73811

Satelliet zorgt voor problemen

LONDEN — Een peperdure en ultramoderne satelliet dreigt in de ruimte verloren te gaan. Er zijn problemen met een van de motoren van de kunstmaan, waardoor hij niet in de gewenste positie kan komen. Technici beraden zich nu op een oplossing. Het wordt niet uitgesloten dat de Space Shuttle er op af wordt gestuurd, zo meldt de BBC.

Het gaat om de satelliet TDRS-I, die de communicatie moet verzorgen tussen de Space Shuttle, het internationale ruimtestation ISS, de Hubble-telescoop en andere satellieten. De TDRS (Tracking and Data Relay Satellite) werd twee weken geleden in een Atlas-raket gelanceerd vanaf Cape Canaveral in Florida. Het gevaarte kostte 825 miljoen dollar.(ANP)

Spits: 25-03-'02

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SPEUREN NAAR EEN TWEEDE AARDE

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Het is hoogseizoen voor planetenjagers. Aan de lopende band ontdekken ze planeten rond andere sterren dan de zon. Maar tweelingen van de aarde zitten er nog niet bij. Wanneer kunnen we de eerste kiekjes van een planeet zoals de onze verwachten?

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Het zoeken naar nieuwe werelden is een industrie op zich. Momenteel lopen wereldwijd een stuk of dertig projecten, gericht op het opsporen van planeten rond andere sterren. En niet zonder succes. Werd in 1995 het eerste exemplaar gevonden, ruim zes jaar later staat de teller al op 75. Zeven sterren worden zelfs door twee of drie planeten vergezeld. Toch is nog geen enkele planeet buiten het zonnestelsel rechtstreeks waargenomen.

Sterrenkundigen leiden hun bestaan af uit minieme schommelingen in de beweging van de moederster. Als de zwaartekracht van een onzichtbare begeleider de ster een klein beetje heen en weer trekt, veroorzaakt dat minuscule kleurveranderingen in het sterlicht. Astronomen kunnen daaruit opmaken op welke afstand de planeet rond zijn 'zon' draait, hoe zwaar hij is en hoe lang een omloop duurt. Deze techniek is het gevoeligst voor reuzenplaneten. Zij trekken namelijk harder aan de ster dan lichtgewichten zoals de aarde, waardoor de schommelingen van de ster gemakkelijker meetbaar zijn. Geen wonder dat alle tot dusverre ontdekte 'exoplaneten' tot de gewichtscategorie van Jupiter behoren, de grootste planeet van ons zonnestelsel. Vreemd genoeg blijkt een groot deel van deze planeten in zeer nauwe banen rond zijn ster te cirkelen. Deze 'hete Jupiters' kunnen daar niet zijn ontstaan. Alleen op grote afstand van een ster is het koud genoeg om de lichte gassen waaruit Jupiterachtige objecten bestaan, tot planeten te laten samenklonteren. Vermoedelijk zijn de planeten in deze kille buitenregionen geboren maar naderhand langzaam naar binnen gespiraliseerd. Andere exoplaneten beschrijven geen mooie cirkels zoals hun soortgenoten in het zonnestelsel, maar langgerekte ellipsbanen. In beide gevallen is er voor planeten zoals de aarde die op comfortabele afstand van de ster hun cirkelbanen trekken, geen plaats. Vroeg of laat komen ze met hun uitzwenkende grotere broers in botsing.

Impressie van Darwin, op zoek naar sporen van leven op verre planeten.
foto Alcatel Space Industries

Toch worden de laatste tijd ook steeds meer planeten in 'normale' banen ontdekt. Neem bijvoorbeeld het stelsel van 47 Ursae Majoris. Twee planeten vergezellen deze ster. Eén begeleider is tweeëneenhalf keer zo zwaar als Jupiter en cirkelt in drie jaar rond de ster. De tweede planeet heeft driekwart van het gewicht van Jupiter en doet iets meer dan zeven jaar over een omloop. In ons eigen zonnestelsel zouden beide planeten ergens tussen Mars en Jupiter hun baantjes trekken. De overeenkomst met het koppel Jupiter-Saturnus is treffend.
In twee stelsels, met ieder twee planeten, heeft de ene begeleider precies twee keer zoveel tijd nodig om zijn baan te doorlopen dan de andere. Dergelijke baanresonanties kennen we ook uit ons eigen zonnestelsel. Ze vormen een extra bewijs dat de exoplaneten daadwerkelijk bestaan, ook al hebben we ze nog nooit gezien. Rond de ster HD 28185 draait zelfs een begeleider op precies dezelfde afstand als de aarde tot de zon. Ook de planeet rond HD 114783 bevindt zich in de zogeheten bewoonbare zone. Daar, op de juiste afstand van de moederster, kan water in vloeibare vorm en dus leven voorkomen. Of de begeleiders, beide van het Jupitertype, leven herbergen is twijfelachtig. Maar op grote manen rond de planeten zouden heel goed omstandigheden zoals op aarde kunnen heersen.

Veel meer dan de massa en de omlooptijd van de nieuw ontdekte werelden weten we niet, maar er is één uitzondering. De begeleider van de ster HD 209458 blijkt een atmosfeer te hebben. Omdat wij tegen de rand van het systeem aankijken, schuift de planeet tijdens zijn omloop eens in de drieëneenhalve dag voor de ster langs. Er treedt dan een bedekking op. Vorig jaar november maakte een team sterrenkundigen onder leiding van David Charbonneau van het California Institute of Technology bekend dat zij bij een dergelijke overgang sporen van een atmosfeer hadden ontdekt. Waarnemingen met de Hubbe ruimtetelescoop lieten zien dat tijdens de overgang een klein beetje sterlicht werd weggefilterd door natriumatomen. Die moeten zich in de dampkring rond de planeet bevinden. De hoeveelheid natrium bleek minder dan verwacht, wat zou kunnen wijzen op de aanwezigheid van wolken.

Voorlopig is dit soort onderzoek nog afhankelijk van toevalstreffers. Ook liggen lichte, aardachtige planeten nog buiten het bereik van de detectiemethoden, maar de techniek staat niet stil. De modernste detectoren kunnen planeten opsporen die nog lichter zijn dan Saturnus. Naar verwachting komen over niet al te lange tijd objecten uit de Uranus en Neptunus-cate-

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gorie in zicht. Uiteindelijk hopen de sterrenkundigen de exoplaneten letterlijk in het vizier te krijgen. Gemakkelijk is dat niet, gezien het extreme verschil in helderheid tussen de ster en een begeleidende planeet. Alsof je van een afstand van duizend kilometer vlak naast een vuurtoren een kaars moet zien te onderscheiden. Begin januari presenteerde Michael Liu van de Universiteit van Hawaii op de 199e bijeenkomst van de American Astronomical Society opnames van een bruine dwerg dicht bij de zonachtige ster 15 Sge. Bruine dwergen zijn uiterst zwakke objecten, te licht om als volwaardige ster door het leven te gaan. Liu maakte gebruik van de 8,1 meter Gemini-North telescoop en de 10 meter Keck telescoop op Maua Kea in Hawaii. Beide instrumenten zijn uitgerust met 'adaptieve optiek', een flexibele spiegel in de lichtweg van de telescoop waarmee je kunt compenseren voor storende trillingen in de aardse atmosfeer. Met adaptieve optiek ziet een telescoop bijna net zo scherp als een kijker in de ruimte. Wat nu lukt bij een bruine dwerg moet binnenkort ook mogelijk zijn met pas gevormde reuzenplaneten rond nabije sterren, aldus Liu en zijn collega Ray Jayawardhana van de universiteit van Californië

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Toch zullen de astronomen het uiteindelijk hogerop moeten zoeken. Zowel in Europa als Amerika bestaan er plannen om aan elkaar gekoppelde telescopen die samen een gigantisch instrument vormen, in een baan rond de zon te brengen. Dergelijke interferometers zouden binnen twintig jaar de eerste kiekjes van aardachtige planeten moeten maken. Bovendien speuren ze in hun atmosferen naar zuurstof en andere tekenen van leven. Darwin is zo'n ambitieus project, een eskader van zes telescopen die in formatie door de ruimte vliegen. Of het peperdure instrument inderdaad rond 2015 de ruimte ingaat, zal nog moeten blijken.

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05-02-2002.

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Impressie van de planeet rond de ster HD209458. In 2001 ontdekte de Hubble ruimtetelescoop bij deze planeet sporen van een dampkring.

19865

Shuttle Work Shifted As Pegasus Launched

CRAIG COVAULT/**KENNEDY SPACE CENTER**

A73819

Orbital Sciences Corp. and the NASA space science program scored a significant Pegasus mission success here last week, while the Kennedy center itself was given a major new role for long-term modification and maintenance of space shuttle orbiters.

Both the $85-million Pegasus mission and orbiter modification decisions were time-critical, coming after substantial delays.

NASA's decision to move Orbiter Major Modification work from Boeing's Palmdale, Calif., facility to Kennedy will result in transferring the equivalent of 235 jobs to the Florida launch site. It also should trim about $30 million from each OMM cycle performed on each of the four orbiters in sequence on a continuing basis.

Initiating upgrades on Discovery, such as installation of a new glass cockpit, has been stalled for six months as NASA debated whether to pull the shuttle modification work out of Palmdale, where it has been done for 20 years by a mix of Boeing and United Space Alliance employees.

NASA and contractor personnel have been pressing for a decision to begin that work. Discovery's teardown and modification will not be able to start here until midsummer, and it will keep Discovery from flight operations until late 2004. The new Kennedy jobs to perform the Discovery work—followed by a similar cycle on Endeavour, then again on Atlantis and Columbia—will now all involve United Space Alliance personnel. The company will hire as many Palmdale employees as possible.

OMM periods are not trivial. They require the complete teardown of orbiters for inspection and modifications that keep them out of service for at least 18 months. Both Boeing and California officials generally opposed the shift to keep the jobs in that state. But NASA opted for the change to save costs and reduce the risk involved in transporting the orbiters between Palmdale and Kennedy on Boeing 747 shuttle carrier aircraft.

Politics also was a factor. New NASA Administrator Sean O'Keefe flew to Tallahassee, Fla., to personally and publicly inform Gov. Jeb Bush about the decision.

The change follows an earlier Boeing decision to pull about 1,000 unrelated space jobs out of other California facilities and also shift them to Kennedy and Houston.

The Feb. 5 launch here of a Pegasus XL booster carrying a long-delayed NASA Goddard/University of California-Berkeley solar spacecraft marks another time-critical event. The flight was also the first major OSC success after Pegasus and Taurus booster failures last year.

Launch of the 645-lb. High-Energy Solar Spectroscopic Imager (Hessi) satellite from a Lockheed L-1011 had been delayed for 19 months owing to both booster and spacecraft issues.

The spacecraft is to take unique high-resolution images of solar flares in X-ray and gamma-ray wavelengths. While other spacecraft can capture solar flares after they have happened, Hessi will image the specific particle and plasma mechanisms that make up these individual gargantuan explosions on the Sun. But it's necessary to get the spacecraft aloft as soon as possible so that it can image flares during the solar maximum, or high point in solar activity, which occurs only every 11 years. Every day of additional delay would have cut into Hessi's science return because solar activity is decreasing.

Hessi was originally set for launch in July 2000 to take advantage of the peak flare activity. But it missed that opportunity when it was seriously damaged at the Jet Propulsion Laboratory by a malfunctioning shaker table that imparted double the planned vibration test loads. Pegasus issues further delayed launch. As a result, Hessi has missed about 1,000 of the 2,000 flare events it otherwise would have imaged. Its planned two-year life, however, should still allow it to image at least 1,000 flares, Hessi managers said.

Orbital Sciences L-1011 "Stargazer" aircraft carrying a Pegasus XL launch vehicle mounted with the Hessi spacecraft is readied at Cape Canaveral's "Skid Strip" airfield. The Feb. 5 mission marked a major success for OSC.

The Orbital Sciences launch team at Kennedy and the seven-member L-1011 aircraft crew were able to smoothly recycle from an initial launch abort 2 min. before drop, when a radio communications problem developed on the aircraft. The problem was cleared as the aircraft was maneuvered on a racetrack course back to the planned launch point at 39,000 ft. about 75 mi. off Satellite Beach, Fla., south of Cape Canaveral. The Pegasus was dropped on the second attempt at 3:58 p.m. EST, and the three-stage vehicle fired to place Hessi in its planned 373-mi. orbit inclined 38 deg.

19866

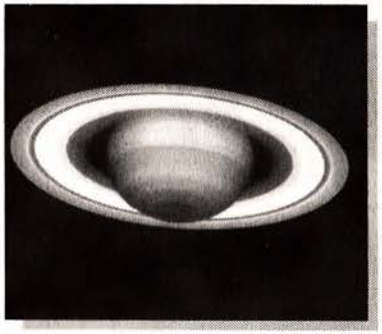
STERRENKIJKEN

SPELEN MET STERLICHT

De Hubble ruimtetelescoop krijgt concurrentie. Om haarscherpe beelden van de kosmos te maken hoef je voortaan niet meer de ruimte in. 'Adaptieve optiek' maakt het mogelijk om hinderlijke trillingen in de dampkring te corrigeren. Steeds meer 'aardse' telescopen worden ermee uitgerust, met verbluffende resultaten.

Twinkelende sterren mogen bij verliefde paartjes romantische gevoelens oproepen, voor sterrenkundigen zijn ze een bron van ergernis. Het verschijnsel heeft niets met de sterren zelf te maken, maar ontstaat in de aardse atmosfeer. Vele lichtjaren reist het sterlicht vrijwel ongehinderd door de ruimte, maar in de laatste kilometers gooit de dampkring roet in het eten. Opstijgende en dalende luchtbellen van verschillende temperatuur buigen het licht een klein beetje af, waardoor de sterren lijken te flikkeren. In de telescoop springt het sterbeeldje razendsnel heen en weer en vormt een trillend vlekje. Alles wordt wazig en van fijne details is niets meer te bespeuren.

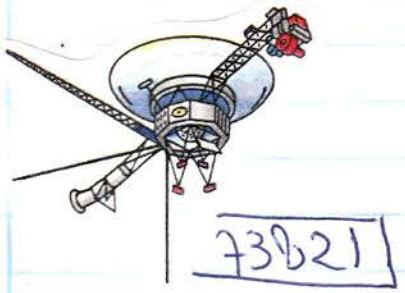
Om een scherper beeld te krijgen, zoeken astronomen het hoger op. Boven in de atmosfeer is de luchtonrust veel minder en dus vind je sterrenwachten tegenwoordig op hoge bergtoppen. Zo staat de grootste telescoop ter wereld, de tien meter Keck-telescoop, op de 4200 meter hoge vulkaantop Maua Kea in Hawaii. Nog hoger, in de ruimte, is er helemaal geen lucht meer die het beeld kan vertroebelen. Daarom draait sinds 1990 de Hubble ruimtetelescoop rond de aarde die maar liefst tien keer scherper kan kijken dan zijn aardse tegenhangers. Maar ruimtetelescopen zijn peperduur en bovendien is de Hubble met zijn spiegel van 2,4 meter een bescheiden middenmoter onder de sterrenkijkers. Want behalve beeldscherpte gaat het in de sterrenkunde ook om lichtsterkte. Hoe groter de diameter van een telescoopspiegel, hoe meer licht het instrument kan opvangen, en hoe zwakker en verder weg de objecten die het kan waarnemen. Reden waarom sterrenkundigen

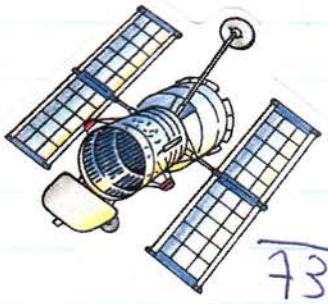


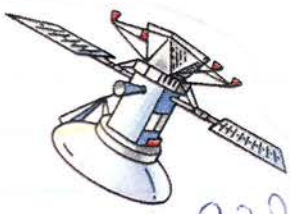
Opname van Saturnus gemaakt met de adaptieve optiek van de Very Large Telescope. *foto ESO*

al jarenlang broeden op technieken om met aardse reuzentelescopen een optimale beeldscherpte te bereiken. Het toverwoord is adaptieve optiek. Dit systeem bestaat uit een klein flexibel spiegeltje dat zich in de lichtweg van de telescoop vlak voor de detector bevindt. Het spiegeltje wordt voortdurend zodanig verbogen dat het de vervorming van het beeld door de atmosfeer corrigeert. Daarvoor moet je wel eerst meten hoe het sterlicht precies wordt verstoord. Dat gebeurt met een aparte sensor die het licht van een redelijk heldere ster in de buurt van het waar te nemen object analyseert op oneffenheden. Vervolgens gaan deze gegevens de computer in die honderden keren per seconde uitrekent hoe de spiegel moet trillen om de verstoringen op te heffen. Geen nood als er toevallig geen heldere ster in het beeldveld staat. In dat geval projecteert een krachtige laserstraal een kunstmatige ster hoog in de atmosfeer, waarmee je de vervorming van het licht ook kunt meten.

Adaptieve optiek werd in de jaren tachtig van de vorige eeuw ontwikkeld in de Amerikaanse defensie-industrie voor het 'Star Wars' programma. Naderhand kwam deze technologie ter beschikking van de sterrenkunde en tegenwoordig zijn al enkele grote telescopen ermee uitgerust. Sinds kort ook een van de vier 8,2 meter telescopen bovenop de 2630 meter hoge bergtop Cerro Paranal in het Chileense Andesgebergte. Samen vormen ze de Very Lage Telescope. De VLT is het paradepaartje van de Europese zuidelijke sterrenwacht ESO, een samenwerkingsverband van acht Europese landen waaronder Nederland. Begin deze maand gaf ESO de eerste met het nieuwe systeem gemaakte opnames vrij van Saturnus en de Jupitermaan Io. Met ongekende scherpte tonen de foto's van Saturnus wolkenbanden, wervelstormen en talrijke structuren in de ringen van de planeet. Op Io zijn vulkanen en lavastromen te zien die eerder van dichtbij werden gefotografeerd door de ruimtesonde Galileo. Anders dan de adaptieve optiek in andere telescopen heeft het systeem van de VLT geen heldere ster nodig om de beeldvervorming te bepalen. Een zwak sterretje volstaat. Het instrument bevindt zich nog in de testfase. Later dit jaar beginnen de echte wetenschappelijke waarnemingen. Dan kun je met de VLT op duizend kilometer afstand een voetbal onderscheiden en zelfs drie keer scherper kijken dan de Hubble ruimtetelescoop. En dat slechts voor een fractie van de kosten.







New Budget Leaves Room for Pluto Probe

FRANK MORRING, JR./**WASHINGTON**

Long-suffering planetary scientists who want Pluto to be NASA's next deep-space destination still may get their wish under the space agency's Fiscal 2003 budget request, even though the Bush Administration has left Pluto funding out of the budget for the second year in a row.

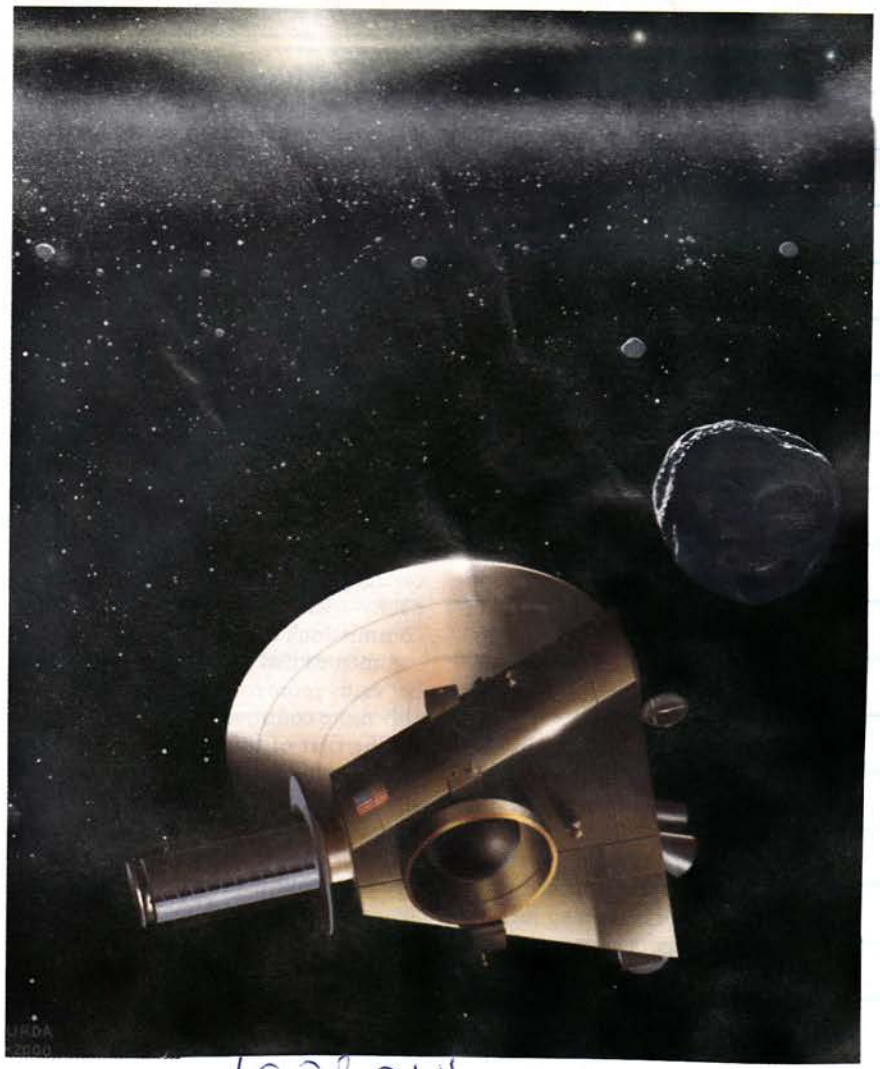
A competitive "New Frontiers" planetary exploration program that would be set up under the Fiscal 2003 budget would be more than adequate to pay for the "New Horizons" mission to Pluto and the Kuiper Belt. New Horizons was planned to fit under a $500-million cost cap, while the New Frontiers program carries a cost cap of $650 million.

And even if New Horizons loses out in the ongoing outer planets funding struggle, the $950-million space nuclear power research program requested in the new NASA budget could develop technology that would enable a delayed, but more detailed reconnaissance of the outermost reaches of the solar system. A nuclear mission might also return the data as soon as or sooner than New Horizons even if it were launched later.

NEW HORIZONS must be launched in 2006 so it can use Jupiter's massive gravity to slingshot out to the edge of the solar system in a 10-year flight. But with the sort of nuclear-electric propulsion envisioned under the new budget, a Pluto mission using ion thrusters like those that powered the Deep Space-1 technology-validation mission might be able to fly to its target in about 10 years without a Jupiter assist. That would free planners from the constraints imposed by Jupiter's orbit (*AW&ST* Feb. 11, p. 34).

The picture should become clearer this spring, when a committee of the National Academy of Sciences is due to issue its priority list for outer planet exploration. For the present decade, the strongest contenders are New Horizons Pluto and an orbital mission around Jupiter's moon Europa, which might have a life-sustaining liquid-water ocean beneath its frozen surface. The academy's priorities, in turn, will have a strong impact on what NASA picks for its first New Frontiers mission next year.

"My own personal belief is those priorities are going to probably be centered



The New Horizons spacecraft would explore the Kuiper Belt as well as fly by Pluto and Charon, but it isn't directly funded in the Fiscal 2003 NASA budget.

around Europa, possibly Pluto, possibly around Titan," said Ed Weiler, associate administrator for space science. "But I think that's probably the limit of the three top priorities we would expect to see from the academy. Maybe they'll surprise us; maybe they won't, but none of those three would be things we couldn't consider within the realm of the New Frontiers program."

Because of the distance from the Sun, all three of Weiler's guesses would require nuclear-electric power to operate at their targets, even without nuclear-electric propulsion. New Horizons would use the sole remaining radioisotope thermoelectric generator (RTG) in the U.S. inventory for which fuel exists, a spare from the Cassini Saturn probe, although one early goal of NASA's new space nuclear power program is to restart RTG production using plutonium-238 fuel purchased from Russia.

NEW HORIZONS WAS PICKED late last year to proceed under a congressionally mandated program funded at only $30 million for preliminary design studies in the current fiscal year. An earlier NASA effort to probe Pluto and the Kuiper Belt was killed when its cost crept from $350 million to $550 million (*AW&ST* June 4, 2001, p. 40; Nov. 12, 2001, p. 30; Dec. 10, 2001, p. 27). Backers of a prompt mission to Pluto have long argued that the planet's 248-year elliptical orbit will soon take it so far from the Sun that its atmosphere will freeze and be unavailable for study.

Colleen Hartman, who manages solar system exploration at NASA headquarters, notes there is still scientific debate on the issue of what will happen to Pluto's atmosphere, and when it will happen. But Alan Stern of the Southwest Research Institute, principal investigator on New Horizons, argues that the planet is also growing darker and more difficult to study with optical instruments as it moves away from the Sun, and so should be visited soon.

AS CURRENTLY PLANNED, New Horizons would study not just Pluto and its large moon Charon, but the icy bodies of the Kuiper Belt as well. It would also take another look at the Jupiter system as it passes through in 2007 for its gravity assist, and if possible it will study a centaur—an icy body, possibly knocked out of the Kuiper Belt, that usually is found inside the orbit of Neptune. Because of the vast distances involved—Pluto is almost 3 billion mi. from the Sun—scientists need a much closer look to answer tantalizing questions raised by what can be observed from Earth.

Many of those questions center around the nature of the early solar system. Since they are so cold, Pluto, Charon and the Kuiper Belt objects may preserve characteristics long boiled away on objects that pass closer to the Sun. By studying the planet and surrounding primitive objects with imagers and spectroscopy, researchers hope to be able to gain new insights into the solar system's overall evolution as well as what happened in its most remote regions as it evolved. New Horizons could also settle the question of what is happening to Pluto's atmosphere as it cools, a possibility that has mission designers working to ensure they can take measurements of nightside Pluto using the moonlight from Charon.

"There's a large number of icy bodies in the outer solar system," said Andrew Cheng of the Applied Physics Laboratory (APL) at Johns Hopkins University, who is project scientist on New Horizons. "The technology of our telescopes has only recently gotten to the point where we're able to find these guys with any kind of efficiency, so that's what's happening. We're rapidly discovering more of these Kuiper Belt objects and related objects, so it's a tremendous opportunity that we have a spacecraft mission that can actually go out and get a close look at some of these objects."

To hold down costs, the New Horizons team is basing its spacecraft on the Contour comet probe in final testing at APL for launch later this year. APL will manage mission development and operations, while Southwest Research Institute will head the science team and manage payload development. Ball Aerospace, Goddard Space Flight Center and Stanford University will also play major roles in getting the mission ready for a launch in January 2006.

THAT PROCESS WILL be complicated by the funding uncertainty, as NASA awaits the National Academy priorities and Congress debates whether to continue funding the mission in the absence of an Administration request. The Fiscal 2003 NASA budget request also clouds the issue by adding the competitive New Frontiers program and the nuclear research effort to the mix. Briefing reporters on the new space nuclear power program, NASA's Weiler suggested it might be better to wait until a new generation of power systems is developed to enable probes that can orbit the distant bodies instead of simply hurtle past them taking "a few snapshots" as they go.

"By necessity we have to take it a step at a time, but our intent is to proceed with a presumption that the program is going to be fully funded next year and the year after, and we would launch," said Stamatios (Tom) Krimigis, head of the Space Dept. at APL. "There is no other way to make efficient use of the funds that have been appropriated."

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FASTER, BETTER, CHEAPER

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Navigators on the planned New Horizons mission to Pluto, Charon and the Kuiper Belt have trimmed a year off the 3-billion-mi. cruise to the outermost planet by optimizing their launch window. That would bring the probe to Pluto for a flyby in 2015 rather than 2016, as originally estimated. Mission advocates say arriving a year earlier would give New Horizons more light for its photography of the planet's surface, a better shot at studying the atmosphere should Pluto's movement away from the Sun cause it to freeze, and more fuel for exploration in its target region. The mission still would need a gravity boost from Jupiter following its launch in 2006, but the revised timeline may give it a little added thrust on Capitol Hill, which has funded the mission against the wishes of the Bush Administration (*AW&ST* Feb. 18, p. 38). Capped at $500 million, New Horizons is already cheaper than the $650-million New Frontiers missions Bush has funded starting in Fiscal 2003, and the shorter cruise time would save a year's wages for mission operations.

AWST:
04-03-2002.

19869

Atlas IIIB Builds Momentum for EELV

CRAIG COVAULT/**CAPE CANAVERAL**

The first launch of the Lockheed Martin Atlas IIIB has enabled the company to flight test 85% of the same critical propulsion and avionics hardware that will make up the more advanced Atlas V evolved expendable launch vehicle.

The 246-ton Atlas IIIB, standing 176-ft. tall, lifted off from Pad 36B at 7:43 a.m. EST Feb. 21 carrying the Echostar VII spacecraft. The overall cost of the International Launch Services (ILS) mission and satellite combined was about $250 million.

The successful flight of the IIIB—equipped with a new twin-engine "stretched Centaur" along with a Khrunichev RD-180 first stage engine—gives Lockheed Martin increased momentum toward the first Atlas V flight planned in May. The Atlas V will use the RD-180 and stretched Centaur to compete against the Boeing Delta IV EELV and the upgraded Ariane 5. The Ariane 5 faces a critical test of its future in the market with the planned launch by next week of the $2.2-billion Envisat mission following an earlier upper stage failure.

THE INITIAL Russian-powered Atlas IIIA flew in May 2000, but that flight used a much less powerful single-engine Centaur with standard oxygen and hydrogen tanks.

The IIIB version upper stage, however, like that to be used on the coming Atlas EELV, uses a never-before-flown stretched Centaur that is 5.5 ft. longer to carry more oxygen and hydrogen propellant for two Pratt & Whitney RL10A-4-1B engines.

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The 8,876-lb. payload launched on the Atlas IIIB last week was also nearly 1,900 lb. heavier than that carried on the first A version mission nearly two years ago. Echostar VII was placed into a 35,627 X 115-mi. transfer orbit. The satellite uses a Lockheed Martin A2100-AX bus. The spacecraft will be parked at 119 deg. W. Long. over the eastern Pacific where it will support Echostar's DISH Network providing direct broadcast services to all 50 states.

WITH SOLAR ARRAYS spanning 80 ft., Echostar VII carries 32 K_u-band transponders that can be operated together at 120 watts or as a group of 16 operated at 240 watts. The spacecraft can also provide up to 15 spot beams.

The new IIIB with an overall 9,200-lb. transfer orbit payload capability also brings the Atlas capability into parity with the Russian Proton. This gives ILS the ability to offer payload sponsors a more equal tradeoff when marketing the ILS Atlas and Proton vehicles.

The mission also provided a second flight test of the oxygen/kerosene twin-nozzle RD-180 engine that will be used with higher throttle settings on the Atlas V.

For the IIIB mission, the vehicle lifted off on 616,000 lb. of thrust at a 74% throttle setting to limit launch pad damage. The RD-180 uses an oxygen-rich mixture that at full power could damage the pad with acoustic overpressures. At about 5 sec. into the flight, when the vehicle cleared the umbilical tower, it throttled to 92% and about 791,380 lb. of thrust. To illustrate how oxygen-rich the engine burns, this setting consumed liquid oxygen at about 2,000 lb./sec.

The 92% setting was tapered to 91% until 24 sec. into the flight when the engine was throttled down to 67% to slow the vehicle's rate of acceleration and reduce aerodynamic loads as it went supersonic at "Max-Q."

The vehicle was then throttled back up to 87% to generate about 812,000 lb. of vacuum thrust, until gradually throttled down to hold a maximum of 5g until first stage cutoff 3 min. into the flight.

The performance of the Russian RD-180 is so great that the IIIB—many tons heavier than the older Atlas II—reached its first stage cutoff speed and velocity targets 2 min. faster than the older Atlas.

First stage separation was followed by an initial firing of the stretched Centaur for just over 5 min. This placed the vehicle in an initial 119 X 114-mi. parking orbit as the stage crossed the Atlantic. The Centaur was ignited for a second time about 23 min. into the flight as the vehicle crossed the equator off the west coast of Africa. This about-2 min. firing achieved the planned transfer orbit, and Echostar VII was separated from the booster over Angola 28 min. after liftoff from the Cape.

Lockheed Martin Atlas IIIB with a twin-engine stretched Centaur upper stage lifts off with 616,000-lb. thrust from its Russian RD-180 engine.

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Hubble servicing mission

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FLORIDA TODAY : 20 DECEMBER 2000.

COLUMBIA IN FINAL STAGE OF OVERHAUL

THAT WAS SLOWED BY WIRING PROBLEMS.

CAPE CANAVERAL - Shuttle Columbia is in the home stretch of an overhaul, but has been mired in defective wiring for months, NASA and Boeing officials said. Columbia, the oldest of NASA's shuttle fleet, is due back at Kennedy Space Center in February. The orbiter is slated to fly again Aug. 2 on a research mission. The shuttle has been at Boeing's Palmdale, Calif. plant since Sept. 25, 1999, undergoing extensive modifications. The work included a thorough inspection of Columbia's miles of wiring. Almost all of Columbia's wiring has been inspected. Some have been repaired and other sections replaced. The wiring became suspect in July 1999 when Columbia suffered a short circuit at launch. The problem forced a backup computer to control one of the orbiter's three main engines during liftoff. The other three orbiters also were grounded after Columbia's return when wiring problems, such as scuff-marks and abrasions, were discovered on the spacecraft. Columbia was sent to California, where it was built, as part of a regular maintenance regimen. About 350 Boeing workers were to install a computerized cockpit and inspect almost all of the orbiter's parts and systems over the course of 10 months. The wiring inspections showed significant damage in parts of the shuttle, where workers may have stepped on wires or scuffed them. Replacing the wire and doing more inspections delayed the overhaul by seven months NASA spokesman James Hartsfield said the work took longer than expected because the wiring inspections were being done for the first time. "We've inspected virtually all the wiring on Columbia," Hartsfield said. After looking over the problems and mapping where they were, NASA modified its workstands at KSC. Lips were added to platforms and other changes were made to keep shoes and tools away from the fragile wires. The new cockpit also took longer than expected, he said. The advanced cockpit, already installed on Atlantis, replaces 1970's-era analog readouts and dials with computer screens similar to those used on modern passenger jets like the Boeing 777. Shuttle Discovery, scheduled to launch March 1, 2001 and again in April, is to make the trip to Palmdale next summer for similar work. The wiring inspections will be the same, but Boeing hopes they will go faster since Discovery does not have as much wiring as Columbia. Also, the inspections techniques are now set. Columbia's role in NASA has not yet been finalized. It is too heavy to carry new pieces of space station Alpha, but shuttle manager Ron Dittemore said recently it may be able to ferry supplies to the station and leave the heavy-lifting to shuttles Atlantis and Endeavour. Columbia also could fly more research missions, such as the one it is scheduled to make in August.

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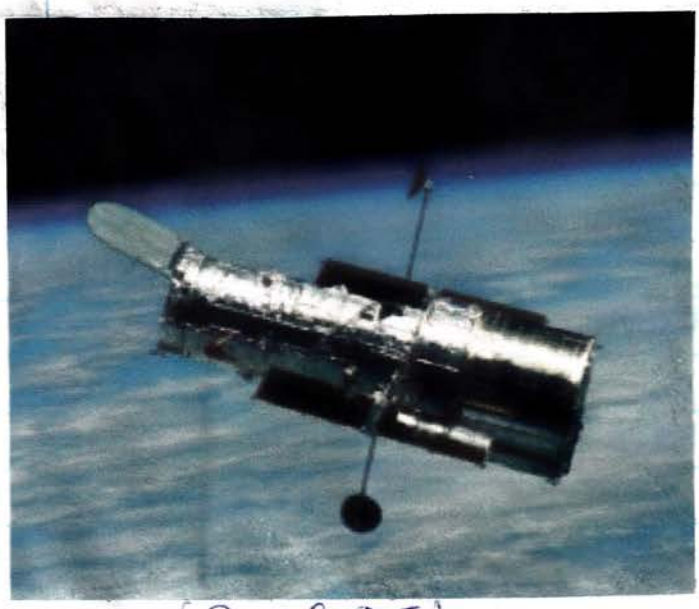
SERVICING LIMITS

NASA astronauts hope to leave the Hubble Space Telescope a much more powerful instrument for discovery at the end of their shuttle STS-109 mission to service the orbiting observatory, but there's a downside to on-orbit upgrades. Anne Kinney, director of the astronomy and physics division at NASA headquarters, notes that the Hubble ultimately is limited by the size of its light-gathering mirror, and there is no way to increase it on the existing telescope. The Next Generation Space Telescope (NGST) will use a deployable mirror almost three times the diameter of the glass mirror on Hubble. Even if there were a way to service the NGST in its orbit around the L2 point a million miles from Earth, which there isn't, economics would mitigate against it, according to Ed Weiler, associate administrator for space science and Kinney's boss. Most of the $200-million-a-year budget for the Hubble goes to maintaining the infrastructure needed to support servicing, he says, including a supply of increasingly outmoded spare parts and the costly training astronauts need to do their jobs (*AW&ST* Feb. 25, p. 79). "Servicing is great, but it costs a lot of money," Weiler told a Women in Aerospace symposium.

AWST

04-03-2002



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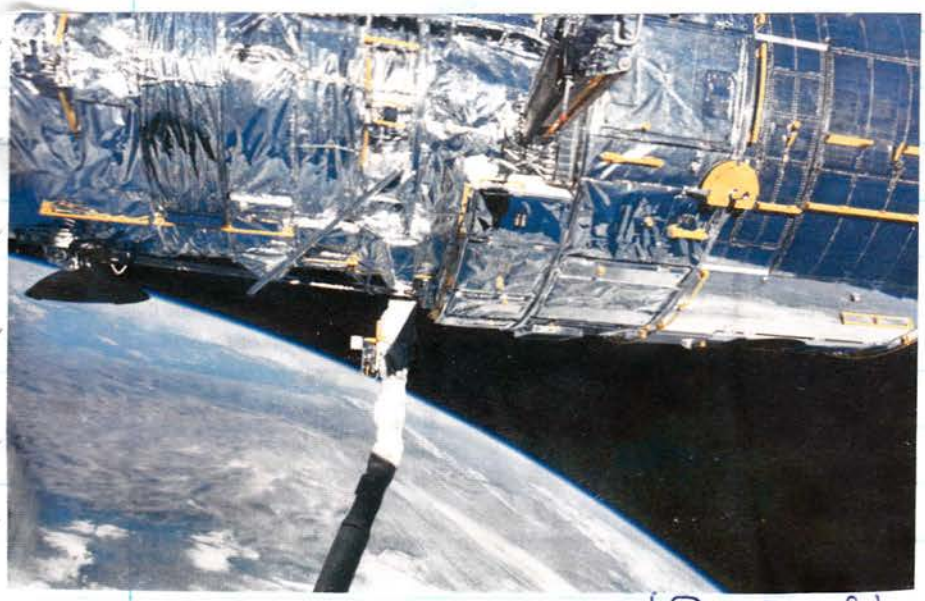

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FLUG REVUE : 03 MAART 2002.

STS-109 captures Hubble.

Hubble-Wartung durch Space-Shuttle-Mannschaft.

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Space Shuttle Columbia arrived at its destination, the Hubble Space Telescope, early Sunday (march 3). At 3:31 a.m. CST (0931 GMT), STS-109 Mission Specialist Nancy Currie used Columbia's robot arm to capture Hubble. She later placed it into the orbiter's payload bay to set the stage for the five space walks that the STS-109 crew will perform to service and upgrade the telescope. Mission Specialists John Grunsfeld and Rick Linnehan are scheduled to begin the mission's first space walk at 12:27 a.m. CST (0627 GMT) Monday. They will install a new solar array onto Hubble. With the Hubble Space Telescope orbiting high overhead, the shuttle Columbia lifted off on Friday on a complex mission to replace and upgrade key telescope systems through five challenging spacewalks. Commander Scott Altman, Pilot Duane Carey, Flight Engineer Nancy Currie and spacewalkers John Grunsfeld, Rick Linnehan, Jim Newman and Mike Massimino blasted off of Launch Pad 39-A at the Kennedy Space Center at 5:22 a.m. Central time as Hubble orbited just west of Sarasota, Florida at an altitude of about 360 miles. Because of its brightness and elevation, the telescope was visible in the pre-dawn sky over the launch site as Columbia began its pursuit.

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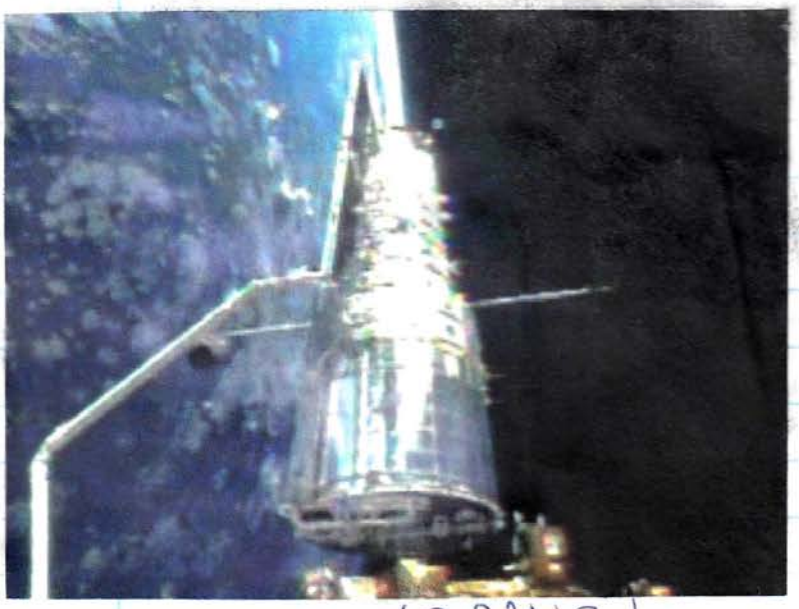

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HOUSTON CHRONICLE : 08 MAART 2002

ASTRONAUTS FINISH RECORD-TYING 5TH SPACEWALK.

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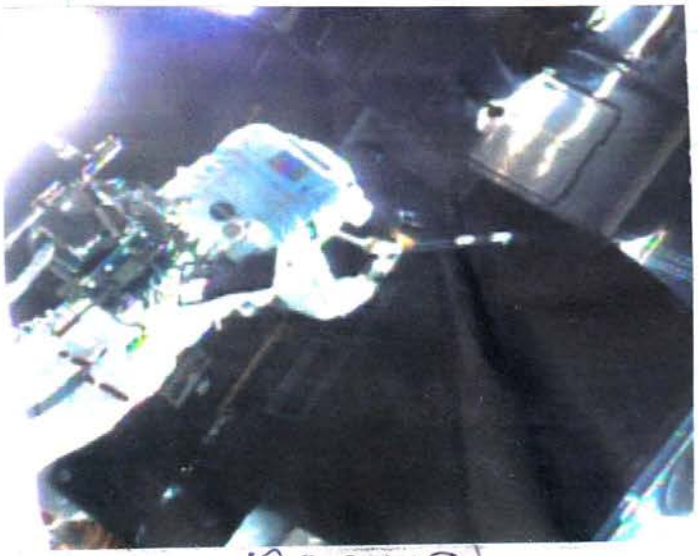
The Columbia astronauts wrapped up their weeklong overhaul of the Hubble Space Telescope today with a record-tying fifth spacewalk by two crewmen to revive a dormant observatory camera. During the 360-mile-high outing, astronaut mechanics John Grunsfeld and Rick Linnehan crawled into the base of the 44-foot-long observatory to equip the telescope's infrared camera with a new cooling device. NASA is hopeful the camera's optical sensors can be re-chilled to 350 degrees below zero, allowing the $105 million camera to be used again after a two-year dormancy. The intense cold allows the imager to peer through the interstellar dust and gas for observations of the distant universe. Astronomers intend to probe the cosmic frontier with the infrared camera for signs of a theorized, unseen "dark" matter or energy that seems to be causing the expansion of the universe to accelerate. The Columbia astronauts pulled along side the 12-year-old observatory on Sunday and used the shuttle's robot arm to hoist the telescope into the cargo bay for an extensive refurbishment. With the makeover finished, the shuttle crew plans to release the telescope on Saturday. During four previous outings, the astronauts replaced the twin solar arrays that plant the observatory to convert sunlight into electricity. They replaced a degrading power control unit that distributes the electricity throughout the telescope. They replaced a faulty pointing device. Thursday, they equipped Hubble with a new camera that promises a 10-fold improvement in the sensitivity, clarity and speed of observations. The imager will help astronomers in their search for the earliest star systems on the frontiers of the universe. The successes of the previous spacewalks created the opportunity for the Columbia crew to dedicate a fifth spacewalk to the revival of the infrared camera. The Near Infrared Camera and Multi-Object Sectrometer was installed by a shuttle crew in February 1997 and chilled then by a block of frozen nitrogen. The nitrogen was expected to remain frozen for five years, but a thermal leak allowed it to melt away two years later. Without cooling, the camera was useless. NASA decided to try a new strategy that required the development of a $21 million mechanical cooler. About the size of a small office refrigerator, the new cooler installed by Grunsfeld and Linnehan relies on the rapid circulation of a neon coolant through the camera by three small turbines that spin at 400,000 revolutions per minute. Mounted inside the telescope, the cooler is in turn chilled by a 13-foot high external radiator that was also installed on Friday by Grunsfeld and Linnehan. The radiator circulates an ammonia coolant. The new cooling mechanism will require about a week of operation to chill the camera to minus 350 degrees below zero. The chiller is a one-of-a-kind device that challenged the ability of engineers to develop sturdy internal bearings, turbines that could rev at high speed with minimal electrical power and a process for obtaining moisture-free neon coolant, said NASA's Preston Burch, the Hubble program manager. The Columbia mission's five spacewalks tie a record for the most ever during a single shuttle flight. The milestone was established during a 1993 mission to Hubble and matched by a similar flight in 1997. The shuttle is due back on Earth on Tuesday.



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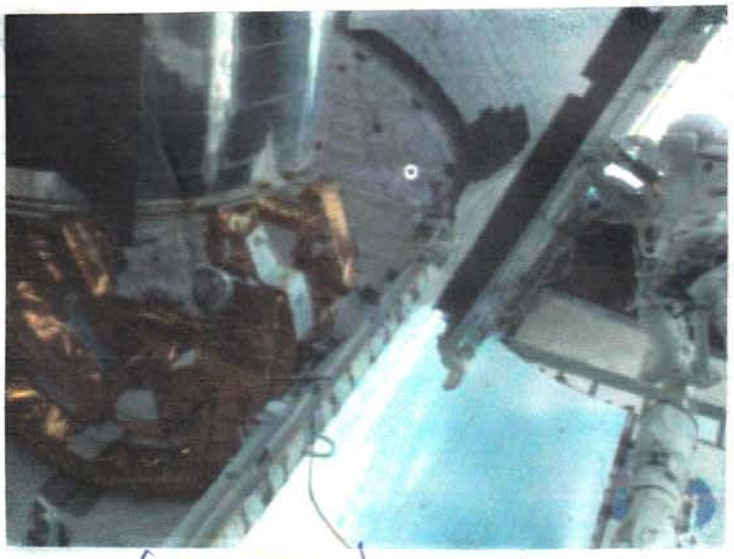

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AP NEWS : 08 MAART 2002

ASTRONAUTS FINISH REPAIRS IN SPACEWALK.

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CAPE CANAVERAL - Shuttle Columbia's astronauts completed five days of repairs to the Hubble Space Telescope on Friday, installing a high-tech, super-cold refrigerator in hopes of reviving a comatose camera. It was the fifth and final spacewalk of the mission, described by NASA as the most challenging service call ever made to the 12-year-old telescope. Spacewalkers John Grunsfeld and Richard Linnehan connected the 310-pound refrigerator to an infrared camera that has not worked for the past three years. They also hung a large radiator to the outside of the telescope and hooked up cables and plumbing that are part of the $21 million cooling system. The system passed its initial tests, but astronomers will not know for at least a month whether the repairs will allow the camera to peer back into the dark, dusty regions of the universe and resume its study of young star clusters, exploding stars and planetary atmospheres. The astronauts set a spacewalking record for a single shuttle mission: 35 hours and 55 minutes. It surpassed, by 29 minutes, the 1993 record held by the first Hubble repair team. Both flights featured five spacewalks.During the mission, a central power unit was installed, along with stronger solar wings, a new pointing mechanism and a powerful new camera. "Many people on this mission, privately, didn't think that we would be able to accomplish everything that we had set out in our plan," said Hubble program manager Preston Burch. All that remained, for the astronauts, was the release of Hubble early Saturday from the shuttle's cargo bay.The infrared camera was installed on Hubble in 1997. But it stopped working in 1999 after its supply of nitrogen ice ran out early. The ice was needed to keep the infrared detectors at their operating temperature of minus-350 degrees. To fix the problem, NASA pioneered a system that uses neon gas as the coolant and a refrigeratorlike compressor. The compressor consists of three tiny turbines that spin at 400,000 revolutions per minute, 50 to 100 times the operating speed of a car engine. It is virtually vibration-free — crucial for Hubble's precise picture-taking. Columbia's astronauts will return to Earth on Tuesday, bringing back all of the old telescope equipment that was removed. "We've given Hubble a new power system that will take it off into the next decade of discovery (news - web sites). We've given it new eyes to see deeper into the universe than it's ever been able to see before," said Grunsfeld, an astrophysicist who led Columbia's spacewalking team. Astronomers everywhere, he said, "will be able to enjoy the beauty and inspiration that these new pictures from Hubble will bring." A satellite that will join others in relaying those pictures rocketed into orbit Friday evening. NASA's newest Tracking and Data Relay Satellite also will provide communication links for space shuttles, the international space station and other science spacecraft circling Earth.

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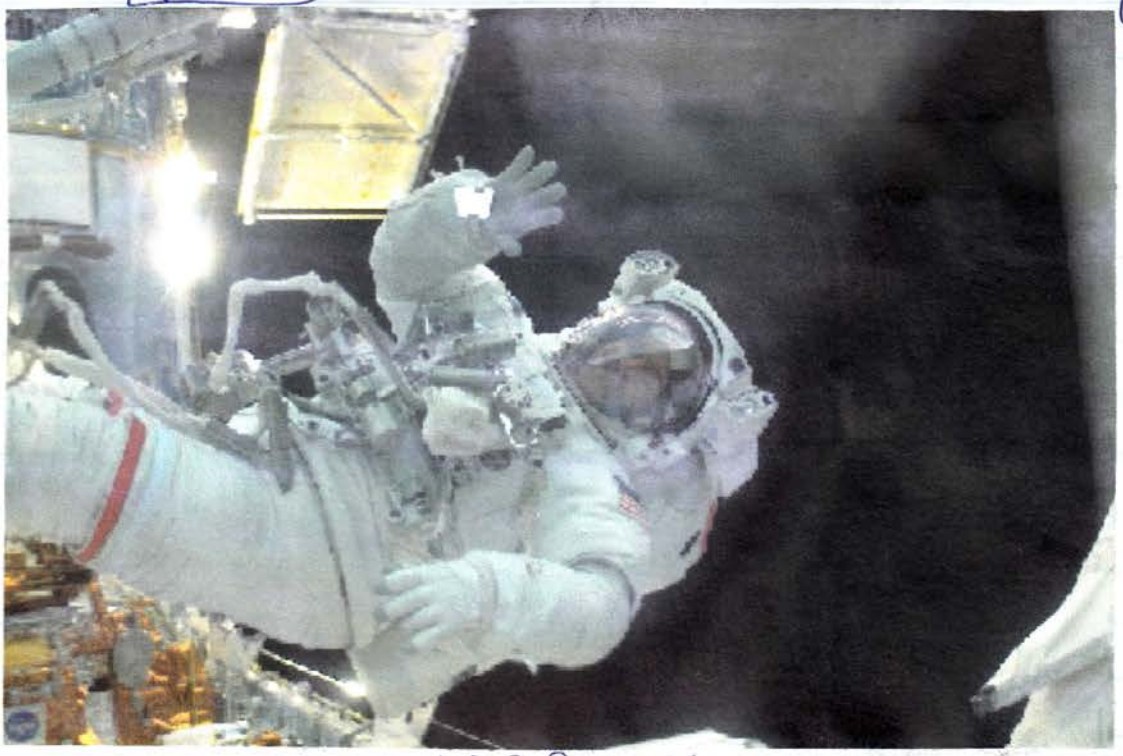

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BBC : 09 MAART 2002.

HUBBLE GOES BACK TO WORK.

Astronauts on board the space shuttle Columbia have released the repaired Hubble Space Telescope (HST) back into orbit after a record-breaking five days of spacewalks. Fitted with state-of-the-art solar panel wings, a new power unit and a new infra-red camera, Hubble is ready to resume its work, revealing the secrets of the Universe. The shuttle crane operator, Nancy Currie, let go of Hubble as the two spacecraft hurtled 580 kilometres (360 miles) above the Atlantic on Saturday. Over the past five days, two teams of astronauts spent 35 hours and 55 minutes carrying out painstaking repairs on spacewalks. All the new components passed the initial tests, but Nasa will not know for at least a month whether an experimental cooling system successfully revitalised the infra-red camera. The Near-Infra-red Camera and Multi-Object Spectrometer, known as Nicmos, stopped working in 1999 after it ran out of coolant unexpectedly. The Nicmos camera was used to study young star clusters, exploding stars and planetary atmospheres. More than half way through its 20-year mission, Hubble has already taken amazing pictures of deep space and given astronomers their best estimate yet for the age of the Universe. Other equipment fitted this week included the very powerful Advanced Camera for Surveys. This replaces the Faint Object Camera - the last of Hubble's original instruments - and will substantially improve the ability of the observatory to pick out objects at great distances. The changes should enable Hubble to see out its mission, which is due to end in 2010. The Columbia crew of seven is expected to land back on Earth on 12 March.

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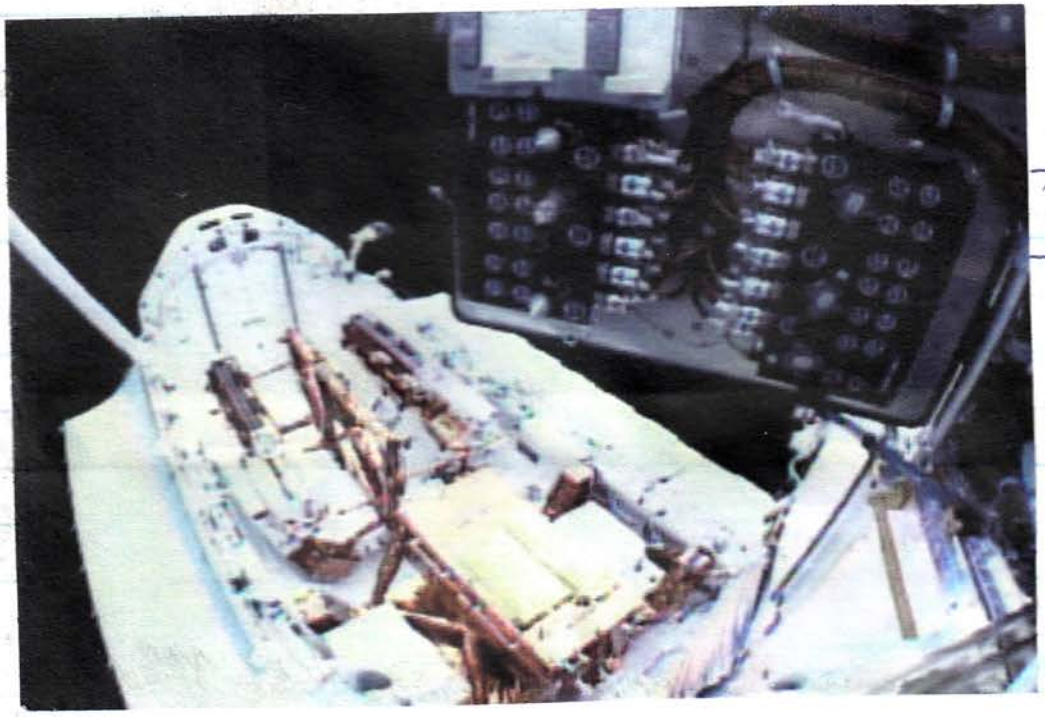

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STS-109 Grunsfeld Report #5
The Cool EVA

Space walk number 5 had Rick and myself going outside for our third trip to install the NICMOS cooling system. NICMOS is the infrared camera on Hubble. Observations in infrared light allow astronomers to look through dust, and also to look very far back into the early universe. On space walk-2, Jim and Mike had installed the electronic control module for the cooling system, and on space walk-5 Rick and I installed the radiator and cryogenic cooler. Going out of the hatch it almost seemed as if we were doing a normal activity. In reality we were stepping out into the vacuum of space, insulated by only a few layers of coated cloth and our helmets. The spacesuits we wear are really remarkable spaceships. Each suit has its own pressure vessel, oxygen system, carbon dioxide scrubber, communication system, computer, cooling/heating system, and even a television camera on the helmet and lights. The suit also has a drink bag that we use to get water during the space walks. One difference between our spacesuit and the shuttle is that there is no toilet – we wear "maximum absorbance garments" (diapers), just in case. Rick and I opened the aft shroud door to get access to NICMOS. I felt like we were opening the doors to a sacred shrine, going inside the area where the scientific instruments on Hubble live. In our training we were taught to have the utmost respect for the delicacy of the instruments, and to treat them with kid gloves, giving some support to the idea of the inside of Hubble as a shrine. Inside of the aft shroud I tried to move as carefully as I could, even through I was in the bulky and clumsy space suit. The interior of the telescope is as clean and pristine as it was when launched, maybe more so after years of out gassing in the vacuum of space. After removing a serpentine vent hose that was originally used for venting gas from the old solid nitrogen cooler on NICMOS, we installed the cryogenic cooler itself. This box, filled with electronics, plumbing and a tiny turbine, which spins at 450,000 rpm went in smoothly. tl looked a bit odd to take the pristine, almost spartan, interior of Hubble and add a box covered with cables and hoses and valves. Next we got the 3-foot by 12-foot radiator off of a carrier in the aft end of Columbia's payload bay and tried to install it on the Hubble. It wouldn't go on. We pushed and pushed but try as we could, it didn't seem to line up. Rick and I took it off of Hubble and realigned it by moving the latches a bit. This time the alignment looked good, but still we couldn't push it on. With some significant effort Rick got his handrail on, and while poised on the robotic arm of Columbia I took one latch at a time (of two) and pressed into the telescope as hard as I could. After a couple of tries at my maximum effort I squeezed the first, then second latch on the handrails of Hubble. A small success. Finally I took a conduit and rotated it down to Rick, poised underneath the telescope. After that, Nancy took me into the aft shroud again over a hole in the bottom of the telescope that was opened up by the vent line removal. I put a couple of tethers together and tried to send the lines through the hole for Rick to catch. I felt as if I was ice fishing, although I could actually see Rick through the hole. He caught the tether, attached it to a long set of cables and cooling lines, and I pulled it through the hole right into where the science instruments live. It was like a giant boa constrictor, and stiff, much stiffer than we had seen in training. Rick joined me and we began the process of hooking up the electronics connectors and the ammonia cooling line to the cryogenic cooler. Inside of the cooler is the neon cooling system driven by the small turbine. The super cooled Neon is used to cool the detectors on NICMOS to near 70 degrees above absolute-zero. Finally we closed the door and cleaned up the payload bay of Columbia for the last time. As part of that activity I got to ride on the robotic arm, just holding on with my hand high above the payload bay. What a view I had, Columbia below, the bright blue earth above, and the Hubble Space Telescope on my side. It seemed as if time was standing still it was so touching a moment for me. My last activity was to remove a protective cover from an antenna on the bottom of the telescope. At the end of five space walks to improve the telescope, I gave Hubble a final small tap goodbye, and wished it well on its journey of discovery. It is likely I will never see the Hubble Space Telescope again, but I have been touched by its magic and changed forever. Today we deployed the telescope back to earth orbit, and while elated that we finished our work, with all the planned upgrades completed, I did feel a twinge of sadness. The same kind of feeling one gets when saying goodbye to a close friend you won't see for a long time.

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SPACEFLIGHT NOW : 09 MAART 2002.

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HUBBLE TO BE SET FREE.

The Columbia astronauts are gearing up to release the rejuvenated Hubble Space Telescope back into open space early today, wrapping up a surprisingly successful five-spacewalk flight to upgrade the $2 billion observatory's electrical system and scientific instruments. Astronaut Nancy Currie, operating the shuttle's 50-foot-long robot arm, plans to lock onto a grapple fixture on the side of the telescope around 1:52 a.m. EST. An electrical umbilical providing shuttle power will then be withdrawn an hour later. A few minutes after that, the 24,000-pound telescope will be hoisted above Columbia's cargo bay and oriented for redeployment. At 3:52 a.m. EST, commands will be sent to power open Hubble's main aperture door, once again exposing its 94.5-inch primary mirror to starlight. Then, at 5:04 a.m. EST (1004 GMT), the space telescope will finally be released back into open space to resume its trail-blazing astronomical observations. "One of the days that'll be the most exciting will be actually deploy day," said astronomer-astronaut John Grunsfeld, who has now carried out five Hubble servicing spacewalks in two mieeions. "That's because we've finished all the hard work, out doing the EVAs, and now we have the hard work of getting Hubble ready to go, making sure that the aperture door opens, that the high-gain antennas are deployed, the solar arrays are ready to go, and then finally opening up the (service platform) latches. "Nancy will take the telescope up, put it over the payload bay and then very gently open up the arm snares and back away. At which point (commander) Scott Altman will fire the shuttle's jets to back out from under Hubble. "The reason it's so interesting is that the particular approach ... takes the Hubble right over our heads," Grunsfeld said. "It goes right over those overhead windows. You know, they're big windows. And it's a 24,500-pound telescope. It's big." During his previous Hubble visit in 1999, the view of Hubble slowly passing overhead just a few feet away was so startling that "even though we expected it, sort of instinctively everybody ducked as the telescope went over." "Once it's gone, our job is basically done," Grunsfeld reflected. "We get to watch this great observatory that we've now made much better recede off into the distance. And I'm expecting I'll have some mixed feelings at that point as I did last time, you know, here's my friend the Hubble telescope and we're leaving it again. But it's just a beautiful sight to see the limb of planet Earth and this jewel in the sky going back out to do astronomy." The astronauts will conduct their first round of media interviews since completing the Hubble overhaul starting at 7:57 a.m.

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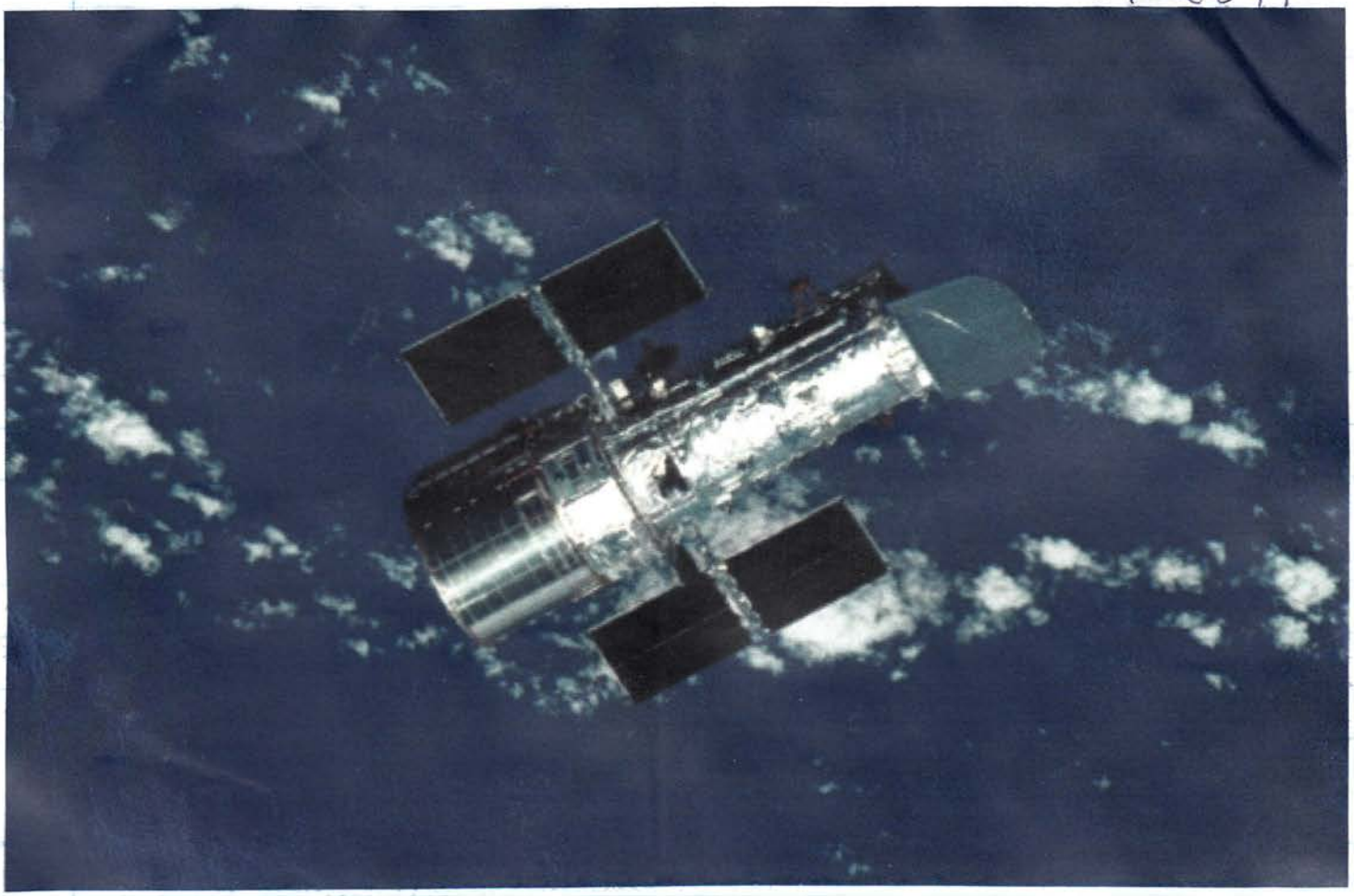

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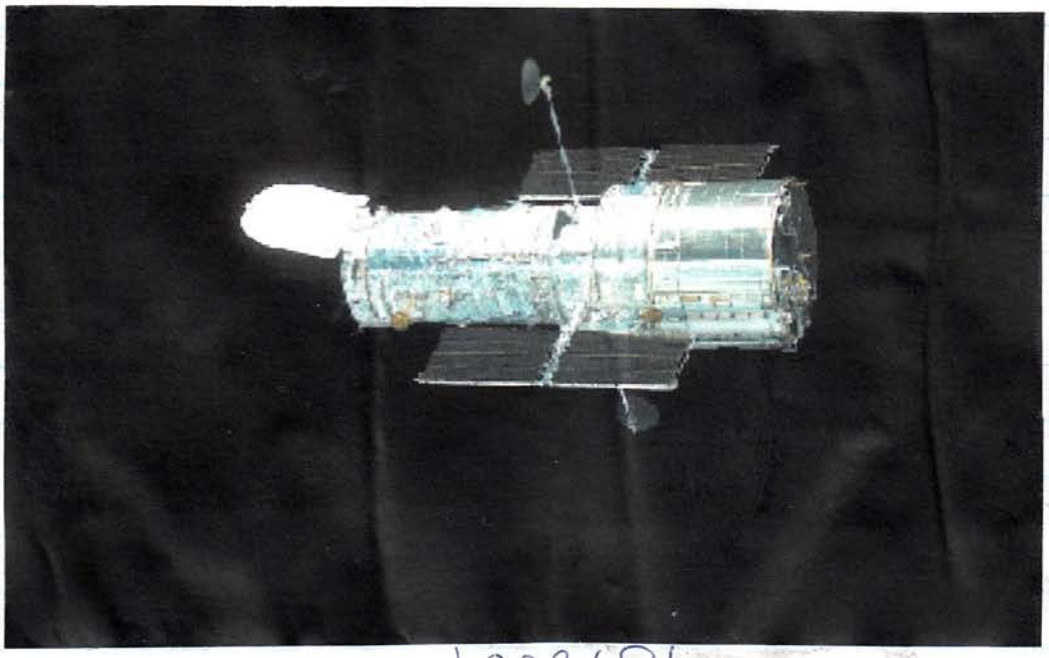

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STS-109 Grunsfeld Report #6
Star Gazing

After deployment of the Hubble Space Telescope it was time to watch the Hubble slowly drift off and away from the space shuttle and to admire its beauty. The look of the telescope has been forever changed. Stout and strong looking panels have replaced the bird-like solar array wings. The new solar arrays have deep blue Gallium Arsenide solar cells, replacing the Silicon cells. On the other side of the arrays are white reflective panels, and so the telescope will no longer emit the golden glow so characteristic of the first 12 years of Hubble's life on orbit. On the aft bulkhead of Hubble is a conduit leading to a large white radiator mounted to handrails on the side of the telescope. Along handrails all around the telescope are hung new cable harnesses to transfer power and signals to new systems on the telescope. As HST moved off into the distance I could only watch in awe (and take an enormous number of photographs). What an amazing telescope that we had worked on over the previous 5 days. More remarkable is the team that developed the new instruments. The Advanced Camera for Surveys will provide us such remarkable views from its three cameras that I can't even imagine the scope of the new discoveries that it will make. Finally as HST became another star in the sky, we went back to work stowing the space suits and space walking tools. The act of making Columbia a space ship again is a tough one, after spending five days using her mid-deck as a space walking staging area. Fortunately, without a payload in the bay of Columbia we could also take time to look out the window at the beautiful blue earth. I watched out the window as we passed over Hawaii searching for the domes of the Kecks, UKIRT, and the other telescopes atop Mauna Kea, with no luck. As we passed over the Andes I desperately searched for Cerro Tellolo, but again to no avail. My tool for these searches is a pair of Ziess 20x60 stabilized binoculars. While my search for observatory domes was not very successful, the good news is that as we orbit the earth we see a night and day every 95 minutes with about 35 minutes of darkness. What a joy it is to be able to darken the cabin and with naked eyes see the broad expanse of the Milky Way. From our vantage point above the atmosphere the stars are steady and don't twinkle. They seem just a bit brighter and the colors of the stars are more vibrant. As we pass southward the Large Magellenic Cloud is easy to discern. Using the binoculars Jupiter is clearly resolved with light banding. The Great Nebula in Orion is a favorite target, as well as the many open clusters. The crescent of the moon is visible as part of a complete orb, illuminated by the bright earth, just around the horizon. The biggest problem with trying to find faint objects is that we are moving so fast around the earth. As a result we only have a few minutes to find an object before it sets or goes out of the view of a window. As the stars head down towards what looks like the visible horizon at night, they first go through the airglow layer, starting at about 95 kilometers. This greenish layer results from excited atoms releasing energy in the form of light. During the day the atmosphere is constantly absorbing sunlight and only in the night pass can we see the dull glow from the atomic de-excitation. When a bright object sets it looks like it should disappear behind the earth, but instead we see the stars a bit longer as the go through the fog of the earth's atmosphere. In this thin region the stars do twinkle and fade before finally blinking out as they go behind the earth. Tomorrow we start turning the space shuttle into a re-entry vehicle. I hope that before we head back home that I have more chances to look out the window and star gaze. There will be a time, and soon I believe, that many people will be able to view the stars as we have on this mission. I would not be surprised to see an observatory on the moon sometime in this century. After all, it has always been the adventurous astronomers who brave cold nights, high altitude environments, and even the rigors of space flight to get a better view and understanding of our universe. I am convinced that as we push out of low earth orbit, and on to the moon and beyond, astronomers will be there. Whether in our own backyards, on a cold and remote mountaintop or in earth orbit, the beauty of the heavens is always present, and the drive to explore and to indulge our curiosity is always strong.

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Nummer 12 - 09.03.2002 / BERICHT UIT DE RUIMTE

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Op 1 maart werd de oudste shuttle Columbia gelanceerd met zeven astronauten aan boord: commandant Scott Altman, piloot Duane Carey, en missie specialisten John Grunsfeld, Nancy Currie, Richard Linnehan, James Newman en Michael Massimino. Dit was de eerste shuttle vlucht in twee jaar die niets met het ISS programma te maken had. De astronauten zetten namelijk koers naar de Hubble ruimtetelescoop om deze aan een grote onderhoudsbeurt te onderwerpen. De Hubble werd in april 1990 in een baan om de aarde gebracht door de space shuttle Discovery. In 1993, 1997 en 1999 voerden shuttle bemanningen onderhoud en reparaties uit. Kort nadat de Columbia in haar baan om de aarde was gekomen werd er een probleem ontdekt in het koelsysteem van de shuttle. Waarschijnlijk was er een verstopping ontstaan ergens in een van de radiatoren aan de binnenkant van de vrachtdeuren. Die radiatoren stralen de door apparatuur ontwikkelde warmte uit en voorkomen zo oververhitting. De verstopping had tot gevolg dat minder freon door de radiator stroomde en dat er dus minder warmte werd uitgestraald. Na een dag de situatie aangekeken te hebben en het probleem niet erger geworden was, besloot NASA dat de vlucht toch door kon gaan. Twee dagen na de lancering vond de ontmoeting met de Hubble plaats. De Columbia vloog naast de ruimtetelescoop terwijl astronauten met de robotarm de Hubble vastpakten. Vervolgens werd de telescoop op een speciale tafel achter in het vrachtruim van de shuttle geplaatst en verankerd. De eerste ruimtewandeling, er zouden er nog vier volgen, vond plaats op 4 maart. Ruimtewandelaars Grunsfeld en Linnehan maakte een ruimtelijk uitstapje van 7 uur en 1 minuut. Gedurende deze wandeling vervingen ze het zonnepaneel aan de stuurboordszijde van de Hubble. Het originele paneel was oprolbaar, terwijl het nieuwe uit twee panelen bestond die opengeklapt moesten worden. Het nieuwe paneel is stijver en men verwacht dat dit minder spanningen geeft als de Hubble in of uit de aardschaduw beweegt. Ook leveren de nieuwe panelen meer energie ook al zijn ze een derde kleiner. Het verwijderen van het oude paneel en de installatie van het nieuwe paneel verliep zonder problemen. Een dag later gingen astronauten Newman en Massimino naar buiten. Tijdens hun 7 uur en 16 minuten durende ruimtewandeling vervingen ze het zonnepaneel aan de bakboordszijde van de Hubble en een van de gyroscopen. Ook werden nog enkele thermische dekens verwijderd zodat men tijdens latere ruimtewandelingen beter bij de apparatuur kan. Op 6 maart vond de meest ingewikkelde ruimtewandeling gedurende deze shuttlevlucht plaats. Grunsfeld en Linnehan vervingen de Power Control Unit (PCU) van de Hubble. De PCU distribueert alle electriciteit afkomstig van de zonnepanelen naar de verschillende instrumenten. Toen in de jaren zeventig de Hubble ontworpen werd, lag het niet in de bedoeling de PCU tijdens een ruimtewandeling uit te wisselen. Maar in 1993 identifeerden technici een potentieel probleem in de PCU dat kon resulteren in het compleet falen van het electrische systeem, zodat de installatie van een nieuwe PCU noodzakelijk werd. Voor het uitwisselen van de PCU moest de Hubble voor het eerst in twaalf jaar helemaal uitgeschakeld worden. Vervolgens begonnen de ruimtewandelaars met het een voor een losschroeven van 36 electrische connectoren; een taak die niet makkelijker gemaakt werd door de dikke handschoenen van de ruimtepakken en de zeer geringe werkruimte om de PCU heen. De oude PCU kon zonder problemen verwijderd worden, waarna de nieuwe PCU in de plaats van de oude kwam. De 36 connectoren werden weer een voor een vastgeschroefd. Een spannend moment brak aan toen de Hubble weer aangezet werd, maar een eerste test liet zien dat de nieuwe PCU naar behoren werkte. Na een ruimtewandeling van 6 uur en 48 minuten zat het karwei erop en konden Grunsfeld en Linnehan weer naar binnen gaan. De volgende dag was het weer de beurt aan Newman en Massimino die een ruimtewandeling van 7 uur en 30 minuten maakten. Gedurende dit uitstapje plaatste het tweetal de Advanced Camera for Surveys in de ruimtetelescoop. De nieuwe camera is vijf maal gevoeliger en levert een twee maal zo hoge resolutie als eerdere instrumenten in de telescoop. De laatste ruimtewandeling vond plaats op 8 maart en werd uitgevoerd door Grunsfeld en Linnehan. Nu installeerden ze een nieuw koelsysteem voor de infraroodcamera van de Hubble. Het originele koelsysteem was defect geraakt in 1995 waardoor waarnemingen in het infrarode gebied van het spectrum onmogelijk werden. Ook deze ruimtewandeling werd zonder noemenswaardige problemen afgesloten. De vlucht van de Columbia zat er nu bijna op. Op zaterdag 9 maart werd om 10:04 uur GMT de Hubble weer uitgezet in zijn baan. De Columbia vloog vervolgens een 'inspectierondje' om de ruimtetelescoop en verwijderde zich vervolgens tot op een veilige afstand. De landing van de Columbia staat op het moment van schrijven gepland voor dinsdag 12 maart om 9:30 uur GMT.

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De Hubble

Afgelopen week is er voor de vierde maal groot onderhoud verricht aan de Hubble Space Telescope (**hubble.nasa.gov**). De ruimtetelescoop is voorzien van nieuwe zonnepanelen en nieuwe wetenschappelijke instrumenten.

Het idee voor een telescoop in een baan om de aarde dateert al uit 1946 (**www.sciencepresse.qc.ca/clafleur**), maar pas in 1990 werd Hubble (genoemd naar de Amerikaanse kosmoloog Edwin Hubble, **www-groups.dcs.st-and.ac.uk**) gelanceerd (**www.ksc.nasa.gov**, zoek missie sts-31). De telescoop is een samenwerkingsproject van de Amerikaanse NASA (**www.nasa.gov**) en de Europese ESA (**www.esa.int**).

De eerste onderhoudsvlucht (**www.ksc.nasa.gov**, missie sts-61) vond al in 1993 plaats, om een probleem met de telescoopspiegel te verhelpen. Sindsdien levert Hubble een continue stroom spectaculaire foto's (**www.seds.org/hst**) en wetenschappelijke resultaten. Vrijwel elk deelgebied van de astronomie heeft geprofiteerd van het oog in de ruimte.

Tijdens de onderhoudsvlucht van afgelopen week (**sm3b.gsfc.nasa.gov**) hebben shuttle-astronauten een nieuwe, gevoelige camera geplaatst, de Advanced Camera for Surveys (ACS, **acs.pha.jhu.edu**), en is de infraroodcamera NICMOS (**nicmos.as.arizona.edu**) voorzien van een nieuw koelsysteem. Beide instrumenten zijn gebouwd door Ball Aerospace (**www.ball.com**). De ACS heeft een groter beeldveld dan de oude Wide Field and Planetary Camera 2 (**wfpc2.jpl.nasa.gov**), en is bovendien veel gevoeliger.

De verrichtingen van de shuttle-astronauten zijn uitgebreid op video te volgen op verschillende ruimtenieuwssites (**spaceflightnow.com**, **www.space.com**). De eerste resultaten van de nieuwe instrumenten worden binnen enkele weken verwacht via het Space Telescope Science Institute (**www.stsci.edu**) en de Europese tegenhanger, de Space Telescope European Coordinating Facility (**www.stecf.org**).

De foto's van de Hubble-telescoop (**hubble.stsci.edu**) spreken enorm tot de verbeelding. Het Hubble Heritage Team (**heritage.stsci.edu**) presenteert elke maand een nieuw hemels juweel, en natuurlijk zijn de Hubble-foto's ook als wallpaper te downloaden (**www.screenthemes.com/packs**). Speciaal voor onderwijsdoeleinden is op de Spacelink-site van NASA (**spacelink.nasa.gov**) veel Hubble-materiaal te vinden.

Ook amateur-astronomen hebben in het verleden incidenteel gebruik kunnen maken van de Hubble Space Telescope (**georgenet.net/hubble.html**). Momenteel wordt zelfs gewerkt aan een telescoop aan boord van het International Space Station (**spaceflight.nasa.gov/station**), die uitsluitend bestemd is voor amateurgebruik (**www.issat.org**).

In 2004 moet de vijfde en laatste onderhoudsvlucht naar de Hubble-telescoop worden uitgevoerd.

FOTO NASA

Daarna hoopt men de telescoop in bedrijf te kunnen houden tot 2009, wanneer de opvolger gelanceerd wordt, de Next Generation Space Telescope (**ngst.gsfc.nasa.gov**). Hubble moet tegen die tijd teruggebracht worden naar de aarde, waar hij geëxposeerd zal worden in het National Air and Space Museum in Washington (**www.nasm.si.edu**).

De toekomst van grote ruimtetelescopen is niet helemaal duidelijk. Nieuwe technische ontwikkelingen, met name adaptieve optiek (**cfao.ucolick.org**), maken het mogelijk dat grote telescopen op aarde, zoals de Keck-telescopen en de Europese Very Large Telescope (**www.eso.org/projects/vlt**), even scherp zien als een telescoop in de ruimte.

Volkskrant: 09-03-'02

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A Power Play 315 Miles High

FRANK MORRING, JR./JOHNSON SPACE CENTER

Columbia astronauts fix Hubble telescope, upgrade instruments in difficult servicing mission

Observations with the Hubble Space Telescope are set to resume in about three weeks after astronauts on board the space shuttle Columbia repaired and upgraded the orbiting instrument with an ambitious set of extravehicular activities (EVAs) that should keep it producing breakthrough discoveries into the next decade.

A gamble by Hubble managers on a risky power shutdown for the first time since the telescope was launched in April 1990 paid off when the crew was able to replace its failing power control unit (PCU). Astronauts John M. Grunsfeld and Richard M. Linnehan overcame a time-consuming cooling-system malfunction in Grunsfeld's space suit to do the job, which required special tools and exhaustive training because the unit was never meant to be changed out in orbit.

"Everything looks terrific," said Preston Burch, Hubble program manager at NASA's Goddard Space Flight Center, as engineers in the Space Telescope Operations Control Center at Goddard restarted Hubble after leaving it without power for 4 hr. 25 min. while Grunsfeld and Linnehan worked.

The PCU swap-out cleared the way for astronauts James H. Newman and Michael J. Massimino to install the new Advanced Camera for Surveys (ACS) in place of the old Faint Object Camera. Grunsfeld and Linnehan were scheduled to return to the payload bay early Friday to restore the telescope's infrared camera by installing a mechanical cryocooler (*AW&ST* Feb. 25, p. 79).

The crew also installed two new solar arrays that will generate more power while reducing atmospheric drag, and replaced a reaction control wheel that suffered a worrying telemetry drop-out last November. The five EVAs were some of the most challenging ever attempted, and unexpected problems in orbit added to the difficulty.

The crucial third EVA of the mission started 2 hr. late on Mar. 6 because a water leak in the cooling system of Grunsfeld's spacesuit forced the astronaut to swap out his soaked suit torso with the one used by Newman to replace one of the solar arrays the day before.

"The back of the suit is pretty well saturated," radioed Army Lt. Col. Nancy J. Currie, the robot arm operator. Dana Weigel, head EVA controller for the mission, later said as much as 9 lb. of water may have leaked when a suspected surge in Columbia's airlock power supply opened a solenoid valve in the suit. The damaged suit was set aside for the remainder of the mission, and EVA astronauts used power from new long-duration batteries in their suits while in the airlock instead of connecting to the suspect airlock power supply.

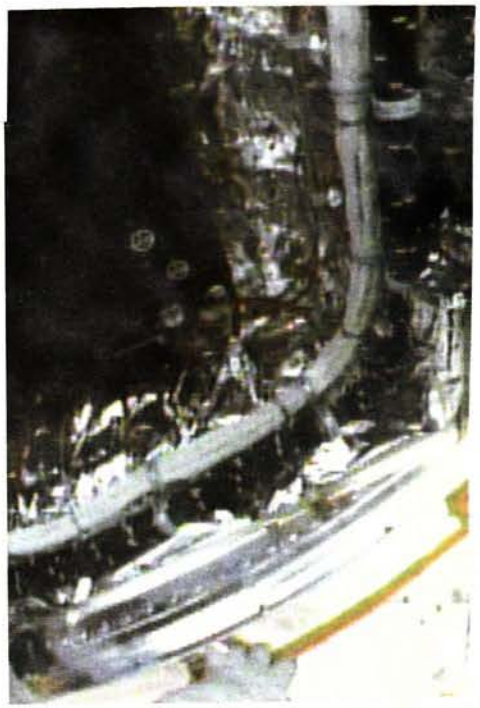
For a time, as Columbia's crew used towels to mop up the water in the suit torso, shuttle and telescope managers contemplated delaying the tedious PCU change-out by a day and installing the ACS instead, or even backing off entirely and trying to catch up with a contingency EVA day on Mar. 9. Ultimately, they decided to go ahead with the original task, and to slip the crew's sleep period.

Servicing the Space Telescope

For more on Hubble and shuttle missions, visit www.AviationNow.com/hubble

While the crew helped Grunsfeld resize and change into Newman's suit, telescope controllers at Goddard commanded heaters to warm the telescope in preparation for unpowered operations. Once they emerged into the payload bay after the EVA started at 3:28 a.m. EST, the astronauts covered star trackers and other delicate components with temporary thermal covers for additional protection as the telescope cooled toward an icy death.

Program manager Burch said the risk associated with turning off the telescope was outweighed by the risk of leaving the old PCU in place. Variable electrical impedance caused by a bolt too short—by mistaken specification—to make a secure connection raised the possibility that the unit might not be able to deliver enough power to operate instruments in parallel or run the new mechanical cooler for the telescope's infrared camera. In the worst case, defined by only a quarter turn of the loose bolt, none of the instruments would have enough power to operate, and the telescope would go into a safehold. That in turn would raise the possibility that two of the batteries might overheat and rupture.

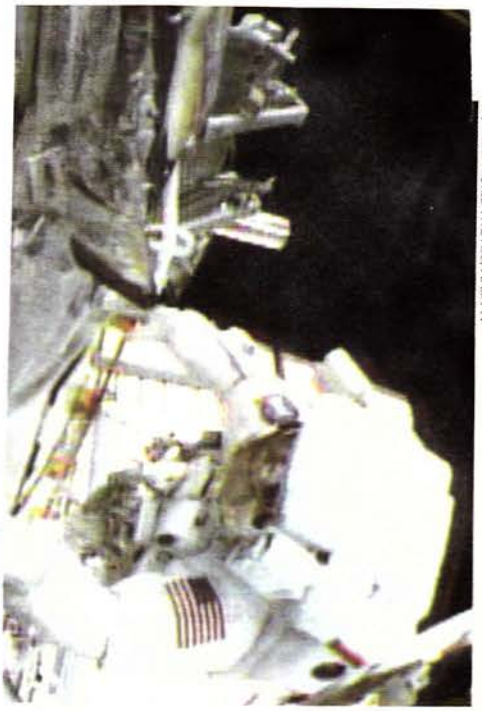


Astronaut John Grunsfeld is caught by Richard Linnehan's helmet camera as he moves toward Bay 4 of the Hubble Space Telescope to change the power control unit.

"There's no way to predict the future on something like this," Burch said. "It's sort of the Dirty Harry question—'do you feel lucky?'—and we don't like to trust to luck with something as important as HST."

The actual work of removing the old PCU and installing the new one went smoothly. Linnehan used a special wrench to disconnect 30 of the 34 cables leading into the left side of the unit, standing at the workstation on the end of the robot arm as Currie raised him up and down and pitched him in and out of the confined space. After a little more than half an hour, Grunsfeld replaced Linnehan on the end of the arm, disconnected the remaining four side cables and two on the bottom of the box to get the feel of the special tool in microgravity. He used his power tool to finish unbolting the unit and pulled it out with a clamp designed to give him a handhold as Currie withdrew him from the PCU bay.

While Linnehan stowed the old unit, Grunsfeld rode the arm back up the telescope body and began the tedious process of bolting in the replacement PCU and connecting the 36 cables to it. The new



AP/WIDE WORLD PHOTOS/NASA TV

unit—actually the ground spare of the old one—was modified to cant slightly outward on the cable-attachment side, giving Grunsfeld a little more room to work. He used mirrors on the palms of his gloves and on a folding wand to inspect his work, making sure the connector pins were straight and free of foreign object debris. Once the replacement PCU was installed, Grunsfeld replaced fuses and reconnected battery cables, and the Goddard controllers started restoring power and checking out spacecraft systems.

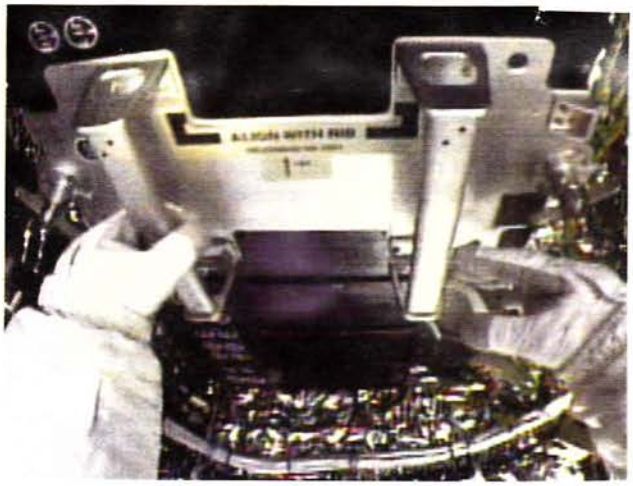
Grunsfeld and Linnehan also took the first EVA early on Mar. 4, replacing the starboard solar array and a related diode box assembly. The procedure went smoothly at first, with Linnehan riding the robotic arm to remove the old array and replace the new one while Grunsfeld handled the electrical attachments. Linnehan had trouble with one of four latches designed to hold the old array in the Rigid Array Carrier for the ride back to Earth, but as Columbia passed over Texas, he was able to close it by loosening one of the other latches first.

With Grunsfeld guiding him from a movable foot restraint on the telescope body, Linnehan opened the new array like a book. Its two panels, fashioned from solar arrays manufactured for the Iridium low-Earth orbit constellation, use gallium arsenide solar cells to deliver 20% more power than the old arrays even though at 24.75 ft. X 8 ft. they are only about two-thirds as large. The smaller arrays will produce less drag on the telescope, while allowing scientists to use all of the science instruments on board simultaneously.

On the second EVA, Newman and Massimino were spared the payload bay setup chores of the day before, and so were able to begin changing the second solar array quickly. Massimino also had trouble latching the old array into its carrier, but by drawing on lessons learned the day before, he was able to stay ahead of schedule even with the glitch. The EVA 2 team also replaced one of the four 100-lb. reaction wheels used to point the telescope at its astronomy targets. The task was added late in preparation for the mission after the wheel they replaced suffered a 7-min. telemetry drop-out on Nov. 10, 2001, that blinded controllers to its rotation speed and briefly disturbed the telescope alignment twice during the blackout.

ALTHOUGH MASSIMINO had a little trouble removing the old reaction wheel assembly, overall the EVA went so rapidly that controllers directed the astronauts to install a new insulation blanket panel outside the reaction wheel bay, a low-priority task scheduled only if time permitted. They also found time to test latch bolts on one of the large aft shroud doors that protect the telescope instruments to see if the latches needed replacing. One latch was replaced, extending the EVA time to 7 hr. 16 min.

In contrast to the work on the power systems over the first three EVAs, the main event on EVA 4 went relatively smoothly. The ACS was designed as an Orbital Replacement Unit (ORU), and so was the Faint Object Camera (FOC) that it replaced. With Currie moving him around on the robot arm and Massimino assisting as the free floater, Newman pulled the FOC from its berth inside the telescope's aft shroud, stowed it in a temporary holder on the side of the bay, pulled the ACS from its carrier and slid it into the vacant space. Once the EVA astronauts connected the new instrument, controllers began the "aliveness" tests that certified it ready for duty while the astronauts stowed the FOC for its return to Earth. The EVA also included some cleanup from the PCU replacement, and get-ahead work for the cryocooler installation on EVA 5.



Grunsfeld used this special clamp to grasp the failing power unit, which was not designed to be replaced in orbit.

The servicing mission got underway at 6:22 a.m. EST Mar. 1, one day late after temperatures at Kennedy Space Center dipped into the 30s and left no margins for cold-weather launch constraints set after the Challenger disaster in January 1986.

While the dawn launch dazzled spectators in Florida, controllers at Mission Control Center-Houston noticed a drop in the flow in one of two freon loops used to keep the orbiter and its electronics cool in orbit. Six seconds after main engine cutoff the flow dropped from 300 lb. per hour to 225, suggesting some kind of blockage in an aft freon line. Flight rules require both loops to be working, and for more than 24 hr. after the launch, mission managers were worried that Columbia would have to return to Earth early. Ultimately, they decided that the flow was adequate to provide redundancy even with the blockage, and the mission continued.

Early on the morning of Mar. 3 Navy Cdr. Scott D. Altman, the mission commander, and copilot USAF Lt. Col. Duane G. Carey maneuvered Columbia slowly up to the telescope from below, with the orbiter's control jets configured so they wouldn't contaminate the telescope for the final 45 min. of the approach. Currie positioned the Canadian-built robotic arm above the payload bay during the approach, which left her in position for a smooth capture and grapple at 4:31 a.m. EST as Columbia flew in darkness 315 naut. mi. over the Pacific southwest of Mexico.

Improvements installed by the end of the servicing mission were expected to allow the Hubble telescope to continue pushing the envelope of human knowledge, answering questions about the universe that in many cases had been raised by its earlier discoveries.

"This telescope is going to be more powerful," said astronomer Wendy Freedman, leader of the team that used the telescope to calculate within 10% the expansion rate of the universe—known as the Hubble Constant. "It's going to have greater sensitivity. It's going to see fainter objects, and see them with much greater clarity, higher resolution, even colors that were not possible with the Hubble previously."

The 11-day mission was scheduled to end on Mar. 12 with a 4:30 a.m. EST landing at Kennedy.


NASA

SPACE.COM : 12 MAART 2002.

SHUTTLE LANDS SAFELY, LEAVING HUBBLE POISED TO PROBE THE COSMOS.

CAPE CANAVERAL - Columbia's astronauts dove through dark skies and returned to the surface of planet Earth Tuesday, leaving an overhauled Hubble Space Telescope poised to peer toward the furthest reaches of the universe. Swooping through the predawn night here in central Florida, Columbia commander Scott "Scooter" Altman piloted the winged spaceship to a 4:32 a.m. EST (0932 GMT) landing at Kennedy Space Center. NASA's 19th nighttime shuttle landing capped a complex but highly successful mission to outfit Hubble with an advanced planetary camera and revive its blind infrared eyes. Amid five challenging spacewalks, the Columbia crew also performed risky transplant surgery on the electrical heart of Hubble and fitted the telescope with a fresh set of smaller but more energetic solar wings. What's more, the astronauts replaced a faulty pointing control device, leaving the rejuvenated telescope ready to answer cosmic questions about the age, evolution and fate of the universe. "Welcome back," fellow astronaut Mark Polansky told the Columbia crew from NASA's Mission Control Center in Houston after the shuttle rolled to a stop on a floodlit runway. "We'd like to congratulate you all on a very successful mission servicing the Hubble Space Telescope." "It's great to be back here at Kennedy Space Center after this incredible experience at Hubble," Altman replied. Launched March 1, the 10-day, 22-hour flight got off to a rocky start. A clogged shuttle coolant line threatened to bring the crew home early. But NASA ultimately okayed a rendezvous with Hubble despite a technical violation of longstanding flight safety rules. Throughout the mission, one of two coolant lines that keep spacecraft electronics from overheating operated outside of established safety limits. The second line, however, worked as intended, and no problems were reported with the congested Freon coolant loop during Columbia's fiery plunge back through the atmosphere. Flying the shuttle tail-first and upside down, Altman revved up Columbia's twin orbital maneuvering engines at 3:22 a.m. EST (0822 GMT) as the ship and its six-man, one-woman crew cruised high above the Indian Ocean east of Africa. The four-minute, four-second firing slowed Columbia enough to send the 90-ton shuttle on an hour-long freefall back to Earth. Trademark twin sonic booms signaled the imminent end to a mission that featured a record-tying five spacewalks in as many days. Added up, two alternating two-man teams - John Grunsfeld and Rick Linnehan, and James Newman and Michael Massimino - - spent 35 hours and 55 minutes scaling up and down the four-story telescope, which was mounted on a cargo bay platform for the work. The new benchmark eclipsed by 29 minutes one set by NASA's first Hubble repair crew during a 1993 mission to fix a debilitating flaw in the observatory's primary mirror. Both flights featured five spacewalks, and the work carried out by Columbia's crew was considered every bit as demanding as the earlier restoration of Hubble's view on the universe. Exhausted but exhilarated by the end of it all, even the astronauts were astonished that they were able to get all the work done during what was an oversubscribed mission. "I'm still riding high on the fact that we did everything we came to do, and that we didn't break the telescope," Grunsfeld told reporters in a space-to-ground news conference Monday. NASA's fourth Hubble servicing mission served as a mid-life makeover for the 12-year-old observatory, which was launched in 1990 and is widely regarded as one of the most scientifically productive machines ever built by humans. The telescope's new $19 million solar wings will generate 20 percent more power than their predecessors, enabling astronomers to operate as many as four Hubble instruments simultaneously. Combined with a fresh power distribution box and a replacement for a problematic pointing device, the rigid blue arrays will give the telescope a new electrical and mechanical lease on life. A $21 million cooling system is expected to enable engineers to resuscitate the observatory's comatose infrared instrument, which was installed in 1997 but has been in a scientific stupor since 1999. A recovery would allow the observatory once again to peer through dark masses of gas and dust to study stellar nurseries and galactic graveyards. And astronomers around the world already are lining up to use Hubble's $76 million Advanced Camera for Surveys. Ten times more powerful than its forerunner, the sharp new eye on the universe will extend the observatory's reach to within a billion or so years of the Big Bang, the primordial and explosive birth of the universe. The camera is expected to come on line in early May, and NASA Hubble project officials already have been deluged with eight times as many observing proposals as they can accommodate. NASA plans a fifth and final Hubble servicing call in 2004, a flight during which the observatory will be fitted with its last two science instruments - another advanced planetary camera and the most powerful spectrograph ever launched into orbit. Its likely final resting place: The Smithsonian Institution's National Air & Space Museum in Washington, D.C. Next up for NASA's shuttle fleet: The planned April 4 launch of Atlantis on a mission to the International Space Station. Spacewalking astronauts on that flight will assemble the hub of the station's central truss, which eventually will stretch 356 feet (108 meters) from end to end. Sistership Endeavour will follow, flying a station crew rotation mission in early May. Tight security, meanwhile, is expected when Columbia returns to orbit mid-July. Onboard the shuttle for that 16-day science mission: Ilan Ramon, Israel's first astronaut.

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HUBBLE UPDATE

Operators and users of the Hubble Space Telescope have found the orbiting instrument largely "healthy and fit" as they wrap up their initial checkout following last month's servicing mission by astronauts from the space shuttle Columbia (*AW&ST* Mar. 18, p. 34). New rigid solar arrays, working with a power control unit that was replaced even though it was never meant to be, have upped power production on the telescope by 27% (see photo). Early imaging with the new Advanced Camera for Surveys has been called "excellent." The experimental mechanical cryocooler for the telescope's infrared camera gave its creators a bad moment early on when it shut down for no apparent reason (*AW&ST* Mar. 25, p. 24), and it has been cooling the camera's detectors more slowly than planned since it was restarted. As a result, checkout and eventual use of the IR camera for observations will slip.

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AWST: 15-04-'02

19887

New HST Cryocooler May Get Other Roles

FRANK MORRING, JR./WASHINGTON

Hubble Space Telescope engineers are spending this week activating an advanced mechanical refrigeration system that they expect will restore the telescope's infrared vision, but without the vibration that could blur images of some of the most distant objects in the universe.

If it succeeds in chilling IR detectors on the Near-Infrared Camera and Multi-Object Spectrometer (Nicmos) to about 70K (-334F) without shaking the telescope, the experimental cryocooler could be the precursor to a new generation of mechanical cooling systems with applications on advanced scientific and military satellites.

The technology was based on work done for the U.S. Air Force over the past eight years, and NASA is already considering it for future missions to find Earth-like planets and study the regions near supermassive black holes. Provided the mechanical cooling systems can be made to operate quietly from the standpoints of vibration and electromagnetic interference, they are lighter and longer-lived than cryogenic dewars built to hold consumable coolants like frozen nitrogen.

"If you have very precise pointing requirements, which a lot of DOD [Dept. of Defense], NRO [National Reconnaissance Office] type spacecraft do, as well as any deep astronomy mission, you want as stable a platform as you can get," said Darrell Zimbelman, the NASA systems engineer responsible for the cooling system. "This type of mechanical cooler is going to allow you to achieve those sub-milli-arcsecond pointing requirements that you could not get before with other types of coolers."

Astronauts from the space shuttle Columbia installed the device on Mar. 8 on the final extravehicular activity (EVA) of their mission to service the telescope, which ended on Mar. 12. Following the successful completion of the difficult rigging job, engineers at Goddard Space Flight Center, Md.—site of the Space Telescope Operations Control Center—were scheduled to begin activating the cooling system over the weekend of Mar. 16-17. A first image with the revitalized Nicmos instrument is due in mid-April.

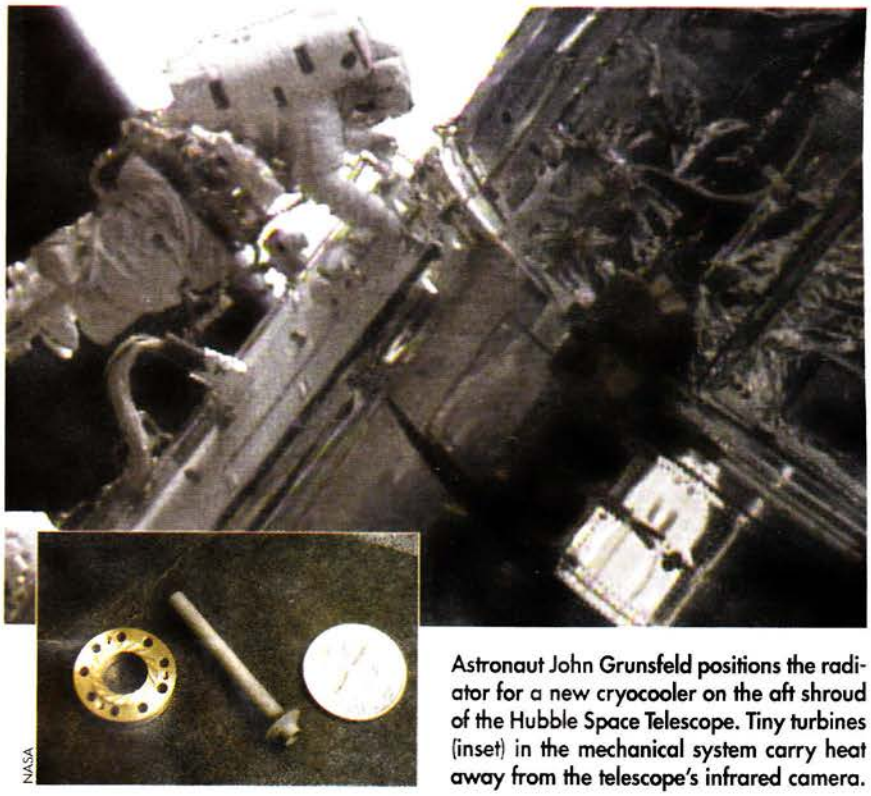
Originally that instrument lasted only for 22 of an expected 60 months because a thermal short depleted the solid nitrogen coolant in its aluminum honeycomb dewar prematurely. Without the cooling nitrogen, the infrared detectors in Nicmos warmed to the point of blindness. As it turns out, the target temperature for the adjustable cryocooler of 70K is better suited for optimum performance than the 60K fixed temperature generated by the frozen nitrogen.

Astronauts John M. Grunsfeld and Richard M. Linnehan took 5 hr. 8 min. of a 7-hr. 20-min. EVA to wire and plumb the cryocooler into the telescope. As they had done two days earlier when they replaced the Hubble's power control unit (*AW&ST* Mar. 11, p. 22), they accomplished a task that wasn't contemplated when the telescope was launched. Moving slowly but deliberately, they bolted the cooler compressor into the telescope aft compartment, latched a 13-ft. radiator onto handrails along the telescope body, snaked a coolant line through a vent in the telescope's aft bulkhead and worked inside the telescope to connect all the plumbing and wiring without generating debris that might damage one of its delicate sensors.

"Looks like a big surfboard, John," astronaut James H. Newman radioed from Columbia's aft flight deck as Grunsfeld—riding the shuttle's robot arm—carried the radiator up from the payload bay floor to the telescope. Astronaut Nancy J. Currie operated the arm, while Michael J. Massimino helped Newman with EVA choreography from the flight deck.

The key to the cryocooler is a turbine about the radius of a dime that rotates on gas bearings to move coolant through the system. Built by Creare Inc. of Hanover, N.H., the machined-titanium turbine spins at 400,000 rpm. to minimize vibration. "It's a combination of the high speed and the fact that they're a very low mass," said Nicholas Jedrich, an engineer on the project with Jackson & Tull of Seabrook, Md., which handled technical management, integration and test support on the cryocooler. "You have very small inertia, so it's high stability."

Moving surfaces in the turbomachinery are coated with diamond-like carbon to prevent wear and tear when they touch. In space, the turbines float on the neon coolant used to draw heat away from the Nicmos detectors and pass it along to a separate ammonia system that takes the heat out of the telescope's aft shroud and into space via the radiator. A similar ammonia radiator is scheduled to be installed



Astronaut John Grunsfeld positions the radiator for a new cryocooler on the aft shroud of the Hubble Space Telescope. Tiny turbines (inset) in the mechanical system carry heat away from the telescope's infrared camera.

during the next servicing mission in 2004 to cool the entire aft shroud so all of the telescope's instruments that will be in place after that mission can be operated at once.

IN COMBINATION with the new solar arrays, Advanced Camera for Surveys and power control unit Columbia's crew installed, the revived Nicmos will dramatically boost the Hubble telescope's ability to make discoveries by cutting through the dust that obscures many regions of scientific interest.

"When you go to longer wavelengths, which the Nicmos camera allows you to do, the light coming from these objects can actually pass through the dust, and you can see them in a way that's not possible in ordinary visible light wavelengths," said Wendy Freedman, an astronomer at the Carnegie Observatories in Pasadena, Calif. "It may be possible to see other planets, failed stars, and to understand how galaxies interact."

Hubble Space Telescope
For more on Hubble, visit
www.AviationNow.com/hubble

Columbia returned to Earth on Mar. 12 with a 4:32 a.m. EST landing at the Kennedy Space Center in pristine weather conditions. The STS 109 descent from 315 naut. mi. altitude began with a twin orbital maneuvering system reentry burn over the Indian Ocean, followed by four hypersonic roll reversals to bleed off energy and to break north out of its orbital ground track to set up for an approach to Runway 33.

To gain stick time in preparation for future landings as a shuttle commander, co-pilot USAF Lt. Col. Duane G. Carey took manual control of Columbia just coming onto the computer-generated heading alignment circle (HAC) projected on cockpit displays. Carey brought the orbiter partway around the 250-deg. right overhead turn and then handed control to Navy Cdr. Scott D. Altman so the STS-109 commander could complete the landing.

Senior Editor Craig Covault contributed to this report from the Kennedy Space Center.

73882

Spectacular servicing mission

The fourth Space Shuttle servicing mission to the Hubble Space Telescope was launched on 2 March to install a new camera that will improve the craft's imaging capability by a factor of ten.

Five spacewalks were planned for the seven-crew STS-109 mission being flown by the orbiter Columbia, fitted with a new glass cockpit and entering its 20th year of operations. Columbia made the first Space Shuttle mission in April 1981 and has flown 26 times.

The STS-109 crew installed the Advanced Camera for Surveys, replacing the Faint Object Camera on the telescope, which will enable astronomers to peer into the distant Universe, further than 12 million light years away.

The Hubble's solar arrays were replaced by a new, lighter pair but with 20 times more electrical power generation capability, and the crew replaced a reaction wheel assembly, a power control unit and other smaller pieces of equipment.

An existing but dormant instrument, the Near Infrared Camera and Multi Object Spectrometer was fitted with a new, experimental cooling system and returned to active service. The total cost of the new equipment to be fitted to the HST was $172 million.

The servicing mission was dubbed 3B, rather than 4 as it comprised the second phase of a third mission, flown in December 1999 which had to be divided into two missions to allow emergency replacement of the HST's gyroscopes on flight 3A.

The HST was launched on the Shuttle in 1990. The first servicing mission, in December 1993 had to include the installation of a purpose-built instrument to correct the optics of the main mirror which was discovered to have been very slightly distorted. A second servicing mission was flown in February 1997.

A final servicing mission will be flown within five years to replace the corrective optics system with a Cosmic Origins Spectrograph, a third Wide Field Camera, a new aft shroud cooling system and a fine guidance sensor.

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Another mission is planned in a ten-year timeframe to "secure" the telescope, which could involve boosting it into a higher "safe" orbit preventing a potentially dangerous re-entry and break up in the atmosphere.

Another more favoured option is to retrieve the HST and return it to Earth. There have been discussions about the famous satellite being placed in the National Air and Space Museum in Washington DC.

Five more Space Shuttle missions are planned for this year, four of which will rotate crews and supply equipment to the International Space Station. One will be an independent 16-day science research mission

19889

Service mission to extend Hubble's lifetime

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After nearly 12 years of incredible scientific discoveries, the Hubble Space Telescope orbiting Earth is about to have another service visit. The servicing mission planned for launch on 28 February will be the fourth since Hubble's launch in 1990 and will install newer and more powerful instruments that will increase Hubble's discovery capabilities and extend the longevity of the observatory.

As a unique collaboration between the European Space Agency (ESA), and NASA, Hubble has had a phenomenal scientific impact. The unsurpassed sharp images from this space observatory have penetrated into the hidden depths of space and revealed breathtaking phenomena.

But Hubble's important contributions to science have only been possible through a carefully planned strategy to service and upgrade Hubble every two or three years. One of the highlights of this servicing mission - which involves five extensive space walks - will be when the ESA-built solar panels are replaced by newer and more powerful ones. The new panels, developed in the US, are equipped with ESA developed drive mechanisms and were tested at the facilities at ESA's European Space Research and Technology Centre (ESTEC) in the Netherlands. This facility is the only place in the world where such tests can be performed.

"A particularly tense moment occurs when the present solar panels have to be rolled up to fit into the Shuttle's cargo bay. The hard environment of space has taken its toll on the panels and it will be a very delicate operation to roll them up," said Ton Linssen, HST Project Manager at ESA, who supervised all ESA involvement in the new solar panels development including the test campaign at ESTEC.

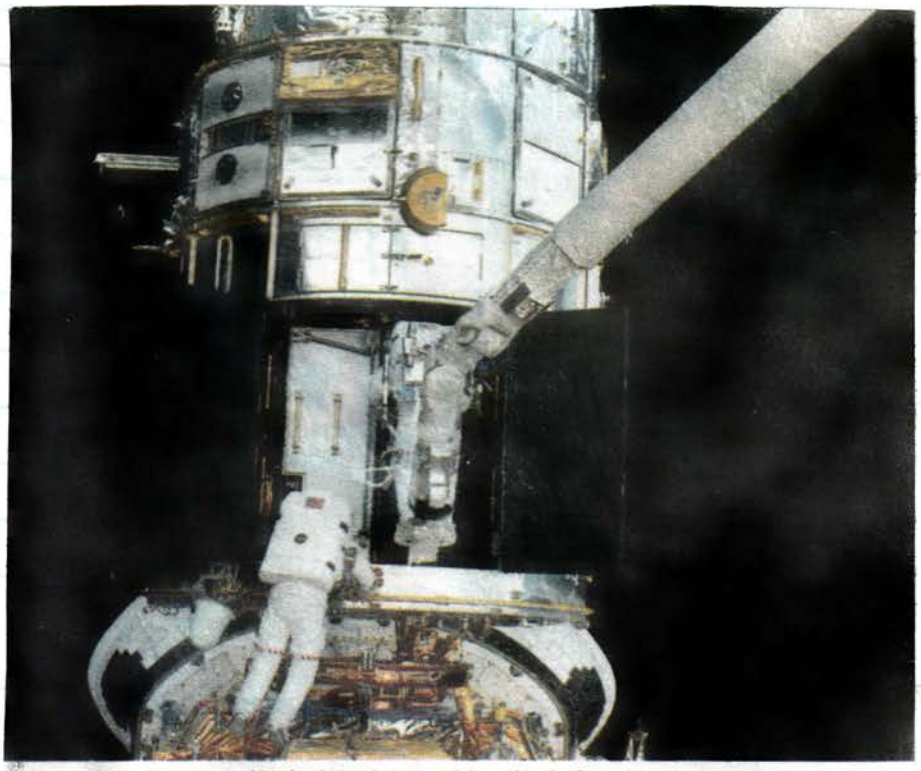
Piero Benvenuti, Hubble Project Scientist at ESA, said: "New super-advanced instrumentation will revitalise the observatory. For example, Hubble's new digital camera - the new Advanced Camera for Surveys, or ACS - can take images of twice the area of the sky and with five times the sensitivity of Hubble's previous instruments, therefore increasing by ten times Hubble's discovery capability."

ACS is going to replace the Faint Object Camera, or FOC, built by ESA. The FOC, which has functioned perfectly since the beginning, has been a key instrument to get the best out of the unprecedented imaging capability of Hubble. The FOC was a "state-of-the art" instrument in the 80s, but the field of digital imaging has progressed so much in the past 20 years that, having fulfilled its scientific goals, this ESA flagship on Hubble is chivalrously giving way to newer technology.

However, the story of FOC is not over yet as experts will still learn from it when it is brought back to Earth and inspected, to study the effects on the hardware of the long duration exposure in space. Hubble is expected to continue to explore the sky during the next decade, after which its work will be taken over by its successor, the powerful ESA/NASA/CSA (Canadian Space Agency) Next Generation Space Telescope.

NGST's main focus will be observations of the faint infrared light from the first stars and galaxies in the Universe.

Spaceflight: april 2002.



Astronauts James Newman and Michael Massimino participated in the first science instrument upgrade of the fourth Hubble Space Telescope (HST) servicing mission during the flight's fourth day of extravehicular activity (EVA).

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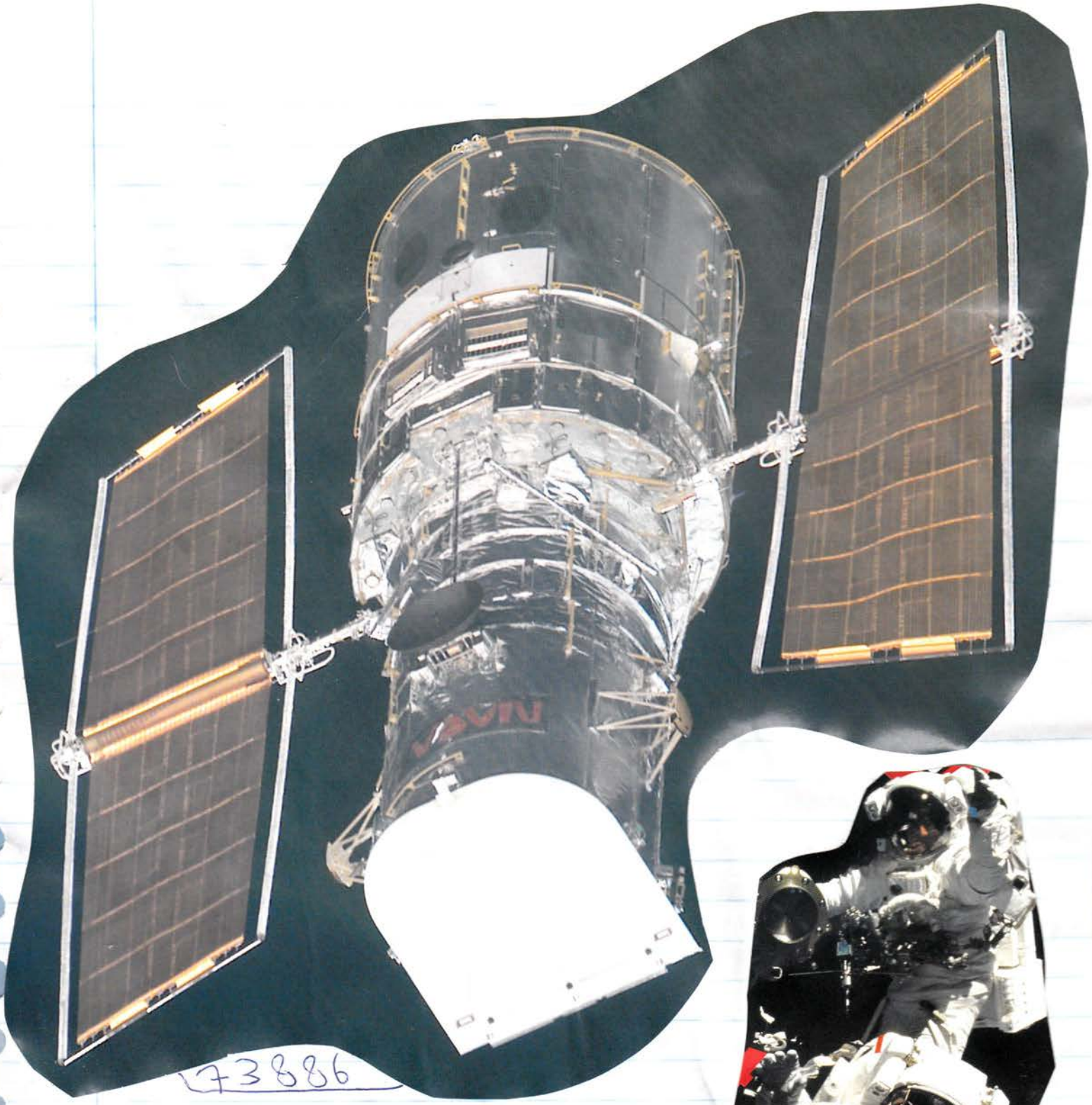

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Spectacular Hubble mission

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Zweieinhalb Jahre nach der letzten Inspektion waren beim Hubble-Weltraumteleskop erneut Instandsetzungen angesagt. Bis 2004 ist der Späher jetzt wieder toppfit.

Service für Hub

SCHWERSTARBEIT IM ALL

ble

DIE ASTRONAUTEN Michael Massimino (links) und James Newman beim zweiten Außenbordeinsatz in der Nutzlastbucht des Shuttle-Orbiters Columbia.

FOTO: NASA

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GRUNSFELD und Linnehan wechseln die Energiekontrolleinheit von Hubble (links)

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ZAHLREICHE spezielle Werkzeuge kamen bei den Arbeiten zum Einsatz.

Schwerstarbeit stand auf dem Flugplan, und das ist keine Übertreibung, nachdem das Arbeitsprogramm des Fluges STS-109/HST Servicing Mission 3B auf insgesamt fünf Ausstiege von je zwei Astronauten fixiert worden war. Schon lange vor dem Einsatz war festgelegt worden, dass die „Veteranen" John Grunsfeld, James Newman und Richard Linnehan sowie der Weltraumneuling Michael Massimino als Missionsspezialisten die Montagearbeiten im freien Raum ausführen sollten. Am 26. März 2001 wurde zudem entschieden, ihnen Scott Altman als Kommandant, Duane Carey als Pilot und Nancy Currie als Flugingenieurin zur Seite zu stellen.

Auch Altman und Currie hatten bereits Erfahrungen aus zwei beziehungsweise drei vorangegangenen Flügen, während Nutzlastkommandant Grunsfeld sogar schon 1999 bei der letzten Hubble-Inspektion dabei war. Vor den sieben Astronauten stand nun die anspruchsvolle Aufgabe, an fünf von insgesamt elf Missionstagen dem milliardenteuren Weltraumteleskop Hubble neue Solarzellenflächen zu verpassen, sowie die dazu gehörigen Diodenboxen, Drallräder für die Lagestabilisierung, eine Energiekontrolleinheit, ein Kühlsystem und als wichtigstes Gerät eine verbesserte Sternenkamera zu installieren, mit der die Astronomen nun noch tiefer in das Universum schauen können.

Die nächsten Monate bis zum Start waren angefüllt mit hartem Training nach einem bis ins kleinste Detail ausgeklügelten Zeitplan, mussten sich doch die Montageteams Grunsfeld/Linnehan und Newman/Massimino den riesigen Neutralauftriebstank im Johnson Space Center mit den Monteuren der Internationalen Raumstation teilen, zumal ja auch stets das erforderliche Trainingsequipment im Wasserbecken komplett zu wechseln war. Nancy Currie indessen verbrachte ungezählte Stunden im Simulator des kanadischen Manipulatorsystems, mit dem sie die Reparaturtrupps unterstützen sollte.

Weil sich der Austausch der Drallräder erst kurzfristig notwendig gemacht hatte, musste der Start gar um eine Woche für zusätzliches Training verschoben werden, doch am 1. März 2002 war es endlich soweit, und der generalüberholte Shuttle-Orbiter Columbia konnte zum „Kaperflug" in Richtung Hubble Space Telescope starten. Seltene Umstände führten dazu, dass das Teleskop, das gerade zum Zeitpunkt des Starts Florida überquerte, mit bloßem Auge vom Cape Canaveral aus zu sehen war.

Knapp zwei Tage später hatte sich die Columbia derart an Hubble herangepirscht, dass die Annäherung und das Einfangen mittels des Kranarmes in Angriff genommen werden konnte. Nancy Currie packte den Satelliten und bugsierte ihn auf die spezielle Halterung in der Ladebucht. Die Zeit davor hatte die Crew zum Auspacken und für letzte Tests der Ausrüstung verwendet, während sich die Bodenkontrolle Gedanken über Abweichungen im Kühlmittelfluss des Backbordradiators machte. Glücklicherweise wurde die Thermalkontrolle des Orbiters davon nicht über Gebühr beeinflusst, so dass die Arbeiten wie geplant fortgesetzt werden konnten.

Als erstes wurden per Funkkommando die alten Solarzellenflächen eingerollt, und obwohl die dafür benötigten Motoren seit 1993 nicht in Betrieb genommen worden waren, arbeiteten sie ohne Probleme. Weil der Kabinendruck bereits am zweiten Flugtag gesenkt worden war, verlief die Anpassung

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DIE BESATZUNG der Mission STS-109 (von links): Duane Carey, Scott Altman, Richard Linnehan, Michael Massimino, James Newman, John Grunsfeld und Nancy Currie.

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der „Aussteiger“ an den Arbeitsdruck ihrer Raumanzüge schneller als sonst, und so konnte bereits beim ersten Arbeitseinsatz die Steuerbord-Solarzellenfläche durch eine neue ersetzt werden. Diese ist rund ein Drittel kleiner als ihr Vorgänger, liefert jedoch 20 Prozent mehr elektrische Leistung. Zudem bietet sie dem Strahlungsdruck der Sonne keine so große Fläche, was wiederum weniger Bahnkorrekturen verlangt.

Die zweite Fläche wurde am nächsten Tag ausgetauscht, gefolgt von der Drallradeinheit, und problemlos verliefen auch die weiteren Ausstiege. Zu den geplanten Reparaturen und Installationen kamen auch noch ein paar kleinere ungeplante, die sich aus der direkten Inspektion des Satelliten ergaben, wie zum Beispiel der Ersatz einiger Segmente der Thermalschutzhülle.

„Viel Glück, Mr. Hubble!“ wünschte die Crew dem Teleskop, als sie sich nach fünf arbeitsreichen Tagen und einer angehobenen Flugbahn von ihrem Schützling verabschiedete. NASA-Management und die wissenschaftliche Gemeinschaft zeigten sich begeistert von der Arbeit der sieben Raumfahrer, die vor ihrer Rückkehr zur Erde noch Funkkontakt zur ISS-Besatzung aufnahmen. Am 12. März schließlich landete die Columbia nach zehn Tagen, 22 Stunden und zehn Minuten sicher wieder am Cape Canaveral. FR

MATTHIAS GRÜNDER

NANCY CURRIE (oben) und Richard Linnehan verbrachten in Vorbereitung der Mission ungezählte Stunden im Simulator.

RUND 650 Kilometer über dem Pazifischen Ozean fing die Shuttle-Crew den Satelliten ein.

Alle Hubble-Servicing-Missionen auf einen Blick

Mission	von-bis	Bemerkungen
HSM 1 / STS-61	02.-13.12.1993	Bei fünf Ausstiegen ersetzte die Crew der Endeavour Gyroskope und die Solarzellenflächen, installierte eine neue Kamera sowie ein Korrektursystem für den optischen Strahlengang des Hauptspiegels.
HSM 2 / STS-82	11.-21.02.1997	Vier Außenbordtätigkeiten der Besatzung der Discovery waren nötig, um ein Spektrometer und einen Spektrographen sowie Sensoren, Speicher und Drallräder auszutauschen.
HSM 3A / STS-103	19.-27.12.1999	Die eigentlich erst für 2001 geplante Mission musste in wesentlichen Teilen vorgezogen werden, weil wegen des Ausfalls von vier Gyroskopen die Stabilität des Satelliten nicht mehr gewährleistet war und die wissenschaftliche Arbeit eingestellt werden musste. Die Crew der Discovery installierte zudem neue Sensoren, einen verbesserten Hauptcomputer sowie einen Datenspeicher und erneuerte Teile der Isolationsschicht.
HSM 3B / STS-109	01.-12.03.2002	Bei fünf Einsätzen wurden eine neue Kamera, verbesserte Solarzellenflächen und ein neues Kühlsystem eingebaut. Der Thermalschutz wurde erneuert und die Bahnhöhe des Satelliten angehoben.
HSM 4	Juli 2003	Ein neuer Infrarot-Spektrograph und eine verbesserte Hauptkamera werden installiert.
HSM 5	2010	20 Jahre nach dem Start soll Hubble zur Erde zurückgeholt werden.

FOTOS: NASA

73901

1996

AP NEWS : 18 MAART 2002.

NASA TO KEEP SHUTTLE LAUNCH TIMES SECRET UNTIL DAY BEFORE LIFTOFF.

CAPE CANAVERAL - Beginning with the next space shuttle flight in two weeks, NASA is keeping its launch times secret until 24 hours in advance to guard against possible terrorist attack. It is the first time in more than a decade that the space agency is refusing to give out a shuttle launch time well in advance. ``NASA is choosing to be extra careful,'' Kennedy Space Center spokesman Bruce Buckingham said Monday. Under the new policy, approved late last week by top NASA officials, the National Aeronautics and Space Administration will give out four-hour launch periods until about 24 hours before liftoff, when the precise time will be announced. Once NASA releases the exact launch time, everything about the flight -- including the landing time-- will be made public. The next launch, of Atlantis on April 4, will occur sometime between 2 p.m. and 6 p.m. (1900 and 2300 GMT), Buckingham noted. It is a space station assembly mission. Even though the seven astronauts assigned to the flight were at the launch site Monday, going through the customary practice countdown, NASA did not announce their arrival in advance for security reasons. ``What we're trying to do is protect the credibility of this agency with the public and the press, and also with the security measures that this nation has put into place at the highest government level,'' NASA spokesman Kyle Herring said from the agency's Washington headquarters. NASA, as a civilian agency, needs and wants to put out as much information to the public as possible, Herring said. ``But we also want to protect the national assets, that is the hardware, the crew and the personnel that work for this agency,'' he said. The launch times of the December and March space shuttle missions were widely known before Sept. 11, and so there was no attempt to make them secret following the terrorist attacks, Herring said. Both launches were conducted amid unprecedented security, which is expected to continue. Herring said the new policy took a while to develop and will remain in effect for subsequent missions, ``with the caveat that it will be reviewed on a flight-by-flight basis.'' Still to be decided: whether and how NASA will confirm the start of the launch countdown. The countdown clocks in public view will not start ticking until 24 hours in advance, Herring said. Even tougher rules were in effect for the seven space shuttle flights that carried classified Defense Department satellites from 1985 through 1990. In those cases, the launch time was not announced until nine minutes before liftoff and a news blackout was imposed on virtually the entire flight.

73902

BBC : 20 MAART 2002.

SOVIET MOON ROCKET SECRETS REVEALED.

Hitherto unseen pictures of the giant rocket that the Soviets hoped would help them beat the United States to land a man on the Moon have been revealed on a Russian website. The images appear on the website of the Russian Strength Research Centre. They show new views of the mighty N1 rocket - the Soviet equivalent of America's Saturn 5 booster. Experts say that new details about the booster can be seen in what are images of early test versions of the booster's first stage. Nine or ten N1's were built at the Baikonur Cosmodrome in the late 1960s and early 1970s. The giant rocket was launched just four times; each one was a disaster ending in abrupt and catastrophic failure. They are interesting photographs because they reveal some previously unseen structure and construction of N1's first stage, Soviet space expert Edwin N Cameron told BBC News Online. Designed to lift the Soviet moon lander into space, the N1 was a titanic feat of engineering. Its first stage involved a cluster of 30 high-powered rocket engines using kerosene and liquid oxygen as fuel. The large number of engines was the rocket's fatal flaw. Engineers could not find a way to effectively balance the thrust of them all meaning that controlling the booster was impossible. Pumping fuel to each rocket motor also proved to be a major problem. When the N1 project was cancelled in 1976 the Soviet space chief Valentin Glushko ordered all the remaining N1 hardware to be destroyed but, despite his orders, a lot survived. In 1997, 94 leftover N1 engines were sold to the American company Kistler for refurbishment and incorporation into a new rocket.

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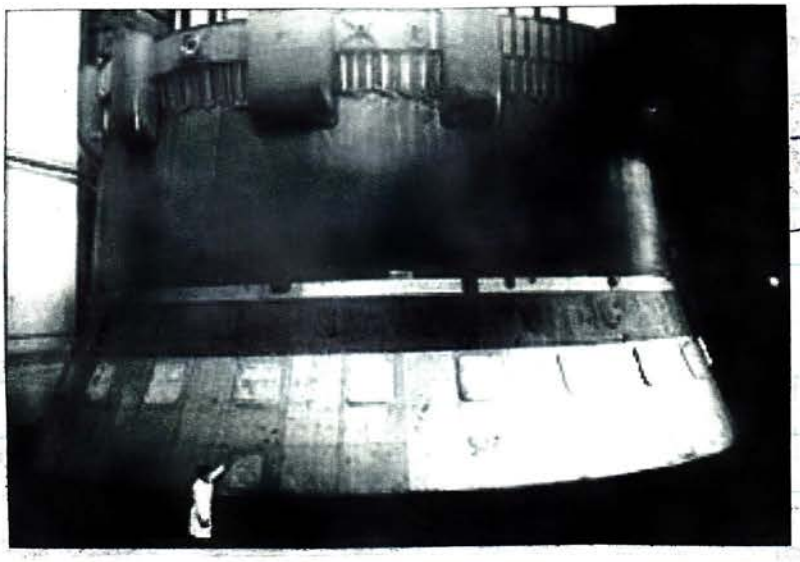


73904

19897

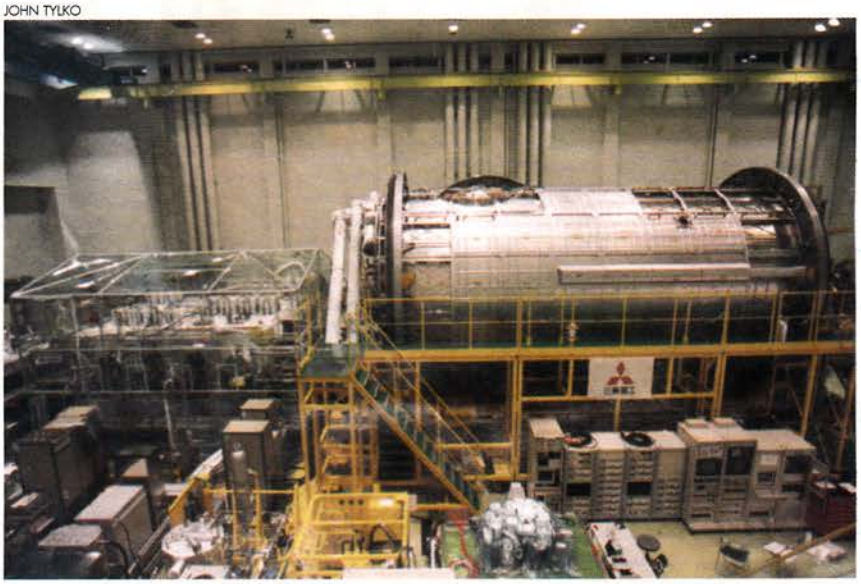
Japanese ISS Hardware Shows Scale Of U.S./Japan Cooperation

CRAIG COVAULT/**KENNEDY SPACE CENTER**

Japanese International Space Station hardware that make up the single largest U.S./Japanese cooperative aerospace effort are shown undergoing final checkout near Tokyo.

Total Japanese investment in ISS hardware and facilities exceeds 400 billion yen ($3.1 billion) and involves nine major Japanese aerospace companies and numerous Japanese subcontractors. Japanese officials are concerned that U.S. changes to the station caused by NASA cost overruns could limit Japanese astronaut participation—and Japanese research return—by reducing the overall ISS crew size.

JOHN TYLKO



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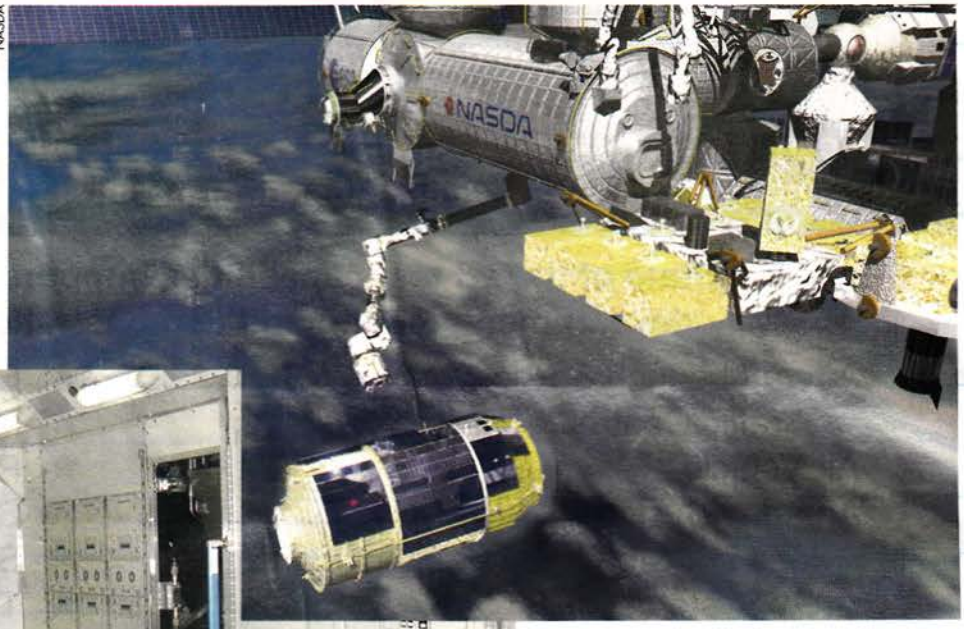

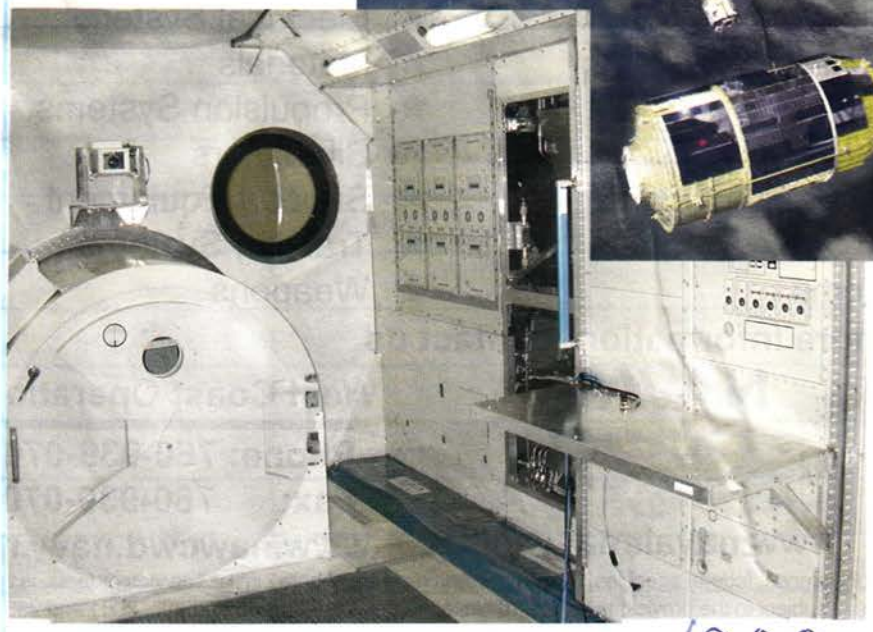

The magnitude of Japan's contribution to the ISS is illustrated by module and robotic hardware being completed in the Space Station Integration and Test Building at the Tsukuba Space Center. Final integration is underway on the 15-ton Kibo Japanese Experiments Module (JEM) (top photo, p. 82) with its 32-ft. Japanese ro-

(73905)

1998

botic arm. Attached to the left side of Kibo is the JEM exposure facility under a clean room greenhouse. Japanese astronauts will use the arm to move research hardware back and forth between the module and the 4-ton porch-like exposure facility. The elements are to be shipped to the U.S. late this year for launch to the ISS by the shuttle by about 2004.

Computer graphic (center image, p. 82) shows how the Japanese hardware will appear as an H-IIA-launched logistics module (HTV) approaches. Japanese astronauts are using a JEM internal mockup (bottom photo, p. 82) for training, as well as a mockup of the airlock (see photo below) that will link the JEM to the exposure facility.

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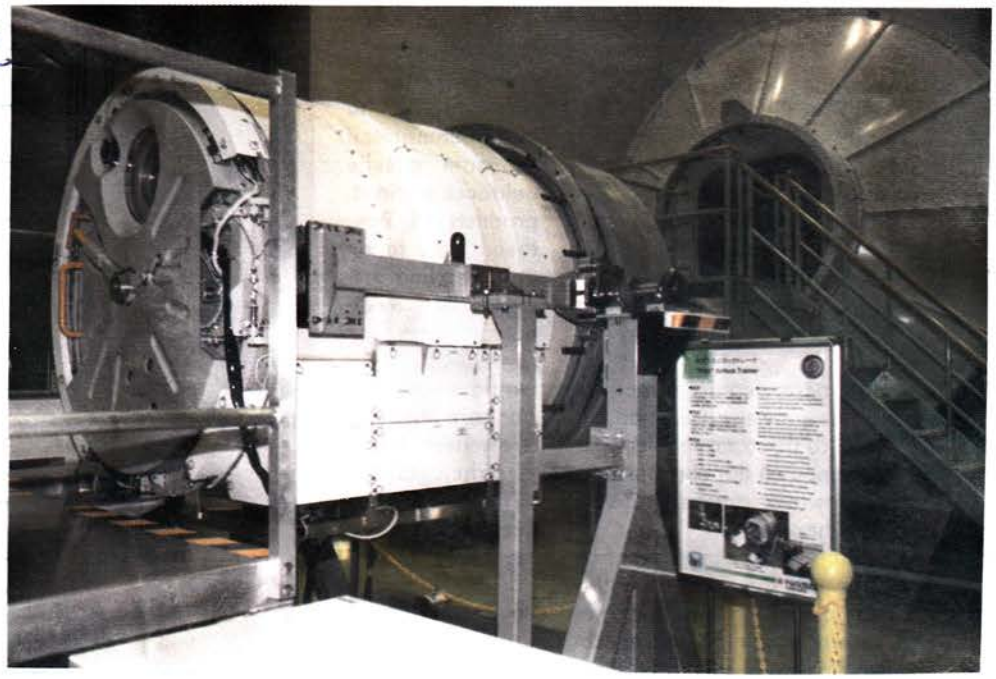

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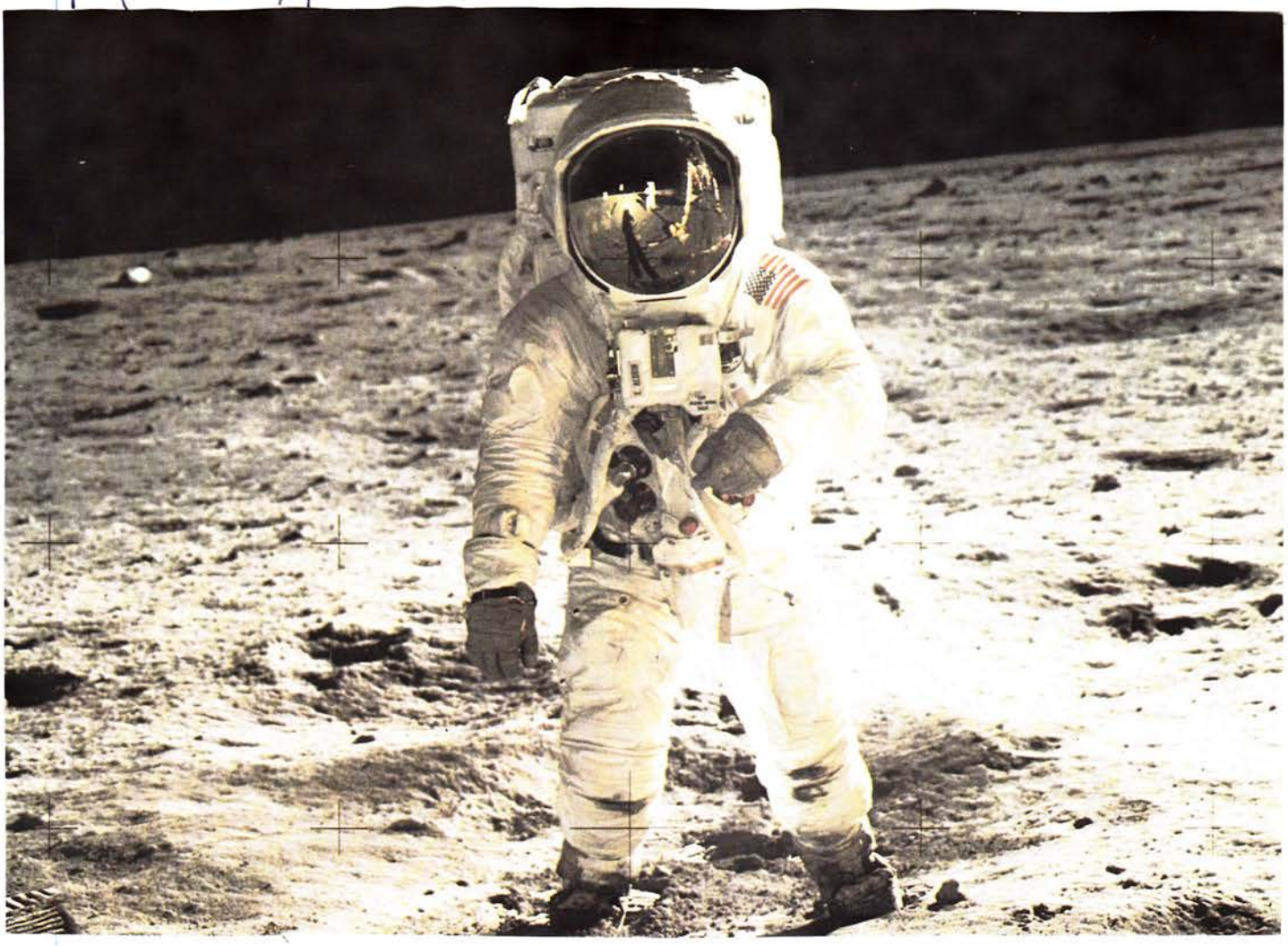

19999

SPACEFLIGHT NOW : 11 MAART 2002.

INAUGURAL ATLAS 5 ROCKET MOVED TO THE LAUNCH PAD.

Lockheed Martin's first Atlas 5 rocket was rolled out to its Cape Canaveral launch pad Monday for fueling tests and a crucial countdown dress rehearsal. Riding atop a mobile transporter, the 191-foot tall rocket made the 1,800-foot roll from its vertical assembly building to the open-air pad at Complex 41. Lockheed Martin has installed a dummy satellite simulator and full nose cone atop of the Atlas 5 for the test, giving a realistic view of what the rocket will look like when it launches on the inaugural flight. The schedule called for the Atlas first stage to be loaded with RP-1 propellant, a highly refined kerosene on Monday. On Tuesday, the launch team will assemble for a full countdown that will include loading the first stage with super-cold liquid oxygen and the Centaur upper stage with its supply of liquid hydrogen and liquid oxygen. If the tests go well, the rocket will be safed and then rolled back to its assembly building on Wednesday. This is the first of three such dress rehearsals planned before launch. Lockheed Martin delayed this initial countdown test by two weeks to deconflict the busy work schedules for the Atlas team, which successfully launched the first Atlas 3B rocket on February 21 and an Atlas 2A rocket last Friday. Crews did roll the rocket to the pad last Wednesday, however, for RP-1 loading exercises and tests with the Air Force-controlled Eastern Range at the Cape. The vehicle was then returned to the hangar on Thursday. The maiden Atlas 5 launch, originally scheduled for May 9, has slipped into June due to delays readying the rocket's paying cargo -- Eutelsat's Hot Bird-6 direct-to-home TV broadcasting satellite.

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Atlas V

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De eerste vlucht van de zeer krachtige Atlas V raket staat nu gepland op 9 mei. Het moet dan de Europese Hot Bird van Eutelsat in een overgangsbaan om de aarde brengen. Dat de lancering alsnog naar een latere datum verschoven wordt, sluiten technici niet uit. Geen enkel risico zal genomen worden: de eerste lancering moet meteen een geweldig succes zijn. De te lancering kunstmaan is een van het 'lichtgewicht' type voor deze raket. Dat houdt in dat er geen hulpraketten bij deze missie aangebracht behoeven te worden. Bij zwaardere vrachten in de toekomst kunnen technici er vijf aanbrengen.

73913

Voor dit jaar staan twee Atlas V lanceringen op het programma en zes voor het volgende jaar.

Lockheed Martin heeft honderden miljoenen euro's geïnvesteerd in de ontwikkeling van deze raket, lanceerfacilliteiten en infrastructuur. De Amerikanen hopen met deze Atlas V raket de concurrentieslag met de Ariane 5 te winnen

73914

73915

The first U.S. Air Force/Lockheed Martin Atlas V evolved expendable launch vehicle has been rolled out to Pad 41 at Cape Canaveral for propellant loading tests. The transfer to the pad of the first EELV flight vehicle after seven years of planning and development marks the beginning of a new era for U.S. unmanned booster operations.

For the first time since the inception of the U.S. space program, there is a large new unmanned vehicle on a pad at Cape Canaveral that was developed as a modern cost-effective launcher in its own right, not derived from earlier intercontinental ballistic missiles as were the older Atlas, Titan and Delta launchers. The USAF/commercial EELV program also involves the Boeing Delta IV vehicle.

Lockheed Martin has poured about $1 billion of its own money into the Atlas V program, which USAF began with $500 million worth of development contracts to each company.

The 191-ft.-high Atlas V is positioned on its 1.3-million-lb. mobile launcher platform equipped with a 184-ft. umbilical mast. Lightning protection towers that are 340 ft. tall surround the vehicle. For scale, note the technicians at bottom and tugs used to push the platform to the pad from the vehicle's Vertical Integration Facility. Additional tests on the pad and in the VIF will continue until launch, now planned for June or July, depending on Eutelsat scheduling for the Hot Bird 6 payload.

The first Boeing Delta IV flight vehicle will be placed on its Pad 37 facility later in the spring. Its first launch of a Eutelsat W spacecraft is planned for no earlier than July.

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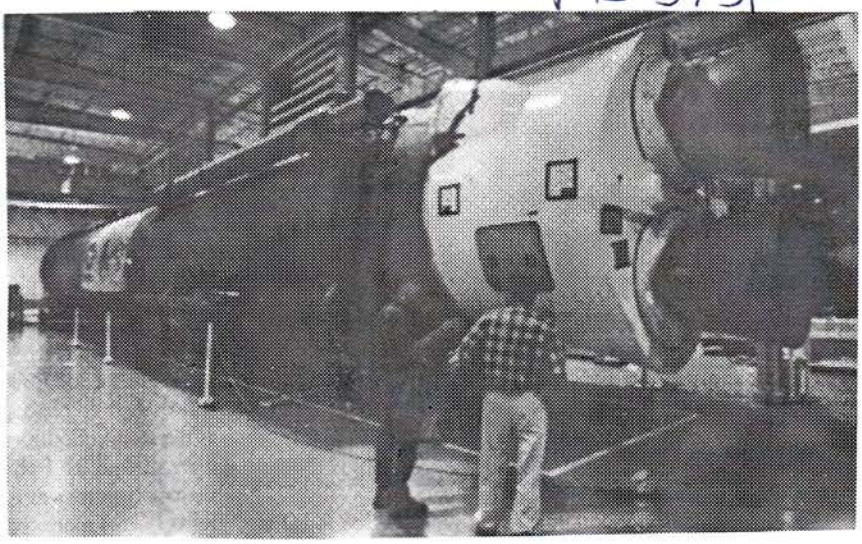
De eerste trap van de Atlas V raket, uitgerust met Russische RD-180 motoren.

73919



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SPACEFLIGHT NOW : 17 MAART 2002.

ATLAS 5 ROCKET PASSES CRUCIAL FIRST LAUNCH PAD TEST.

The Atlas 5 rocket spent over 90 straight hours on the launch pad for its first countdown test last week. The Lockheed Martin Atlas 5 rocket is one step closer to its summertime inaugural launch following the successful countdown rehearsal and fueling tests conducted at Cape Canaveral's Complex 41 last week. Known as a Wet Dress Rehearsal, or WDR, three of these countdown tests are planned over the next couple of months as pathfinder exercises to practice transporting the rocket to the pad, loading propellants and conducting simulated launch days for the control team. The tests give engineers the chance to find any problems early so they can be resolved before the real launch day arrives. Other than a few technical bugs that were uncovered with ground equipment, officials said the Atlas 5 rocket performed "flawlessly" during the crucial tests. "The first one was a hit the first time out," John Karas, Lockheed Martin's vice president of Atlas Development, said of the successful 4 1/2-day test. "It exceeded everyone's wildest expectations." Riding atop its 1.5-million pound mobile launching platform, the rocket was rolled from the new Vertical Integration Facility (VIF) to the open-air launch pad on Monday, March 11. The 1,800-foot trip takes about 20 minutes. The Atlas 5 rocket leaves the VIF for the launch pad 1,800 feet way. Photo: Lockheed Martin. For a real launch day, the Atlas 5 will be moved to the pad just 11 hours before blastoff to be fueled up and readied for the final countdown. With such a short stay, a mobile service tower isn't needed at the pad. Over the past two years, Complex 41 has been transformed from its legacy of launching Titan 4 rockets to supporting the next-generation Atlas 5. Adrian Laffitte, Lockheed Martin's Atlas launch director, says all that remains of the Titan 4 era is the flame ducts and four lightning protection towers. After reaching the pad Monday, the first stage was loaded with RP-1 propellant, a highly refined kerosene. Tuesday was spent working through some technical issues with ground systems. On Wednesday, the launch team -- stationed in the new Atlas 5 Spaceflight Operations Center at Complex 41 -- oversaw the loading of the Centaur upper stage with its supplies of super-cold liquid oxygen and liquid hydrogen. The cryogenics were drained later that day. Thursday saw the completion of a simulated launch day with the pumping of liquid oxygen into the Atlas 5's first stage. The countdown clock reached T-minus 4 minutes before the test was concluded and the liquid oxygen off-loaded. Technicians spent Friday morning draining the RP-1 fuel from the first stage and readying the rocket for its return to the VIF building. The rollback was finished by lunchtime. "The last piece of the Atlas 5 launch system left to test was the integration of vehicle and launch pad, which has now been verified to perform as designed and advertised," Karas said. "Once again the entire Atlas 5 team has done a fabulous job achieving another critical program milestone," said Col. Bob Saxer, the Air Force's Evolved Expendable Launch Vehicle system program director. The Atlas 5 and Boeing's Delta 4 rockets are being developed in conjunction with the EELV program to usher in a new generation of U.S. launch vehicles. "The technical challenges associated with bringing a brand new launch vehicle and launch pad to life are not insignificant. John Karas and the entire Atlas 5 technical team are to be commended for the outstanding job they've done; successfully tanking the entire vehicle, taking it to flight pressures, and counting down to T-minus 4 minutes during the first WDR is very impressive. I look forward with great anticipation to our first launch." In all, the rocket spent over 90 hours standing on its launch pad, experiencing winds of up to 31 knots, rainshowers and even some lightning in the area. Since there is no protective service tower to enclose the rocket on the pad, the vehicle is designed to safely withstand over 60 knots of winds. Karas said the next rehearsal will occur in about a month. Engineers will spend the next few weeks reviewing all the data gathered during this first test. The next WDR will also see the rocket fully fueled and clocks ticking down to T-0 seconds while the launch team practices countdown aborts and simulated problems. This first Atlas 5 rocket, tail-number AV-001, will fly in what Lockheed Martin calls the 401-vehicle configuration. That means it will have a four-meter (14-foot) payload fairing nose cone, no strap-on solid rocket boosters and one Pratt & Whitney RL-10 engine on the Centaur upper stage. As with all Atlas 5 configurations, the first stage is made up of a "Common Core Booster" powered by a Russian RD-180 engine.Standing 191 feet tall and capable of delivering 10,900 pounds of satellite cargo into geosynchronous transfer orbit, the 401-configuration will be the largest and most powerful version of the Atlas rocket to fly, surpassing the records set just last month with the inaugural Atlas 3B. Launch of the first Atlas 5 has been delayed from its long-standing May 9 target date at the request of the mission's customer -- Eutelsat. The Hot Bird 6 direct broadcasting satellite won't be ready for launch until late June or early July. Lockheed Martin has tentativelv looked at July 8 as the new launch date.

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An Aerojet solid rocket booster (SRB) for the Lockheed Martin Atlas 5 program malfunctioned during a ground test near Sacramento, Calif., Mar. 15. The 67 X 5-ft. solid performed normally for about 30 sec. of its planned 95 sec. firing, but then its thrust and chamber pressure dropped and there were changes in the motor's rocket plume. The motor did not explode, enabling instruments to obtain good data which is being examined to determine the cause of the malfunction. The motor was the second Atlas V SRB tested and was verifying a "cold ignition" at 40F along with use of a propellant inhibitor for a more gentle thrust buildup. The first Atlas V, set for launch in June or July, will not use solids. Aerojet SRBs are not slated for the flight program until 2003.

73922

AWST:
25-03-2002

19903

SPACE.COM : 18 MAART 2002.

INVESTIGATION BEGINS OF TROUBLED ATLAS 5 SOLID ROCKET MOTOR TEST.

CAPE CANAVERAL, Fla. – Officials are investigating why a new Atlas 5 solid rocket booster didn't properly fire for two-third's of the time it was supposed to burn during a ground test in California on Friday. Intended to last 95 seconds, the test went well for about 30 seconds or so when the appearance of fire and smoke belching from the motor's nozzle changed and instrumentation showed a drop in thrust and internal pressure, Lockheed Martin spokeswoman Joan Underwood said. Coverage of the test by a Sacramento television station appeared to show the motor firing for more than two minutes before it was clear the booster had burned all its solid propellant fuel. It didn't appear in the aerial video footage that the exhaust burned through the casing. The exercise was the first in a series of tests intended to qualify the Aerojet-built motor for use on Lockheed Martin's new Atlas 5 Evolved Expendable Launch Vehicle. "We're not considering the test a failure," said Aerojet spokesman Mike Finkle. "We were able to capture some excellent data and we were able to achieve several of our test goals." Those goals included chilling the motor to start at a temperature of 40 degrees Fahrenheit (4 degrees Celsius), testing a mix of propellant used at ignition that will put less stress on the Atlas 5 at liftoff and verifying engineering models that predicted what the proper thrust and pressure should be -- at least until the problem surfaced. Underwood said it was too early to say what happened to ruin the final two-thirds of the test and that engineers are still collecting data, inspecting the spent motor and examining videotape and films of the test. First use of the new solid rocket boosters on the Atlas 5 is planned for some time in 2003 and at this point managers don't think the troubled test will delay the introduction of the motor, Underwood said. Aerojet won a $500 million contract from Lockheed Martin in 1999 to design, test and produce the new Atlas 5 boosters, which are largely based on the company's design and experience with the solid motors used on the Minuteman and Peacekeeper intercontinental ballistic missiles. First launch of the Atlas 5 rocket, which will not use any of the Aerojet motors on its inaugural mission, is expected this summer.

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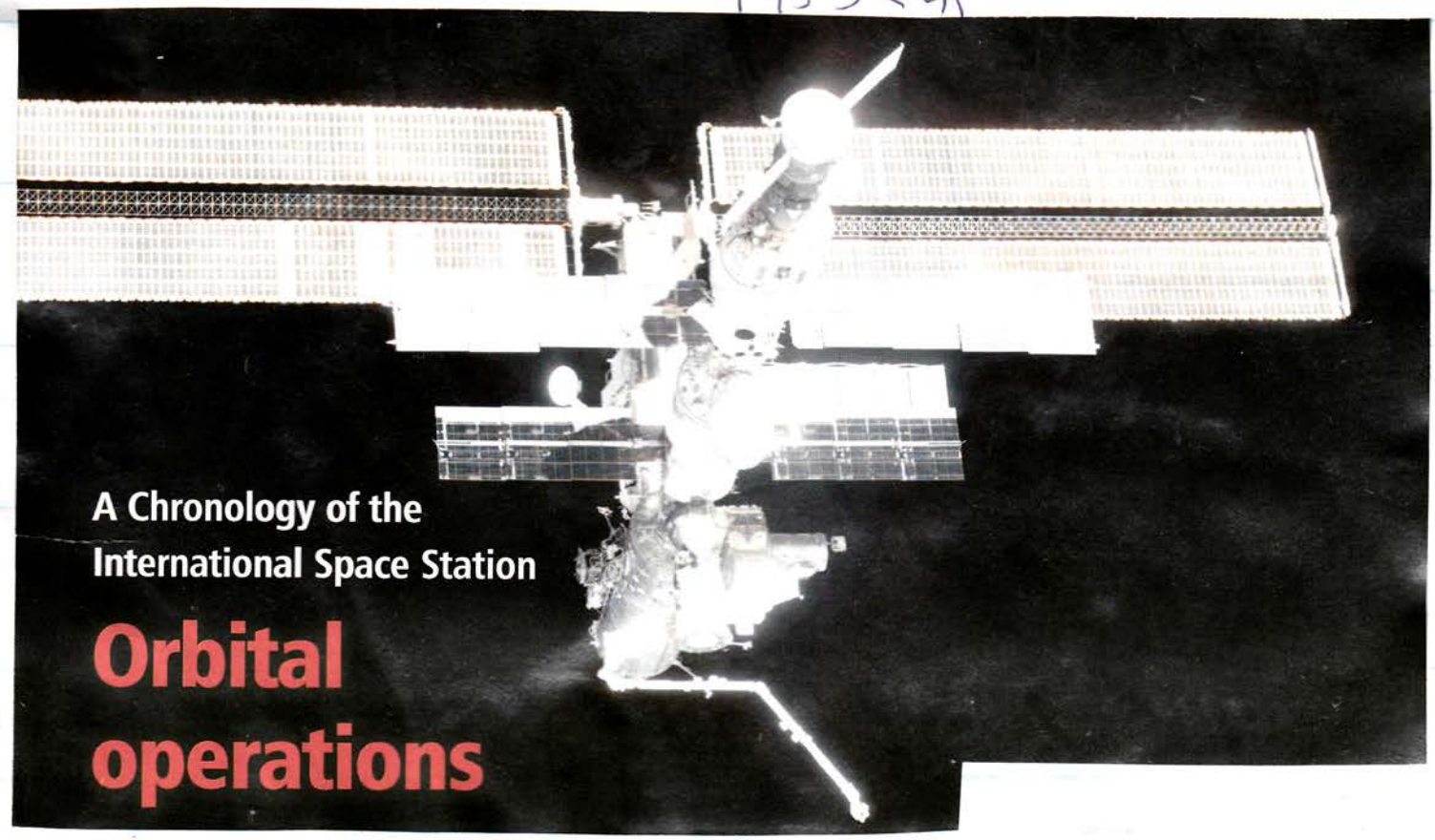

19904

SPACE.COM : 01 MAART 2002.

FIRST EVER NIGHT IMAGES OF MARS RELEASED.

The first ever night image of Mars was released by NASA today during a press conference that marked a promising new era of discovery at the Red Planet. While also announcing fresh evidence of water ice near the surface of Mars, scientists were surprised by the quality of Odyssey's new images and by what they're seeing on the surface of Mars. "We had no idea what to expect," said Phillip Christensen of Arizona State University. "We're startled by the diversity." Several new images were released, all made in the first 6 hours of Odyssey's first day of official science observations, using the spacecraft's Thermal Emission Imaging System (THEMIS). The camera also takes visible-light images. But it is the heat-detecting infrared images that most captivated researchers. The night image, made with a camera that uses technology just like night-vision goggles, reveals how different material on the planet's surface retains or releases heat after the Sun goes down. Along with other thermal infrared images, the early results promise a new look at the composition of Mars. Infrared pictures -- during the day or at night -- allow scientists to see material that might be buried just under the surface. Unseen rock, for example, can retain heat better than the thin layer of dust that might cover it. Visible-light images, therefore, often see a dusty surface and don't reveal the real composition below. Other new daytime pictures taken at infrared wavelengths show how the Sun warms one crater wall while leaving the other dark and cold. Rocks thrown from the craters long ago, but since buried, are now starkly revealed. Also, the first color infrared images of Mars were returned. In the future, these color images will help scientists map differences in composition and even detect minerals that might have formed in water, providing clues to where life might once have existed. "Those will act as beacons for places we want to go" and study further, said Christensen, the lead investigator on THEMIS.

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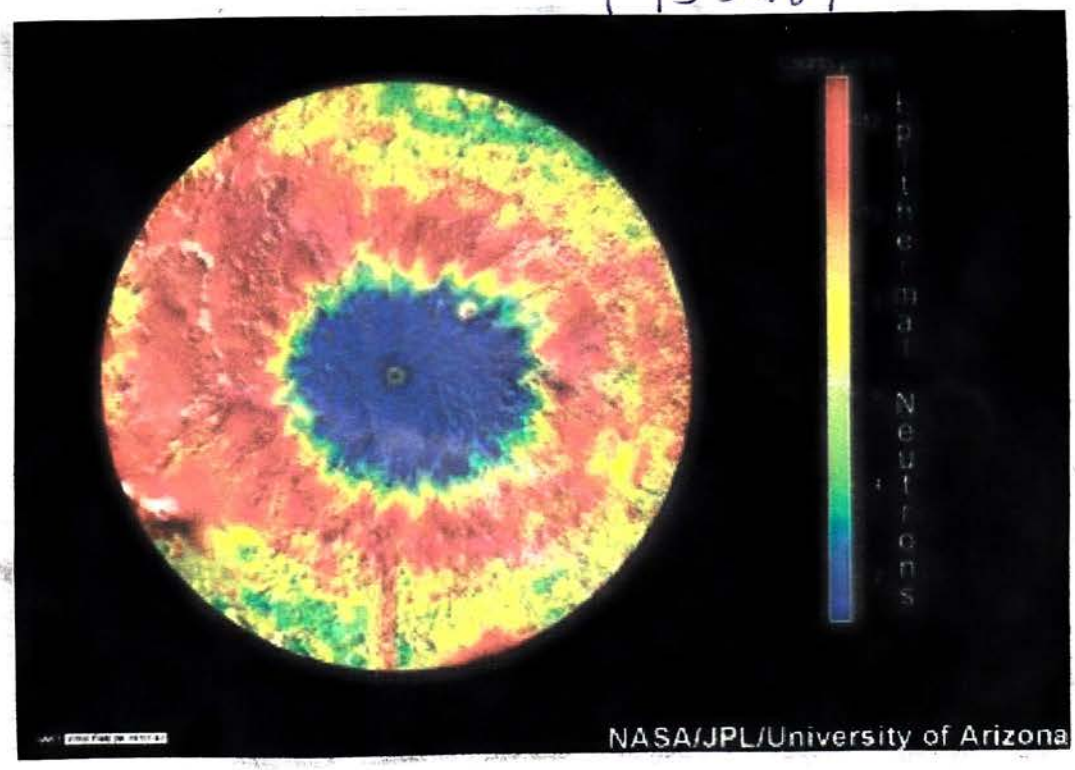

19905

SPACE.COM : 01 MAART 2002.

ODYSSEY DISCOVERS ABUNDANT WATER ICE ON MARS.

Mars holds vast stores of water ice right near the surface and away from the permanently frozen south polar ice cap, scientists said today in announcing first major science findings from NASA's Mars Odyssey spacecraft. The discovery makes it all the more possible that life may have once existed on Mars or could still be supported. "There's a lot of ice on Mars," said William Boynton, a University of Arizona researcher who is the principal investigator for the Gamma Ray Spectrometer suite of instruments, used to make the discovery. "We really have a whopping large signal." That signal is of hydrogen, one component of water. Boynton and his colleagues are confident the new measurements represents actual water ice at the surface and down a few feet. They said, however, that additional observations are needed to confirm the results. Scientists already knew there was water locked up in the northern ice cap, along with carbon dioxide ice. But life is thought to require liquid water. So finding water ice nearer the equator greatly boosts the chances that it might melt seasonally or at least periodically, and could therefore potentially support life. The findings were detailed at a press conference at the Jet Propulsion Laboratory, which manages the Odyssey mission for NASA, and they build on preliminary data reported in December. Odyssey's science mission officially began Feb. 19, but some data and images have been gathered since the craft first went into orbit around Mars on Oct. 23. Boynton said the northern hemisphere might contain similar amounts of water ice, but that won't be determined until it is summer there and the large polar cap recedes. The cap's seasonal component is largely carbon dioxide ice and it masks what might be underneath. Today's findings are just a glimpse of what's to come, said Stephen Saunders, an Odyssey project scientist from JPL. "For the first time we're seeing elementary chemicals on the surface of Mars," Saunders said. "Our Odyssey has just begun." Other signs of water Scientists have long suspected that water once flowed freely on a warmer Mars. Supporting evidence has mounted in recent years, thanks mostly to the Mars Global Surveyor, another NASA spacecraft orbiting the planet. As Mars cooled millions or billions of years ago and surface water froze or evaporated into space through a thinning atmosphere, some may have remained frozen in the soil or trapped in underground reservoirs. Heat from within may still keep some of that water in liquid form, some scientists speculate. Or, underground water ice might be periodically melted by this geothermal activity. Research has not shown conclusively whether Mars is still geothermally active, however. Surveyor's most significant discovery was evidence of seasonal deposits that could be associated with surface springs, first reported by SPACE.com in June of 2000. Surveyor and Odyssey will both continue to explore Mars for more signs of liquid water on and below the surface.

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73928

Sonde vindt ijs op Mars

De Marsbodem bevat waterijs. Wat al jarenlang wordt vermoed, is nu eindelijk aangetoond door metingen van de ruimtesonde 2001 Mars Odyssey, die in een baan om de Rode Planeet draait.

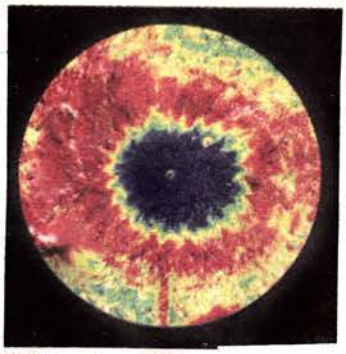
Mars Odyssey is op 19 februari met zijn wetenschappelijke meetprogramma begonnen. De gammaspectrometer aan boord van de ruimtesonde heeft de aanwezigheid van grote aantallen waterstofatomen in de Marsbodem aangetoond.

Hoogenergetische kosmische straling die op het Marsoppervlak terechtkomt, produceert snelle neutronen, die door botsingen met atoomkernen worden afgeremd. Waterstofatomen zijn zeer efficiënte remmers, omdat ze ongeveer even zwaar zijn als neutronen. De neutronen worden geabsorbeerd door atoomkernen, onder uitzending van gammastraling, waarvan de energie karakteristiek is voor het atoom.

73929

In een 3500 vierkante kilometer groot gebied rond de zuidpool van Mars heeft Mars Odyssey een groot tekort aan snelle neutronen geregistreerd (blauw op de foto). Tevens werd uit dit gebied gammastraling opgevangen met een energie die kenmerkend is voor waterstof. Dat de metingen verklaard worden door ijs in de Marsbodem, wordt door vrijwel niemand in twijfel getrokken.

Volkskrant: 09-03-'02



Zuidpool van Mars.

19906

'New Eyes' Probe Mars Terrain

BRUCE A. SMITH/LOS ANGELES

The Odyssey spacecraft has begun its planned 30-month primary science mission, and two types of NASA instruments in use for the first time at Mars are already providing some interesting observations.

Jeffrey J. Plaut, Odyssey deputy project scientist at NASA's Jet Propulsion Laboratory, said the gamma-ray spectrometer instrument suite has detected hydrogen on the surface of the red planet's southern hemisphere.

The gamma-ray spectrometer, which includes a gamma sensor and two neutron detectors, should be capable of detecting hydrogen up to about 1 meter beneath the surface of Mars, instead of only surface frost or atmospheric vapor.

The finding, indicating water ice may be more widely distributed on the planet than previously believed, was made by the neutron detectors. The significance of the observation has yet to be determined, Plaut said, but project scientists will monitor the surface patterns that have been detected and observe how they evolve as seasons change.

"It's pretty well understood that if we detect hydrogen, it is pointing you toward water—either present-day or past water in the soil." The primary goal of the overall instrument package is to measure the chemical elements of the Martian surface, particularly hydrogen.

"We are just beginning to see what the potential is for changing our views of Mars," Plaut said. "Basically, we've got new eyes to see the planet with." The gamma-ray spectrometer was originally on the Mars Observer spacecraft that failed on approach to the planet. The Mars Global Surveyor and Mars Climate Orbiter spacecraft did not carry gamma-ray spectrometers.

Meanwhile, Odyssey's thermal emission imaging system (Themis), the first infrared imaging instrument sent to Mars by NASA, has detected a significant amount of thermal detail as it observes surface material cooling during cold Martian nights.

Scientists are seeing detailed contrasts as different materials on the surface cool at varying rates, with dense materials such as rocks remaining relatively warmer at night compared with loose materials such as soil and sand. Plaut said such observations can provide clues about the nature of surface materials, which could be useful in selecting landing sites for future spacecraft and operational areas for rover vehicles.

The Themis instrument is primarily an infrared camera capable of imaging the planet with a resolution of 100 meters per pixel. The instrument, which also uses nine different wavelength bands in infrared, will be used to map the entire planet. It will be the highest resolution global map of Mars to date, Plaut said.

The instrument also has a visible light detector, with a resolution of 18 meters per pixel and five bands in the visible portion of the spectrum.

Odyssey's Thermal Emission Imaging System (Themis) made this nightside infrared image of an extremely disrupted region near the equator of Mars called Hydaspis Chaos (left). Steep slopes of canyons are littered with rocks, while plateaus and mesas are covered with dust.

Themis daytime infrared image of Terra Sirenum is shown in three segments (right and below). The 300-km.-long (186-mi.) imaged area in the southern cratered highlands has brightness variations due to temperature differences on Sun-facing and shadowed features.

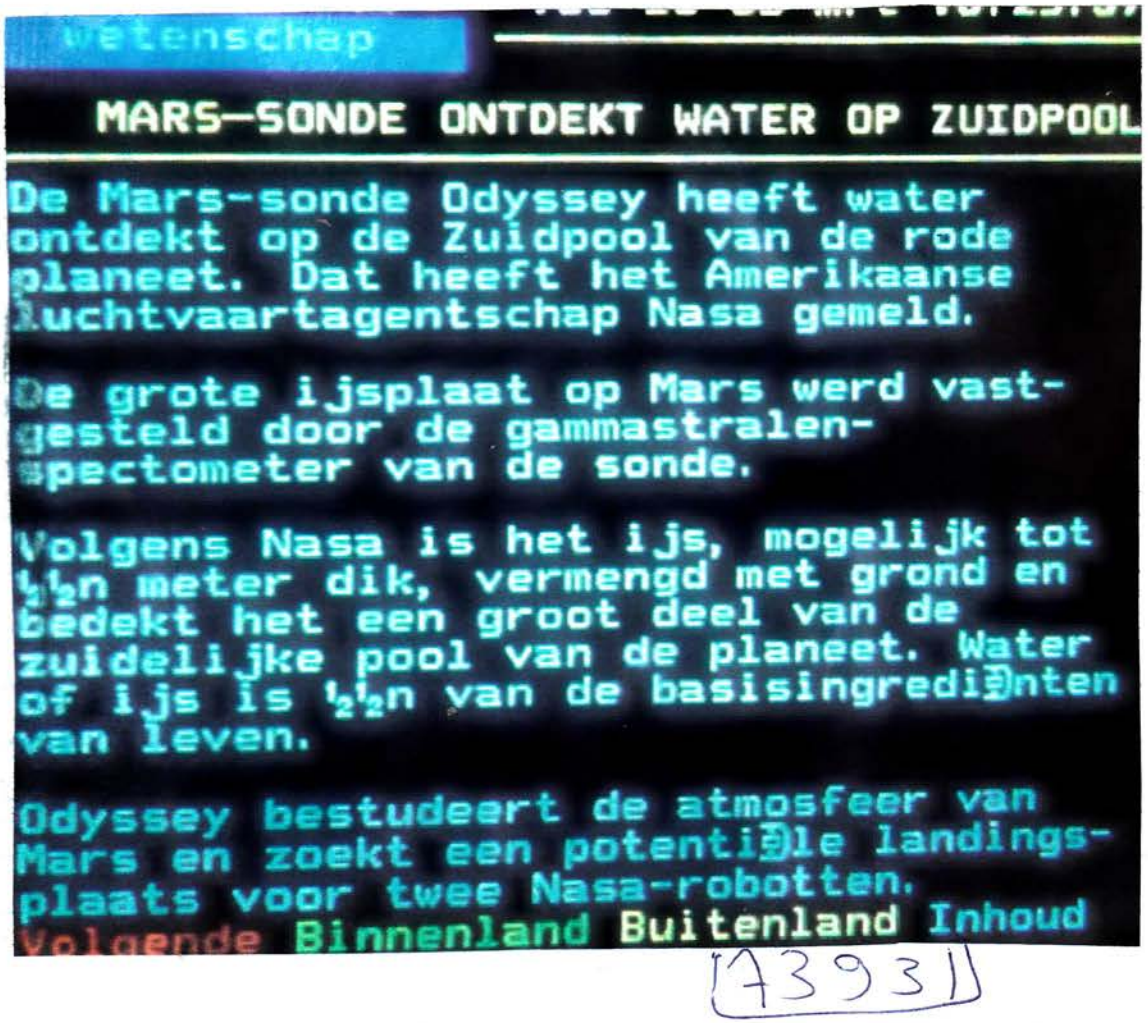
Its primary use is mapping mineral distribution, although it will also be used in night observations to search for thermal anomalies coming from the Martian interior, such as possible dormant volcanoes that may still have hot springs or other types of thermal irregularities associated with them.

A third instrument, the Mars Radiation Environment Experiment (Marie), has not been operational since last August. Project officials are again beginning to trouble-shoot the problem now that the spacecraft has settled into its primary science mapping mission.

Odyssey reached Mars last October, aerobraked into its mapping orbit for about 3.5 months and then underwent a series of orbital adjustments and system checkouts for 5-6 weeks before beginning its science mission Feb. 19.

ON THE WEB

For more information on Mars exploration, visit www.AviationNow.com/mars



73931

NASA-AMES NEWS RELEASE : 04 MAART 2002.

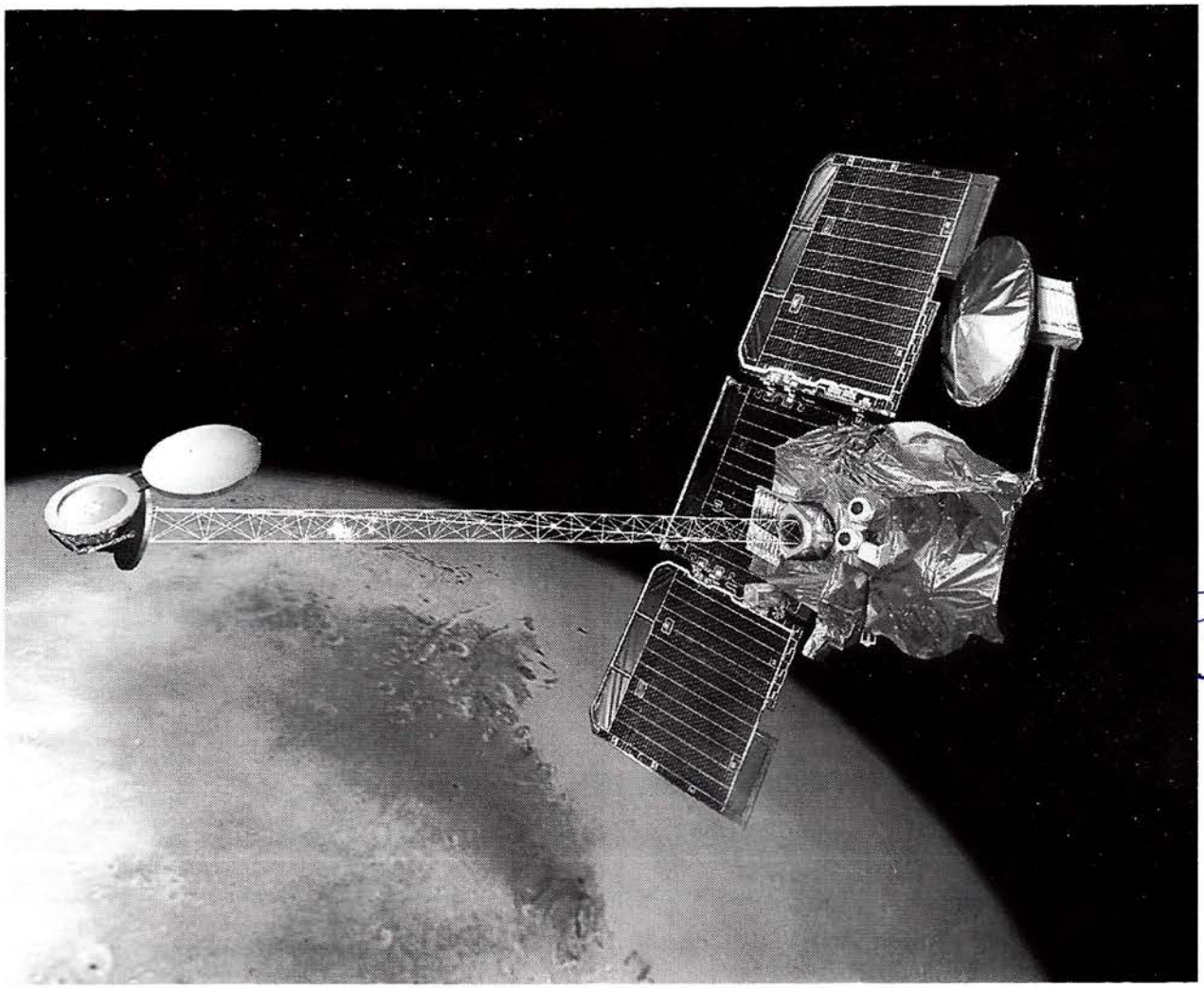
AN EARLY NASA PROBE STILL ON THE JOB IN DEEP SPACE.

73932

It took a little extra effort, but NASA this weekend bridged a nearly seven-and-a-half billion mile span to make contact with Pioneer 10, a plucky space probe that first left Earth's gravitational pull more than 30 years ago. On Friday, scientists at the NASA Jet Propulsion Laboratory's (JPL) Deep Space Network in Goldstone, Calif., sent a signal to the spacecraft, which is still hurtling toward the fringes of the solar system. Twenty-two hours later, at 1:47 p.m. EST, researchers at the network's facility in Madrid, Spain, carefully monitoring a 70-meter dish antenna, heard Pioneer's response. "We are overjoyed that we still have the spacecraft," said Robert Hogan, chief of NASA Ames Research Center's Space Projects Division, where the Pioneer project is managed. "As an eternal optimist, I was confident it would succeed. Pioneer 10 has been discounted in the past, but somehow it always manages to land on it feet," recalled Pioneer 10 Project Manager Dr. Larry Lasher of Ames, located in California's Silicon Valley. "This success is a testament to good solid design." "From Ames Research Center and the Pioneer Project, we send our thanks to the many people at the Deep Space Network and JPL who made it possible to hear the spacecraft signal again," said Pioneer 10 Flight Director David Lozier. NASA previously lost contact with Pioneer 10 in August 2000, but made contact again in April of last year by switching the spacecraft to a different communications mode. NASA most recently made contact with the spacecraft on July 9, 2001. Launched on March 2, 1972, Pioneer 10, built by TRW Inc., Redondo Beach, Calif., is now 7.4 billion miles from Earth. Pioneer 10 was the first spacecraft to pass through the asteroid belt and the first to make direct observations and obtain close-up images of Jupiter. During its tour of the Jovian system, Pioneer 10 also charted Jupiter's intense radiation belts, located the planet's magnetic field, and established that Jupiter is predominantly a liquid planet. In 1983, it became the first man-made object to leave the solar system when it passed the orbit of Pluto, the most distant planet from the Sun. The spacecraft continued to make valuable scientific investigations in the outer regions of the solar system until its science mission ended on March 31, 1997. Pioneer 10's weak signal continues to be tracked by the Deep Space Network as part of an advanced concept study of communications technology. The probe was also used to help train flight controllers how to acquire radio signals from space. Pioneer 10 is headed toward the constellation Taurus, where it will pass the nearest star in the constellation in about two million years. "Pioneer 10 has performed much better than expected," added Hogan, who is also a member of the original launch team for the spacecraft. "It's amazing that it's lasted this long." Scientific data received from Pioneer 10's Geiger-Tube Telescope instrument is analyzed by original principal investigator Dr. James Van Allen of the University of Iowa, who discovered the Earth's radiation belts bearing his name. Based on the previous data received, Van Allen concluded that galactic cosmic radiation is being moderated by the Sun's influence, meaning Pioneer 10 has not yet crossed the boundary into interstellar space.

19908

Mars Odyssey draait om de rode planeet



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Dat het Amerikaanse ruimtevaartuig Mars Odyssey van harte welkom was bij Mars, kon niet bepaald gezegd worden. Na een reis van 460 miljoen kilometer zorgden remraketjes ervoor dat deze sonde op woensdag 24 oktober 2001 in een baan om de rode planeet terecht kwam. Een stormachtig welkom, want in de tweede helft van augustus was op deze planeet een krachtige storm opgestoken. Apparatuur werd wel ingeschakeld, maar veel viel er niet te zien. Geen probleem overigens, want het echte werk moest pas eind januari beginnen.

Vanaf een hoogte van 400 km legt het elke twee uur een omloopbaan af op zoek naar eventuele bevroren watermassa's en mineralen. Op deze manier ontstaat er een warmtekaart.

Ondanks de stofstorm waren technici en geleerden bijzonder blij dat Mars Odyssey correct in een baan om Mars was gekomen, immers deze missie mocht na twee voorafgaande missers niet mislukken.

Van deze sonde die twee en een halve meter groot is en 725 kg weegt, wordt verwacht dat het gedurende enkele jaren zal werkzaamheden zal verrichten. Voor wetenschappers die zich met klimaatonderzoek bezighouden, is die stofstorm wel interessant. Maar dat was niet het hoofddoel.

De drie belangrijkste instrumenten aan boord (Themis, GRS en Marie) hebben tot taak een zo gedetailleerd mogelijke warmtekaart van Mars te maken. En voordat die instrumenten aan deze taken kunnen gaan beginnen zullen er heel wat maanden verstreken zijn, wordt algemeen gevreesd. Daarbij komt nog dat de geringere aantrekkingskracht ervoor zorgt dat de stofdeeltjes er veel langer overdoen voordat ze terug op het oppervlak zijn dan op aarde.

De baan van Mars Odyssey om de planeet was aanvankelijk ellipsvormig (300 x 27.000 km), maar zal geleidelijk overgaan in een cirkelvormige. De hoogte zal dan zo'n 400 km bedragen. Om dit te bereiken zal de beproefde methode, namelijk tijdens de kortste nadering tot de planeet, het ruimtevaartuig even door de ijle atmosfeer te laten vliegen. Op die manier ontstaat er een afremming van de snelheid en komt het verste punt steeds dichter bij het oppervlak te liggen. Ook waren de technici zeer tevreden over het feit dat het gelukt was het toestel in een baan over de polen te brengen, niet nauwelijks afweek van de geplande.

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1999

Nummer 12 - 09.03.2002 / BERICHT UIT DE RUIMTE

Op vrijdag 1 maart stuurden wetenschappers van het Jet Propulsion Laboratory een signaal naar de Pioneer-10 sonde, die toen 11.9 miljard kilometer van de aarde verwijderd was. Tweeëntwintig uur later werd met de 70-meter radioantenne nabij Madrid, Spanje, een zwak antwoord van de Pioneer-10 opgevangen. Pioneer-10 werd op 2 maart 1972 gelanceerd en vloog als eerste sonde door de astroïdengordel en langs Jupiter. Na de passage van de grootste planeet van ons zonnestelsel vloog de Pioneer-10 steeds verder van de zon af, richting de sterren. In 1983 passeerde ze de baan van Neptunus, en verliet als eerste ruimtevaartuig het zonnestelsel. NASA verloor het contact met de Pioneer-10 in augustus 2000, maar slaagde er in april en juli vorig jaar nog in met de oude sonde te communiceren. Met het in 1973 gelanceerde zusterschip Pioneer-11, die langs Jupiter en Saturnus vloog, is al sinds 1995 geen contact meer geweest. Nog twee andere ruimtesondes zijn op weg naar de sterren, de in 1977 gelanceerde Voyager 1 en 2. Voyager 1 is momenteel het verst van de zon verwijderd op 12,5 miljard kilometer.

73937

NASA selects new Discovery missions

NASA has selected two new $299 million missions, called Dawn, an asteroid explorer, and the planet-hunting Kepler telescope for its Discovery programme.

Dawn will be launched in 2006 on a nine-year journey to explore the two largest asteroids, Vesta and Ceres in the main belt between Mars and Jupiter.

Vesta is thought to be a dry body of basaltic lava flows, while Ceres - the largest asteroid and the first to be discovered - apparently has a primitive surface, water-bearing minerals, frost and a weak atmosphere. Dawn will orbit each asteroid, coming to within 100 km of the surface of each body.

The Kepler telescope, also to be launched in 2006, will look for planets orbiting other stars, by observing their transits across the face of the stars, creating a periodic dimming of the star, the signature of which will indicate the presence of a planet, its size and orbit.

NASA's exaggerated announcement about Kepler indicated that Kepler may also be able to tell "if there are other beings like us in the universe".

Telescopic observations have so far detected about 80 Jupiter-sized planets around other stars. The existence of life on any of them would be an assumption not an automatic conclusion.

73939

The Discovery programme began with the launch of NEAR Shoemaker to the asteroid Eros and was followed by Mars Pathfinder and Lunar Prospector.

Current Discovery craft are Stardust and Genesis, interplanetary material collectors, which will be followed by the comet explorer, Contour in 2002 and Mercury orbiter, Messenger in 2004.

AMERICAN GEOPHYSICAL UNION NEWS RELEASE : 13 MAART 2002

73939

RESEARCHERS: MARS "FEATURES NOT ERODED BY RUNNING WATER.

Scientists have provided new evidence that liquid carbon dioxide, not running water, may have been the primary cause of erosional features such as gullies, valley networks, and channels that cover the surface of Mars. Research suggesting that condensed carbon dioxide found in Martian crust carved these features is reported by Kenneth L. Tanaka and colleagues at the U.S. Geological Survey in Flagstaff, Arizona, and the University of Melbourne, Australia, will appear this month in Geophysical Research Letters, published by the American Geophysical Union. Using Mars Orbiter Laser Altimeter (MOLA) data, Tanaka and his colleagues constructed elevation profiles of the Hellas basin, which, at 2000 kilometers [1,240 miles] wide and nine kilometers [six miles] deep, is the largest well-preserved impact basin on Mars. By examination of digitally created elevation profiles with 500-meter [2,000 foot] resolution, they found that the volcanic regions of Malea and Hesperia Plana, along the rim of the Hellas basin, are several hundred meters [yards] lower than adjacent rim sectors. Additionally, these areas lack the prominent triangular peaks, called massifs, that are common in nearby areas. Along the inner slopes of these regions, the researchers found, however, evidence of old massifs covered by volcanic rocks. They are too low to be covered, if there were volcanic activity today. The researchers suggest as an explanation that prior to volcanic activity, these regions along the rim of the basin resembled nearby areas, but were eroded to their present-day elevations following the emplacement of the volcanic rocks. Tanaka and his colleagues propose a "magmatic erosion model" to explain the features of the volcanic areas of Malea and Hesperia Plana, suggesting that they underwent catastrophic erosion associated with explosive eruptions of molten rock. They suggest that liquid in the Martian crust was heated when molten rock, or magma, rose to the surface. As the liquid was heated, it expanded, until the pressure of overlying material was too great, and an explosive eruption occurred, shattering overlying rock, and causing it to move with the magma in an erosive debris flow. The authors believe that the fluid in the crust along this area of the rim of the Hellas basin was mainly liquid carbon dioxide. A debris flow dominated by carbon dioxide would flow faster and farther than a water-based flow, they say. Also, carbon dioxide is more volatile than water at lower temperatures, and the cold temperatures found on Mars would mean that less carbon dioxide- based magma would be required to produce the observed erosion than magma containing mainly water. The researchers suggest that this mechanism of erosion can also explain collapse features and channels elsewhere on Mars. They also note, however, that their model is based on a variety of assumptions that must be further tested. The paper by Kenneth L. Tanaka, Jeffrey S. Kargel, David J. MacKinnon, Trent M. Hare [Astrogeology Team, U.S. Geological Survey], and Nick Hoffman [University of Melbourne], "Catastrophic Erosion of Hellas Basin Rim on Mars Induced by Magmatic Instrusion in Volatile-Rich Rocks," will be published online within the next two weeks and later in the print edition of Geophysical Research Letters. Its citation, which is to the online version, is 10.1029/2001GL13885, 2002.

1991a

NASA PRESS RELEASE : 15 FEBRUARI 2002.

ISS SPACEWALK FROM QUEST AIRLOCK.

On the 40th anniversary of the first U.S. orbital spaceflight by John Glenn, Flight Engineers Carl Walz and Dan Bursch will conduct the planned six-and-a-half-hour Extravehicular Activity (EVA), or spacewalk, to revalidate all systems of the Quest Airlock. Hatch opening on the Quest is expected shortly after 7 a.m. EST. This will be the first use of the station's airlock since July 2001 and sets the stage for four spacewalks out of Quest to attach the first of several large truss segments to the complex during the STS-110 shuttle mission scheduled for early April. Commander Yury Onufrienko, who will serve as the spacewalk choreographer from inside the Destiny Laboratory, will assist Walz and Bursch, who will be wearing U.S. spacesuits called Extravehicular Mobility Units. Walz will be visible by the red stripes on his suit, while Bursch's suit will have no markings. Each already has conducted a spacewalk since boarding the ISS in December. This will be the second spacewalk mounted from Quest, which was delivered to the ISS and inaugurated by STS-104 spacewalkers Mike Gernhardt and Jim Reilly last July. The Expedition Four crew is in the third month of a planned five-month stay on the complex

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BERICHT UIT DE RUIMTE
Nummer 11 - 18.02.2002
Mensen in de Ruimte

73943

Het ruimtestation ISS verloor op 4 februari de controle over de standregeling, toen een computer in de Russische woonmodule Zvezda crashte. Hierdoor kregen de vier gyroscopen in het Z1-Truss geen informatie meer omtrent de standregeling van het station. Om 14:18 uur MET begon het ISS langzaam te tuimelen, waardoor de zonnepanelen niet langer op de Zon gericht waren. Door het gebrek aan electriciteit werden alle experimenten uitgeschakeld, en alle systemen gingen in de zogenaamde "overlevingsmodus." Gelukkig was de driekoppige bemanning in staat om de zonnepanelen handmatig aan te sturen en op de Zon te richten, zodat de batterijen weer konden worden opgeladen. Om 19:43 uur MET was de situatie in zoverre hersteld dat het standregelingsysteem van het station weer operationeel was. Later op die dag waren de meeste systemen en experimenten weer opgestart. Het ISS wordt momenteel bewoond door de Rus Yuri Onufrienko en de Amerikanen Carl Walz en Daniel Bursch. Op 20 februari zullen Walz en Bursch een ruimtewandeling uitvoeren. Hiervoor zullen ze de Amerikaanse luchtsluis Quest gebruiken. Gedurende hun ruimtewandeling zullen ze voorbereidend werk verrichten ten behoeve van de installatie van de S0-Truss in april.

19911

RUSSIA

International Space Station operations were disrupted for several hours Feb. 4 when two of three navigation data streams from a computer in the Russian Zvezda service module failed to maintain navigation data flow to a guidance and control computer on the U.S. side of the station. The malfunction generated erroneous data that caused a loss of U.S. gyro attitude control. This put the ISS in free drift, which had the effect of rolling the solar arrays off the sun and mispointing communications antennas. The Expedition 4 crew used a manual mode to repoint the arrays to maintain a positive charge on the station's batteries and communicated with Russian ground controllers using backup routes until the computer problem was resolved several hours later.

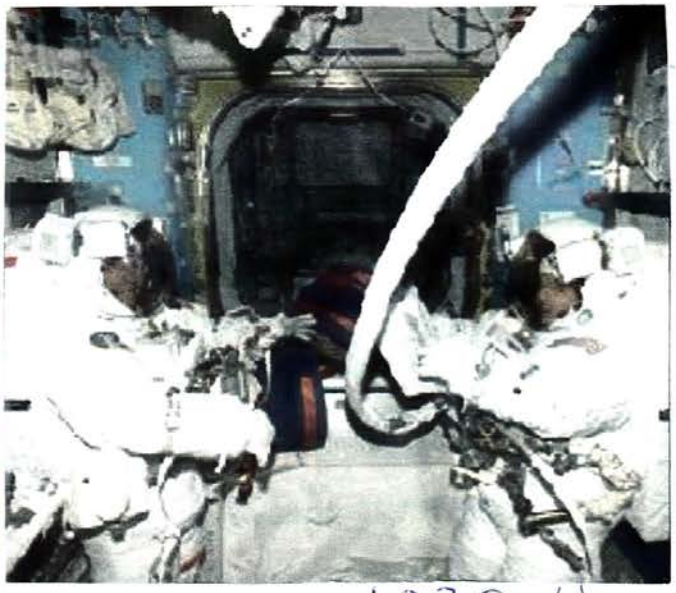
73944

AWST: 11-02-'02

International Space Station astronauts Carl Walz and Daniel Bursch performed a 6-hr. extravehicular activity Feb. 20 to further evaluate the new U.S. airlock on the station and prepare hardware for complex station assembly EVAs to be performed by the STS-110 Atlantis crew in April. The mission will install the first large section of the station's 300-ft. solar array truss. The tasks performed by Walz and Bursch verified new airlock procedures and positioned tools to give the shuttle EVA crew extra time margins for the truss installation work.

73945

AWST: 25-02-'02



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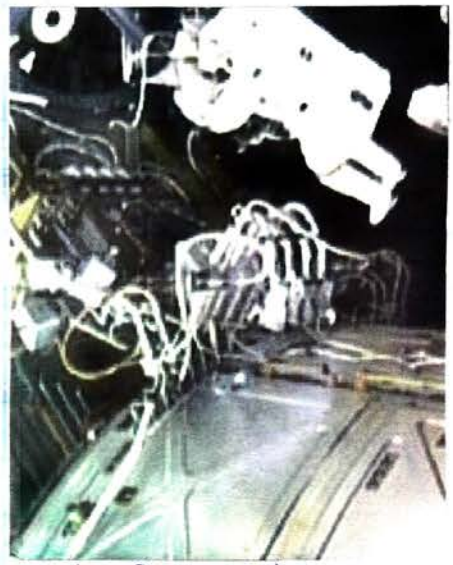

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19912

FLORIDA TODAY : 19 FEBRUARI 2002.

ASTRONAUTS TO PRACTICE FOR STATION BUILDING MISSION ON SPACEWALK.

CAPE CANAVERAL -- Two residents of space station Alpha will step outside again Wednesday morning for the third spacewalk of their 5 1/2-month mission. Astronauts Carl Walz and Dan Bursch will attach and unwind a set of cables along the Destiny laboratory module for a future attachment to the outpost. Wiring work on the Z-1 truss and gathering tools for future tasks is also on the agenda for the 6 1/2-hour session. Most of their goals are to practice for the shuttle construction mission to Alpha in April, scheduled to make four spacewalks from Alpha. Russian commander Yuri Onufrienko will watch from inside Alpha, using the robotic arm to focus cameras on Walz and Bursch. Unlike the previous two spacewalks, this one will begin from the American Quest airlock, a front porch of sorts for the outpost. Two spacewalks this year began from a Russian airlock. "We want to make sure we put Quest through its paces before we do the four spacewalks from it in April," spacewalk officer Dina Barclay said. One spacewalk began from the American airlock last year, when a shuttle was connected to the station. The spacewalk also will show ground controllers whether station residents can learn enough about a spacewalk while living in space to pull it off successfully. "This is a crew that hasn't been in the (water tank) for months," Flight Director Sally Davis said, pointing out that Walz and Bursch have to practice using virtual reality computer programs instead of the large swimming pools that simulate microgravity.

73950

AP NEWS : 20 FEBRUARI 2002.

RUSSIA HOPES TO GET GREATER SHARE IN INTERNATIONAL SPACE STATION.

73951

MOSCOW -Building a new Mir would be "absurd," and instead Russia should take a larger role in the new international space station as NASA scales back under budget cuts, the Russian space chief said Wednesday. When Russia discarded the Mir space station last March after 15 years in orbit, some officials spoke about the prospect of launching a Mir-2. But Russian Aerospace Agency Director Yuri Koptev firmly ruled out the project as an "absurd" waste of money. Koptev said Russia must concentrate on developing the 16-nation international space station, where the U.S. space agency NASA is being forced to scale back its contribution to research plans to avoid budget overruns. In the past, it has been Russia that put the space station project behind schedule. But Koptev told a news conference here, "The situation may evolve in such a way that Russia could acquire the leadership in the project." NASA's planned cuts would eliminate a U.S.-funded lifeboat for the space station and living quarters that would accommodate seven people instead of current crew of three. The smaller crew would sharply limit the chance for research at the station. Koptev has earlier suggested that Russia could provide new living quarters and lifeboat at a fraction of the original U.S. cost. Previously, Russian budget problems were the cause of delays; the service module, which houses the crew, was held up for two years before being put into orbit in July 2000. Once the station became manned, Russia began pushing efforts to commercialize it by offering rides to space tourists. The first, California businessman Denis Tito, made an eight-day trip to the station last April and May for a reported $20 million. NASA strongly objected to Tito's flight, saying he would be a burden to the crew, but Koptev's agency got the upper hand. U.S. and Russian space officials have since reached common ground on space tourists, and the next visitor, South African Internet tycoon Mark Shuttleworth, underwent both Russian and NASA training for his flight set for April. Russian officials have not released the contract sum, but Shuttleworth said he would pay roughly the same amount as Tito plus some extra for conducting scientific experiments. Koptev said his agency is mulling over several tourist candidates to visit the station in October. "The earnings provide serious support for the industry, the cosmonauts' training center and mission control," he said.

CNN : 20 FEBRUARI 2002.

ASTRONAUTS FLOAT THROUGH NEW STATION AIRLOCK.

73952

Two residents of the international space station stepped outside their orbital home on Wednesday, testing a new airlock, performing numerous maintenance jobs and soaking up space radiation for an experiment. NASA flight engineers Carl Walz and Dan Bursch wrapped up their foray into space abour six hours after it began, closing the hatch on the Quest Airlock at 12:25 p.m. EST. The expedition was the first use of Quest without the assistance of a visiting space shuttle and set the stage for four upcoming spacewalks from the U.S.-built portal. Those walks will be to attach the first of several large truss segments to the station during a shuttle mission currently scheduled for early April. Other spacewalks have been conducted through the Russian airlock, which is attached to the Russian portion of the modular outpost. Walz and Bursch, both of whom performed spacewalks last month, took orders from Russian commander Yuri Onufrienko, who choreographed the walk from his perch inside the space station. When they left the station through Quest, they marveled at what they saw from 250 miles high. "The view is spectacular," Walz said. "Yee-haw!" exclaimed Bursch. The Americans performed a bevy of tasks while on the outside, removing four thermal blankets from the Z-1 truss, the base structure for the U.S. solar array on the space station, and picking up tools to take back inside the station so the next spacewalking team will be able to use them. The two also tested electrical circuitry, tightened loose latches and took high frontier insurance pictures of dings and dents on station radiators, likely caused by a tiny meteor or orbita debris fragment. On the experimental front, Walz and Bursch wore devices to monitor space radiation dosages encountered by the eyes, internal organs and skin. The test will help scientists better understand the effects of intense space radiation and design better spacesuits. Halfway into the work detail, the spacewalkers paused to reflect on a historic day in space exactly four decades ago, when John Glenn became the first American in orbit. "One of the biggest differences from 40 years ago, the space race was a competition," said Bursch, speaking of the rivalry between the United States and the Soviet Union at the time. "But now the space race has turned into cooperation," he said, noting that the space station currently had a Russian commander and American crew, which would have been unthinkable years ago. Walz, Bursch and Onufrienko, who comprise the Expedition Four crew, are in their third month of a planned five-month stay on the station.

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Daniel Bursch and Carl Walz (obscured) undergo preparations in the crew lock of Quest prior to the space walk.

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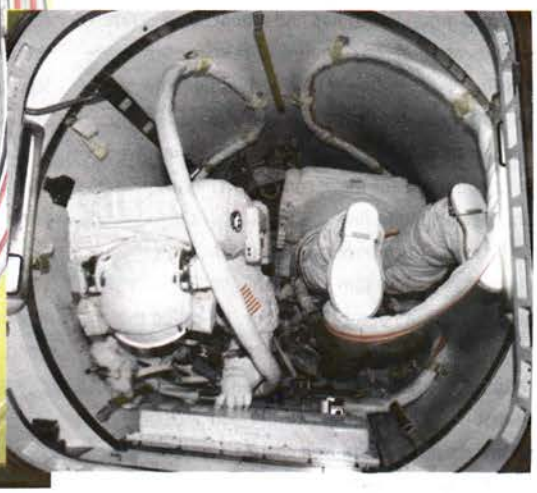
Both images show Daniel Bursch and Carl Walz in the crew lock of the Quest prior to the 20 February space walk. Attired in NASA extravehicular mobility units (EMU), the two astronauts worked on the orbital outpost for a total of five hours and 47 minutes. The EVA involved testing of equipment and procedures for the Airlock Quest and other tasks in preparation for Space Shuttle Atlantis' STS-110 mission in April. The photograph was taken by cosmonaut Yury Onufrienko, Expedition Four commander.

All photos: NASA



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SPACE.COM : 20 FEBRUARI 2002.

Expedition 4 astronauts Carl Walz and Dan Bursch completed a successful 5-hour, 47-minute spacewalk Wednesday, testing equipment and procedures for the Airlock Quest and performing other tasks to prepare for Space Shuttle Atlantis' STS-110 mission to the International Space Station in April. The spacewalk, which began at 5:38 a.m. CST and ended at 11:25 a.m., notched some firsts. It was the first spacewalk from Quest without the presence of a space shuttle at the station, earning it the designation of U.S. EVA 1. It also marked the first U.S. use of an Intravehicular (IV) officer, Astronaut Joe Tanner, working from Houston's Mission Control Center instead of from onboard the spacecraft, as has been the case up to this point. Also, new procedures were used to expedite airlock depressurization at the start of the spacewalk. STS-110 will bring the S0 Truss to the station, the first segment of what will be the station's backbone. Four spacewalks will be conducted during that flight, all from the airlock and all using an oxygen/exercise protocol to purge nitrogen from the spacewalkers' bloodstreams. Walz and Bursch used that protocol today. During the spacewalk today, Walz and Bursch deployed two electrical cables from their stowage area on the U.S. Laboratory Destiny and connected them to a cable tray near the base of the Z1 Truss. Plans to disconnect and restow the cables were put on hold while engineers evaluated unexpected readings from current conversion units in the circuit the cables completed. Walz removed four thermal blankets from the Z1 Truss and stowed them inside the truss, while Bursch retrieved tools to be used on STS-110 spacewalks and brought them to the airlock. The two also secured looser-than-expected latches on two oxygen tanks and two nitrogen tanks, on the airlock. Walz and Bursch removed adaptors on which a Russian cargo crane had been mounted and attached one of them to the Zarya module's exterior. They brought the other, U.S.-made, adaptor into the airlock. They also inspected cable connectors outside the station and photographed the MISSE (Materials International Space Station Experiment). Some of the materials samples being exposed to the harsh conditions of space apparently were peeling back off their mountings. Scientists used the spacewalk to gather additional data for an experiment looking at the effects of spacewalks and long-term exposure to microgravity on lung function. Also, Walz and Bursch wore radiation sensors for the EVARM experiment, a study of radiation doses experienced by spacewalking astronauts. Walz and Bursch each had made one previous spacewalk from the station last month, and Walz also made a spacewalk on STS-51 in September 1993. During today's spacewalk, Expedition 4 Commander Yury Onufrienko operated cameras on the station's Canadian provided robotic arm to document activities. A planned upgrade of the station's software is scheduled for late this week to prepare station computers for arrival of the S0 Truss and other equipment to be delivered on subsequent flights.

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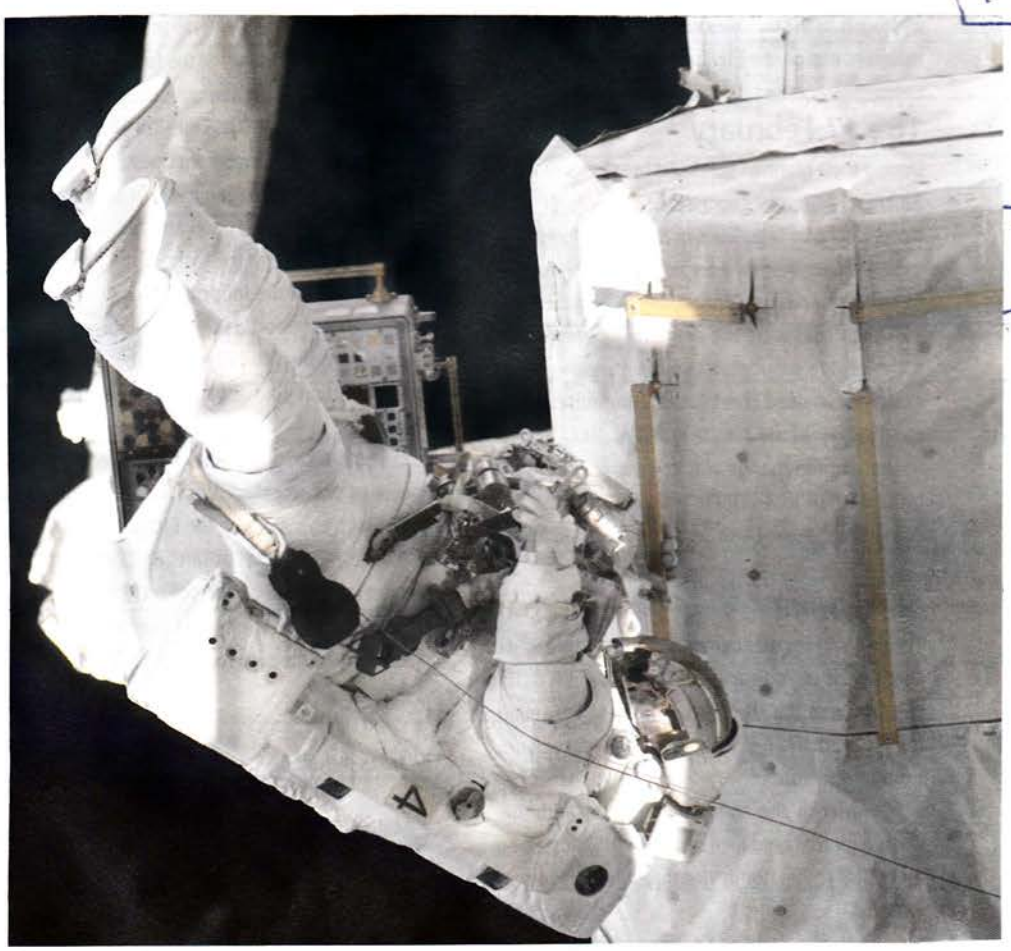

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Daniel Bursch moves near the oxygen and nitrogen tanks on the exterior of Quest Airlock during the space walk. The square device (partially obscured by Bursch) on the Space Station Remote Manipulator System (SSRMS) or Canadarm2 is the Materials International Space Station Experiment (MISSE).

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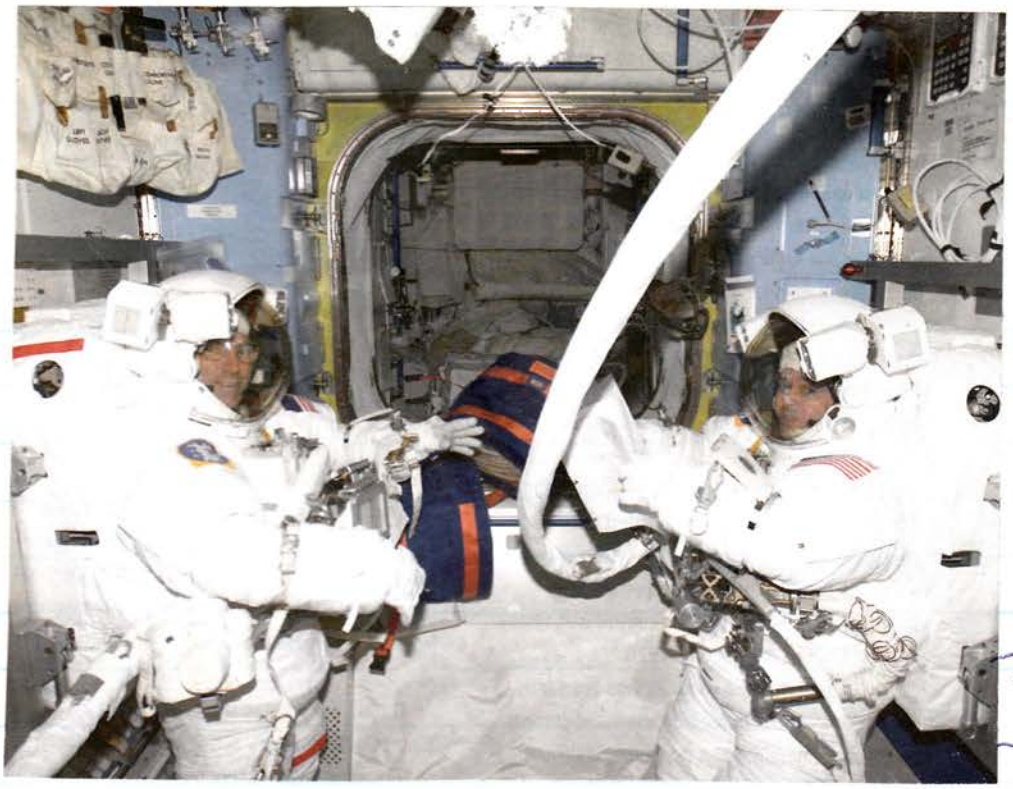

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ISS: Expeditie-4 maakt ruimtewandelingen

Het internationale ruimtestation ISS trekt al sinds 20 november 1998 baantjes rond de aarde, en natuurlijk is er in die tijd veel gebeurd wat jullie allemaal hebben kunnen lezen in de Astruims van de afgelopen jaren. Maar toch kreeg het ISS niet de aandacht die het eigenlijk verdient. Met ingang van dit nummer zal Jacques van Oene jullie op de hoogte houden van wat zich - tussen de Space Shuttle-vluchten door - allemaal aan boord van het ruimtestation afspeelt. Hij begint het overzicht op 1 januari 2002.

73962

Onderhoud

De huidige bemanning van ISS, Expedition-4, bestaande uit Yuri Onufrienko, Dan Bursch en Carl Walz, genoot van een rustige jaarwisseling. De drie waren in die dagen veel in contact met familie en vrienden om de nodige gelukwensen voor het nieuwe jaar uit te wisselen. Ook was de bemanning nog volop bezig om alles op te bergen wat de Space Shuttle allemaal naar het ISS had gebracht tijdens STS-108. Aan het einde van de eerste week begon de bemanning met het aanpassen van hun slaapschema, dit ter voorbereiding op de eerste van vijf ruimtewandelingen die op het programma stonden.

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Ruimtewandeling 1

Onufrienko en Walz begonnen op 14 januari om 8 uur 's morgens Ned. Tijd aan hun ruimtewandeling. Gekleed in Russische Orlan ruimtepakken verlieten de twee de Pirs koppel module. Hun eerste op-dracht was het verlengen van een van de twee vrachtkranen die zich bevinden aan de Zarya module. De kranen - genaamd Strela (pijl) - worden onder andere gebruikt tijdens ruimtewandelingen om astronauten en gereedschap te verplaatsen. De volgende opdracht was het bevestigen van een radioantenne aan de Zvezda module. Deze antenne zal de astronauten aan boord van ISS leven, in staat stellen om contact te onderhouden met radioamateurs op aarde. De totale duur van het uitstapje was 6 uur en 3 minuten.

Tussen de eerste en tweede ruimtewandeling was de Expeditie-4 bemanning vooral bezig met onderhoudswerkzaamheden aan boord van ISS. Carl Walz installeerde met behulp van experts op de grond een nieuw geheugen voor een van de drie computers. Walz had hier in totaal 4 uur voornodig, 2 om de unit te vervangen en te instaleren en de andere 2 uur werden gebruikt door vluchtleiders om alles te testen. Burch en Onufrienko hielden zich ondertussen bezig met het klaarmaken van de ruimtepakken voor de volgende ruimtewandeling, het controleren van gereedschappen en het testen van apparatuur die ze zouden instaleren aan de buitenkant van het station.

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Ruimtewandeling 2

Op 25 januari begonnen Onufrienko en Bursch aan het tweede uitstapje van deze vlucht. Hun eerste taak was het installeren van zes uitlaatafbuigers die zich bij de stuurraketjes bevinden aan het uiteinde van de Zvezda module. Daarna verwijderden de twee materiaal dat al een tijdje was blootgesteld aan de open ruimte voor onderzoek op aarde. Een tweede radioamateurantenne werd ook geinstalleerd. Tijdens het 5 uur en 59 minuten durende uitstapje bediende Walz de Canadarm-2 en filmde hij de verrichtingen van zijn twee metgezellen. Vlak voordat de twee ruimtewandelaars weer naar binnen gingen via de Pirs koppelmodule, inspecteerden ze nog een raam van Zvezda op eventuele beschadigingen.

Ontspanning en wetenschap

Nu de eerste belangrijke werkzaamheden van deze bemanning er even opzaten, was het tijd voor wat ontspanning. De bemanning had tijd om met een aantal televisie- en radiostations op aarde te praten. Ook spraken ze 650 leraren toe die bijeen waren in Houston voor een conferentie.

Walz en Bursch deden onder andere een long-experiment. Dit experiment controleert de functie van de longen in de ruimte. Vooral de longen van Dan Bursch stonden in de belangstelling van de wetenschappers op aarde omdat hij een paar dagen daarvoor een inspannende ruimtewandeling had gemaakt.

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Verschillende scholen in Amerika en één in Duitsland doen mee aan een project genaamd EarthKam. Met dit experiment kunnen scholieren een camera op afstand bedienen die vooraf geselecteerde gebieden op aarde fotografeert voor gebruik in het klaslokaal als lesmateriaal. Eind januari konden scholieren 4 dagen achtereen gebruik maken van dit project wat sinds een half jaar aan boord van ISS is.

Computerproblemen

Op 4 februari om ongeveer 1 uur in de morgen werd de bemanning opgeschikt door een groot computerprobleem. De hoofdcomputer die voor de oriëntatie in de ruimte moet zorgen, hield er onverwachts

mee op. Deze computer bevindt zich in de Zvezda module. Als gevolg hiervan konden de zonnepanelen van ISS zich niet meer richten op de zon en moest de bemanning hals over kop zoveel mogelijk apparatuur uitzetten om stroom te sparen. Zowel in Moskou als in Houston werd druk gewerkt om de problemen zo snel mogelijk te verhelpen. De astronauten aan boord probeerden handmatig de zonnepanelen weer op de zon gericht te krijgen. ,,We sturen nu de zonnepanelen, dit is leuk werk" konden we een van de Amerikanen horen zeggen. Om 3:30 uur lukte het vanaf de grond om de computer weer aan de praat te krijgen. Carl Walz: ,,We komen weer tot leven." Houston: ,,We bevestigen dat Carl, jullie kunnen het licht weer aan doen". Om 5:30 uur was het computer probleem voor het grootste gedeelte verholpen en kon de bemanning beginnen om de uitgeschakelde apparatuur weer aan te zetten. Al met al is men ongeveer 24 uur bezig geweest om alles weer bij het oude te krijgen. De rest van de eerste week van februari hielden de astronauten zich voornamelijk bezig met wetenschappelijk onderzoek en onderhoudswerkzaamheden. Op 6 februari vierde Commandant Yuri Onufrienko zijn 41 verjaardag.

Ruimtewandeling 3

In de week voor de derde ruimtewandeling hield de Expeditie-4 bemanning zich voornamelijk bezig met de voorbereidingen op de derde ruimtewandeling.
Behalve de gebruikelijke tests van de ruimtepakken en gereedschappen werd er ook een volledige proef uitgevoerd met de Quest luchtsluis. Dit zou namelijk de eerste ruimtewandeling worden vanuit Quest sinds juli 2001 en zonder dat er een Space Shuttle gekoppeld is aan ISS. Het belangrijkste doel van deze wandeling was voorbereidende werkzaamheden verrichten voor STS-110.

De ruimtewandeling begon op 19 februari. Astronauten Carl Walz en Dan Bursch verlieten de Quest luchtsluis om 22:38 uur. De twee droegen Amerikaanse pakken en voor het eerst werd er tijdens deze EVA gebruik gemaakt van een coördinator die zich niet aan boord van het ruimtestation zelf bevond: astronaut Joe Tanner gaf aanwijzingen aan de twee vanuit Houston. Tijdens de ruimtewandeling verwijderde Walz thermische beschermdekens van de Z1 truss. Dit om het bevestigen van de S0 truss, die tijdens STS-110 gebracht wordt, makkelijker te maken. Bursch bevestigde elektrische kabels van de Destiny module aan Z1 truss. Deze zullen later aan de S0 truss vastgemaakt worden. Gereedschap dat zal worden gebruikt door de bemanning van STS-110 werd ook alvast "klaargelegd". Aan het eind van de ruimtewandeling controleerden de twee nog verschillende dingen aan de buitenkant van ISS en hier en daar werden wat schroeven aangedraaid. Yuri Onufrienko bediende de Canadarm-2 en filmde het gehele uitstapje.

Vervelende stank

Nadat de astronauten klaar waren met de het opbergen van de ruimtepakken in Quest en zich klaarmaakten om naar bed te gaan, meldden ze een vreemde stank. Al snel werden ventilatie systemen uitgeschakeld om verspreiding van de stank door het ruimtestation te voorkomen, en werd het luik naar de Quest-luchtsluis dichtgedaan, maar de bemanning kreeg al last van hoofdpijn. Via de grond werd in de Destiny module een luchtverversingssysteem aangezet. Het bleek te gaan om het metaal dioxide, een soort koolstof, dat wordt gebruikt om de ruimtepakken schoon te maken. Waarschijnlijk heeft er ergens wat gelekt. Uit voorzorg sliepen de astronauten die nacht in de Zvezda module. ⌫

Toekomstige ISS-bemanningen

Soyuz TM34, 25 april 2002:

TAXI-3: Yuri Gidzenko
Roberto Vittori (Italië)
Mark Shuttleworth (ZA)

STS-111, 2 mei 2002:

EXP-5: Valeri Korzun
Sergei Y. Treshchev
Peggy A. Whitson

STS-113, 6 september 2002:

EXP-6: Kenneth D. Bowersox
Donald A. Thomas
Nikolai M. Budarin

Soyuz TMA1, november 2002:

TAXI-4: Sergei Zalyotin
Frank de Winne (België)
Leszek Czarnecki (??)

STS-114, 16 januari 2003:

EXP-7: Yuri I. Malenchenko
Sergei I. Moshchenko
Edward T. Lu

Soyuz TMA2, april 2003:

TAXI-5: Yuri V. Lonchakov
André Kuipers (Ned.)
Lance Bass (??)

STS-116, 30 mei 2003:

EXP-8: C. Michael Foale
William S. McArthur
Valeri I. Tokarev

STS-118, 3 oktober 2003:

EXP-9: Gennadi I. Padalka
Edward M. Fincke
Oleg G. Kononenko

STS-120, 19 februari 2004:

EXP-10: Carlos I. Noriega (??)
Salizhan S. Sharipov
John L. Phillips (??)

STS-121, 1 juli 2004

EXP-11: Aleksandr Y. Kaleri
Dimitri Y. Kondratyev
Donald R. Pettit (??)

NASA NEWS RELEASE : 19 MAART 2002.

ASTRONAUTS ASSIGNED FOR STATION EXPEDITION TRAINING.

As continuous habitation of the International Space Station (ISS) nears the 18-month mark, NASA has named crewmembers to begin specialized training for future long-term expeditions to the orbiting research facility. Three crewmembers have been assigned to train for the ninth expedition aboard the station. Veteran Russian Cosmonaut Gennady I. Padalka (Col., Russian Air Force) will serve as station commander, and first-time flyers Astronaut E. Michael Fincke (Lt. Col., USAF) and Cosmonaut Oleg D. Kononenko will serve as flight engineers for Expedition Nine. Padalka previously served as commander of Russian Space Station Mir Mission 26 and ISS Expedition Four backup commander. A graduate of the Eisk Military Aviation College, he served as a pilot and senior pilot in the Russian Air Force. Fincke, a member of the 1996 astronaut class, served as backup flight engineer for Expedition Four. He has two Bachelor of Science degrees from the Massachusetts Institute of Technology (MIT), a master's in Aeronautics and Astronautics from Stanford University, and a master's in Physical Sciences (Planetary Geology) from the University of Houston-Clear Lake. Kononenko has a degree from the Kharkov Aviation Institute and a post-graduate degree from the Kuibyshev Aviation Institute (Samara). Astronaut Daniel M. Tani, who flew in space for the first time aboard STS-108 in December 2001, will serve as Fincke's backup for Expedition Nine. Tani, also a member of the 1996 astronaut class, has undergraduate and graduate degrees in mechanical engineering from MIT. Cosmonauts Aleksandr F. Poleschuk and Roman Y. Romanenko will serve Russian backup crewmembers. Astronaut John L. Phillips, Ph.D., has been named as backup flight engineer for Expedition Seven, replacing Paul Richards, who resigned from NASA last month to pursue private interests. Richards flew as a mission specialist on STS-102 in March 2001.Phillips was a member of the STS-100 crew in April 2001 and had been assigned as a backup crewmember for the Expedition Eight crew. Replacing Phillips in that role is Charles J. Camarda, Ph.D. Camarda is a member of the 1996 astronaut class and currently serves as a Mission Control Center communicator with the space station crew. He is a graduate of the Polytechnic Institute of Brooklyn. He has a master's degree from George Washington University and a doctorate in aerospace engineering from Virginia Polytechnic Institute and State University. Camarda joins astronaut Leroy Chiao and cosmonaut Mikhail B. Kornienko as the backup crew for Expedition Eight.

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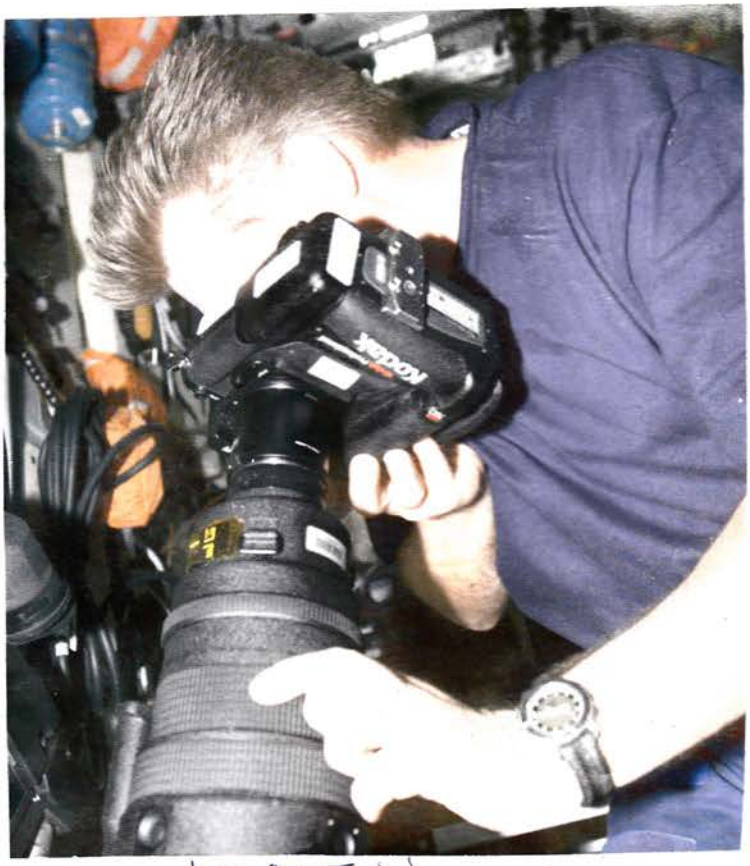

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CNN : 22 MAART 2002.

STATION CREW TO SPEND EXTRA TIME IN ORIBT / SET RECORD.

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JOHNSON SPACE CENTER - The astronauts aboard the international space station will spend an extra month in orbit because of robot arm trouble, pushing their mission to a U.S. record-setting 189 days. NASA decided Thursday to bump the crew's ride home from May to June so the visiting astronauts can replace a wrist joint in the space station's mechanical arm. The additional 3 1/2 weeks are needed to train the shuttle astronauts for the repair work and add the spare joint to the mission payload. American astronauts Carl Walz and Daniel Bursch and their Russian commander, Yuri Onufrienko, moved into the space station in early December and logged their 106th day in orbit on Thursday. Space shuttle Endeavour was supposed to lift off with their replacements on May 6; that launch is now scheduled for May 31. That will keep the three men in orbit until June 12, beating NASA's current space endurance record by a single day. Shannon Lucid's 1996 Mir mission lasted 188 days; she still will hold the world's space endurance record for women. Even at 189 days, Onufrienko won't come close to surpassing his country's space endurance record: an incredible 438 days set by Russian cosmonaut-physician Valery Polyakov aboard Mir in 1994 and 1995. The space station residents were notified of the shuttle delay shortly after the decision was made, but had had a hunch they would be staying up longer than planned because of the robot arm problem. NASA can work around the problem with computer software for the upcoming space station construction mission by Atlantis, due to lift off April 4 with a 44-foot (13-meter) girder to be installed on the orbiting outpost. But managers want to fix the station's robot arm as soon as possible after Atlantis' flight, by having shuttle astronauts replace one of three wrist joints in the 58-foot (17.5-meter) Canadian-built crane. The joint malfunctioned a few weeks ago; the brakes would not release, possibly because of an electrical short or radio interference. The robot arm experienced a fleeting problem last summer that engineers now suspect may be related to the current wrist trouble. Space station flight director Bob Castle said the space station astronauts are healthy and in good spirits, and there is no reason why they cannot stay up for six months.

19919

BERICHT UIT DE RUIMTE

Nummer 13 - 23.03.2002

Aan boord van het ruimtestation ISS waren de Rus Yuri Onufrienko en de Amerikanen Carl Walz en Daniel Bursch druk bezig om de vrachtcapsule Progress M1-7 vol te laden met afval en ongebruikte spullen. Op 19 maart werden de luiken tussen de Progress M1-7 en het station gesloten en even later ontkoppelde het vrachtschip. Terwijl de Progress M1-7 zich van het station verwijderde, werd een klein satellietje, Kolibry-2000, uitgezet. Dit 20,5 kilogram satellietje, beschikt over een deetjesdetector en een magnetometer om de ruimte direct boven Europa en Australië te onderzoeken. Ook zullen fysische processen in de stralingsgordels en het magnetisch veld van de aarde onderzocht worden. Nadat de Kolibry was uitgezet ontstak de Progress M1-7 zijn motoren en verbrandde even later in de bovenste lagen van de aardatmosfeer boven de Grote Oceaan.
Op 21 maart werd de Progress M1-8 gelanceerd. Op zondag 24 maart zal dit vrachtschip vastmaken aan de Zvezda module van het ruimtestation. Inmiddels is bekend geworden dat het verblijf van Onufrienko, Walz en Bursch aan boord van het ISS drie weken langer zal gaan duren. De lancering van de shuttle Endeavour, waarmee het drietal terug naar de aarde zal keren, is uitgesteld van 6 mei naar omstreeks 31 mei. Dit om de bemanning van de Endeavour extra trainingstijd te geven nadat vorige week besloten is om een van de scharnieren van de Canadese robotarm van het ruimtestation te vervangen. Hiervoor moet een extra ruimtewandeling gemaakt worden. Dit scharnier heeft al problemen gegeven sinds de arm geïnstalleerd werd in mei 2001. NASA gaat ervan uit dat de armproblemen de installatie van de S0-Truss volgende maand, niet zullen beïnvloeden, zodat de vlucht van de Atlantis gewoon door kan gaan.
Op zondag 24 maart koppelde om 20:58 uur GMT de Progress M1-8 aan de achterste koppelpoort van de Zvezda woonmodule van het International Space Station. De Progress M1-8 was drie dagen eerder vanaf de Russische basis Baykonur in Kazachstan gelanceerd met nieuwe voorraden voor de vierde expeditie, bestaande uit de Rus Yuri Onufrienko en de Amerikanen Carl Walz en Daniel Bursch. De dagen erna waren zij druk bezig met het uitladen van de voorraden en het opbergen ervan op diverse plaatsen in het ruimtestation, terwijl zij ook een oogje op de lopende experimenten hielden. De Progress M1-8 bracht 2,4 ton aan nuttige lading naar het station, zoals brandstof, voedsel, water, zuurstof, documentatie en Italiaanse en Zuidafrikaanse experimenten. Nadat de Progress M1-8 was aangekoppeld bedroeg de massa van het ISS 137,4 ton.Dinsdag 26 maart was de 110-de dag in de ruimte voor de drie bewoners. Twee dagen later werd de robotarm van het station aan een test onderworpen ter voorbereiding van de installatie van het S0-Truss, dat in april door de shuttle Atlantis naar het ruimtestation zal worden gebracht.

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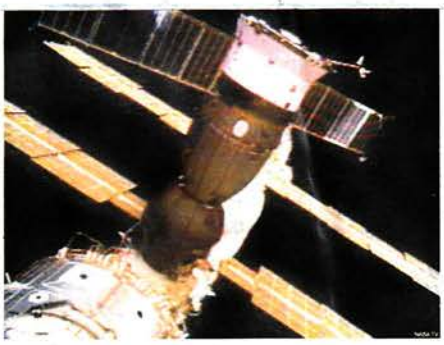
Tito realised his ultimate dream when on 28 April 2001 he was launched aboard a Soyuz spacecraft for a taxi mission to the Space Station.



When Tito arrived at the Space Station on 30 April 2001 he was welcomed by both the American and Russian crew.

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Despite a small bout of initial space sickness, floating in space for eight days was one of Tito's greatest joys.

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Yuri Onufrienko (right), and Daniel Bursch perform maintenance on equipment in the Zvezda Service Module on the International Space Station.

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LOCKHEED MARTIN NEWS RELEASE : 30 MAART 2002

ASTRONAUTS TRAIN WITH SPACE STATION SOLAR ARRAYS.

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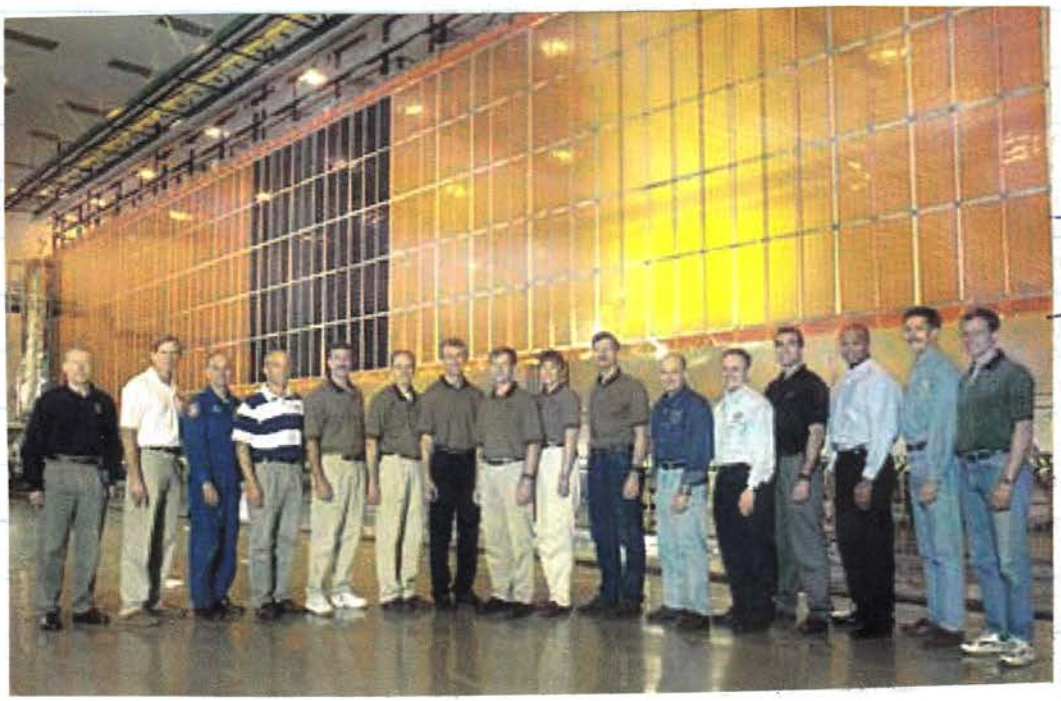
A group of 16 NASA astronauts, who will be flying to the International Space Station (ISS) in the next few years to install the remaining Lockheed Martin-built solar arrays, visited the Company's facility in Sunnyvale on Thursday. The visit allowed them the opportunity to observe at first hand the deployment of a massive solar array blanket, 107 feet long and 14 feet wide, and to carefully examine the intricate mechanisms with which they will be working on their visits to the Space Station. In addition, the astronauts and their Extravehicular Activity (EVA) ground support team members, from the NASA Johnson Space Center in Houston, were able to consult with the Lockheed Martin Space Systems engineers and technicians who built and tested the solar arrays. NASA believes it important that astronauts and support teams have direct hands-on experience with the hardware that they will be taking into space. The first of four pairs of massive solar arrays for the International Space Station, built at Lockheed Martin Space Systems in Sunnyvale, were launched aboard the space shuttle Endeavour to the International Space Station on Nov. 30, 2000. During a 12-day mission, astronauts connected the package of giant solar arrays and associated electronics, batteries, radiators, and support structure to the Station. Subsequent pairs of arrays, already delivered to NASA, will be carried on shuttle flights currently scheduled for 2003, 2004, and 2006. The Space Systems ISS solar arrays are the largest deployable space structure ever built and will be by far, the most powerful electricity-producing arrays ever put into orbit. When the Station is completed a total of eight flexible, deployable solar array wings will generate the reliable, continuous power for the on-orbit operation of the ISS systems. The eight array wings were designed and built under a $450 million contract from the Boeing-Rocketdyne Division in Canoga Park, Calif., for delivery to the Boeing Company and NASA. Each of the eight wings consists of a mast assembly and two solar array blankets. Each blanket has 84 panels, of which 82 are populated with solar cells. Each panel contains 200 solar cells. The eight photovoltaic arrays thus accommodate a total of 262,400 solar cells. When fully deployed in space, the active area of the eight wings, each 107 by 38-feet, will encompass an area of 32,528-sq. ft., and will provide power to the ISS for 15 years.



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Increasing Space Station crew capacity

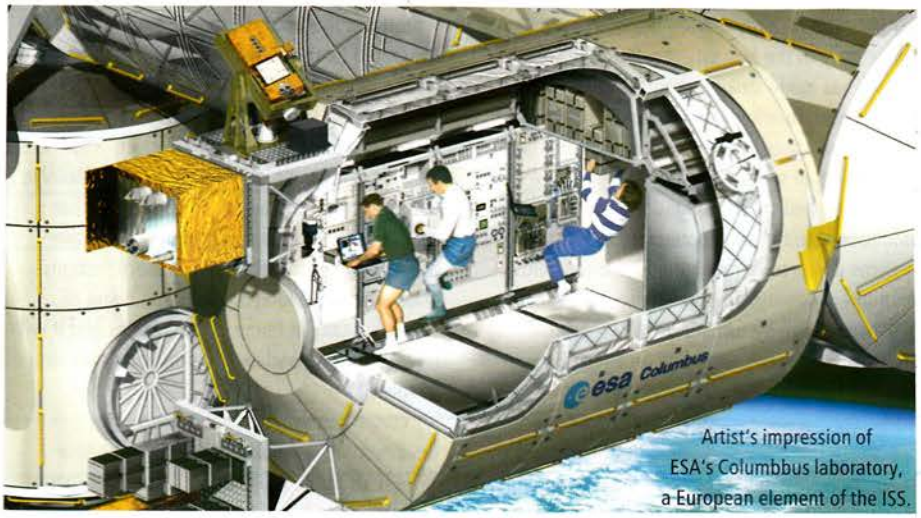
Sir, With reference to the International Space Station and its recent truncation of construction plans, I would like to offer some suggestions as to how the ISS might accommodate more personnel.

As it is (and as it will be, upon completion of the 'Core Complete' design), the ISS will have only three crewpersons: hardly enough to carry out both Station maintenance and a reasonable amount of science. The following suggestions may help to solve this impasse.

First – Incrementing the crew complement from three to four. This could be achieved by using two Soyuz crew transport craft: one docked onto the Zarya (as is now) and the other docked at the base of the Pirs airlock module. But each Soyuz would only transport (for the moment) just two persons: one Russian and one American. This second Soyuz would still be swapped for new every six months, but it would be three months after (and before) that of the first Soyuz, thus allowing the added opportunity of flying twice as many Russian visiting flights to the ISS. (It would be launched with three crewpersons: one pilot cosmonaut plus two space flight participants.) Also, such visiting/swap over flights could spend more time docked to the ISS: up to three weeks, and still return the old Soyuz with in the Russian standard landing window. The cost of supplying a second Soyuz would be borne out by the sale of the two seats aboard each of the two Soyuz vehicles to space flight participants (scientists, engineers or otherwise: yes, even tourists!)

Implementation of the above could occur soon after early 2004, when the ESA built NODE 2 is in place, from where (already existing in the Destiny module) the temporary sleeping quarters could be re-located along with another, identical sleeping quarters. (the two Russians sleeping in the Zvezda module: the two American crew in the NODE 2.)

Of course, a more permanent solution to the crew accommodation and added life support systems eventually will need to be addressed. A possible solution could be the refurbishment of the already exiting Italian built third MPLM cargo module and attach it to the ESA built NODE 3. This MPLM module, (named Donatello) could be returned back to Alenia and perhaps converted to a mini habitation module (for four occupants) as was earlier suggested last year: the difference being rather than building such a module from new, instead, using existing hardware: the Donatello MPLM module. Then, and only then could the twin docked Soyuz spacecraft carry three crew persons for rescue, rather than (up to that point) just two each. This way, the crew would be increased to six persons: enough to comfortably use the two new laboratories; the ESA Columbus and the Japanese Kibo. Perhaps the cost for upgrading the Donatello module to have status could be borne out by cooperation between both ESA, ASI and Alenia, and possibly the Russians, whom, just recently have stated that they would like to contribute more to the construction of roll of the ISS.



Artist's impression of ESA's Columbbus laboratory, a European element of the ISS.

The above, two phase scenario to increment the ISS crew from three to four, then to six, would allow the ISS to be, at least for this decade, scientifically usable, with a view for possible further development of the ISS, should budgets allow, to provide the ISS with a winged CRV and seven crew persons. But, at least with four crew persons in 2004, and six just a few years later, the ISS would stand a much better chance of continuing, rather than possibly being abandoned as not being usefully efficient with only just three persons, as it is today, and, as presently planned with the Core Complete plan, as it will be in the foreseeable future. Unless engineers can consider adopting and implementing a crew expansion plan, perhaps similar to the above, and politicians endorsing it, the ISS with just three persons will not serve neither space flight nor science very well. But it is worth considering - for the ISS and the future of human space flight is worth every penny spent.

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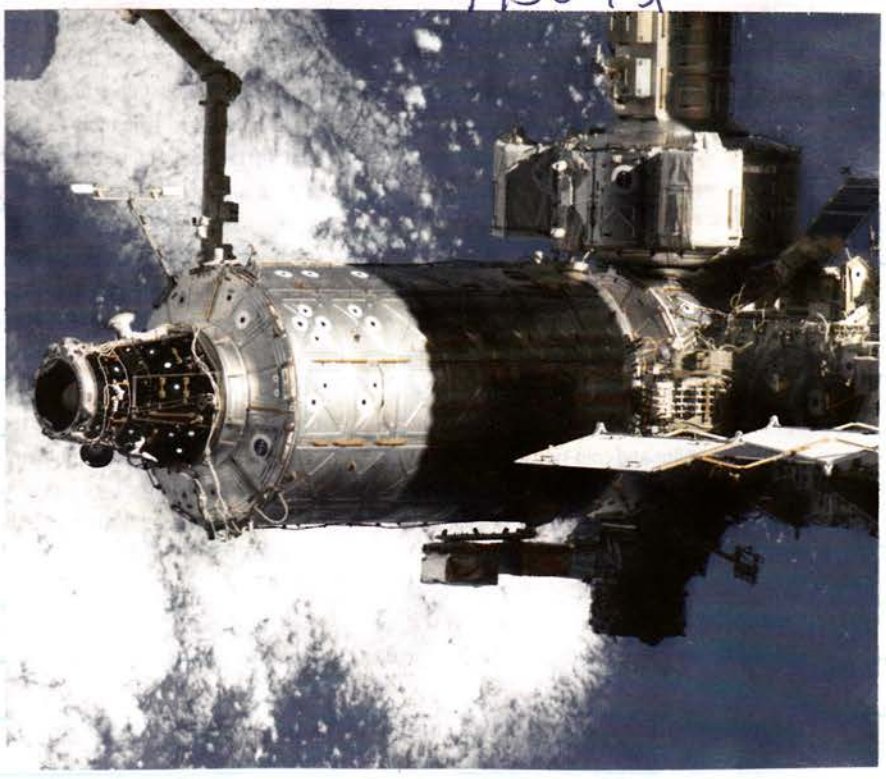

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Expedition Four

120 Day Report

Start:
Monday, 18 March 2002
GMT 077 / 2002
2 p.m. Houston, 11 p.m. Moscow
Time on orbit: 102 days, 21 hours 40 minutes
End:
Saturday, 6 April 2002
GMT 096 / 2002
8 a.m. Houston, 5 p.m. Moscow
Time on orbit: 121 days, 15 hours 40 minutes

As you can see from the times above, I started this note soon after our 100th day in orbit. I had hoped to make this a "100 day report," but it has turned into the "120 day report!" In this report I hope to give you a feel for what it has been like the past 120 days for a "first time" expedition crew member.

Launch of Endeavour, STS-108/UF-1: December 5, 2001

The launch was the first time for me on the middeck and from there our view is a row of lockers with no outside reference. It surprised me that I noticed the roll shortly after liftoff more than I remember when I was on the flight deck, where we can see outside through the forward and overhead windows.
The docked phase was very high paced and things did not slow down until the Shuttle undocked. When the Shuttle is docked, there is always a limited time in which to accomplish everything (hand-over, transfer, robotics), so there was always the pressure of doing all of the assigned tasks as well as "handing over" with Expedition Three before the hatches closed for the last time. Yuri told us that it would be a strange feeling when the Shuttle undocked and we were the only ones left. It was like a fast paced family reunion that suddenly came to an end. It also felt like the first day of a Naval deployment where we knew that we just started a long journey and couldn't even begin to imagine the end. The pace did slow a bit for the holidays, but quickly picked up again as we prepared for two space walks (EVA's) in January, as well as completed unloading of the "Progress" (Russian cargo ship).

Just "Us" on Station

The holidays were a nice break from the rapid pace of a Shuttle mission. I kept thinking about what several experienced expedition crew members had told me; the Shuttle mission is a sprint, and the Station mission is a marathon. Of course, being away from family during the holidays is always tough. It was very hard for me to be away from my family, but I couldn't help but think of all of the service men and women that were away from their families as well. And I also couldn't help but think about the tens of thousands of people that were missing friends and family over the holidays because of the terrorist acts of September 11th. And for them there would be no future reunion. I suddenly felt very fortunate to have a healthy family on Earth, knowing that they were sharing the holidays with loved ones.
We spent most of the holidays catching up on sleep, writing e-mail, watching movies and calling friends and family using an internet phone application that uses our high-data rate communication system, otherwise known as "Ku" (frequency band in which it operates). It was very special to be able to call family and friends, but what became most entertaining were peoples' reactions when we said we were calling from space! I didn't expect to get the chance to talk to so many visiting relatives of my friends on Earth!

Daily Routine

Our days are based on "Universal Time" (Greenwich Mean Time) and start with an 0600 wakeup and end at 2130. Sometimes we shift our schedule to adjust to another upcoming event, such as a Russian EVA, Shuttle docking, or Soyuz docking. We do this to either maintain good coverage over Russian communication sites or to line up our schedule with a visiting vehicle (whose workdays are determined by their launch time, which is determined by our orbit).Each day we get several messages that we need to read that are part of a daily "execute package." We access everything through one of the many laptops we have, and can print something if desired. We also review daily news and we need to import files that update our "inventory management system." We have a computer-based system that keeps track of everything on board. Without such an accounting system, most of our time would be spent hunting for some piece of equipment that got stuffed behind a panel by a previous crew...or by ourselves, just like you might misplace something at home. Unlike at home, however, we know that it is "in the house" somewhere!

Between 0600 and 0800 we read the daily mail, power up and/or restart some of the two dozen computers we have, "wash" up, eat breakfast, review the day's schedule and prepare any questions we may have for a morning conference with our teams on the ground in Houston (U.S. Mission Control), Huntsville (Payload Operations Control Center) and Moscow (Russian Mission Control), as they prepare questions and notes for us. We usually have about 2.5 hours of exercise every day and an hour for lunch. Breakfast and dinner do not show on our daily electronic schedule, but we do have time reserved after wakeup and before sleep for those meals. We usually try to fit dinner in between 1730 and 1830.

We have a combination of Russian and American food and it provides us with quite a large assortment. Yury said that our tastes would gradually change and he was right. The spicy food, like shrimp cocktail, is not so spicy anymore. The teriyaki chicken tastes just a bit different. I was used to tastes changing during Shuttle flights, but those changes I could associate mainly with how a "stuffy head" can affect your taste when you cannot smell as well. Also, some foods that we really liked on Earth are suddenly not appealing anymore. I am glad that we have such an assortment to choose from! Yury says that our tastes will continue to change. I still can't wait to try some pizza when we return!!

Our daily activities include maintenance (preventive and when something breaks unexpectedly), experiments/payloads, inventory audits, taking pictures inside and outside. Depending on future events, we may operate the SSRMS (Station robot arm) and/or study material for upcoming space walks or robotic activity. Our "planning team" assembles all of these varied activities on the ground. I am constantly amazed at how they can put together so many activities while working with three different centers, different time zones and different languages! I really enjoy taking pictures of our beautiful planet. The best days are when I have accomplished everything on the schedule, plus a little bit more, and I've been able to take several pictures throughout the day!! A few times I was disappointed that I missed taking a picture, but now I understand that on an expedition flight there will always be another chance!

The Tallest Peak

One morning I happened to be up early. I glanced at our world map and saw that we'd be passing near Mt. Everest soon. I checked the computer, realized that we were in an attitude that would allow me to open the window shutter and there was Mt. Everest! It almost seemed to jump out at me. The low sun angle (it was close to orbital sunrise) gave tremendous relief to the mountains. It was just one of those sights that will be forever burned into my brain!

Flying

Flying through Station is more fun than I thought it would be. We fly like Superman from one end to the other, being careful to know when to slow down and what big pieces of structure to miss (if you hit something hard, it still hurts!). We get to know our favorite handrails and paths from one place to another. After a month I tried using the ceiling. It seemed as though I had discovered another new Station! Everything looked different from the ceiling view, and I discovered that in some ways it was a better route (better hand-holds, fewer obstructions)! It still is a little disorienting when I am upside down and try to instantly decide which way to turn, but I am learning! Another interesting trick is to "fly formation." Pick something to translate with, then let it go and fly on its "wing." You really have to watch out how fast you go...stopping can get pretty messy sometimes! My grandmother used to say "The faster I go, the behinder I get!" That is also true for flying in space! That idea came in handy during the EVA's.

First Space Walk: January 25, 2002

I was a little nervous before my first space walk. I took that as a good sign. I felt it helped me stay on my toes a little more and take it slowly. In the weeks prior, I asked several other folks who had been on space walks before for their advice. The most common advice was to "take it slow" and/or "not to go fast, slow down." Things move in response to an outside force. The more force you use, the faster it will accelerate. You control best by slowing down. I am thankful for the advice!

The Russian EVA suit (Orlan) and U.S. EVA suit (EMU) provide the same basic capabilities, but have some important differences. Each suit reflects the mission for which they were designed: the Orlan for a crew of two and less pre-breathe requirements, and the EMU for a larger crew and for tasks requiring more dexterity. Because we go to a much lower pressure in the space suits, we have "pre-breathe" requirements to prevent the bends or decompression sickness, the same things that concern scuba divers. We are at risk at the beginning of our "dive," where divers are at risk at the end of theirs. The Station is pressurized close to sea level, about 14.7 psi. The Orlan is pressurized to about 5.6 psi

and the EMU to about 4.3 psi. Lower pressure means more mobility and dexterity, but the disadvantage is a longer pre-breathe protocol. The Orlan prebreathe is shorter, but the suit is harder to work in as we are working against higher pressure. The advantages of the Orlan include faster donning and it is also designed to be "self-donning." You enter the suit through the back and you can close the back without assistance. All of the Orlans are nearly identical with the exception of gloves. Sizing is accomplished through sizing straps in the arms and legs, and can be done in about an hour. The EMU is pressurized to 4.3 psi and we need someone to help us put it on. It is nearly "custom fit," but the size can be changed using different sizing rings. In fact, I used the same suit that Dan Tani used on UF-1 but with different sized arms, legs and gloves. During STS-110 (8A), Rex Walheim will use the suit I used, with again different sizing and different gloves. The lower pressure in the EMU makes working in the suit easier and the gloves give you better dexterity.

Second Space Walk: February 20, 2002

In January Houston told us that Carl and I would get the opportunity to go outside again, but this time in the U.S. suit, or "EMU." Many people on the ground worked endless hours preparing us for this walk. Not only did they send up procedures and pictures, but they also sent up special files that we used in a software program called "DOUG" that allowed us to perform our EVA on a laptop. It has the same graphics used in a "Virtual Reality Laboratory" at the Johnson Space Center, where we had trained for EVA's and robotics before launch. We had several weeks to prepare equipment and ourselves for the walk. It was the second time that the U.S. airlock had been used and the first time by a Station crew without the Shuttle present (often called a "deferred EVA"). We did a dry-run of the procedures the week before, worked out some kinks, then went out for real a few days later. Yury suited us up and then passed over the communication to Joe Tanner who acted as our "IVA" during the walk. Yury was inside controlling cameras, much like I did when he and Carl went out on their EVA mid-January. It was very successful and, once again, we are very thankful to our great team on the ground that prepared us and guided us through the EVA.I felt more comfortable during this walk, perhaps because of the extra mobility of the EMU; perhaps because I had more experience in the EMU. I wasn't as tired as I was after the Orlan. Having both suits on board gives us some flexibility that will no doubt come in handy in the future. In fact, one could say that the quick-donning and short pre-breathe features of the Orlan already was demonstrated when Expedition 3 had to do an EVA prior to our launch on STS-108. They removed part of a seal that was preventing a Progress from docking properly.

Roommates

One very important aspect of long duration space flight are the mental challenges associated with living in the same "can" with two other people. I finally realized the other day that living in the same enclosure with two other people for more than three months is a pretty unique experience. Working closely with someone is a big jump from an acquaintance. Living with someone is a big jump from working with them. And living and working together with only two other people for several months is yet another big jump. If you have a bad day, you can't just go for a walk. I have come to accept that all of us will have (and have had) good days and bad days. Frank Culbertson told us some good advice...some days you just need "to let go"...meaning (I think!!) that sometimes some things will get to you...but you have to let them go. And soon you will realize how insignificant they are and will probably laugh that they even bothered you in the first place. But I have also found that it is important to let the others know when something bothers you, because just like any other relationship...whether with a friend or spouse...if you let things go all the time, they will collect inside and always come out at the wrong time. So, the balancing act of life is the same in space as it is on Earth!!

Columbia and Hubble

It was fun following the STS-109/Hubble mission. The ground sent up daily reports on their progress and we were also able to watch their launch real-time via a live video feed over the Ku band to one of our computers. We also got to talk to them after their EVA's. It was neat knowing that for a short time there were 10 people in space...and even though we were in very different orbits, I felt somehow closer to them knowing that we were in "space" together. It is also hard to believe that their mission has come and gone.

An Extension

We just got news that our Shuttle flight home has been delayed about one month. That should send us over the six-month mark and we should break Shannon Lucid's U.S. record of 188 continuous days in space. That feels nice to be able to share in a record...but I sure do miss my family. During a deployment in the Navy, it is difficult to return home, but it is always possible. It is definitely different when your only ride home is with a spacecraft that also happens to be your only lifeboat when the Shuttle isn't present. Again, though, I think of all the men and women serving our country that are

deployed right now in far way places, and my job seems pretty easy. I also know that the immediate families of these people have perhaps the toughest job. And I know without a doubt that my wife has the toughest job between the two of us with three little ones at home!

Cargo Ship Arrives: March 26, 2002

Every four to six months a Russian unmanned cargo ship, called a "Progress," arrives bringing supplies including fresh fruit and care packages from home. When I was on a Naval deployment on the carrier, I remembered that we always knew when the "Carrier On-board Delivery" airplane, or COD, landed on board. Its arrival was announced over the loudspeaker, including how much mail was on board. It was also nice after we did underway replenishment (UNREP) with other cargo ships because it usually included fresh food. My experience on carriers was all before e-mail and phones on ships. I was amazed at how much I anticipated the arrival of this Progress. I thought that because we had e-mail and the "phone," that I wouldn't think the Progress was such a big deal...but it was! I underestimated how much I would anticipate the arrival of fresh fruit and care packages...something from Earth...something from home...that my friends and family had touched not too long ago!!

The entire approach and docking is automatic, but the crew can take over and complete the docking remotely if something doesn't look right during the approach. We simply follow the approach based on time and do our best to follow the vehicle with cameras located inside and outside. Yuri and Carl stood by the "TORU" remote control system on board and were ready to take over if necessary. Everything went well and after pressure checks we opened the hatch about midnight. I felt as if it was Christmas morning! Everything was tightly packed, but we managed to get to our care packages after about an hour. I honestly forgot that we hadn't been visited for the past three months...and something "fresh" from home was VERY welcome!! We got new books on CD, cards, letters, pictures and some new DVD's.

STS-110/8A Launch: April 4, 2002

Today is the scheduled launch of STS-110, which will be bringing up the S-zero truss segment. It will form the backbone of the truss structure that will eventually hold the four solar array "wings" of the U.S. segment. I am very much looking forward to the arrival of Atlantis and her crew. They promise to bring new care packages from home, fresh "smells" of the Earth and old friends. We know that the work pace will once again speed up, but we are ready! We worked many hours together on the ground developing procedures to use the Space Station robotic arm (SSRMS) as a "cherry picker" as we maneuver space walkers "flying" on the end of the arm. This will be the first time that this new arm will be used in such a capacity. The SSRMS will first be used to install the S-zero truss, then we will continue to use it for all 4 space walks.

Later, we heard that the launch was delayed. It is disappointing, but I am fairly familiar with launch delays and understand what the crew is feeling right now. There are many things that need to come together before the SRB's ignite. Some we can control, some we can't.

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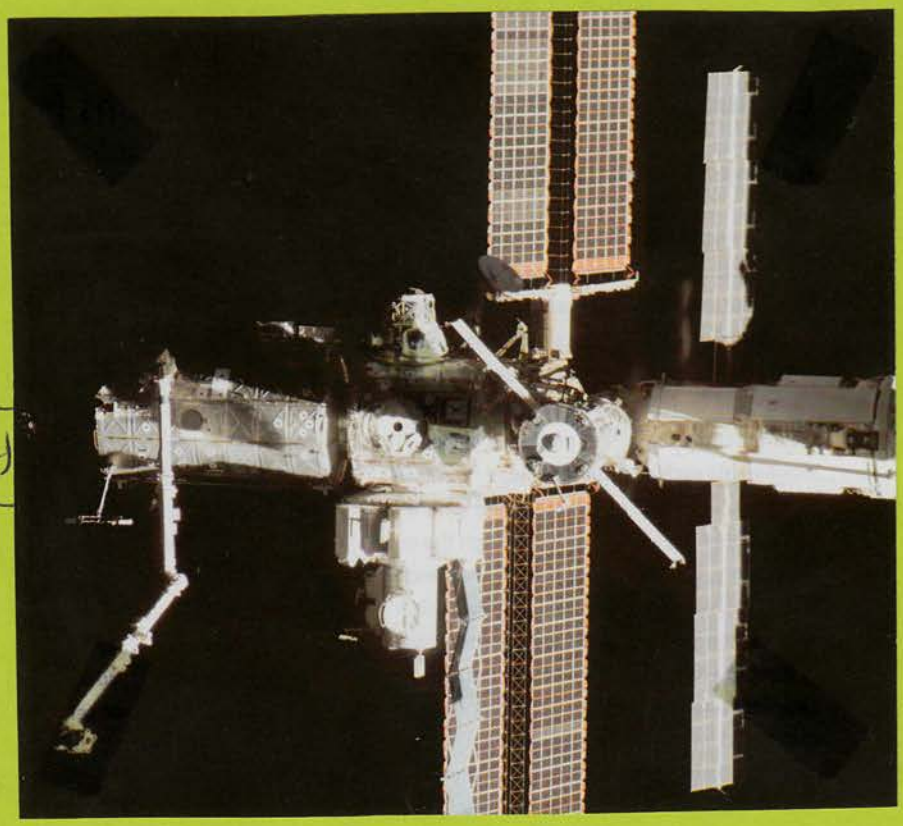
As we await the arrival of Atlantis, I wish all of you a great weekend!

Dan Bursch
April 6, 2002



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Europe Holds Firm On ISS Configuration

MICHAEL A. TAVERNA/NOORDWIJK, NETHERLANDS

European space leaders are hoping that a new round of talks with NASA and other International Space Station partners will permit the facility to operate with a full complement of seven astronauts, and not the scaled-down version now being considered.

In the wake of a massive $4.8-billion cost overrun, NASA managers have fallen back on a "core complete" configuration adequate to support only three astronauts (*AW&ST* Apr. 1, p. 30). This is the maximum number that can be evacuated by the Soyuz spaceship that currently serves as the station rescue vehicle.

The full configuration stipulated in the International Governmental Agreement (IGA) underlying ISS cooperation, signed in 1998, is for seven astronauts. This would require development of a crew rescue vehicle (CRV), an expensive ($1.5-billion) enterprise that NASA planners say can probably no longer be financed.

However, partner nations reaffirmed in a meeting of the Multilateral Control Board (MCB) in Washington on Mar. 28 that they would insist on a capacity at or close to the figure stipulated in the IGA. A three-person limit, officials noted, would render Europe's Columbus laboratory, to be orbited in October 2004, and a similar facility to be provided by Japan basically useless.

"We understand that NASA must get its house in order, but we insist that not be to the detriment of the other partners," said Joerg Feustel-Buechl, director of manned space and microgravity for the European Space Agency.

"A three-man crew would be a catastrophe," Feustel-Buechl said here at briefings on the status of the automated transfer vehicle (ATV). "It's a nonstarter." The ATV, a cargo carrier/space tug to be boosted to the station by an Ariane 5, will form an essential part of the ISS logistics system, alongside the shuttle, the Soyuz and Japan's HTV.

Europe needs to come to an arrangement on ISS configuration so that it can issue production contracts for the ATV, which will resupply the station and periodically reboost it to higher orbit.

one option being considered, Feustel-Buechl said, is to offer NASA more ATVs, under a barter arrangement, in order to reduce shuttle uploads.

Also dependent on a rapid decision is a huge 2.5-billion-euro ($2.2-billion) ISS utilization contract that ESA has yet to issue. ATV/Ariane 5 procurement will account for the bulk of this award.

Feustel-Buechl insisted that ESA could live with a temporary three-person configuration, as long as the full complement remained the ultimate goal. In the event the CRV is discontinued, the sum allotted to date for the program could be made available for possible barter arrangements, he said. In total, 200 million euros have been allocated for barter deals under the new multiyear ISS utilization spending plan.

The agency heads are to meet in Paris in June to discuss some of the basic principles behind the various solutions, particularly regarding the Soyuz buy, which is considered the most likely option.

According to Feustel-Buechl, these include whether NASA will be allowed to negotiate with the Russians for procurement of the additional Soyuz vehicles without violating U.S. import control laws. The agency has already received authorization to initiate preliminary discussions. Feustel-Buechl dismissed suggestions being made in some quarters that Europe might negotiate a deal in lieu of the U.S.

A second related matter is whether the Russians will make the Soyuz available at an affordable price. Moscow has reportedly been asking for around $65 million each, which would require a $1.3-billion outlay over the 10-year nominal life of the station. An International Partner Negotiating Team has been formed to talk down the asking price.

Observers noted that the Russians have proven intractable on price in negotiations to install a Soyuz launch pad in Kourou, French Guiana, seemingly dooming that initiative to oblivion. But ESA officials remarked that Russia has shown itself to be flexible in previous ISS hardware deals.

Meanwhile, the NASA astronaut office has released a document defining the conditions under which the "safe haven" option would be an acceptable solution. This concept involves ensuring the means—mainly extra medical facilities installed in various areas of the station—to maintain the crew in good health until they can be evacuated.

According to Alan Thirkettle, who heads ESA's manned spaceflight department, the document found the concept could be applied for three broad categories of evacuation: medical reasons; hostile-atmosphere conditions caused, say, by a fire; and loss of major ISS systems such as power or attitude control. The only category of risk for which the concept would be inapplicable is immediate evacuation of the entire crew, which the document noted had never been required in 40 years of manned space.

At the MCB meeting, the partners agreed to set up a special task force to discuss technical aspects of the different options. According to Feustel-Buechl, three basic scenarios are being discussed:

- The station would be built as initially configured, but the CRV would be delayed until an unspecified future date.
- An additional Soyuz would be substituted for the CRV, enabling the ISS to be manned by six crewmembers.
- The station would be limited to the "core complete" configuration, with a single Soyuz and no CRV, but a full complement of astronauts would be ensured by adopting "safe haven" concepts.

THE OBJECTIVE IS to choose a final scenario acceptable to all by autumn. Feustel-Buechl said he's "quite optimistic" the goal would be reached.

Several important European milestones depend on coming to a rapid decision. For example, ESA has frozen two-thirds of station utilization funding for the period 2002-06 until an acceptable deal is struck. Agency leaders are to meet in the fall to discuss reinstating the funds (*AW&ST* Nov. 19, 2001, p. 88).

A quick decision is also required so that ESA can let production contracts for the ATV. So far, only one unit has been ordered, for launch in September 2004. Eight others are to be procured. However,

France, Russia Affirm Mars Interest to NASA

CRAIG COVAULT/KENNEDY SPACE CENTER

France has reaffirmed its intent to pursue strong new Mars mission cooperation with NASA, while Russia is also seeking new Mars collaboration with the U.S.

The French affirmation means that a formal memorandum of understanding (MOU) on the collaboration—which has been awaiting completion at the U.S. State Dept.—will now proceed, said Ed Weiler, NASA associate administrator for space science.

French national space agency Director General Gerard Brachet and CNES President Alain Bensoussan met in Washington late last month to discuss the Mars initiative and other cooperation with Weiler and NASA Administrator Sean O'Keefe.

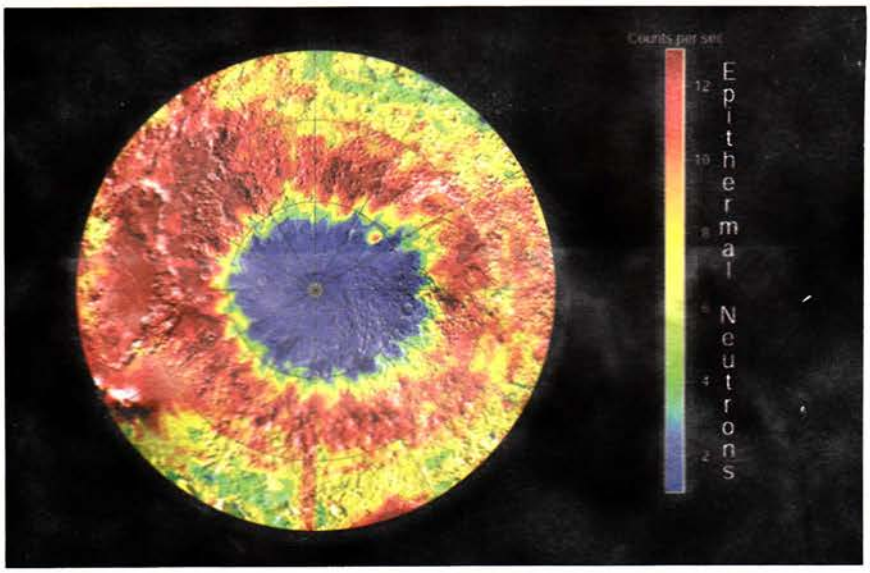
"We are looking at very strong collaboration with the French, so now it is a matter of getting the MOU done," Weiler said.

He said the French decision to stick with earlier intentions to become a strong new Mars exploration partner is especially significant in light of assessments that show the ultimate objective—an international sample return mission—will slip from 2011 to at least 2016 (*AW&ST* Feb. 25, p. 38).

"They said they are solidly with us on the sample return in spite of it being pushed downstream," Weiler said.

The sample return strategy (as currently envisioned) has CNES as a key element for both precursor flights and as lead on the development and launch of a Mars orbiter that would capture samples launched from the surface by a future U.S. lander (*AW&ST* Dec. 11, 2000, p. 60). A portion of the French orbiter would then separate and fire back toward Earth, where a U.S. reentry vehicle integrated with the French bus would be separated to land with the Martian rock and soil samples.

During the meetings, the U.S. and French officials also discussed major U.S. participation in the CNES-led Mars Netlander mission set for launch on an Ariane 5 in 2007. "We are going to have major U.S. collaboration on the French 2007 mission . . . the U.S. will be supplying part of the science payload as well as Deep Space Network tracking support," Weiler said.



Mars' south polar cap is imaged by the neutron spectrometer on the Mars Odyssey spacecraft orbiting the planet. Blue color indicates hydrogen atoms indicative of water ice, critical for life assessments.

The 2007 mission will include a French orbiter and four 145-lb. Netlanders that would return surface data. Germany, Finland and Belgium are the primary partners with France in that project. Italy is especially interested in supplying additional Mars mission technology (*AW&ST* Oct. 29, 2001, p. 90).

The Russians have also renewed discussions with the U.S. on Mars mission cooperation, Weiler said. "We are sort of in a mating dance with the Russians," he said.

One problem, however, is that Russia would like to supply launch vehicles for Mars missions, but U.S. law precludes the use of Russian launchers unless it is part of a broader cooperative science effort. "We just can't go out and buy Russian launch vehicles; we are precluded from doing that," Weiler said. The issue will be discussed this summer or fall when Weiler holds his annual science coordination meeting with the Russians.

In addition to the Russian heavy Proton booster, the medium Soyuz launcher is capable of flying Mars missions. A Starsem Soyuz is to launch the European Space Agency Mars Express orbiter carrying the small Beagle 2 lander in 2003. Soyuz Mars missions can be flown for only about $45 million in launch costs, Starsem believes.

Other new NASA science collaboration unrelated to Mars is also under discussion with ESA as well as Japan.

Weiler and David Southwood, who heads space science for ESA, along with other NASA and ESA science managers will meet in Spain in May to discuss the status of U.S./ESA science cooperation.

European participation in the Next-Generation Space Telescope (NGST) program will be a primary area of discussion, as will an ESA role in the new NASA "Living With A Star" program.

"ESA is looking seriously at joining us in the Living With A Star effort, which is an excellent program for collaboration because it will involve many relatively small satellites," Weiler said. ESA has formed a working group to define its part in the program, which would involve multiple spacecraft launched starting later in the decade to study the Sun and its interaction with the Earth.

In another NASA/international science milestone, Weiler said the U.S. and Japan have just inked an agreement for the U.S. to provide an X-ray telescope to replace the Astro-E mission lost during a Japanese M-5 booster failure in early 2000.

The original Astro-E spacecraft carried a U.S.-developed telescope, and the new accord will allow a nearly identical telescope to be built for a reflight of the mission to again be launched on a Japanese booster.

The Future of Mars Missions

For more on Mars missions, visit www.AviationNow.com/mars

BBC : 15 MAART 2002.

DISTANT PLANET IS BLUE AND BEAUTIFUL.

The Subaru Telescope on Hawaii has produced a stunning image of Uranus. Two of planet's moons are visible, as is its remarkable dust ring. This picture of the seventh major body from the Sun is not only visually appealing, it is helping astronomers probe the composition of the planet's atmosphere. It is actually a composite image, combining infrared light in three different regions of the spectrum. This means that the actual appearance of the planet and its rings is not what we would normally see. In the colour scheme, methane, the dominant component of the Uranus atmosphere, shows up as blue. Uranus is a gas-giant world that is difficult to study from the Earth even with the largest telescopes. It has been visited by a spaceprobe only once when the Voyager craft passed it in 1986. There are no plans as yet to return to the world. The new image adds to the Subaru Telescope's growing reputation for producing stunningly beautiful images of the cosmos. The planet itself, its ring system, and two of its satellites, Miranda (top) and Ariel (bottom-left), were imaged by the telescope's Coronagraphic Imager as part of its programme of commissioning. Uranus was discovered on 13 March, 1781, by William Herschel. The object, which was initially thought to be a comet, turned out to be a new planet outside Saturn's orbit. It revolves around the Sun in approximately 84 years on an elliptic orbit whose average radius is approximately 2.8 billion kilometres (1.7 billion miles). Unlike other planets, Uranus spins on its side with respect to its orbital plane. Since 1851, more than 10 satellites and 10 rings have been found around it. Scientists from several research institutes and universities, in addition to the National Astronomical Observatory of Japan, have been involved in the commissioning of the Subaru Telescope.

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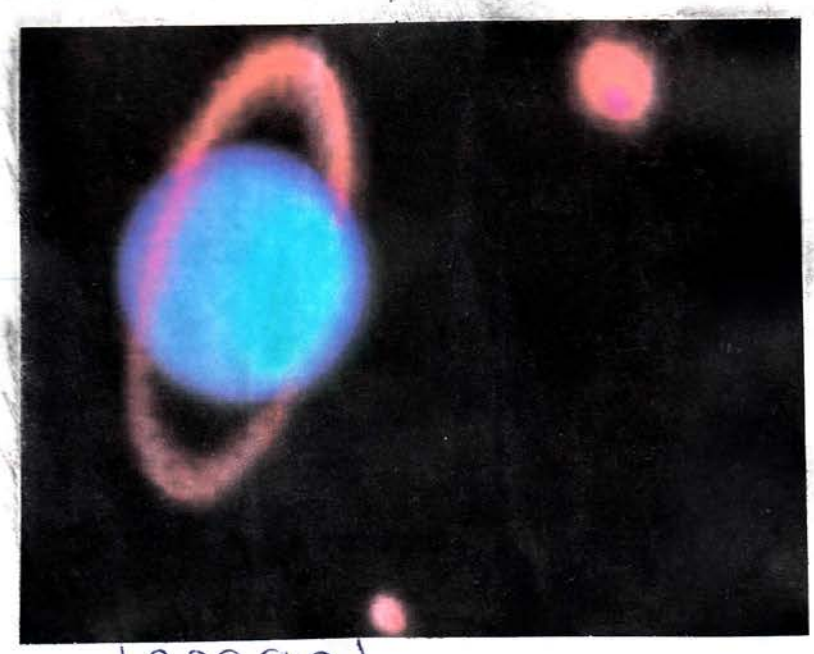

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STILL PHONING HOME

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NASA successfully communicated earlier this month with Pioneer 10, now 7.4 billion mi. from Earth (see rendering). The TRW-built spacecraft, launched in 1972, completed its science mission in 1997, but continues to be tracked by the agency's Deep Space Network as part of an advanced concept study of communications technology. Pioneer 10 was the first spacecraft to make close-up images of Jupiter.

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AWST:
18-03-2002

19929

(73993)

Zijn er nu dertien of toch nog steeds twaalf sterrenbeelden? Op deze en andere vragen poogt de kleine, maar interessante expositie 'Sterrenbeelden' in het Limburgs Science Centrum eXplorion in Heerlen, de voormalige Sterrenwacht Schrieversheide, antwoord te geven.

De Slangendrager (Ophiuchus), het dertiende dierenriem-sterrenbeeld. Onder: de Stier (Taurus).

D.D.Li. 12-03-2002.

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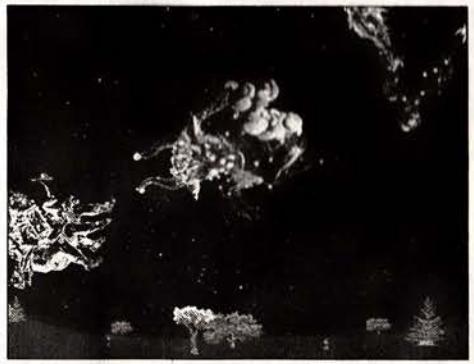
DE STIER WERD RAM MAAR BLEEF STIER

„Welk sterrenbeeld ben je?", vraagt Jan-Willem Souren van eXplorion. „Stier", antwoordt de verslaggever. „Wanneer ben je geboren?" „Op 26 april 1953", antwoord ik. „Dan ben je géén Stier, maar Ram. In dat jaar stond de zon op die dag in het sterrenbeeld Ram en niet in Stier. Als je bijvoorbeeld in het jaar 553 geboren zou zijn, was je wèl Stier."
Schrik, slik. Altijd in de horoscoop het verkeerde sterrenbeeld zitten lezen. Daarom ben ik nooit rijk geworden, zoals me zo vaak beloofd is. Volgens de directeur van het eXplorion ben ik geen Stier maar Ram omdat de route van de jaarlijkse reis die de zon langs de hemel maakt, in de loop der jaren in de sterrenbeelden een beetje is opgeschoven. Dat heeft er zelfs toe geleid dat er een sterrenbeeld van de dierenriem is bijgekomen: Slangendrager. Zit tussen Schorpioen en Boogschutter in. En omdat er een sterrenbeeld méér is, heeft ongeveer vijftig procent van de mensen een ander sterrenbeeld dan gedacht, zeggen de astronomen.

Slangendrager is van 29 november tot 18 december. In die tijd staat de zon niet in Schorpioen of Boogschutter, maar in Slangendrager. Kijk maar omhoog, de hemel levert het bewijs.
„Volgens de astronomie, de sterrenkunde, ben je misschien een Ram, volgens de astrologie ben je nog steeds een Stier", troost astrologe Ine Hoeijmakers uit Heerlen. „Wij astrologen gaan uit van de ecliptica van 360 graden en hebben die verdeeld in twaalf vlakken van elk 30 graden. Die vlakken zijn benoemd met dierenriemtekens. Dat zijn slechts namen. De naam van jouw vlak is en blijft gewoon Stier. Daar verandert de ontdekking van de Slangendrager – overigens al in het jaar 1928 – niets aan." Dus hou ik al die goede karaktereigenschappen van de Stier gelukkig toch.



De ecliptica is de baan die de zon jaarlijks langs de hemel aflegt. Op die reis staat de zon in de verschillende sterrenbeelden. Vóór Christus al gaven Griekse astrologen namen aan de sterrenbeelden waar de zon in die ecliptica toen voor stond: Vissen, Ram, Stier, Tweelingen, Kreeft, Leeuw, Maagd, Weegschaal, Schorpioen, Boogschutter, Steenbok en Waterman. De bekende dierenriem. De astrologie beweert dat de stand van sommige hemellichamen invloed heeft op de gang van zaken op moeder aarde en dat het karakter van een mens mede bepaald wordt door het sterrenbeeld waarin de zon staat op het moment van zijn geboorte. Ook de plek waar je geboren bent is daarop van invloed. Astronomen plaatsen daar vaak vraagtekens bij. Doen zelfs wat lacherig over die rare astrologen.
De sterrenbeelden-expositie heeft het eXplorion gemaakt naar aanleiding van vragen van veel scholieren die jaarlijks op excursie komen voor het vak algemene natuurwetenschappen. „In dat vak worden de sterrenbeelden vaak behandeld. Scholieren moeten dan weten hoe ze sterren herkennen, wat hun helderheid is, hoe groot de afstand tot de aarde is, maar ook wat de mythologische achtergrond van de namen is. Dat alles leggen wij hier nu uit", verklaart Jan-Willem Souren. „Vroeger", vervolgt hij, „toen het 's nachts nog echt hartstikke donker was en de mensen geen televisie hadden, stonden ze vaak uren buiten naar de sterren te kijken. Dan wees opa naar zo'n figuur van sterren aan de hemel en vertelde hij daar een spannend verhaal over. De hele Griekse mythologie kun je vertellen aan de hand van de sterrenbeelden. Toen er nog geen klok en kalender bestonden, zag je overdag aan de zon hoe laat het was en aan de hand van de sterrenbeelden aan de nachtelijke hemel kon je bijvoorbeeld zien wanneer het lente was en je zaden in de grond moest stoppen."
In het eXplorion kunnen de bezoekers ook een supersnelle reis maken door ons melkwegstelsel, een platte schijf met honderd miljoen sterren. Maar je kunt ook nog verder weg, in andere melkwegstelsels, een kijkje nemen. Dat gebeurt via het computerprogramma Starry Night, dat op een groot scherm wordt geprojecteerd. Op deze manier kun je je eigen sterrenbeeld eens van dichtbij bekijken. Dan zie je dat de sterren in zo'n beeld meestal helemaal niet bij elkaar horen en dat het beeld van de dierenriem, wanneer je van een andere kant naar je sterrenbeeld kijkt, niet meer herkenbaar is.

„Al die sterrenbeelden zijn groepen zonder samenhang. Ze hebben niets met elkaar te maken. Wij laten hier de feiten zien", zegt Jan-Willem Souren beslist. Volgens hem ontkracht de astronomie de astrologie. Ine Hoeijmakers is het niet met hem eens: „Astronomie is de waarneming, astrologie is de interpretatie van die waarneming. Astronomie is exacte wetenschap. Astrologie is eigenlijk een belevingswetenschap. Het kan je helpen, je meer inzicht in jezelf geven. Echte astrologie is niet zo simpel als sommige mensen denken. Het heeft absoluut niets te maken met de horoscopen die je in de bladen leest."
Maar astronoom of astroloog: beiden zijn gefascineerd door dezelfde sterrenhemel.

'Sterrenbeelden' is tot september te zien, eXplorion is geopend di t/m vr en zo van 13-17 uur.
Sterrenkijkavond elke vrijdag van 19.30-22 uur.
Vrijdag 22 maart is landelijke sterrenkijkdag.
In augustus, wanneer het sterrenteken Slangendrager 's nachts te zien is, zijn er speciale avonden.
Info: www.sterrenwacht.nl; astrologie-cursussen, e-mail: ihoev@freeler.nl

Odyssey Controllers Revive Experiment

BRUCE A. SMITH/ LOS ANGELES

The Odyssey spacecraft is beginning its 30-month primary mission at Mars with a full set of science instruments, following reactivation of one of its three experiments that had been out of operation for about seven months.

Controllers got the Martian Radiation Environment Experiment (Marie) instrument running again earlier this month and placed it in its science configuration on Mar. 13.

Marie had run for about four months after Odyssey was launched last April, but was turned off on Aug. 20 during the spacecraft's travel to Mars when the instrument failed to respond to a downlink session.

The experiment was designed to measure radiation fields during the cruise portion of the mission and while the spacecraft is in orbit around the planet. The measurements were to be used to determine radiation levels that astronauts might be exposed to during possible future Mars exploration.

The spacecraft's other two instruments—the Gamma Ray Spectrometer (GRS) and Thermal Emission Imaging System (Themis)—were operating normally when Odyssey's primary science mission officially began on Feb. 19. Both the Themis and GRS instruments have made some interesting observations during the initial stages of the Odyssey science mission (*AW&ST* Mar. 4, p. 49).

Roger Gibbs, deputy Odyssey project manager at Jet Propulsion Laboratory, said that after project officials reactivated the Marie instrument, they synchronized communications with the experiment, played back data that had been stored on board since August and placed the instrument in its science mode. The experiment has operated normally since then.

Gibbs said the most likely scenario for the instrument's problem last August was a single event upset (SEU) to the instrument's memory, which resulted in Marie automatically ceasing operations so it could begin error detection and correction.

The instrument stops communicating with spacecraft systems while it is going through the error detection and correction process. Orbiter systems detect the lack of communication and try to reset the instrument, but the reset cannot be accomplished until the instrument's "scrub" has been completed.

Odyssey controllers twice increased the reset timer to lengthen the period they thought would be necessary for completion of the scrub, but were not able to restart the instrument. At that point, they decided to temporarily stop troubleshooting so they could focus on inserting the spacecraft in orbit around Mars, as well as aerobraking it into its planned science orbit. They planned to begin troubleshooting the instrument problem again once the spacecraft was in its final mapping orbit.

Instrument team members about that time determined it could take up to 10 hr. for Marie to complete the process of correcting the computer problem. Odyssey project officials had previously allowed a maximum of 8 hr. for the process.

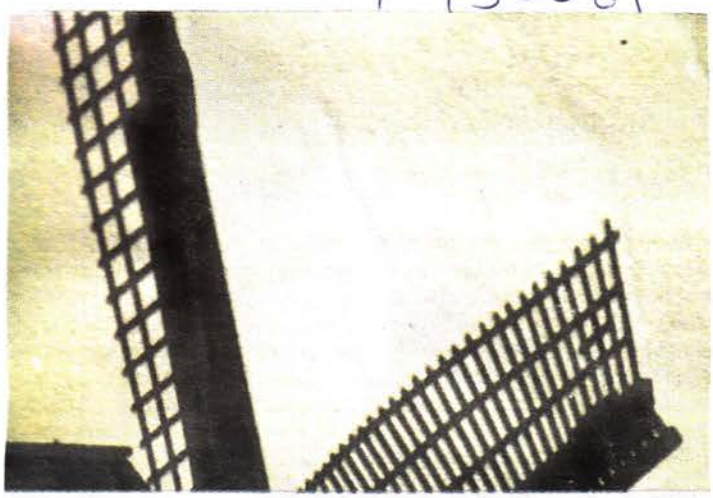
EARLIER THIS MONTH, while in mapping orbit, Odyssey controllers began the process again with the instrument. Eight hr. 16 min. later, the instrument began to respond, Gibbs said.

The 7.3-lb. Marie instrument uses a spectrometer to measure radiation sources originating from the Sun and from outside the solar system through a 68-deg. field of view. The experiment, which uses 7 watts of power, was designed to remain in operation for the duration of the science mission.

Similar instruments are flown on space shuttles and the International Space Station, according to NASA, but none have been flown outside the Earth's protective magnetosphere.

(73995)
(73996)

AWST: 18-03-2002.



Komeet boven Nederlands luchtruim

De komeet Ikeija-Zhang was het afgelopen weekeinde, tijdens de sterrenkijkdagen, goed te zien boven Nederland. Met het blote oog is het nog slechts een zwak geel puntje, maar door een telelens is de komeet, vernoemd naar de Chinees en Japanner die hem onlangs ontdekten, goed te bewonderen. Een komeet geeft zelf geen licht, de zonnestralen reflecteren op de 'stofstaart' die hij achterlaat op zijn reis door het heelal. Deze komeet is op weg richting de zon. De sterrenwachten en professionele amateurs hadden hun telescopen, zoals hier in Enschede, het hele weekeinde op de hemel gericht om niets van dit schouwspel te missen. FOTO: WFA

(73997)

Metro: 25-03-2002.

1993 2

D.D.L. 12-03-'02

STERRENKIJKEN

DE MAAN OP AFSTAND

Niet dat je er iets van kunt zien, maar komende donderdag blijft de maan extra ver bij ons uit de buurt. De aarde en haar metgezel bereiken dan hun grootste onderlinge afstand van de hele eenentwintigste eeuw. Hoofdschuldige is de zon die met haar zwaartekracht de baan van de aardse wachter behoorlijk kan verstoren.

De maan draait om de aarde. Klinkt eenvoudig, maar de werkelijkheid zit een stuk ingewikkelder in elkaar. Strikt genomen draait de maan helemaal niet om het middelpunt van de aarde. Ze bewegen allebei rond een gemeenschappelijk zwaartepunt. Als de maan en de aarde even zwaar zouden zijn, zou dit *barycentrum* precies halverwege de twee hemellichamen liggen. In werkelijkheid is de aarde meer dan tachtig keer zo zwaar als de maan. Daardoor bevindt het gemeenschappelijk zwaartepunt zich binnen in de aarde, ongeveer zeventienhonderd kilometer onder het oppervlak. Dat is nog altijd 4670 kilometer van het middelpunt van onze planeet verwijderd.

De baan die de maan eens in de 27,3 dagen rond de aarde beschrijft is ook geen mooie cirkel, maar een ellips. Ellipsbanen zijn in meer of mindere mate uitgerekt, waardoor de afstand aarde-maan niet altijd hetzelfde is. In het *perigeum*, het baanpunt dat het dichtst bij de aarde ligt, nadert de metgezel van de aarde onze planeet tot op 363.296 kilometer. De grootste afstand tot de aarde, 405.504 kilometer, bereikt de maan in het *apogeum*. Erg uitgerekt is de maanbaan niet. De afwijking van de gemiddelde afstand van 384.400 kilometer bedraagt vijf procent en uitgetekend op een blad papier zou je de baan van de maan niet van een cirkel kunnen onderscheiden. Maar de grootste en de kleinste afstand van de maan vertonen nogal wat variaties. Onze planeet en zijn begeleider draaien ook nog rond de zon, die met haar zwaartekracht het aarde-maanstelsel niet onberoerd laat. Eens in de 206 dagen wijst

Lick Observatory

de lange as van de maanbaan, de verbindingslijn tussen perigeum en apogeum, in de richting van de zon. Je zou verwachten dat dit iedere zes maanden gebeurt, maar de lange as van de maanbaan draait ook langzaam in het rond. Eén omloop duurt iets minder dan negen jaar. Als de lange as op de zon gericht is, rekt haar aantrekkingskracht de baan van de maan extra uit. Het apogeum bevindt zich dan nog verder van de aarde af, terwijl de perigeum-afstand kleiner is dan normaal. Of de maan dan ook werkelijk dichter bij of verder weg van de aarde staat, hangt ervan af of zij zich op dat moment toevallig in het perigeum of apogeum bevindt. Op 14 maart is het laatste het geval. Dan wijst de lange as van de maanbaan nagenoeg naar de zon. Tegelijkertijd bereikt de aardse wachter zijn 'hoogste' baanpunt, waardoor de afstand aarde-maan groter is dan bij een gemiddeld apogeum. 406.707 kilometer strekken zich nu uit tussen de middelpunten van beide hemellichamen, een afstand die in de hele eenentwintigste eeuw niet meer zal worden overtroffen. Daarvoor moeten we wachten tot 23 januari 2107 als de maan er nog een schepje van negen kilometer bovenop doet. Dan sneuvelt ook het record uit de vorige eeuw, toen de metgezel van de aarde op 2 maart 1984 een afstand van 406.712 kilometer haalde.

Als de maan verder weg staat dan gemiddeld, moet ze er ook kleiner uitzien. Maar het heeft geen zin om te gaan kijken. Komende donderdag is het namelijk ook nieuwe maan en blijft onze naaste buur in het heelal onzichtbaar. De maan staat dan tussen de aarde en de zon in, zodat wij tegen haar onverlichte zijde aankijken. En zelfs al zouden we de maan kunnen zien, dan nog zou het verschil in grootte niet opvallen. Bij een gemiddeld apogeum is de maanschijf een procent of elf kleiner dan wanneer de man het dichtst bij de aarde staat. De tweehonderd kilometer die de maan nu meer van ons verwijderd is voegt daar niet zo veel aan toe. Een 'nabije' en een 'verre' maan zou je alleen van elkaar kunnen onderscheiden als ze tegelijkertijd naast elkaar aan de hemel staan. In werkelijkheid is dat natuurlijk niet mogelijk, maar de fotocamera biedt uitkomst. Leg een foto van de maan in het perigeum naast een apogeum-opname en het verschil is duidelijk te zien.

19933

BBC : 13 MAART 2002

COMET RETURNS AFTER 341 YEARS.

73999

Skywatchers gazing at the heavens just after sunset during the next few days should get a glimpse of a cosmic wanderer - Comet Ikeya-Zhang. The comet is a surprise visitor to the inner Solar System, having appeared without warning a few weeks ago. The object, first picked up by two amateur astronomers in Japan and China, is hovering on the limits of unaided-eye visibility but is a spectacular sight in binoculars for those looking from the Northern Hemisphere. In a few days, Ikeya-Zhang will round the Sun and appear on the star's other side in Earth's pre-dawn sky, where it should also make a fine spectacle. But astronomers warn casual observers that they should never look directly at the Sun with either the naked eye or any optical aid as blindness can result. According to Denis Buczynski of Conder Brow Observatory near Lancaster, UK, the comet is remarkable for two reasons. "First, that it was discovered visually. These days, most comets are discovered by automatic patrols. "Secondly, it is a return of a comet last seen in the 1600s. No other comet with such a long period has been observed on subsequent returns before." The comet hangs in the star fields of the constellation of Pisces, not far from the Sun after it sets. Over the next few days, a good view should be had between 1900 and 2000 GMT. Martin Mobberley of the British Astronomical Association has been following the progress of the comet. He said: "From a country site it can be seen as an extra star. The comet's gas tail is not hard to spot in binoculars... it stretches upwards from the comet into the evening twilight." Denis Buczynski told BBC News Online: "The comet's head is almost star-like with a hint of fuzziness around it from which flows a long tail which broadens and splits about a degree or so along its length." The view in binoculars or a telescope shows a wealth of detail along the length of the tail, with knots and kinks caused by the outflowing of gases and dust from the comet's head interacting with the solar wind. "The comet reaches its closest approach to the Sun in a few days' time, after which it will then appear in the north-western pre-dawn sky," Denis Buczynski said. "Although the comet will be receding from the Sun, it will come closer to the Earth on its outward bound journey and should still appear as bright as it is now." Martin Mobberley added: "This will probably be its best period. "It's the best Northern-Hemisphere comet since Comet Hale-Bopp in 1997, but will probably peak at less than a 10th the brightness of that monster and the superb 1996 comet Hyakutake."

74000

74001

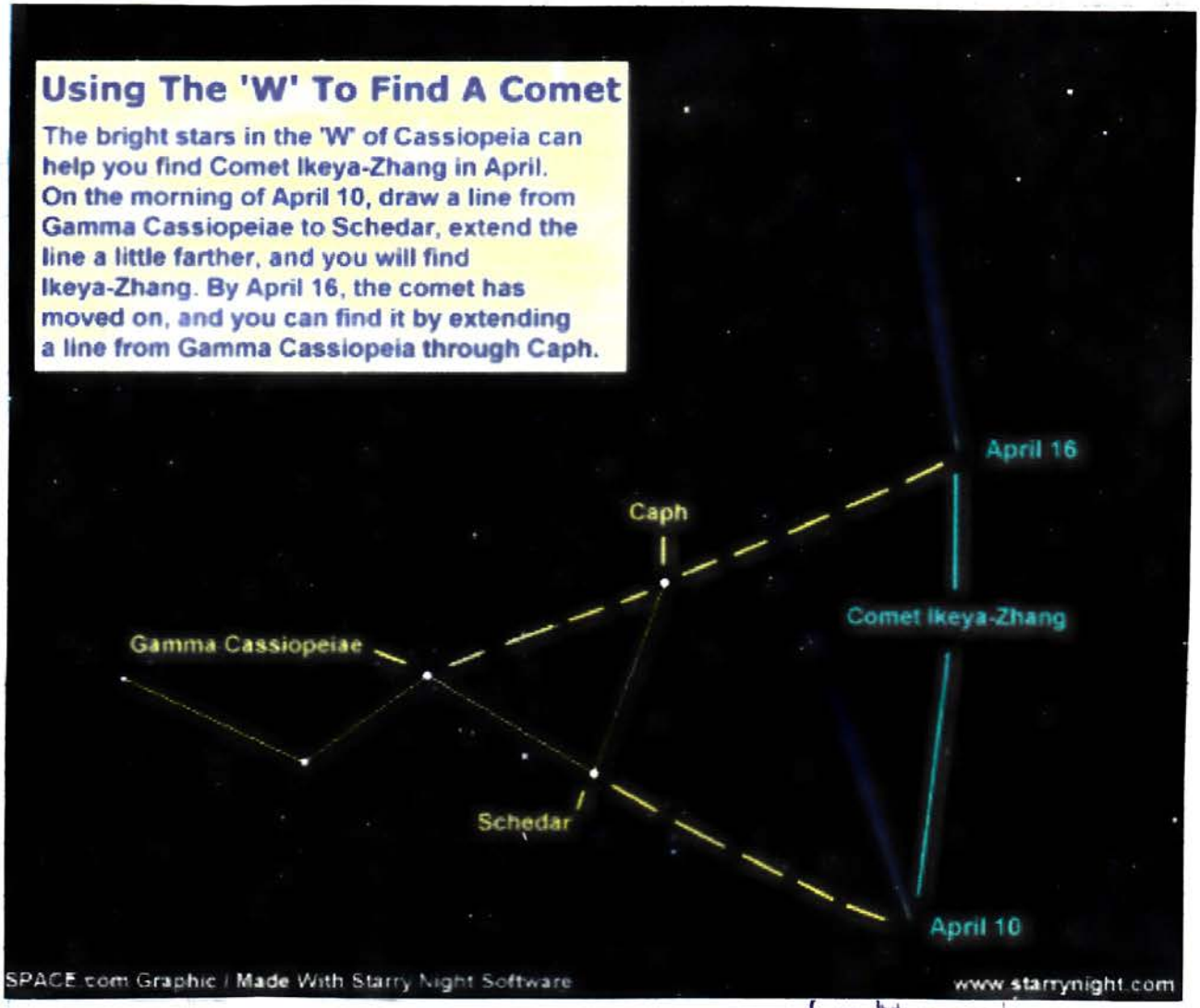
HARVARD-SMITHSONIAN CENTER NEWS RELEASE : 23 MAART 2002.

BRIGHT NEW COMET GRACES EVENING SKY.

74002

The brightest comet since 1997's Hale-Bopp is currently gracing the western skies of North America. Comet Ikeya-Zhang (pronounced "ee-KAY-uh JONG") was discovered on February 1st by two amateur astronomers in Japan and China, respectively. Calculations of the comet's orbit by Brian Marsden of the Harvard-Smithsonian Center for Astrophysics show that it was last seen in 1661. This makes Ikeya-Zhang the first long-period comet(a comet with a period longer than 200 years) to be identified on its return to the inner solar system. No telescope is necessary to look at this beautiful visitor as it swings around the Sun and heads back to deep space. The comet has brightened to naked-eye visibility, but is easiest to see through binoculars. A casual glance will show the bright, starlike nucleus surrounded by a fuzzy cloud of dust and gas called the coma. The comet's tail streaks away from the Sun, pointing nearly straight up from the horizon. To find Comet Ikeya-Zhang, look in the western sky shortly after sunset. A red point of light about 18 degrees up in the sky is the planet Mars. (An outspread hand at arm's length covers about 15 degrees, so Mars is a bit higher than one hand-span.) To the right of Mars are two bright stars in a nearly vertical line. The comet is at the same height as Mars, to the right of the two bright stars about as far again as the distance from Mars to the stars.

19934



74003

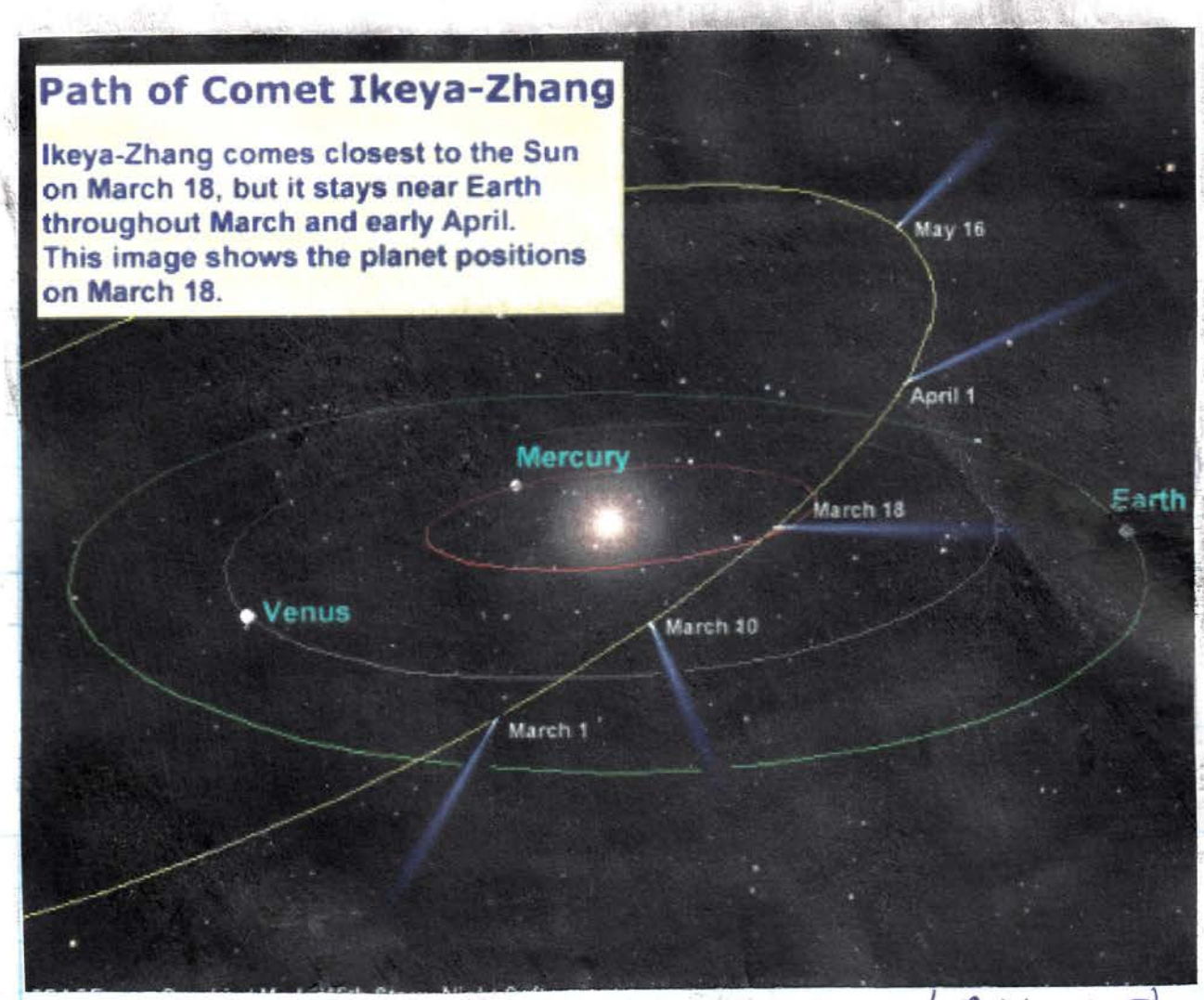
CNN : 29 MAART 2002.

BRIGHT NEW COMET HEADING OUR WAY.

74004

As Comet Ikeya-Zhang rounds the sun and approaches the Earth, astronomers wonder if the picturesque ice boulder will become even brighter. Spotted by amateur sky watchers in February, the comet can continue to be observed in the weeks ahead. Currently it appears low in the western sky just after sunset, near the planet Mars, which resembles a bright red star. In extremely dark and clear conditions, observers might be able to see Ikeya-Zhang with the naked eye. For the best view of the comet and its long tail, astronomers recommend being far from city lights and using strong binoculars. "They're good for sweeping around for the comet and actually give you a better view actually than a big telescope," said Steve Maran of the American Astronomical Society. Travelling in an eccentric orbit, Ikeya-Zhang made its closet approach to the sun on March 18. From our terrestrial perspective, the comet will skirt completely over the sun next week and reappear in the predawn sky. Heading outbound from the center of the solar system, it will make its closest swing by Earth on April 28. "At one time or another in the month of April, people most places on Earth where they have a dark sky should see the comet. But it's a lot easier for us up in the Northern Hemisphere because it will be moving progressively north (in the sky)," Maran said. Ikeya-Zhang could be the brightest comet since Hale-Bopp five years ago. To learn more about comets, Maran recommends that the curious join viewing parties through amateur astronomy clubs, science museums or planetariums. NASA is doing its part to learn more about the dirty ice travelers. An agency-sponsored mission called Stardust should rendezvous with comet Wild 2 in 2004 to retrieve particles from its tail. Scientists think comets contain frozen remnants of our early solar system and may have struck Earth in its infancy, seeding the oceans with water. Usually comets appear brightest when near the sun. But some eccentric ones keep brightening afterwards. It Ikeya-Zhang falls into the latter category, it could contine to brighten during April, according to Sky & Telescope. After its appearance on February 1, astronomers concluded within weeks that it is probably the same one that swept through the inner solar system in 1661. The comet was named for its modern co-discoverers, Daqing Zhang of China and Kaoru Ikeya of Japan. Ikeya has discovered or co-discovered five previous comets, according to Sky & Telescope.

19935



74005

74006

SPACE.COM : 05 APRIL 2002

COMET IKEYA-ZHANG THRILLS SKYWATCHERS.

74007

Ikeya-Zhang made its closest approach to the Sun, called perihelion, on March 18. In the days that followed, people who found the comet in the northwest evening sky saw a bright and bluish-white, starlike nucleus surrounded by a fuzzy cloud of dust and gas, called the coma.The comet's tail streaks away from the Sun, as always, pointing nearly straight up from the horizon now because of the comet's position in relation to the Sun as seen from Earth.In the 10 days after perihelion, Ikeya-Zhang shone almost consistently at magnitude 3.3, making it equal in brightness to Megrez, the star that joins the handle with the bowl of the Big Dipper. This is exactly midway between the predictions previously published on SPACE.com in February by comet experts Terry Lovejoy and John Bortle. Comets shine brightly because some of their gas and dust burns off when they are near the Sun. This halo of material reflects sunlight. Although Ikeya-Zhang is now moving away from the Sun, it is approaching Earth, so any fade-down is probably going to be slow to occur. On April 1, the comet was equally distant from the Sun and the Earth at 56 million miles. It will continue to draw nearer to Earth until April 29, when it will be 37.6 million miles away (60.5 million kilometers). Our latest "guesstimate" for Ikeya-Zhang's brightness in the coming weeks is for it to gradually dim to about fourth magnitude by mid-April and to around fifth magnitude by the beginning of May. Those blessed with very dark skies might be able to continue following the comet with just their unaided eyes until about the middle of May. Of course, the comet could dim much more rapidly. Or, conversely, a sudden unexpected flare-up could also occur. But these are extreme possibilities. So far, the comet has performed very well, and pretty much as expected, and it is likely to continue to delight Northern Hemisphere observers for a few more weeks. Again, the darker your observing site, the better view you'll get of the comet. Viewing during the second and third weeks of April will be aided by the fact that the Moon will be mostly out of the way. Ikeya-Zhang was discovered by Kaoru Ikeya of Japan and Daqing Zhang of China on Feb. 1, 2002. It is thought, however, to be the return of a comet first discovered in 1661.

19936

STERRENKIJKEN

DE AARDE OP DRIFT

'Eppur si muove' (en toch beweegt ze). Dat zou Galileo Galileï hebben gezegd toen hij in 1633 onder dwang van de katholieke kerk moest afzweren dat de aarde rond de zon draait. Maar ook de zon staat niet stil en sleurt haar planetenfamilie mee door de ruimte. Hoe beweegt de aarde eigenlijk ten opzichte van de rest van het heelal?

Galileï kreeg uiteindelijk het gelijk aan zijn kant: de aarde zit niet vast verankerd in het centrum van de kosmos. In één jaar tijd raast onze planeet met maar liefst dertig kilometer per seconde rond de zon. Dat wij van die duizelingwekkende snelheid niets merken was voor de kerk reden om de revolutionaire stellingen van Galileï als absurd van de hand te wijzen. Desondanks bleek later dat ook de zon niet erg honkvast is. Samen met haar gevolg van negen planeten vliegt onze ster met twintig kilometer per seconde in de richting van het sterrenbeeld Hercules. Hierbij gaat het om een vrij lokale beweging, gemeten ten opzichte van sterren in de buurt van de zon. Daarbovenop komt nog de draaiing van de zon rond het centrum van het Melkwegstelsel. Samen met tweehonderdmiljard van haar soortgenoten maakt zij deel uit van een kolossale schijf die als een kosmisch vuurwiel langzaam roteert. Het hele systeem meet een kleine honderdduizend lichtjaar in doorsnede. De zon bevindt zich in de buitenregionen van de Melkwegschijf en draait er met 220 kilometer per seconde om het middelpunt heen. Eén omloop duurt 245 miljoen jaar.

Ook ons Melkwegstelsel is geen rust gegund. Het bevindt zich namelijk in de greep van de Andromedanevel, een soortgelijke sterrenstelsel 2,2 miljoen lichtjaar ver weg. Beide sterrensystemen vertegenwoordigen een totale massa van vele miljarden zonnen, zodat ze door hun onderlinge aantrekkingskracht met ruim honderd kilometer per seconde naar elkaar toevallen. Over zes miljard jaar staan onze nazaten een spektakel te wachten. Dan komt het namelijk tot een botsing, waarbij de beide stelsels zullen samensmelten.

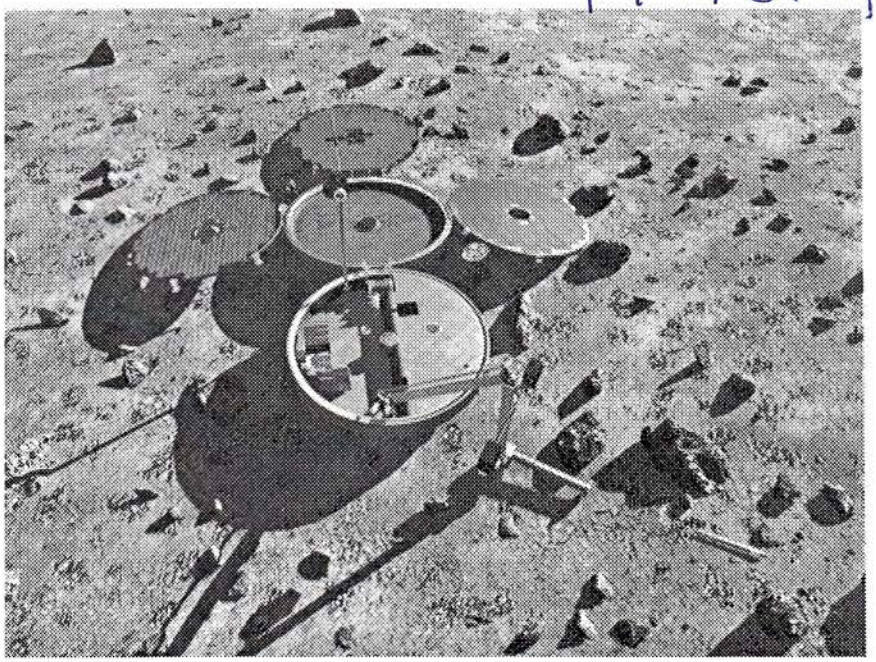
Het centrum van de Grote Aantrekker. *foto ESO*

Het Melkwegstelsel en de Andromedanevel vormen de belangrijkste leden van de Locale Groep, een conglomeraat van een dertigtal sterrenstelsels. Behalve de Locale Groep bevolken nog talloze andere groepen en clusters van sterrenstelsels het heelal. De dichtstbijzijnste grote cluster is de Virgocluster, op een afstand van vijfenvijftig miljoen lichtjaar. Voor ons onvoorstelbaar ver weg, maar op kosmische schaal is dat nog altijd vlak naast de deur. Daarom staan wij onder de invloed van de zwaartekracht van de Virgocluster, die de Locale Groep met ongeveer 250 kilometer per seconde naar zich toe trekt. Nog grotere clusters ver weg in het heelal doen ook hun invloed gelden. Zo beweegt alles binnen 150 miljoen lichtjaar van de Locale Groep in de richting van de sterrenbeelden Waterslang en Centaurus. Daar, driehonderd miljoen lichtjaar ver weg, bevindt zich de Grote Aantrekker, een verzameling clusters met een totale massa van een half miljoen melkwegstelsels. Sterrenstelsels uit de wijde omgeving, inclusief de Locale Groep en de Virgocluster, 'stromen' met vijfhonderd kilometer per seconde in de richting van de Grote Aantrekker.

Toch lijkt de Grote Aantrekker het topje van de ijsberg. Om te bepalen hoe de aarde werkelijk beweegt ten opzichte van de rest van het heelal, heb je een vast meetpunt nodig dat voor het hele universum geldt. Zo'n referentiepunt bestaat. Overal om ons heen nemen we een zwakke radioruis waar, het overblijfsel van straling die bij de geboorte van de kosmos uit de Oerknal vrijkwam. Deze kosmische achtergrondstraling is niet helemaal uniform. In de ene richting heeft ze een iets kortere golflengte dan aan de andere kant van de hemel. Uit dit verschil kunnen sterrenkundigen de beweging van de Locale Groep ten opzichte van het heelal als geheel bepalen. Als de politie met radargolven de snelheid van auto's meet, maakt zij van een soortgelijke methode gebruik. Samen met het Melkwegstelsel en de aarde blijkt de Locale Groep met 620 kilometer per seconde in de richting van het sterrenbeeld Waterslang te bewegen. Dat is dezelfde kant uit als de Grote Aantrekker, alleen ligt de snelheid een stuk hoger. Daarom vermoeden de sterrenkundigen dat er zich nog meer Grote Aantrekkers in het heelal schuilhouden die bepalen hoe wij door de kosmos reizen.

Beagle 2: Britten landen op Mars

Michel van Pelt



Beagle 2 na een geslaagde landing en klaar om te beginnen naar het zoeken van sporen van leven.

Als in juni 2003 de Mars Express van de Europese ruimtevaartorganisatie ESA vertrekt van de lanceerbasis in Kourou, gaat deze niet alleen op weg. Gekoppeld aan de Marssatelliet zal de kleine maar geavanceerde Beagle 2 lander meevliegen naar de rode planeet. Daar aangekomen zal het bijna geheel door Groot-Brittannië ontwikkelde ruimtevoertuig worden losgekoppeld om aan zijn eigen missie te beginnen: het uitvoeren van een zachte landing en het zoeken naar sporen van leven op Mars.

De laatste ruimtevoertuigen die op Mars naar leven zochten waren de twee Amerikaanse Viking landers in de jaren zeventig. Zij hadden een soort minilaboratorium aan boord om een beetje Marsgrond met behulp van allerlei chemische proefjes te onderzoeken. De resultaten van de experimenten konden helaas allemaal verklaard worden door middel van chemische reacties waarbij geen bacteriën of andere levensvormen nodig zijn. Er werd dus geen bewijs voor leven gevonden op de plaatsen waar deze landers terecht waren gekomen.
Beagle 2, genoemd naar het expeditieschip van de grondlegger van de evolutietheorie Charles Darwin, zal de eerste na de Vikings zijn die op zoek gaat naar simpele levensvormen op de rode planeet. Daarvoor zullen nieuwe en betere experimenten worden gebruikt dan bij de eerdere Amerikaanse missies.

Beagle 2 wordt de eerste Europese Marslander en de eerste niet uit Amerika of de voormalige Sovjet Unie afkomstige ruimtesonde, die op een andere planeet landt. Een andere bijzonderheid is dat de Beagle 2 missie niet geheel door ESA betaald wordt; het meeste geld komt van Britse wetenschappelijke instituten en sponsors. De organisatie van dit project is zo simpel mogelijk opgezet. Contracten tussen de diverse deelnemers aan het project zijn veelal gebaseerd op mondelinge afspraken. Dit draagt ertoe bij dat de kosten zo laag mogelijk blijven, maar maakt de kans op fouten groter dan bij andere ESA projecten, waar bij alles formeel wordt vastgelegd in bergen papier. ESA heeft daarom kortgeleden besloten haar rol in het project te vergroten om de risico's te verkleinen. Hierdoor werd Beagle 2 zo'n 7,3 miljoen euro duurder, maar tegelijkertijd maakte ESA ook bekend zelf 16 miljoen euro in het project te steken. Het totale budget dat nodig is, bedraagt nu 44 miljoen euro.

De Beagle lander bestaat uit een hamburgervormig voertuig van ongeveer 60 kg, dat door middel van een hitteschild, parachutes en grote luchtkussens een zachte landing zal uitvoeren (deze methode is vrijwel gelijk aan de manier waarop de beroemde Mars Pathfinder op de rode planeet werd neergezet.). Tijdens de zes maanden durende reis zit de Beagle ingepakt tussen het hitteschild en een afsluitschild aan de achterkant. Dit is niet alleen om de lander tijdens de vlucht door de ruimte te beschermen, maar ook om er voor te zorgen dat er tijdens de lanceervoorbereidingen op Aarde geen microben aan boord kunnen komen. Die zouden de onderzoeken op Mars kunnen verstoren, want als er micro-organismen worden gevonden wil men zeker zijn dat deze ook inderdaad van Mars komen en geen Aardse verstekelingen zijn. Voordat de capsule wordt ingepakt zal deze daarom helemaal goed gesteriliseerd worden.

De Beagle wordt draaiende van de Mars Express satelliet losgekoppeld, zodat de capsule stabiel in de Marsatmosfeer zal afdalen. De afkoppelfase is een gevaarlijk moment, want als dit niet goed wordt uitgevoerd kunnen zowel de Beagle 2 als de Mars Express zelf

verloren gaan. Als het geheel op Mars tot stilstand is gekomen, worden de drie luchtkussens van elkaar losgemaakt waarna ze elk de vorm van een bal aannemen en van elkaar wegstuiteren. De lander zelf valt daarbij ongeveer een halve meter naar het oppervlak. Vervolgens zal het zichzelf als een oester uitklappen zodat de instrumenten en vier zonnepanelen vrij komen. Ook als de Beagle ondersteboven landt zal door het slimme uitklapproces de goede kant vanzelf boven komen te liggen. Dan kan de Beagle beginnen met het onderzoek, waarvoor de volgende instrumenten worden meegenomen.

* De **GAP**, een instrument voor gasanalyse. Kleine bodemmonsters worden in de GAP elektrisch verhit, waarna de vrijgekomen gassen worden geanalyseerd door een massaspectrometer. Deze kan verschillende moleculen herkennen en een overzicht geven waaruit het gas bestaat. Sommige gassen, bijvoorbeeld methaan, kunnen een aanwijzing vormen voor het bestaan van leven in de Marsbodem. Methaan wordt door organismen geproduceerd en in de atmosfeer van Mars snel afgebroken. Wordt er dus methaan gevonden, dan is dat een aanwijzing dat er momenteel leven op Mars is. De verhouding tussen de hoeveelheid koolstof 12 en koolstof 13 isotopen is een indicatie voor vroeger leven op de rode planeet: op Aarde heeft leven een voorkeur voor het opnemen van koolstof 12 isotopen, waardoor sedimenten die zijn ontstaan uit organismen (zoals kalksteen) een hogere concentratie koolstof 12 hebben dan andere, niet organische bodemlagen. Het instrument wordt ontwikkeld door de Open University in Groot-Brittannië in samenwerking met het Duitse Max Planck instituut. De massaspectrometer zal ook worden gebruikt om de atmosfeer van Mars te onderzoeken.

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* De **Mole**, ofwel mol. Dit is een holle buis die door middel van een veermechanisme binnenin schoksgewijs over het oppervlak kan kruipen. Als de Mole een heuveltje of een steen tegenkomt, zal het apparaat in de bodem doordringen. De buis kan dan daar worden geopend om een beetje grond in de buis op te nemen, en vervolgens worden binnengehaald. Het bodemmonster, dat niet door de intense zonnestraling is aangetast, wordt daarna in de GAP onderzocht. Dit is een hele verbetering ten opzichte van de Viking missies, die alleen bodemmonsters van het oppervlak namen waar leven vrijwel onmogelijk is. Het apparaat wordt door de Duitse ruimtevaartorganisatie DLR ontwikkeld.
* De **Paw**, een soort robotarm die met een carrousel met verschillende instrumenten wordt uitgerust. De betekenis van 'Paw' is 'dierenpoot', een toepasselijke naam aangezien een Beagle een Engelse jachthond is.
De Paw wordt uitgerust met een borstel, een schepje, een panoramaspiegel, een boor en een stenenvermaler. Met deze instrumenten kunnen ook bodemmonsters worden genomen, waaronder stukjes geboorde rots. Ook het monster genomen door de Mole wordt door middel van de robotarm in het GAP minilaboratorium gedeponeerd. De arm wordt ontwikkeld door de Universiteit van Leicester.
* Een **Mossbauer spectrometer** , dat ook op de Paw wordt bevestigd. Dit door het Duitse Max Planck Instituut voor Chemie ontwikkelde instrument zal de oxidatiegraad, oftewel de 'verroesting' van het Marsoppervlak onderzoeken.
* Een **Röntgen spectrometer** van de universiteit van Leicester, die in staat zal zijn de samenstelling van rotsen te meten. Om door de geoxideerde buitenlaag heen te komen en het originele rotsmateriaal binnenin te bereiken zal de vermaler op de Paw de buitenlaag van de rotsen een stukje afschuren. Vervolgens kan de op de Paw bevestigde spectrometer de hoeveelheden aluminium, magnesium, ijzer etc in de rots meten. Dit is een verbetering in vergelijking met de röntgenspectrometer die op de Sojourner robotkarretje van NASA's Pathfinder was bevestigd. Deze kon alleen de verweerde buitenkant van de stenen onderzoeken.

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* Een aantal op de Paw bevestigde camera's, ontwikkeld door het Mullard wetenschapslaboratorium van de universiteit van Londen. Met twee camera's zullen stereoscopische panorama-opnamen van het landingsgebied en de operaties van de Paw worden gemaakt. Hierbij kan ook op de Paw bevestigde spiegel worden gebruikt. Een microscoop zal worden gebruikt om het schoongeschuurde oppervlak van stenen te bestuderen.
* Een serie sensoren, voor metingen van ultraviolet licht, waterstofperoxyde in de atmosfeer, straling, atmosferische druk, temperatuur, windrichting en -kracht, versnellingen en stof. De universiteit van Leicester en de Open University zullen deze sensoren leveren, die bij elkaar niet meer dan 180 gram mogen wegen.

De Beagle 2 is ontworpen om minstens 180 dagen te werken. De levensduur wordt voor al bepaald door het elektrisch vermogen dat beschikbaar is om de lander tijdens de koude Marsnacht warm te houden. Er zijn geen radioactieve verwarmingselementen aan boord, zoals bij NASA landers gebruikelijk is, maar gevoelige onderdelen zoals de lithium ionen batterij en de elektronica worden met isolerend materiaal omsloten. Sommige experimenten zullen 's nachts worden uitgevoerd zodat de warmte die ze veroorzaken kan worden gebruikt om de lander op temperatuur te houden.
De zonnepanelen zullen be-

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dekt raken met een laag stof, waardoor de hoeveelheid elektrische stroom zal afnemen. Om dit te voorkomen kan de borstel op de Paw worden gebruikt om de panelen schoon te vegen.
De communicatie zal verlopen via Mars Express of een van de nieuwe NASA satellieten om Mars; de antenne van de Beagle heeft niet genoeg vermogen om direct contact met de Aarde te kunnen maken.

Beagle 2 zal ergens rond de 19 graden noorderbreedte landen om maximaal te kunnen profiteren van het lange daglicht van de lente op het noordelijk Marshalfrond. Andere zaken waarnaar wordt gekeken bij de keuze van de landingsplaats zijn het risico voor een mislukte landing en de kans op het vinden van (vroeger) leven. Gebieden met teveel grote keien en ravijnen en die lijken op oude rivierbeddingen hebben dus de voorkeur. Ook mag de landingsplaats niet te hoog liggen omdat anders de parachutes niet genoeg luchtweerstand zullen ontwikkelen om voldoende af te remmen. Het Isidis gebied of in een van de interessante plaatsen die met de Mars Global Surveyor zijn ontdekt, zijn kandidaat voor de uiteindelijke plek waar de Beagle 2 onderzoek zal doen.

Met Mars Express en de Beagle 2 zal Europa vollop meespelen in het Marsonderzoek. Beide sondes hebben unieke instrumenten aan boord die informatie kunnen geven die geen van de NASA missies tot dusver hebben opgeleverd. De Beagle 2 missie is daarmee niet alleen belangrijk voor Groot Brittannië en Europa, maar voor de hele wereld. Misschien geeft de kleine lander ons eindelijk antwoord op de vraag of de Aarde de enige planeet is waar leven voorkomt, of dat organismen ook elders kunnen worden gevonden.

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JOHNS HOPKINS UNIVERSITY APPLIED
PHYSICS LABORATORY NEWS RELEASE : 30 MAART 2002.

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PROJECT CLEARED TO BUILD MERCURY ORBITER PROBE.

The first mission to orbit the planet Mercury took a big step toward its scheduled March 2004 launch when NASA's MESSENGER project received approval to start building its spacecraft and scientific instruments. MESSENGER - which stands for MErcury Surface, Space ENvironment, GEochemistry, and Ranging - passed a thorough four-day critical design review last week, during which a project advisory panel and NASA assessment team examined every detail of the mission and spacecraft design. "The review was very successful," says Max R. Peterson, MESSENGER project manager at the Johns Hopkins University Applied Physics Laboratory (APL), Laurel, Md. "Both panels confirmed that our designs are sound and meet the mission's science and engineering requirements. We're ready to move to the next stage." MESSENGER team members are building flight hardware now and will begin integrating parts on the spacecraft this November, Peterson says. After launch and a five-year journey through the inner solar system, MESSENGER will orbit Mercury for one Earth year, providing the first images of the entire planet and collecting information on the composition and structure of Mercury's crust, its geologic history, the nature of its thin atmosphere and active magnetosphere, and the makeup of its core and polar materials. While cruising to Mercury the spacecraft will fly past the planet twice - in 2007 and 2008 - snapping pictures and gathering data critical to planning the orbit study that begins in April 2009. A key MESSENGER design element deals with the intense heat at Mercury. The sun is up to 11 times brighter than we see on Earth and surface temperatures can reach 450 degrees Celsius (about 840 degrees Fahrenheit), but MESSENGER's instruments will operate at room temperature behind a sunshield made of heat-resistant Nextel fabric. The spacecraft will also pass only briefly over the hottest parts of the surface, limiting exposure to reflected heat. "The project is well on its way," says Dr. Sean C. Solomon, MESSENGER principal investigator from the Carnegie Institution of Washington (D.C). "Exploring the many mysteries of Mercury will help us to understand all of the terrestrial planets, including Earth. The team is eagerly looking forward to assembling and launching the spacecraft and to the first new data from the innermost planet." In July 1999, NASA selected MESSENGER as the seventh mission in its innovative Discovery Program of lower-cost, highly focused space science investigations. APL manages the $286 million project for NASA's Office of Space Science and will build and operate the MESSENGER spacecraft. The Applied Physics Laboratory, a division of The Johns Hopkins University, meets critical national challenges through the innovative application of science and technology.

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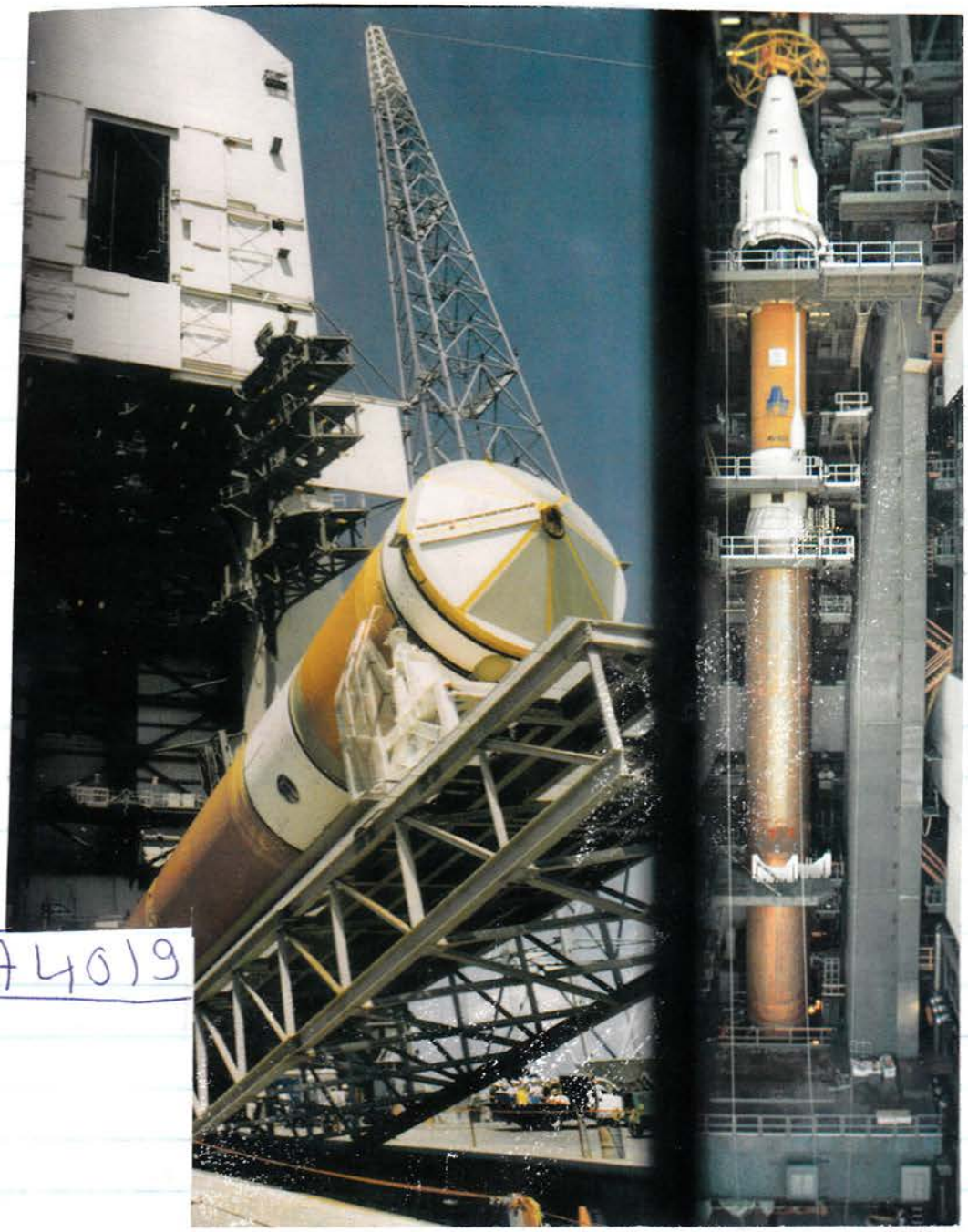

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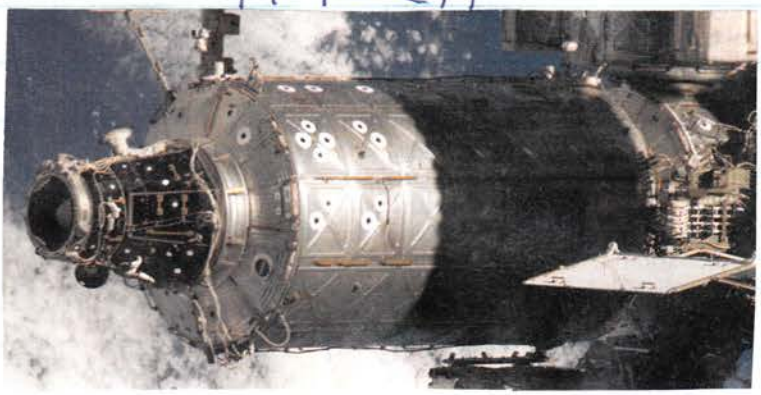

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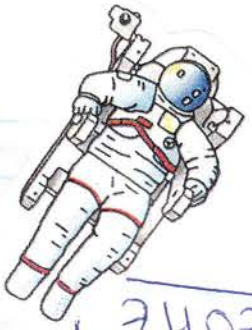

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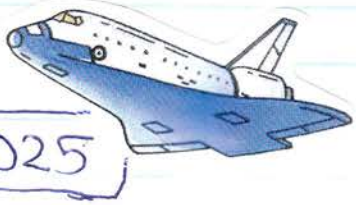

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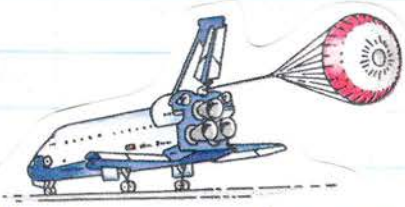

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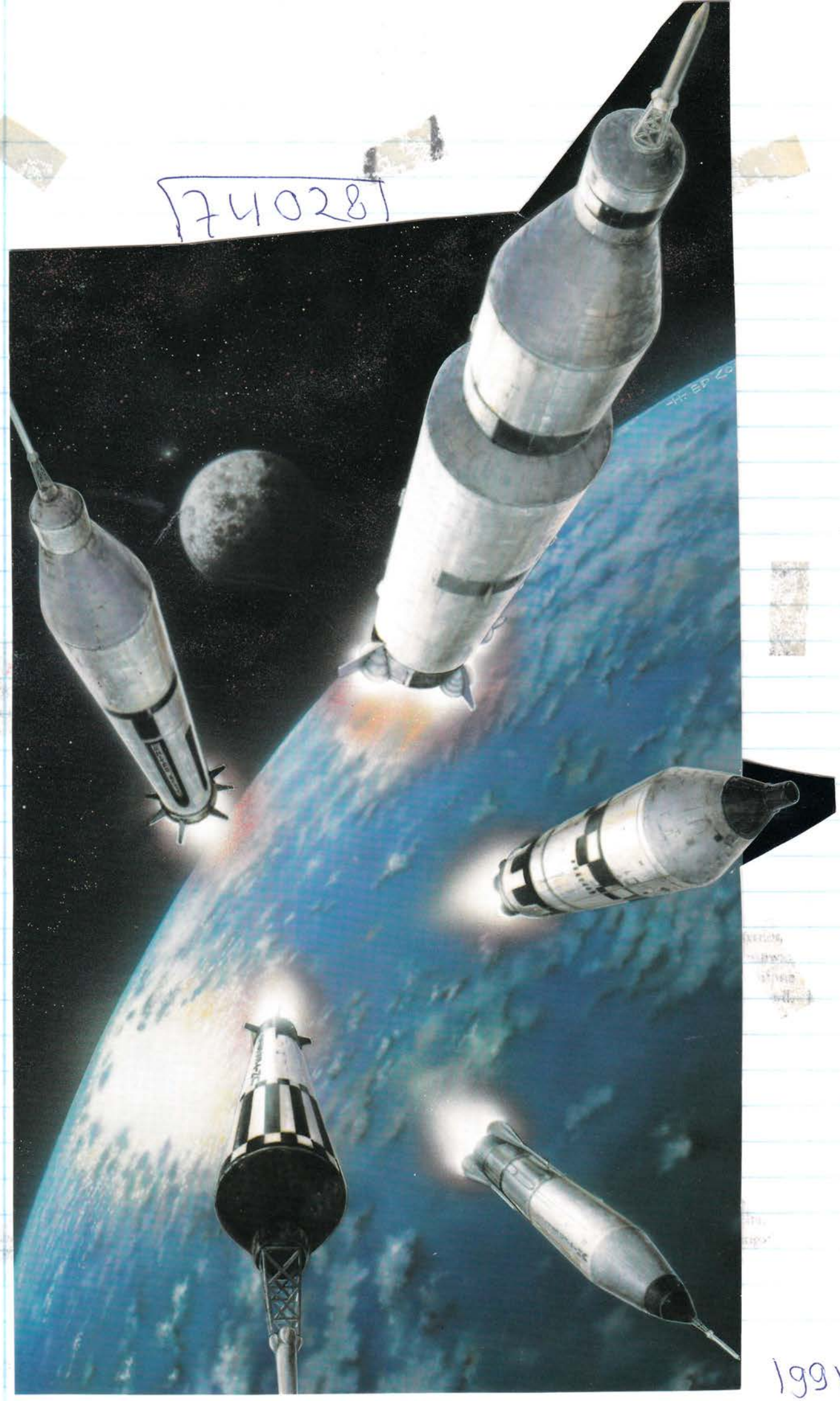

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