Hubble Facts

National Aeronautics and
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Hubble Space Telescope Servicing Mission 3B

Plans for the Future

The Hubble Space Telescope's purpose is to spend 20 years probing the farthest and faintest reaches of the cosmos. Crucial to fulfilling this objective is a series of on-orbit servicing missions. Hubble was placed in orbit on April 25, 1990 by the shuttle Discovery and subsequent servicing followed in December 1993 and February 1997. The third in the series of planned servicing missions for the Hubble Space Telescope was separated into two flights. The first of these flights, Servicing Mission 3A was successfully completed in 1999, and the second, Servicing Mission 3B, is scheduled for early 2002. The Fourth Servicing Mission is scheduled for 2004 with a "close-out Mission" in 2010.

As originally planned, Servicing Mission 3 called for astronauts to install six new gyros; the Advanced Camera for Surveys; an advanced, radiation-hardened computer; a Solid State Recorder; a Fine Guidance Sensor (FGS); a radio transmitter; new solar arrays; battery voltage/temperature improvement kits; and new cooling system hardware. In addition to these installations, astronauts will replace an aging Power Control Unit, a Reaction Wheel Assembly and time permitting, place protective coverings over existing damaged insulation.

Three instruments are currently in active scientific use on Hubble – the Wide Field and Planetary Camera 2, the Space Telescope Imaging Spectrograph, and Fine Guidance Sensor 2, which has been designated as the prime FGS for astrometric science. Other instrument bays are occupied by the Near Infrared Camera and Multi-Object Spectrometer (NICMOS), the Faint Object Camera, (which is obsolete and has been decommissioned,) and the corrective optical device called COSTAR, which is no longer needed.

Servicing Mission 3A

After three of Hubble's six gyroscopes failed, it became necessary to service Hubble as soon as possible. During Servicing Mission 3A, astronauts replaced all six gyroscopes, a fine guidance sensor and Hubble's main computer. Also installed were a new transmitter, and a solid state data recorder. Voltage/temperature improvement kits were attached to the batteries, and thermal coverings were applied to the exterior. If time permits during the next mission additional thermal coverings will be applied, completing this task.

Servicing Mission 3B

This servicing mission will focus on installing the Advanced Camera for Surveys, more powerful rigid solar arrays, a Reaction Wheel Assembly and the Power Control Unit. Astronauts also will install an experimental cooling system to reactivate NICMOS, which became dormant after its solid nitrogen coolant was exhausted in January 1999.

Advanced Camera for Surveys

During this mission, astronauts will remove the Faint Object Camera and install a new science instrument—the Advanced Camera for Surveys. It is estimated that the survey capability of the Telescope will be increased tenfold. Several other maintenance activities are planned for the crew to perform during five days of spacewalks.

Solar Array 3

Currently four large flexible solar array (SA) panels provide power to Hubble. During Servicing Mission 1, the original European Space Agency arrays (SA1) were replaced with a new upgraded set of solar arrays, called SA2. These arrays consist of silicon cells installed on a thin layer of Kapton blanket. The blanket is supported by a set of bi-stems that also are used to retract and deploy the solar panels. When the SA2 panels are removed they will have powered the Telescope for more than 8 years.

The newest arrays (SA3) are rigid arrays, which do not roll up and therefore are more robust. They also are smaller and more powerful, and will greatly reduce the effects of atmospheric drag on the spacecraft. SA3 has

several enhancements incorporating new technology: The panels were purchased off the production line of a commercial system of communications satellites (Iridium). The panel frames are built of Lithium Aluminum alloy tubes, in an "H"-shaped configuration. The "H" is closed at the hinged end and is braced with a single diagonal support member. The panel hinges are designed to allow the Solar Arrays to be folded for transport, and easily lock into place when fully deployed.

Power Control Unit (PCU)

As Hubble's power switching station, the PCU controls and distributes electricity from the solar arrays and batteries to other parts of the telescope. Replacing the original PCU, which has been on the job for 11 years, will require Hubble to be completely powered down for the first time since its launch in 1990. Hubble's new PCU allows astronomers to take full advantage of additional power generated by the new solar arrays.

Reaction Wheel Assembly

One of four reaction wheel assemblies (RWA), which is part of Hubble's pointing control system, will be replaced. Spin momentum in the reaction wheels moves the telescope into a commanded position and maintains it in this stable position.

NICMOS Cryocooler

The NICMOS Cryocooler, an experimental cooling system will be connected to NICMOS to reactivate this dormant instrument. This system, tested during the 1998 HOST Mission on STS-95, will provide mechanical cooling for the infrared detectors in the NICMOS instrument.

It is expected that the new cooling system will allow NICMOS to recover operations and continue to provide IR science for five more years.

Possible Reboost

Although the atmosphere is quite thin at satellite altitudes, it is not a perfect vacuum. Over time, all low Earth orbiting satellites feel the effects of atmospheric drag and lose altitude. If the altitude is not restored, the Telescope eventually will re-enter Earth's atmosphere.

Hubble has no on-board propulsion, so the only way to restore lost altitude is by the creative use of shuttle jets. If necessary, before the last EVA, Hubble will be reboosted to a higher altitude. This was done on both SM1 and SM2.

Servicing Mission 4

Plans for SM4 include two Science Instruments which are currently in development. COSTAR will be removed during this servicing mission to make room for the Cosmic Origins Spectrograph, and Wide Field Camera 3 will replace the Wide Field and Planetary Camera 2. Also, a refurbished Fine Guidance Sensor will be installed leaving Hubble in optimum condition.

Cosmic Origins Spectrograph

COSTAR will be removed and replaced with the Cosmic Origins Spectrograph (COS). COS is a spectrograph specifically designed to observe into the near and mid ultraviolet. The ultraviolet region is particularly interesting for observing high energy activities such as are found in new hot stars and Quasi Stellar Objects. It is also a good region for viewing the composition and character of the Interstellar Medium.

Wide Field Camera Three

Wide Field Camera Three (WFC3) will be the last main imaging camera. WFC3 will replace the current workhorse of Hubble, Wide Field and Planetary Camera 2. This upgrade will allow Hubble to maintain good imaging capabilities throughout the remainder of its mission. Everyone has seen the amazing pictures generated by the Wide Field and Planetary Cameras (1 and 2). WFPC2 was installed during the 1993 servicing mission and will be more than 10 years old when it is replaced by the WFC3.

Aft Shroud Cooling System

This new system is designed to carry heat away from scientific instruments in the Aft Shroud area of the Telescope assembly and to allow the instruments to operate better at lower temperatures. The cooling system allows multiple instruments to operate simultaneously, helping the science team maintain the program's high productivity

Fine Guidance Sensor

The Fine Guidance Sensors are systematically refurbished and upgraded. In "round-robin" fashion one FGS per servicing mission is being replaced. It is returned to the ground, disassembled and refurbished, and then taken back to Hubble on the next servicing mission to become the replacement unit for the next FGS to be serviced. By the conclusion of SM4 all three FGS's will have been brought up to optimum condition in this manner.

Closeout Mission

NASA will determine the best approach to secure the Telescope, upon the completion of Hubble's 20-year mission. Currently there are several options being considered.

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