**Theme:** Astronomical Search for Origins

Hubble Watches Light from Mysterious Erupting Star Reverberate Through Space - In January 2002, a dull star in an obscure constellation suddenly became 600,000 times more luminous than our Sun, temporarily making it the brightest star in our Milky Way galaxy. The mysterious star, called V838 Monocerotis, has long since faded back into obscurity. But observations by NASA's Hubble Space Telescope of a phenomenon called a "light echo" around the star have uncovered remarkable new features. These details promise to provide astronomers with at CAT-scan-like probe of the three-dimensional structure of shells and dust surrounding an aging star.

# Astronomical Search for Origins

## MAJOR EVENTS IN FY 2005

- The Spitzer Space Telescope (formerly SIRTF - the Space Infrared Telescope Facility) will begin its second cycle of science proposals.
- The Stratospheric Observatory for Infrared Astronomy (SOFIA) will be delivered for final science testing.
- James Webb Space Telescope (JWST) will undergo its System Definition Review.

## **Theme:** Astronomical Search for Origins

### OVERVIEW

Where did we come from? Are we alone? Astronomers search for answers by looking both far away -- towards the beginning of time -- to see galaxies forming, and close to home, searching for planetary systems like our own around nearby stars. NASA's Astronomical Search for Origins (ASO) is a series of closely linked missions that build on prior accomplishments in the quest for answers to these questions and thus directly support the President's new vision to explore the solar system as well as worlds beyond. As each mission makes radical advances in technology, innovations are fed forward, from one generation of missions to the next. In FY 2005, we will operate ongoing missions such as the Hubble Space Telescope (HST) and the Spitzer Space Telescope (SST, formerly SIRTF), and continue development of first and second generation follow-on missions, including the James Webb Space Telescope (JWST), Space Interferometry Mission (SIM), and Terrestrial Planet Finder (TPF).

| Mission | Goals supported by this Theme | Objectives supporting these Goals |
|---|---|---|
| To Explore the Universe and Search for Life | 5. Explore the solar system and the universe beyond, understand the origin and evolution of life, and search for evidence of life elsewhere. | 5.8 Learn how galaxies, stars, and planetary systems form and evolve. |
| | | 5.9 Understand the diversity of worlds beyond our solar system and search for those that might harbor life. |

### RELEVANCE

Knowing where we come from requires understanding how the universe began and how its subsequent evolution culminated in everything we are and observe today. Understanding whether we are alone in the cosmos depends upon our search for life-sustaining planets or moons, and our understanding of the diversity of life here on Earth. ASO programs are aimed at developing the technologies, building the instruments that make the observations, and doing the science that will bring us the answers to our questions.

| Education and Public Benefits |
|---|
| Over the last decade, few scientific endeavors have provided the world with more spectacular images or yielded more fascinating results than ASO's flagship: the Hubble Space Telescope (HST). As more sophisticated instruments have been added through the years, we have witnessed the birth of stars, begun to unravel the mysteries of black holes, and looked billions of years into our past. This flood of knowledge -- and questions -- has spread throughout the globe via front page press, television, websites, and school curricula at all levels. ASO will continue to make significant contributions toward meeting national goals for the reform of science, math and technology education and the general elevation of scientific and technological literacy throughout the country. |

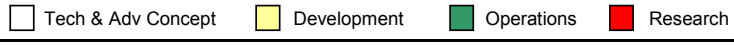
### IMPLEMENTATION

The Astronomical Search for Origins theme is composed of many elements that work together to achieve the program's goals and objectives. Repeated management and scientific peer reviews ensure that each mission provides data in a cost-effective manner. In many cases, the data obtained from different missions are complementary and are combined in cross-disciplinary studies by members of the scientific community. Theme responsibility resides in the Office of Space Science at NASA HQ. Enterprise official is Dr. Edward Weiler, Associate Administrator for Space Science. Theme director and point of contact is Dr. Anne Kinney, Director of the Astronomy and Physics Division at NASA HQ. This theme is in full compliance with NPG 7120.5B.

## **Theme:** Astronomical Search for Origins

### IMPLEMENTATION SCHEDULE

| Theme Element | Schedule by Fiscal Year 02 03 04 05 06 07 08 09 | Purpose |
|---|---|---|
| Spitzer Space Telescope (SST) | | Study the formation of stars, galaxies, and planets via spectroscopy, high-sensitivity photometry and imaging. |
| Hubble Space Telescope (HST) | | Provide a serviceable, state-of-the-art, orbiting observatory to study the history of the Universe. |
| Far Ultraviolet Spectroscopic Explorer (FUSE) | | Study physical processes governing the evolution of galaxies as well as the origin and evolution of stars and planetary systems. |
| Kepler | | Explore the structure and diversity of planetary systems, with a special emphasis on detecting Earth-size planets in the habitable zone around other stars. |
| Stratospheric Observatory for Infrared Astronomy (SOFIA) | | Study the properties of interstellar space as well as planet and star formation. |
| Keck Interferometer | | Characterize exo-zodiacal dust to support TPF design; direct detection of "hot Jupiters" and brown dwarfs; astronomic detection of planets. |
| Space Interferometry Mission (SIM) | | Detect planets outside the solar system by observing thousands of stars; serve as technological pathfinder for TPF. |
| James Webb Space Telescope (JWST) | | Provide the next generation space telescope to observe the first stars and galaxies; determine the shape and fate of the Universe. |
| Terrestrial Planet Finder (TPF) | | Find/characterize Earth-like planets around nearby stars. |




No exceptions to NPG 7120.5B have been taken.

### STATUS

- Both SIM and JWST successfully completed Confirmation Reviews to enter Phase B development.
- SOFIA telescope assembly was installed in the 747 aircraft.
- SIRTF (renamed the Spitzer Space Telescope), last of the Great Observatories, was launched in August 2003.
- HST discovered a 13-billion–year-old planet, the oldest known in the Milky Way.
- Keck Interferometer achieved its first scientific result: detection of a young star surrounded by dust in which planets may be forming.

For more detailed status information: http://origins.jpl.nasa.gov/.

### PERFORMANCE MEASURES

| Outcomes/Annual Performance Goals (APGs) | |
|---|---|
| *Outcome 5.8.1* | *Learn how the cosmic web of matter organized into the first stars and galaxies and how these evolved into the stars and galaxies we see today.* |
| 5ASO4 | Demonstrate James Webb Space Telescope (JWST) primary mirror technology readiness by testing a prototype in a flight-like environment. |
| 5ASO5 | Successfully demonstrate progress in learning how the cosmic web of matter organized into the first stars and galaxies and how these evolved into the stars and galaxies we see today. Progress towards achieving outcomes will be validated by external review. |
| *Outcome 5.8.2* | *Understand how different galactic ecosystems of stars and gas formed and which ones might support the existence of planets and life.* |
| 5ASO6 | Successfully demonstrate progress in understanding how different galactic ecosystems of stars and gas formed and which ones might support the existence of planets and life. Progress towards achieving outcomes will be validated by external review. |
| *Outcome 5.8.3* | *Learn how gas and dust become stars and planets.* |
| 5ASO7 | Successfully demonstrate progress in learning how gas and dust become stars and planets. Progress towards achieving outcomes will be validated by external review. |
| *Outcome 5.8.4* | *Observe planetary systems around other stars and compare their architectures and evolution with our own.* |
| 5ASO3 | Demonstrate system-level instrument pointing precision consistent with SIM's flight system basic performance requirements, as specified in program plan. |
| 5ASO8 | Successfully demonstrate progress in observing planetary systems around other stars and comparing their architectures and evolution |

## **Theme:** Astronomical Search for Origins

| **Outcomes/Annual Performance Goals (APGs)** | |
|---|---|
| | with our own. Progress towards achieving outcomes will be validated by external review. |
| *Outcome 5.9.1* | *Characterize the giant planets orbiting other stars.* |
| 5ASO9 | Successfully demonstrate progress in characterizing the giant planets orbiting other stars. Progress towards achieving outcomes will be validated by external review. |
| *Outcome 5.9.2* | *Find out how common Earth-like planets are and see if any might be habitable.* |
| 5ASO2 | Successfully complete the Kepler mission Preliminary Design Review (PDR). |
| 5ASO10 | Successfully demonstrate progress in finding out how common Earth-like planets are and seeing if any might be habitable. Progress towards achieving outcomes will be validated by external review. |
| *Outcome 5.9.3* | *Trace the chemical pathways by which simple molecules and dust evolve into the organic molecules important for life.* |
| 5ASO1 | Deliver the SOFIA Airborne Observatory to Ames Research Center for final testing. |
| 5ASO11 | Successfully demonstrate progress in tracing the chemical pathways by which simple molecules and dust evolve into the organic molecules important for life. Progress towards achieving outcomes will be validated by external review. |
| *Outcome 5.9.4* | *Develop the tools and techniques to search for life on planets beyond our solar system.* |
| 5ASO12 | Successfully demonstrate progress in developing the tools and techniques to search for life on planets beyond our solar system. Progress towards achieving outcomes will be validated by external review. |
| **Uniform Measures** | |
| 5ASO13 | Complete all development projects within 110% of the cost and schedule baseline. |
| 5ASO14 | Deliver at least 90% of scheduled operating hours for all operations and research facilities. |
| 5ASO15 | At least 80%, by budget, of research projects will be peer-reviewed and competitively awarded. |

### INDEPENDENT REVIEWS

| Review Types | Performer | Last Review Date | Next Review Date | Purpose |
|---|---|---|---|---|
| Subcommittee | ASO Subcommittee | 10/03 | 2/04 | Review science strategy, program implementation Strategy. |
| Nat'l Acad. of Sciences Advisory Council | Space Studies Board | 7/00 | 7/10 | Decadal Survey for Astronomy and Physics. |
| Federal Advisory Committee | NAC | 12/03 | 3/04 | Review science/program implementation strategies. |
| Federal Advisory Committee | SSAC | 11/03 | 3/04 | Review science/program implementation strategies. |

### BUDGET

| Budget Authority ($ millions) | FY 2003 | FY 2004 | Change | FY 2005 | Comments |
|---|---|---|---|---|---|
| **Astronomical Search for Origins** | **685.3** | **898.8** | **+168.0** | **1,066.8** | |
| Development | 358.6 | 245.0 | -88.1 | 156.9 | |
| Hubble Space Telescope | 140.7 | 139.8 | -110.1 | 29.7 | |
| SOFIA | 46.6 | 54.4 | -54.4 | | |
| Spitzer Space Telescope | 148.3 | | | | |
| Kepler | 23.0 | 50.8 | +76.4 | 127.2 | |
| Operations | 7.2 | 24.4 | +32.2 | 56.6 | |
| Research | 119.1 | 197.8 | +34.5 | 232.3 | |
| Technology and Advanced Concepts | 200.5 | 431.6 | +189.4 | 621.0 | |
| James Webb Space Telescope | 95.7 | 253.1 | +65.0 | 318.1 | |
| Technology and Advanced Concepts | 104.8 | 178.5 | +124.4 | 302.9 | |

Indicates changes since the previous year's President's Budget Submit

Indicates budget numbers in full cost.

**Theme:** Astronomical Search for Origins
**Development:** Hubble Space Telescope

## PURPOSE

| Objectives | Performance Measures |
|---|---|
| 5.8 | 5ASO5-7,13 |

Since 1990, the Hubble Space Telescope (HST) has used its pointing precision, powerful optics and state-of-the-art instruments to explore the visible, ultraviolet and near-infrared regions of the electromagnetic spectrum. Hubble will continue to investigate the formation, structure and evolution of stars and galaxies, studying the history of the universe, and providing a space-based research facility for optical astronomy. HST has already rewritten the textbooks of astronomy, and is expected to do so until decommissioned.

## OVERVIEW

Extending HST's operational life has required instrument upgrades to keep the observatory at the forefront of astronomical research throughout its mission. During Servicing Mission 3B in March 2002, astronauts installed the Advanced Camera for Surveys (ACS) and a cryo-cooler that brought the Near Infrared Camera and Multi-Object Spectrometer (NICMOS) back to life. These instruments should enable HST to continue to provide high quality astronomical data for several more years, after which the observatory will be decommissioned pending its controlled reentry into Earth's atmosphere using an automated spacecraft. The previously planned Servicing Mission SM4 has been cancelled due to safety considerations related to flying the Space Shuttle to a different orbit from that of the International Space Station (which could provide a safe haven in an emergency). Hubble development funding will now go to support the development of a robotic spacecraft that will be launched on an expendable launch vehicle, rendezvous with the observatory, and deorbit the Hubble Space Telescope safely after the end of its useful science life. In addition, modification and upkeep of ground operations systems continue.

Link to the Hubble Homepage for more information. http://hubble.gsfc.nasa.gov/index.html.

## PROGRAM MANAGEMENT

GSFC is responsible for HST project management, including mission and science operations. The HST program is governed by the GSFC Program Management Council. The Agency Program Management Council has oversight responsibility for the program. Enterprise Official is Dr. Edward Weiler, Associate Administrator for Space Science at NASA HQ. Theme Director and point of contact is Dr. Anne Kinney, Director of Astronomy and Physics at NASA HQ. This program is in full compliance with NPG-7120.5B.

## TECHNICAL COMMITMENT

| Technical Specifications | FY 2005 President's Budget | Change from Baseline |
|---|---|---|
| Mission Life | 15+ years | -- |
| Science Instruments | up to 5 | -- |
| Stellar Energy within 0.1 arcsec | 70% | -- |
| Image Jitter | < .012 arcsec RMS/24 hr | -- |
| Pointing Error | < .03 arcsec | -- |

| Schedule | FY 2005 President's Budget | Change from Baseline |
|---|---|---|
| Retrieval Mission | CY10 | -- |

## ACQUISITION STRATEGY AND PERFORMING ORGANIZATIONS

Changes since FY 2004 President's Budget: SM4 has been cancelled; deorbit mission to be carried out by an automated spacecraft. The HST program will require the acquisition of this module to deorbit the observatory safely at the end of its useful science life. The acquisition strategy and performing organizations are TBD. These changes will be reflected in NASA's Initial FY04 Operating Plan.

| Current Acquisition | Actual* | Selection Method | Actual* | Performer | Actual* |
|---|---|---|---|---|---|
| Cooperative Agreement | 0% | Full & Open Competition | 55% | Industry | 67% |
| Cost Reimbursable | 93% | Sole Source | 45% | Government | 1% |
| Fixed Price | 5% | | 100% | NASA Intramural | 0% |
| Grants | 1% | | | University | 2% |
| Other | 1% | Sci Peer Review | 100% | Non Profit | 30% |
| * as of FY03 direct procurement | 100% | * as of FY03 direct procurement | | * as of FY03 direct procurement | 100% |

**Theme:** Astronomical Search for Origins
**Development:** Hubble Space Telescope

| Future Acquisition - Major | Selection | Goals |
|---|---|---|
| Automated spacecraft for HST deorbit. | TBD | TBD |

## AGREEMENTS

Internal: 1. OSF Form 1628 between the Office of Space Flight (OSF) and the Office of Space Science (OSS) to provide launch services to conduct servicing missions, signed May 4, 1990. 2. OSF/Space Communications -- agreement between OSF and OSS to provide HST ground systems development, maintenance, and flight-related telecommunications services. Revision 7, September 21, 1990. External: NASA-ESA Memorandum of Understanding, dated October 7, 1977, and including Riders 1, 1A, 1B, and 2. Changes since FY 2004 President's Budget: None.

## RISK MITIGATION

| Top Risks | Y | Overall | Y | Cost | Y | Schedule | Y | Probability | Impact | Mitigation Plan |
|---|---|---|---|---|---|---|---|---|---|---|
| Propulsion Module Development | | | | | | | | Medium | High | Under development |

## INDEPENDENT REVIEWS

| Review Types | Performer | Last Review Date | Next Review Date | Purpose |
|---|---|---|---|---|
| Independent Implementation | IPAO/IRT | 8/02 | 12/03 | To ensure compliance with PCA-defined technical, cost and schedule thresholds. |
| Independent Science Review | HST-JWST Transition Panel | 8/03 | 8/03 | Review agency plans and to receive community input on the HST - JWST transition. |

## BUDGET/LIFE CYCLE COST

| Budget Authority ($ millions) | Prior | FY03 | FY04 | FY05 | FY06 | FY07 | FY08 | FY09 | BTC | Total | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| FY2005 PRESBUD | | 228.6 | 241.6 | 130.1 | 122.8 | 199.2 | 290.3 | 130.5 | 128.4 | | |
| Development | | 140.7 | 139.8 | 29.7 | 23.7 | 98.7 | 189.7 | 31.6 | 128.4 | | |
| Operations | | 4.8 | 8.7 | 6.9 | 7.1 | 7.3 | 8.0 | 8.1 | | | |
| Data Analysis | | 83.1 | 93.1 | 93.5 | 92.0 | 93.2 | 92.6 | 90.8 | | | |
| Changes since 2004 PRESBUD | | +0.4 | +2.7 | -12.4 | -25.1 | +30.7 | +71.2 | +130.5 | -324.2 | | |
| Development | | +1.8 | +3.4 | -13.3 | -20.0 | +35.9 | +79.7 | +31.6 | -47.5 | | SM4 cancelled; plan for robotic deorbit mission |
| Operations | | -0.3 | -0.1 | -0.1 | -0.2 | -0.3 | -0.1 | +8.1 | -16.8 | | |
| Data Analysis | | -1.1 | -0.6 | +1.0 | -4.8 | -4.9 | -8.3 | +90.8 | -259.9 | | Programmatic reduction |
| FY2004 PRESBUD | | 228.2 | 238.9 | 142.5 | 147.9 | 168.5 | 219.1 | | 452.6 | | |
| Development | | 138.9 | 136.4 | 43.0 | 43.7 | 62.8 | 110.0 | | 175.9 | | |
| Operations | | 5.1 | 8.8 | 7.0 | 7.3 | 7.6 | 8.1 | | 16.8 | | |
| Data Analysis | | 84.2 | 93.7 | 92.5 | 96.8 | 98.1 | 100.9 | | 259.9 | | |

Indicates changes since the previous year's President's Budget Submit
Indicates budget numbers in full cost.

**Theme:** Astronomical Search for Origins
**Development:** SOFIA

## PURPOSE

| Objectives | Performance Measures |
|---|---|
| 5.8, 5.9 | 5ASO7,11,13 |

The SOFIA program extends the range of astrophysical observations significantly beyond that of previous infrared airborne observatories through increases in sensitivity and angular resolution. SOFIA will be used to study many different kinds of astronomical objects and phenomena, including: star birth and death; solar system formation; complex molecules in space; planets, comets, and asteroids in our solar system; nebulae and dust in galaxies; and black holes at the centers of galaxies.

## OVERVIEW

SOFIA is an astronomical observatory consisting of a 2.5 meter aperture telescope permanently installed in a specially modified Boeing 747 aircraft. The aircraft, with its open-port telescope provided through a partnership with the German Aerospace Center (DLR), will provide routine access to nearly all of the visual, infrared, far-infrared, and submillimeter parts of the spectrum. It will operate from Moffett Federal Airfield in Northern California as well as from deployment sites in the Southern Hemisphere and elsewhere, as dictated by its astronomical targets. SOFIA will serve as a training ground for the next generations of instrument builders well into the 21st century, while producing new instrumentation important to NASA's future space observatories. SOFIA will have an active Education & Public Outreach Program, which will include flying educators along with astronomers.

Go to the SOFIA Homepage for more information: http://sofia.arc.nasa.gov/

## PROGRAM MANAGEMENT

SOFIA is a single-project program with program responsibility delegated to the Ames Research Center. The Space Science Enterprise Program Management Council (PMC) has SOFIA governing responsibility. Enterprise Official is Dr. Edward Weiler, Associate Administrator for Space Science at NASA HQ. Theme Director and point of contact is Dr. Anne Kinney, Director of Astronomy and Physics at NASA HQ. This program is in full compliance with NPG7120.5B.

## TECHNICAL COMMITMENT

The baseline for this technical commitment was made in 9/2000 and is detailed in the SOFIA PCA.

| Technical Specifications | FY 2005 President's Budget | Change from Baseline |
|---|---|---|
| Effective aperture of telescope: | 2.5 meters | -- |
| Telescope wavelength range: | 0.3 to 1,600 microns | -- |
| Optical image quality: | 80 % of visible wavelength encircled energy, from a point source within a 1.5 arcsecond diameter at the focal plane. | -- |
| Image stability of telescope: | 1.1 arcsec root mean square (rms) at first science flight. 0.2 arcsec rms three years after first science flight. | -- |
| Operational capability: | Operate in observing configuration for 6 hours or more at altitudes of at least 41,000 feet. Provide 960 research hours per year beginning in the third year of operation. | -- |
| Science Instruments: | 8 science instruments at beginning of operations, 15 after 5 years, up to 40 investigation teams per year. | -- |

| Schedule | FY 2005 President's Budget | Change from Baseline |
|---|---|---|
| Start of Formulation | Oct-91 | -- |
| Start of Implementation | Mar-96 | -- |
| Telescope Delivery for Installation | Sep-02 | +10 mos |
| Operations Readiness Review | Mar-05 | +28 mos |
| First Science Flight | Apr-05 | +29 mos |
| Data Proprietary Period | 1 year after receipt by investigators | -- |
| Observatory Operational Lifetime | 20 years | -- |

**Theme:** Astronomical Search for Origins
**Development:** SOFIA

## ACQUISITION STRATEGY AND PERFORMING ORGANIZATIONS

Major acquisitions for SOFIA are: science investigations; aircraft systems and Operations Center development; MOU with the German Aerospace Center (DLR) for Telescope Assembly; and science operations (5 years with 5 year option). Seven instruments were selected for development in September 1997. Calls for proposal (CFPs) to be issued: science instrument development as needed; annually for observing time. Universities Space Research Association (USRA) selected in 1996 as prime contractor for the aircraft, operations center, and first 5 years of operations, with L3 Systems as the key subcontractor. Changes since FY 2004 President's Budget: United Airlines has dropped out of the partnership.

| Current Acquisition | Actual* | Selection Method | Actual* | Performer | Actual* |
|---|---|---|---|---|---|
| Cooperative Agreement | 0% | Full & Open Competition | 100% | Industry | 75% |
| Cost Reimbursable | 83% | Sole Source | 0% | Government | 0% |
| Fixed Price | 0% | | 100% | NASA Intramural | 9% |
| Grants | 0% | | | University | 11% |
| Other | 17% | Sci Peer Review | 100% | Non Profit | 5% |
| * as of FY03 direct procurement | 100% | * as of FY03 direct procurement | | * as of FY03 direct procurement | 100% |

| Future Acquisition - Major | Selection | Goals |
|---|---|---|
| None - all major acquisitions are in place. | | |

## AGREEMENTS

Internal: The program is not dependent on other NASA activities outside of the control of the Associate Administrator for Space Science. External: Provision of the Telescope Assembly and support for observatory operations from the German Aerospace Center (DLR), according to NASA/DARA Memorandum of Understanding, signed December 1996. (Note: DARA was subsequently absorbed into DLR.) Changes since FY 2004 President's Budget: None.

## INDEPENDENT REVIEWS

| Review Types | Performer | Last Review Date | Next Review Date | Purpose |
|---|---|---|---|---|
| Independent Annual Review | IRT | 6/02 | 11/03 | Assure compliance with PCA defined technical, cost and schedule parameters. |

**Theme:** Astronomical Search for Origins
**Development:** SOFIA

## BUDGET/LIFE CYCLE COST

| Budget Authority ($millions) | Prior | FY03 | FY04 | FY05 | FY06 | FY07 | FY08 | FY09 | BTC | Total | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| FY2005 PRESBUD | 271.4 | 46.6 | 54.4 | 52.5 | 48.2 | 56.8 | 58.8 | 59.8 | | 648.5 | |
| Development | 271.4 | 46.6 | 54.4 | | | | | | | 372.4 | |
| Operations | | | | 33.4 | 28.3 | 37.7 | 39.1 | 40.1 | | 178.6 | |
| Data Analysis | | | | 19.1 | 19.9 | 19.1 | 19.7 | 19.7 | | 97.5 | |
| Changes since 2004 PRESBUD | | -0.3 | -0.3 | +1.3 | -7.1 | -0.6 | -0.9 | +59.8 | | +51.9 | |
| Development | | -0.3 | -0.3 | | | | | | | -0.6 | Reserves moved from Ops. |
| Operations | | | | +0.5 | -7.8 | +0.2 | -0.1 | +40.1 | | +33.0 | Added FY 09 |
| Data Analysis | | | | +0.7 | +0.7 | -0.7 | -0.8 | +19.7 | | +19.6 | Added FY 09 |
| FY2004 PRESBUD | 271.4 | 46.9 | 54.7 | 51.2 | 55.3 | 57.4 | 59.7 | | | 596.6 | |
| Development | 271.4 | 46.9 | 54.7 | | | | | | | 373.0 | |
| Operations | | | | 32.9 | 36.1 | 37.5 | 39.2 | | | 145.6 | |
| Data Analysis | | | | 18.4 | 19.2 | 19.8 | 20.5 | | | 77.9 | |
| Initial Baseline | 271.4 | 38.0 | 38.9 | 40.1 | 41.3 | | | | | 429.7 | |
| Development | 234.8 | | | | | | | | | 234.8 | |
| Operations | 36.6 | 38.0 | 38.9 | 40.1 | 41.3 | | | | | 194.9 | |

Indicates changes since the previous year's President's Budget Submit
Indicates budget numbers in full cost.

**Theme:** Astronomical Search for Origins
**Development:** Kepler

## PURPOSE

| Objectives | Performance Measures |
|---|---|
| 5.9 | 5ASO2,10,13 |

The scientific goal of the Kepler mission is to explore the structure and diversity of planetary systems, with a special emphasis on detecting Earth-size planets in the habitable zones around other stars. The Kepler mission's specific objectives include: (1) determine the frequency of terrestrial and larger planets in or near the habitable zones of a wide variety of spectral types of stars; (2) determine the distribution of planet sizes and their orbital semi-major axes (half the longest diameter of the orbit); (3) estimate the frequency and orbital distribution of planets in multiple-stellar systems; and (4) determine the distributions of semi-major axis, albedo, size, mass, and density of short-period giant planets. The Kepler mission will continuously and simultaneously observe over 100,000 target stars.

## OVERVIEW

The Kepler spacecraft will be launched into an Earth-trailing, heliocentric orbit similar to that of SST. Following a 30-day period during which the photometer and spacecraft are characterized, Kepler begins acquiring its scientific data. It is expected that "hot Jupiters" (giant gas planets) in short period orbits will be identified after the first month of observation. During the first year, terrestrial planets with orbital periods shorter than that of Mercury -- as well as a wide range of larger planets with similar periods -- should be detected. Finally, the anticipated identification of Earth-size planets in the habitable zones of other star systems will begin during the third year of the Kepler mission.

Link to the Kepler Homepage for more information: http://www.kepler.arc.nasa.gov/

## PROGRAM MANAGEMENT

Kepler is a project in the Discovery Program with project responsibility delegated to the Principal Investigator (PI) at the Ames Research Center. The JPL Program Management Council (PMC) has Kepler governing responsibility. Enterprise Official is Dr. Edward Weiler, Administrator for Space Science at NASA HQ. Theme Director and point of contact is Dr. Anne Kinney, Director of Astronomy and Physics at NASA HQ. The program is in full compliance with NPG7120.5B.

## TECHNICAL COMMITMENT

The baseline for this technical commitment will be set at Confirmation Review.

| Technical Specifications | FY 2005 President's Budget | Change from Baseline |
|---|---|---|
| Photometer: | 0.95-m aperture | -- |
| Primary mirror: | 1.4 m dia., 85% lightweighted | -- |
| Detectors: | 42 CCDs - 2200 x 1024 pixels | -- |
| Mass: | 903 kg | -- |
| Power: | 613 W | -- |
| Launch Vehicle | D2925-10L (Delta II) | -- |
| Mission lifetime: | 4 years of flight | -- |
| Telemetry: | Ka-and X-band | -- |

| Schedule | FY 2005 President's Budget | Baseline | Change from Baseline |
|---|---|---|---|
| System Readiness Review: | 10/03 | 10/03 | -- |
| Preliminary Design Review: | 10/04 | 10/04 | -- |
| Critical Design Review: | 08/05 | 08/05 | -- |
| Launch: | 10/07 | 10/07 | -- |

## ACQUISITION STRATEGY AND PERFORMING ORGANIZATIONS

Ames Research Center (ARC) provides the Principal Investigator (PI), Deputy PI and some members of the science team. ARC acquires the other science team members through grants and contracts as appropriate. The Jet Propulsion Laboratory (JPL) provides the project management, mission assurance and project system engineering. Ball Aerospace and Technology Corporation provides the spacecraft, photometer and mission operations center. Changes since FY 2004 President's Budget: None.

**Theme:** Astronomical Search for Origins
**Development:** Kepler

| Current Acquisition | Actual* | Selection Method | Actual* | Performer | Actual* |
|---|---|---|---|---|---|
| Cooperative Agreement | 100% | Full & Open Competition | 100% | Industry | 95% |
| Cost Reimbursable | 0% | Sole Source | 0% | Government | 0% |
| Fixed Price | 0% | | 100% | NASA Intramural | 5% |
| Grants | 0% | | | University | 0% |
| Other | 0% | Sci Peer Review | 100% | Non Profit | 0% |
| * as of FY03 direct procurement | 100% | * as of FY03 direct procurement | | * as of FY03 direct procurement | 100% |

| Future Acquisition - Major | Selection | Goals |
|---|---|---|
| None - all major acquisitions are in place. | | |

## AGREEMENTS

Internal: The project is not dependent on other NASA activities outside of the control of the Associate Administrator for Space Science. External: None. Changes since FY 2004 President's Budget: None.

## RISK MITIGATION

| Top Risks | G | Overall | G | Cost | G | Schedule | | Technical | Probability | Impact | Mitigation Plan |
|---|---|---|---|---|---|---|---|---|---|---|---|

## INDEPENDENT REVIEWS

| Review Types | Performer | Last Review Date | Next Review Date | Purpose |
|---|---|---|---|---|
| Confirmation Review | HQ/OSS | | 11/04 | Approval to continue to Phase C/D. |
| Independent Assessment | Discovery Program Offics | | 10/04 | Critical Design Review; ATLO (Pre-Environmental Review). |

## BUDGET/LIFE CYCLE COST

| Budget Authority ($ millions) | Prior | FY03 | FY04 | FY05 | FY06 | FY07 | FY08 | FY09 | BTC | Total | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| FY2005 PRESBUD | 4.6 | 23.0 | 50.8 | 127.2 | 114.4 | 69.7 | 11.3 | 8.2 | 50.7 | 459.8 | |
| Development | 4.6 | 23.0 | 50.8 | 127.2 | 114.4 | 69.7 | | | | 389.6 | |
| Mission Operations & Data Analysis | | | | | | | 11.3 | 8.2 | 50.7 | 70.2 | |
| Changes since 2004 PRESBUD | +0.2 | -2.5 | -0.3 | -6.4 | +0.6 | +7.6 | -14.8 | +8.2 | +50.7 | +43.4 | |
| Development | +0.2 | -2.5 | -0.3 | -6.4 | +0.6 | +7.6 | -11.1 | | | -11.7 | MO&DA combined |
| Operations | | | | | | | -11.5 | | | -11.5 | |
| Mission Operations & Data Analysis | | | | | | | +11.3 | +8.2 | +50.7 | +70.2 | |
| Data Analysis | | | | | | | -3.6 | | | -3.6 | |
| FY2004 PRESBUD | 4.3 | 25.5 | 51.1 | 133.6 | 113.8 | 62.1 | 26.1 | | | 416.4 | |
| Development | 4.3 | 25.5 | 51.1 | 133.6 | 113.8 | 62.1 | 11.1 | | | 401.4 | |
| Operations | | | | | | | 11.5 | | | 11.5 | |
| Data Analysis | | | | | | | 3.6 | | | 3.6 | |

Indicates changes since the previous year's President's Budget Submit
Indicates budget numbers in full cost.

## **Theme:** Astronomical Search for Origins
## OPERATIONS

### PURPOSE

| Objectives | Performance Measures |
|---|---|
| 5.8, 5.9 | 5ASO5-12,14 |

Maximize the scientific return from NASA's investment in spacecraft and other data collection sources by efficiently and reliably operating the data-collecting hardware that enables scientific discoveries.

### OVERVIEW

ASO Operations currently supports the Hubble Space Telescope (HST) and the Far Ultraviolet Spectroscopic Explorer (FUSE). HST provides a state-of-the-art, orbiting observatory to study the history of the universe. FUSE studies physical processes governing the evolution of galaxies, as well as the origin and evolution of stars and planetary systems. The Spitzer Space Telescope (SST, formerly SIRTF) was launched in August 2003, and will study the formation of stars, galaxies and planets via spectroscopy, high-sensitivity photometry and imaging.

Starting in FY 2005, the operations funding for the Far Ultraviolet Spectroscopic Explorer (FUSE), Kepler, and the Wide-field Infrared Survey Explorer (WISE) will be combined with the Data Analysis funding for those missions (see Enterprise summary section for more information).

For more information on HST, go to: http://hubble.gsfc.nasa.gov/index.html For more information on FUSE, go to: http://fuse.pha.jhu.edu/ For more information on Spitzer, go to: http://sirtf.caltech.edu/

### PROGRAM MANAGEMENT

Enterprise official is Dr. Edward Weiler, Associate Administrator for Space Science. Theme Director and point of contact is Dr. Anne Kinney, Director of Astronomy and Physics at NASA HQ. HST and FUSE are managed by the Goddard Space Flight Center. SST is managed by the Jet Propulsion Laboratory. This program is in full compliance with NPG7120.5B.

### TECHNICAL COMMITMENT

The baseline is documented in the Program Commitment Agreement for each ASO mission.

| Technical Specifications | FY 2005 President's Budget | Change from Baseline |
|---|---|---|
| All missions | All missions will meet Level I specifications as identified in the Program Plan. | -- |

| Mission | Launch Date | Comments |
|---|---|---|
| Far Ultraviolet Spectroscopic Explorer | June 1999 | Mission extended. |
| Hubble Space Telescope | April 1990 | Mission extended. |
| Spitzer Space Telescope | August 2003 | Prime mission through February 2006. |

### ACQUISITION STRATEGY AND PERFORMING ORGANIZATIONS

The prime contractor for HST operations is the Consolidated Space Operations Contractor, Lockheed Martin Space Operations. FUSE operations are performed by the Johns Hopkins University. SST operations will be performed by the Jet Propulsion Laboratory. In FY03, direct procurement represented 100% of budget authority. Changes since FY 2004 President's Budget: None.

| Current Acquisition | Actual* | Selection Method | Actual* | Performer | Actual* |
|---|---|---|---|---|---|
| Cooperative Agreement | 0% | Full & Open Competition | 100% | Industry | 66% |
| Cost Reimbursable | 100% | Sole Source | 0% | Government | 0% |
| Fixed Price | 0% | | | NASA Intramural | 0% |
| Grants | 0% | | 100% | University | 0% |
| Other | 0% | | | Non Profit | 34% |
| * as of FY03 direct procurement | 100% | * as of FY03 direct procurement | | * as of FY03 direct procurement | 100% |

**Theme:** Astronomical Search for Origins
**OPERATIONS**

| Future Acquisition | Selection | Goals |
|---|---|---|
| Consolidated Space Operations Contract recompetition | late 2003 | 100% Full & Open Competition |

## AGREEMENTS

Internal: The program is not dependent on other NASA activities outside of the control of the Associate Administrator of Space Science. External: None. Changes since FY 2004 President's Budget: None.

## INDEPENDENT REVIEWS

| Review Types | Performer | Last Review Date | Next Review Date | Purpose |
|---|---|---|---|---|
| Senior Review | External panel | 6/02 | 7/04 | To consider mission extensions and funding levels for operating ASO spacecraft |

## BUDGET

| Budget Authority ($ millions) | FY 2003 | FY 2004 | FY 2005 | Comments |
|---|---|---|---|---|
| FY2005 PRESBUD | 7.2 | 24.4 | 56.6 | |
| HST Operations | 4.8 | 8.7 | 6.9 | |
| SST Operations | | 14.2 | 16.3 | |
| FUSE Operations | 2.4 | 1.5 | | |
| Other | | | 33.4 | |
| Changes since 2004 PRESBUD | -2.6 | -0.2 | | |
| HST Operations | -0.3 | -0.1 | | |
| SST Operations | -3.2 | -0.2 | | |
| FUSE Operations | +1.0 | | | MO&DA combined |
| FY2004 PRESBUD | 9.7 | 24.6 | | |
| HST Operations | 5.1 | 8.8 | | |
| SST Operations | 3.2 | 14.4 | | |
| FUSE Operations | 1.4 | 1.5 | | |

Indicates changes since the previous year's President's Budget Submit
Indicates budget numbers in full cost.

## **Theme:** Astronomical Search for Origins
## RESEARCH

### PURPOSE

| Objectives | Performance Measures |
|---|---|
| 5.8, 5.9 | 5ASO5-12,14-15 |

The research program provides fundamental data analysis for operating ASO missions including HST, SST, and FUSE. The research program also supports fundamental research and analysis vital to the successful completion of strategic goals and objectives.

### OVERVIEW

The ASO research program supports ASO Research and Analysis (R&A) and the analysis of data (DA) from the ASO operating missions, and the science data tools and archives needed to perform the research. DA programs are tied to specific missions, which are focused on the achievement of specific strategic objectives. The scope of R&A programs is generally wider because they must provide the new theories and instrumentation that enable the next generation of flight missions. The alignment of Research programs with ASO strategic goals is ensured through two mechanisms. First, NASA Research Announcements soliciting R&A proposals contain explicit prioritization criteria with respect to Enterprise objectives. Second, the entire R&A program is reviewed triennially to assess scientific quality and productivity of the major components and to adjust plans to best support Enterprise goals. Data Analysis (DA) programs have traditionally been performed by mission instrument teams and interdisciplinary scientists competitively selected for an individual mission for the lifetime of that mission. The DA program also includes annual, open and competitive solicitations to all missions that can accommodate guest investigations.

Starting in FY 2005, the operations funding for the Far Ultraviolet Spectroscopic Explorer (FUSE), Kepler, and the Wide-field Infrared Survey Explorer (WISE) will be combined with the Data Analysis funding for those missions (see Enterprise summary section for more information).

OSS Research Opportunities Site http://research.hq.nasa.gov/code_s/code_s.cfm Space Science Missions Site http://spacescience.nasa.gov/missions/index.htm Hubble Site http://hubble.stsci.edu/

### PROGRAM MANAGEMENT

NASA Headquarters is responsible for the ASO research program. Enterprise official is Dr. Edward Weiler, Associate Administrator for Space Science at NASA HQ. Theme Director and point of contact is Dr. Anne Kinney, Director of the Astronomy and Physics Division at NASA HQ. This program is in full compliance with NPG7120.5B.

### TECHNICAL COMMITMENT

Research baselines are consistent with those defined in individual Research Announcements released by OSS. Data Analysis baselines are defined by the program PCA or equivalent document.

| Technical Specifications |
|---|
| The NASA Strategic Plan incorporates results of the Office of Space Science Strategic Planning process, which specifies goals, strategic objectives and research focus areas. The OSS Strategic Plan draws from the Astronomy and Physics Decadal Survey (NRC) and road mapping activities by the Astronomical Search for Origins Subcommittee of the Space Science Advisory Committee. All research proposals, selection processes and review of elements of the ASO research program use these strategic items as a guide. |

| Schedule | FY 2005 President's Budget | Change from Baseline |
|---|---|---|
| Data Analysis Senior Reviews | Every two years | -- |
| R & A Research Opportunities In Space Science (ROSS) | Yearly in February | -- |

### ACQUISITION STRATEGY AND PERFORMING ORGANIZATIONS

The Research and Analysis (R&A) and Data Analysis (DA) programs make awards following peer reviewed competitions under NASA Research Announcements (NRA), Announcements of Opportunity (AO) and Cooperative Agreement Notices (CAN). In FY 2003, direct procurement represented 100% of budget authority. Changes since FY 2004 President's Budget: None.

**Theme:** Astronomical Search for Origins
**RESEARCH**

| Current Acquisition | Actual* | Selection Method | Actual* | Performer | Actual* |
|---|---|---|---|---|---|
| Cooperative Agreement | 1% | Full & Open Competition | 98% | Industry | 3% |
| Cost Reimbursable | 32% | Sole Source | 2% | Government | 4% |
| Fixed Price | 7% | | | NASA Intramural | 7% |
| Grants | 49% | | 100% | University | 71% |
| Other | 11% | | | Non Profit | 15% |
| * as of FY03 direct procurement | 100% | * as of FY03 direct procurement | | * as of FY03 direct procurement | 100% |

| Future Acquisition | Selection | Goals |
|---|---|---|
| Annual HST call for proposals | April 2004 | 100% Science Peer Review |
| Annual R&A research announcement | Late 2004 | 100% Science Peer Review |

## AGREEMENTS

Internal: The program is not dependent on other NASA activities outside of the control of the Associate Administrator for Space Science. External: HST Data Analysis involves agreements with the European Space Agency. Changes since FY 2004 President's Budget: None.

## INDEPENDENT REVIEWS

| Review Types | Performer | Last Review Date | Next Review Date | Purpose |
|---|---|---|---|---|
| MO&DA Senior Review | Sr. Review committee | 6/02 | 6/04 | Recommend approval and funding level for extending science investigations. |
| R&A peer review | Peer review | 7/03 | 7/04 | To review ASO proposals responding to the annual R&A announcement. |

## BUDGET

| Budget Authority ($ millions) | FY 2003 | FY 2004 | FY 2005 | Comments |
|---|---|---|---|---|
| FY2005 PRESBUD | 119.1 | 197.8 | 232.3 | |
| ASO R&A | 23.6 | 29.3 | 37.6 | |
| ASO Mission Operations & Data Analysis | 95.5 | 168.5 | 194.7 | |
| Changes since 2004 PRESBUD | -29.3 | -1.1 | | |
| ASO R&A | +0.2 | | | |
| ASO Mission Operations & Data Analysis | +95.5 | +168.5 | | Reflects MO&DA combination |
| ASO Data Analysis | -125.1 | -169.7 | | |
| FY2004 PRESBUD | 148.4 | 198.9 | | |
| ASO R&A | 23.3 | 29.3 | | |
| ASO Data Analysis | 125.1 | 169.7 | | |

Indicates changes since the previous year's President's Budget Submit
Indicates budget numbers in full cost

## **Theme:** Astronomical Search for Origins
## Technology and Advanced Concepts

### PURPOSE

| Objectives | Performance Measures |
|---|---|
| 5.8, 5.9 | 5ASO3,5-12 |

The ASO Technology and Advanced Concepts program includes future missions in formulation, and the development of advanced technologies needed for specific science missions. This process begins with mission studies - the first phase of flight program development. In this phase, scientists work collaboratively with technologists and mission designers to develop the most effective alignment of technology development programs with future mission requirements. This collaboration enables intelligent technology investment decisions through detailed analysis of the trade-offs between design considerations and cost. In ASO, future missions will seek to detect and characterize distant planetary bodies around other stars, probe ever farther into the deepest reaches of space with increasing resolution, and bring us new understanding of the nature of matter and energy. Technologies critical to the success of these missions include interferometry, high performance sensors, lightweight large-aperture reflectors, cryocoolers for infrared detectors, and autonomous information technology.

### OVERVIEW

ASO projects in this phase of implementation during FY 2005 include the Space Interferometry Mission (SIM) and the ground-based Keck Interferometer, as well as various smaller efforts, such as the Large Binocular Telescope Interferometer (LBTI). Technology and Advanced Concepts also includes funding for the Wide-field Infrared Survey Explorer (WISE), selected as a new Explorer in FY 2003 and currently in pre-development. In keeping with the Search for Origins theme, technology development from these missions will serve as stepping stones for eventual launch of the Terrestrial Planet Finder (TPF). Projects comprising the Navigator Program (including the Space Interferometry Mission, the Terrestrial Planet Finder, and the Keck Interferometer) will seek to detect and characterize Earth-like planets, understand the formation and distribution of planetary systems in our galaxy, and contribute to understanding the formation and evolution of stars, planets and galaxies. For example, by observing thousands of stars, SIM will detect planets through high-resolution and starlight nulling imagery, and serve as a science and technological pathfinder for TPF.

### PROGRAM MANAGEMENT

Program responsibility has been delegated to the Jet Propulsion Laboratory (JPL) for the Navigator Program. The Agency Program Management Council (PMC) has governing responsibility for flight projects; at the time of Systems Requirements Review, the Enterprise Governing Program Management Council has oversight for Navigator ground-based projects. Enterprise official is Dr. Edward Weiler, Associate Administrator for Space Science at NASA HQ. Theme Director and point of contact is Dr. Anne Kinney, Director of Astronomy and Physics at NASA HQ. With the minor exceptions noted in the Navigator Program PCA, this program is in full compliance with NPG7120.5B.

### TECHNICAL COMMITMENT

Project technical baselines are defined by the individual Formulation Authorization Document (FAD), Program Commitment Agreement (PCA) or equivalent documentation.

| Mission | Launch Date | Comments |
|---|---|---|
| Space Interferometry Mission (SIM) | Dec. 2009 | -- |
| Terrestrial Planet Finder (TPF) | TBD | -- |
| Keck Interferometer | Operational through 2020 | -- |

### ACQUISITION STRATEGY AND PERFORMING ORGANIZATIONS

Navigator acquisition strategy relies on the capabilities of JPL, universities, and other NASA Centers to develop "first application" technologies. Additionally, the program will develop strategic collaborations with appropriate technical entities to acquire proven hardware and promote technology transfer. Where an industrial firm has a unique capability, it may be engaged to develop first technology applications. Current Navigator participants include Lockheed-Martin Missles and Space, TRW Space and Electronics Group, Ball Aerospace and Technologies, Boeing-SVS, Eastman Kodak, Goodrich Coorporation, CalTech, University of Arizona, MIT, California Association for Research in Astronomy (CARA), Princeton University and others. Changes since FY 2004 President’s Budget: None.

**Theme:** Astronomical Search for Origins
**Technology and Advanced Concepts**

| Current Acquisition | Actual* | Selection Method | Actual* | Performer | Actual* |
|---|---|---|---|---|---|
| Cooperative Agreement | 4% | Full & Open Competition | 80% | Industry | 12% |
| Cost Reimbursable | 74% | Sole Source | 20% | Government | 0% |
| Fixed Price | 4% | | 100% | NASA Intramural | 16% |
| Grants | 1% | | | University | 64% |
| Other | 17% | | | Non Profit | 8% |
| * as of FY03 direct procurement | 100% | * as of FY03 direct procurement | | * as of FY03 direct procurement | 100% |

| Future Acquisition | Selection | Goals |
|---|---|---|
| Space Interferometry Mission (SIM) | Late 2005 | Full and Open Competition |

## AGREEMENTS

Internal: The program is not dependent on other NASA activities outside of the control of the Associate Administrator of Space Science. External: Memorandum of Understanding (MOU) exists between TPF and the European Space Agency's (ESA) Darwin mission. Changes since FY 2004 President's Budget: None.

## INDEPENDENT REVIEWS

| Review Types | Performer | Last Review Date | Next Review Date | Purpose |
|---|---|---|---|---|
| Independent Implementation Reviews | IRT/IPAO | 8/03 | 11/03 | To ensure compliance with defined technical, cost and schedule thresholds (PCAs, Roadmaps). |

## BUDGET

| Budget Authority ($ millions) | FY 2003 | FY 2004 | FY 2005 | Comments |
|---|---|---|---|---|
| FY2005 PRESBUD | 104.8 | 178.5 | 302.9 | |
| SIM | 42.3 | 71.4 | 155.1 | |
| TPF | 34.4 | 43.9 | 52.5 | |
| Keck | 10.4 | 9.7 | 12.4 | |
| Other | 17.7 | 53.5 | 82.9 | |
| Changes since 2004 PRESBUD | -52.7 | +21.9 | | |
| SIM | +2.8 | -8.4 | | |
| TPF | +14.7 | -0.3 | | |
| Keck | +1.1 | -0.1 | | |
| Other | -4.0 | +30.8 | | |
| Starlight | -67.3 | | | |
| FY2004 PRESBUD | 157.5 | 156.6 | | |
| SIM | 39.5 | 79.8 | | |
| TPF | 19.7 | 44.2 | | |
| Starlight | 67.3 | | | |
| Keck | 9.3 | 9.8 | | |
| Other | 21.7 | 22.7 | | |

Indicates changes since the previous year's President's Budget Submit
Indicates budget numbers in full cost.

**Theme:** Astronomical Search for Origins
**Technology and Advanced Concepts:** James Webb Space Telescope

## PURPOSE

| Objectives | Performance Measures |
|---|---|
| 5.8 | 5ASO4-7 |

The James Webb Space Telescope (JWST) is the planned successor to the Hubble Space Telescope (HST), extending the discoveries made by HST into the infrared, where the highly redshifted early universe must be observed, where cool objects like protostars and protoplanetary disks emit strongly, and where dust obscures shorter wavelengths. Taking full advantage of technological advancements in lightweight deployable optics and infrared detectors, JWST will be the only facility capable of observing predicted first light objects (protogalaxies, supernovae, and black holes) at redshifts out to 20, when the universe was just 180 million years old.

## OVERVIEW

JWST will be deployed with a segmented mirror and actuators to adjust the optical system, carrying three instruments and a fine guidance camera with science capabilities. These instruments will provide imaging, spectroscopy, and coronagraph, all optimized for ultimate sensitivity due to the faintness of the first light objects. JWST will be launched to orbit around Lagrange point L2, the gravitational balance point in which it will move around both Sun and Earth once per year with minimal fuel consumption. While in orbit, a multi-membrane shield will protect the telescope from radiation.

The JWST science program will address the questions: How did we get here?, Are we alone? To answer these questions, JWST research will explore four themes: First Light, Assembly of Galaxies, Origins of Stars and Planetary Systems, and Planetary Systems and the Origins of Life.

Following selection of a prime contractor (Northrop Grumman Space Technology), the JWST project underwent a major replan led by NASA and NGST, involving our international partners (the European and Canadian Space Agencies), the instrument teams, and the Space Telescope Science Institute (STScI). Significant outcomes from this effort included baselining the mirror area at 25 square meters, maintaining all original science instruments, and scheduling launch for August 2011. JWST has now received confirmation to proceed to the preliminary design phase of development (Phase B).

## PROGRAM MANAGEMENT

Program responsibility for JWST has been delegated to Goddard Space Flight Center. The Agency Program Management Council (PMC) has oversight responsibility for the project. Enterprise Official is Dr. Ed Weiler, Associate Administrator Space Science at NASA HQ. Theme Director and point of contact id Dr. Anne Kinney, Director of Astronomy and Physics at NASA HQ. This project is in full compliance with NPG7120.5B.

## TECHNICAL COMMITMENT

Project technical baseline is defined by the Formulation Authorization Document (FAD).

| Mission | Launch Date | Comments |
|---|---|---|
| James Webb Space Telescope (JWST) | Aug. 2011 | -- |

## ACQUISITION STRATEGY AND PERFORMING ORGANIZATIONS

The observatory prime contractor is Northrop Grumman Space Technology, teamed with Ball, Kodak and Alliant Techsystems; the instrument complement is being provided under an Announcement of Opportunity. The Space Telescope Science Institute is the contractor for science and operations.

| Current Acquisition | Actual* | Selection Method | Actual* | Performer | Actual* |
|---|---|---|---|---|---|
| Cooperative Agreement | 0% | Full & Open Competition | 80% | Industry | 50% |
| Cost Reimbursable | 100% | Sole Source | 20% | Government | 0% |
| Fixed Price | 0% | | 100% | NASA Intramural | 0% |
| Grants | 0% | | | University | 50% |
| Other | 0% | Sci Peer Review | 100% | Non Profit | 0% |
| * as of FY03 direct procurement | 100% | * as of FY03 direct procurement | | * as of FY03 direct procurement | 100% |

| Future Acquisition | Selection | Goals |
|---|---|---|
| None -- major acquisitions are in place. | | |

**Theme:** Astronomical Search for Origins
**Technology and Advanced Concepts:** James Webb Space Telescope

## AGREEMENTS

In work.

## BUDGET

| Budget Authority ($ millions) | FY 2003 | FY 2004 | FY 2005 | Comments |
|---|---|---|---|---|
| FY2005 PRESBUD | 95.7 | 253.1 | 318.1 | |
| James Webb Space Telescope | 95.7 | 253.1 | 318.1 | |
| Changes since 2004 PRESBUD | -30.6 | -1.5 | | |
| James Webb Space Telescope | -30.6 | -1.5 | | |
| FY2004 PRESBUD | 126.3 | 254.6 | | |
| James Webb Space Telescope | 126.3 | 254.6 | | |

Indicates changes since the previous year's President's Budget Submit
Indicates budget numbers in full cost.