Discovery Dispatch

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Discovery Welcomes John McNamee, New Program Manager

On January 7, JPL Director Charles Elachi announced the formation of the Discovery and New Frontiers Program Office and the appointment of John McNamee as the Program Manager. NASA Headquarters asked JPL to form the new office based on the successful organizational arrangement that has been implemented for the Explorer and Mars programs. The new office is responsible for the planning and end-to-end implementation of the Discovery and New Frontiers Programs consistent with top level policies, strategies, requirements, and funding established by NASA Headquarters.

McNamee previously was the project manager for the Deep Impact Discovery mission. Prior assignments have included project manager for the Outer Planets/Solar Probe and the 1998 Mars Surveyor mission, manager of Mars Exploration Preprojects, and mission design manager for the Mars Path-finder project. His work as the navigation team chief for the Magellan mission to Venus earned him NASA's Exceptional Service Award.

The 4th annual Discovery Program retreat was held in Novem-ber in Williamsburg, VA. Discovery Program Scientist Dr. Susan Niebur did an excellent job of organizing the two-day gathering of principal investigators, project managers, budget analysts, education and outreach coordinators, and others involved with the program.

The focus was on lessons learned from the missions throughout the development, implementation and operations phases. Open discussions took place on the challenges facing the missions in terms of cost, schedule and performance. A recurring thread throughout the meeting was the need for better and more frequent communication at all levels.

A new Discovery educational product is now available at discovery.nasa.gov/edu_unlocking.html. It includes "Unlocking the Mysteries," the award-winning program video, and an activity for students to design their own future Discovery mission.

Discovery Home Page

http://discovery.nasa.gov

Stardust Snares Comet Dust and Begins Journey Home

The Stardust mission passed a huge milestone on January 2nd when it flew within 240 kilometers (149 miles) of the nucleus of comet Wild 2 (pronounced "Vilt-2"), collecting samples of comet particles and snapping detailed pictures of Wild 2's pockmarked surface.

The second close-up image of Comet Wild 2 taken Jan. 2 by the Stardust spacecraft shows one hemisphere in sunlight and the other in shadow. Several large depressed regions can be seen. The comet is about 5 km (3.1 miles) in diameter.

"Things couldn't have worked better in a fairy tale," said Tom Duxbury, Stardust project manager at JPL. "These are the best pictures ever taken of a comet," said Principal Investigator Dr. Don Brownlee of the University of Washington, Seattle. "Although Stardust was designed to be a comet sample return mission, the fantastic details shown in these images greatly exceed our expectations."

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The mission used a collector the size of a tennis racket and a substance called aerogel to capture the comet dust particles, which are more than 4.5 billion years old and have remained virtually unchanged since the beginning of the solar system. The collector is now stowed in the sample return capsule onboard Stardust and will return to Earth on January 15, 2006, making a soft landing at the U.S. Air Force Utah Test and Training Range. The microscopic samples of comet and interstellar dust collected by Stardust will be taken to the planetary material curatorial facility at NASA's Johnson Space Center, Houston, TX, for in-depth analysis.

Stardust has traveled about 3.2 billion kilometers (2 billion miles) since launch on February 7, 1999, to reach its target. As it closed the final gap with its cometary quarry, it endured a bombardment of particles surrounding the nucleus of comet Wild 2. To protect Stardust against the blast of expected cometary particles and rocks, the spacecraft rotated so it was flying in the shadow of its "Whipple Shields." The shields are named for American astronomer Dr. Fred L. Whipple, who, in the 1950s, came up with the idea of shielding spacecraft from cometary particles hurtling toward it at about six times the speed of a rifle bullet. The system includes two bumpers at the front of the spacecraft — which protect Stardust's solar panels — and another shield protecting the main spacecraft body. Each shield is built around composite panels designed to disperse particles as they impact, augmented by blankets of a ceramic cloth called Nextel that further dissipate and spread particle debris.

Close-up of particles captured in aerogel during an experiment using a special air gun to shoot particles at high velocities.

"Comet Wild 2 gave up its particles but it did not do so without a fight," said Duxbury. "Our data indicates we flew through sheets of cometary particles that jostled the spacecraft and that on at least 10 occasions the first layer of our shielding was breached. Glad we had a couple more layers of the stuff."

Stardust entered the comet's coma - the vast cloud of dust and gas that surrounds a comet's nucleus - on December 31, 2003, and the shields were in place for the duration of the encounter. "We thought we would see a uniform increase in the number of particles the closer we came to the comet's nucleus and then a reduction," said Brownlee. "Instead, our data indicate we flew through a veritable swarm of particles and then there would be almost nothing and then we would fly through another swarm."

As Stardust scooped up cometary particles, it also took some remarkable images of comet Wild 2's five-kilometer wide (3.1-mile wide) nucleus. "Our navigation camera was designed to assist in navigation, not science," said Stardust's imaging team lead Ray Newburn at JPL. "But these are the best images ever taken of a comet, and there is a remarkable amount of information in those 72 pictures. Not only did we image the jets of material spewing out from the comet, but for the first time in history we can actually see the location of their origin on the surface of the comet."

"These pictures are really going to open up a new window into understanding how comets actually work," Brownlee said. "Seeing those pits, you realize there's some process going on you didn't realize even existed before."

Just minutes after its closest approach with the comet, Stardust pointed its high gain antenna at Earth and began transmitting a data stream that took over 30 hours to send but will keep cometary scientists busy for years to come. Stardust then began its two-year, 1.14 billion kilometer (708 million mile) trek back to Earth. "It was a very thrilling day for us," Brownlee said. "This is a very challenging and daring mission - Stardust flying into really unknown territory, the rock and dust clouds surrounding an active comet. We have successfully collected samples from a comet, and we're bringing them home for analysis in laboratories all over the world."

Mars Express In Orbit; ASPERA-3 is Operating

Mars Express, the European Space Agency's (ESA) first mission to Mars, has already been producing significant science results since its first instrument was activated on 5 January. The importance of the first data was emphasised by the scientists at a press conference on 23 January at ESA's Space Operations Centre, Darmstadt, Germany.

"I did not expect to be able to gather together - just one month after the Mars Orbit Insertion of 25 December - so many happy scientists eager to present their first results," said Professor David Southwood, ESA Director of Science. One of the main targets of the Mars Express mission is to discover the presence of water in one of its chemical states. Through the initial mapping of the south

polar cap on 18 January, OMEGA, the combined camera and infrared spectrometer, has already revealed the presence of water ice and carbon dioxide ice.

This picture was taken by the High Resolution Stereo Camera on board Mars Express on 14 January 2004. It shows a portion of a 1700 km long and 65 km wide swath which was taken in south-north direction across the Grand Canyon of Mars (Valles Marineris) from two perspectives. It is the first image of this size that shows the surface of Mars in high resolution (12 metres per pixel), in colour and in 3D.

Credits: ESA/DLR/FU Berlin (G. Neukum)

This information was confirmed by the Planetary Fourier Spectrometer, or PFS, a new high-resolution spectrometer of unprecedented accuracy. The first PFS data also show that the carbon oxide distribution is different in the northern and southern hemispheres of Mars.

ASPERA-3, a plasma and energetic neutral atoms analyser, is aiming to answer the fundamental question of whether the solar wind erosion led to the present lack of water on Mars. The preliminary results show a difference in the characteristics between the impact of the solar wind area and the measurement made in the tail of Mars.

(The ASPERA-3 instrument has four sensors to gather data. Two of the sensors, the Electron Spectrometer (ELS) and the Ion Mass Analyzer (IMA) Imaging Detector, are being funded by NASA as a Discovery Mission of Opportunity).

The Mars Radio Science Experiment, or MaRS instrument, a sophisticated radio transmitter and receiver, emitted a first signal successfully on 21 January that was received on Earth through a 70- meter antenna in Australia after it was reflected and scattered from the surface of Mars. This new measurement technique allows the detection of the chemical composition of the Mars atmosphere, ionosphere and surface.

Another exciting experiment was run by the SPICAM instrument (an ultraviolet and infrared spectrometer) during the first star occultation ever made at Mars. It has simultaneously measured the distribution of the ozone and water vapour, which has never been done before, revealing that there is more water vapor where there is less ozone.

On 16 January, Mars Express flew almost directly over the NASA Spirit rover at Gusev Crater at an altitude of about 300 kilometers (180 miles). Mars Express uses four instruments to look down, while Spirit looks up. Spirit's science team will be able to take advantage of the special possibilities presented by this pass of the European orbiter. The aim is to get observations from above and below at the same time to determine the dynamics of the atmosphere as accurately as possible. The Mars Express observations are also expected to supplement earlier information from two NASA Mars orbiters about the surface minerals and geological features in Gusev Crater.

Mars Express will reach its final orbit on 28 January. There has still been no signal from the Beagle 2 lander which descended to the surface of Mars on 25 December. The ESA control team is trying a variety of approaches to make contact, and they are in regular contact with their colleagues on the Beagle 2 team and the Jodrell Bank telescope in the UK, with NASA ground stations, and with several other European partners. Many international offers have been made to support the search for the Beagle 2 lander, and the ESA team is encouraged by the continued determination to locate the missing lander.

CONTOUR Mishap Board Completes Investigation

NASA's Comet Nucleus Tour (CONTOUR) Mishap Investigation Board (MIB) identified four possible causes for the failure of the comet-rendezvous mission launched in July 2002. The Board concluded the probable proximate cause for this accident was structural failure of the spacecraft due to plume heating during the embedded solid-rocket motor burn.

However, the lack of telemetry and observational data, immediately prior to and during the burn, and the lack of recoverable debris, leave open the possibility that one of several other problems could have led to the accident. The alternate possible causes are catastrophic failure of the solid rocket motor; collision with space debris or meteoroids; and loss of dynamic control of the spacecraft.

NASA was not able to re-establish contact with the spacecraft on August 15, 2002, following a propulsive maneuver involving the solid rocket motor. On August 22, 2002, the Associate Administrator for Space Science established the NASA CONTOUR Mishap Investigation Board with Theron Bradley Jr., NASA Chief Engineer, as chair. The purpose of the Board was to examine the processes,

data, and actions surrounding the events of August 15; search for proximate and root causes; and develop recommendations that may be applicable to future missions.

Based on various facts and data, the MIB concluded the alternate possible causes were less likely than the identified proximate cause. Nonetheless, in the spirit of constructively improving future mission reliability, the Board drew conclusions, identified lessons learned, and made recommendations based on the broader range of possible causes, according to Bradley.

Artist's concept of the CONTOUR satellite

Launched on July 3, 2002, CONTOUR was intended to encounter at least two comets and perform a variety of investigations and analyses of the comet material. It remained in Earth orbit until August 15, 2002, when an integral Alliant Techsystems STAR 30BP solid rocket motor was fired to leave orbit and begin the transit to the comet Encke.

CONTOUR was programmed to re-establish telemetry contact with the ground following the burn, but no signal was received. The mission design did not provide for telemetry coverage during the solid rocket motor burn and no provision was made to optically observe the burn.

Active attempts to contact CONTOUR were unsuccessful. On August 16, 2002, limited ground observations identified what appeared to be three separate objects on slightly divergent trajectories near, but behind, CONTOUR's expected position. Further attempts to contact CONTOUR were made through December 20, 2002, when NASA and The Johns Hopkins University Applied Physics Laboratory (APL), Laurel, MD, concluded the spacecraft was lost. The project manager at APL oversaw the technical implementation of the project and was responsible for the design, development, test and mission operations.

"NASA will apply the lessons from CONTOUR to future missions," Bradley said. He stated the report represented a lot of tough detective work by the many individuals and organizations involved in the investigation. "The lack of data meant the investigators could leave no stone unturned in their search for possible causes," he said.

The CONTOUR Mishap Investigation Board Report is available on the Internet at: http://discovery.nasa.gov/news_101703.html.

MESSENGER Launch Preparations Continue

The MESSENGER team continues it preparations for a scheduled May launch. The spacecraft was transported from the Applied Physics Lab (APL) in Laurel, MD, where it was designed and built, to the environmental testing facilities at NASA's Goddard Space Flight Center in Greenbelt, MD, on Dec. 19.

The 20-mile delivery capped nearly four years of detailed design, assembly, and testing on one of the most complex spacecraft APL has ever built. With features ranging from a lightweight composite structure and miniaturized instruments to a heat-radiation system and protective ceramic-fabric sunshade, MESSENGER (short for MErcury Surface, Space ENvironment, GEochemistry, and Ranging) is well equipped for a 5-year cruise through the inner solar system and a yearlong study of Mercury starting in July 2009.

MESSENGER team members check the spacecraft after the acoustic test by deploying a solar panel, using the same type of pyrotechnically triggered separation nuts MESSENGER will use in flight. Both solar panels as well as the magnetometer boom were successfully deployed.

"We're sending a spacecraft to orbit a planet where the sun is 11 times brighter than what we see on Earth and temperatures can climb past 800 degrees Fahrenheit," said MESSENGER Project Manager David G. Grant, of APL. "This is an incredible engineering and scientific challenge that no one has ever tried before, and the team is doing all it can on the ground to make sure MESSENGER succeeds at Mercury."

Early in December engineers finished the first of MESSENGER's "shake and bake" tests, checking the spacecraft's structural strength atop large vibration tables at APL. After arrival at Goddard

the team will check MESSENGER's balance and alignment; put it before speakers that simulate the noise-induced vibrations of launch; and seal it in a large thermal-vacuum chamber that duplicates the extreme heat, cold and airless conditions of space. In March, MESSENGER will be sent to Kennedy Space Center/Cape Canaveral Air Force Station, FL, and prepared for its May launch aboard a Boeing Delta II rocket.

"Each part of the spacecraft has passed individual vibration and environmental tests, and under tougher conditions than we expect they will see at Mercury," says James C. Leary, MESSENGER mission systems engineer at APL. "Now we're looking at MESSENGER as a whole system. By the time it launches MESSENGER will have been thoroughly tested."

MESSENGER's seven scientific instruments will image Mercury globally for the first time. It also will gather data 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 mission's orbit phase.

Follow MESSENGER's progress via the live webcam and regular updates at http://messenger.jhuapl.edu.

Education and Public Outreach Highlights

MESSENGER Fellows Program
Lizzie Taylor continued establishing the different components involved in the ongoing support for the Fellows in the Educator Fellowship Program. A "Meet the MESSENGER Fellows" page has been added to the web site, with a group picture.

Work continues to update the education portion of the MESSENGER web site, including an interactive section for students.

The latest MESSENGER Education Module, or MEM, under development is "Ice in the Solar System." It is anticipated that the CD will be ready for distribution at the time of the launch.

The MESSENGER documentary team completed several shoots recently, including the repair of cells and mirrors on the solar panels at APL and the working group meetings at Astrotech in Florida.

Genesis Mission Update

The Genesis spacecraft continues its mission collecting solar wind material expelled from the Sun. Telemetry from the Genesis spacecraft indicates that all spacecraft subsystems are reporting nominal operation.

There are three collector arrays aboard Genesis that are either exposed to or hidden from the solar wind, one array for each of the three solar wind regimes. Which collector array is exposed is determined by the data received by sensitive ion and electron monitors located on the spacecraft's equipment deck. These monitors scrutinize the solar wind passing by the spacecraft and relay this information to the onboard computer, which in turn commands the collector arrays to deploy and retract as needed. Recent solar activity has called for the low solar speed array to be deployed 100% of the time. Also, the E-Array, which handles coronal mass ejections, was unshaded 94% of the time.

The Genesis team met at the Utah Test and Training Range approximately one year before the scheduled capsule arrival date of Sept. 8, 2004. Team members traveled into the desert to a location inside the capsule arrival zone, a large elliptical-shaped area within which the capsule is expected to return to Earth. The team placed a plaque on the desert floor in anticipation of a successful capsule return.
http://genesismission.jpl.nasa.gov/mission/index.html

2004 Sneak Peek!

APRIL 2004
Completion of Sample Collection
On April 2, 2004, the solar wind collector arrays will be stowed away and sealed in the protective canister to begin the return journey to the Earth.

MAY 2004
Earth "Flyby" on its way to L2
On May 2, 2004, Genesis will conduct an Earth flyby as it journeys homeward.

SEPTEMBER 2004
Sample Capsule Returns to Earth
The Genesis spacecraft returns to the Earth on September 8, 2004 in a dramatic mid-air capture.
http://genesismission.jpl.nasa.gov/mission/return.html

Education and Public Outreach Highlights

NASA's Genesis Web site http://www.genesismission.jpl.nasa.gov has a new look with feature items that center upon the upcoming sample return event in September 2004. Stay tuned in coming months for updates!

Science teachers from the Dallas Independent School launched a rocket, ventured a million miles away, captured solar wind particles, and plan to do it all again — next time taking their students along on the same journey. On Saturday, November 8, 2003, these educators participated in an all-day Genesis workshop in an effort to bring real NASA mission science to their classrooms through hands-on activities that are not only fun but also aligned to state and national science standards.

Flying M&Ms! Splattered pudding! Scattered rice! Sound like a food fight among a group of rowdy kids in the cafeteria? It's a Genesis mission lesson in action as middle school science educators modeled the process of collecting solar wind during a

hands-on workshop offered at the Colorado Science Teacher Conference on November 21, 2003, in Denver. At the same conference, the Genesis education and public outreach team also presented instructional activities suitable for all ages during the seminar *Everyone Loves a Story: Science by Storytelling.* Participants listened attentively to a story that tells how our solar system might have formed and how it found a home with the help of a young, heroic star named Helios. As the story builds suspense and unfolds, the audience learns space science concepts, terminology, and theories about the origins of our solar system.

Genesis education and public outreach efforts focus on bringing the excitement of mission science to classrooms and space enthusiasts of all ages.

Teachers at Genesis educator workshop in Dallas.

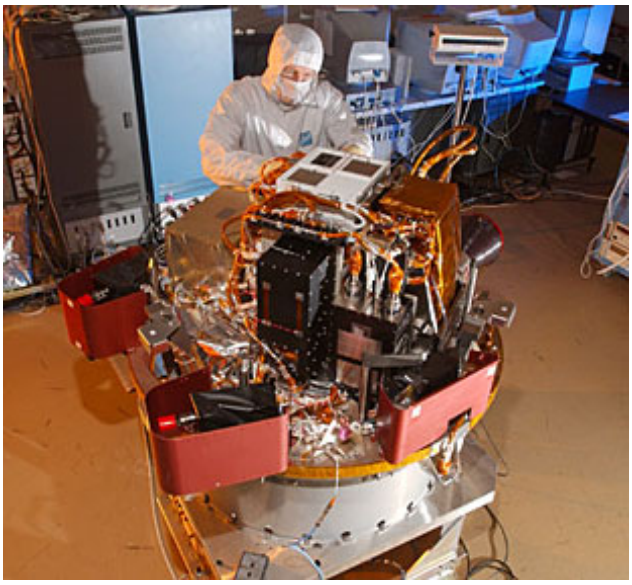
Deep Impact Prepares for Environmental Tests

The Deep Impact project is beginning to ready itself for the start of system level environmental tests that begin in late March. The Flyby and Impactor spacecraft have been fully integrated with their science instrument complements and have undergone a rigorous set of Mission Scenario Tests. Currently, several assemblies (Spacecraft Control Units, Scalable Space Inertial Reference Units, and Remote Interface Units) have been removed from both spacecraft in order to perform necessary upgrades prior to the start of environmental tests. Flight Software Version 5.5, containing about 97% of the intended software functionality, is scheduled for delivery at the end of January. The project is on track for its scheduled shipment to the Kennedy Space Center in October, with a launch window beginning December 30, 2004.

Education and Public Outreach Highlights

The Deep Impact mission moved into its "One Year To Launch" window and is preparing to close the "Send Your Name to a Comet" campaign. Names will be transferred to a CD attached to the impactor, giving participants an opportunity to see their names make a deep impact during the encounter with Comet Tempel 1.

The project released its sixth Deep News newsletter during the month of December. Deep News has been the venue for featuring new additions to the Deep Impact web site and a place for Principal Investigator Mike A'Hearn to give current updates to the mission.



Integration and Test Sr. Technician Rod Gillard checks the configuration of the Impactor's Spacecraft Control Unit at the Ball Aerospace facility in Boulder, CO. The Deep Impact team is completing the final checkout of the Impactor spacecraft prior to the start of the Environmental Test program early next year.

Deep Impact pioneered a relationship with the Tournament of Roses, bringing NASA missions Stardust, Genesis, Deep Impact, Voyager and Ulysses together with the Deep Space Network for an exhibit at "Fanfest" at the Rose Bowl, a three-day festival in held in conjunction with the Rose Parade and the Rose Bowl football game. Hundreds of visitors from the local area and across the country enjoyed the warm California sun while they learned about the missions. Enthusiastic fans put their signatures on a "GO WILD" banner of support for the Stardust team and signed up to send their names to a comet. Children had the opportunity to make star finders, design a comet picture frame and color pictures of the spacecraft and DSN antenna.

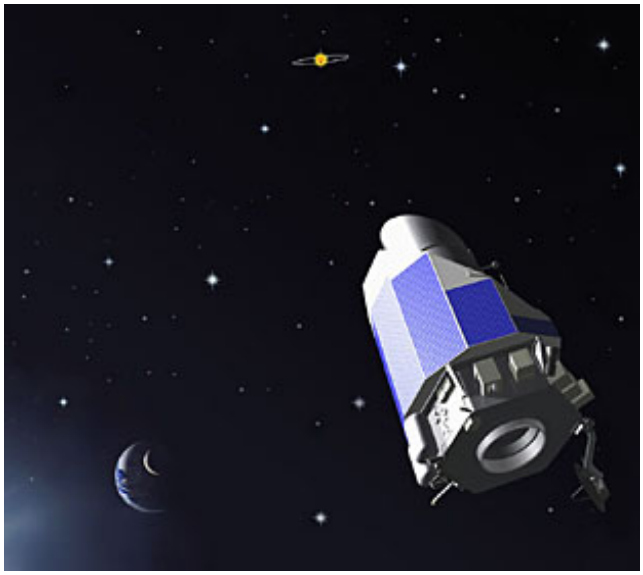
During November and December, outreach team members continued to train Girl Scout master leaders to train other leaders. During December, Deep Impact and Stardust, the two Discovery comet missions, partnered on several outreach activities. Deep Impact outreach also participated with other missions at the Planetary Society event to celebrate the Stardust encounter and Mars rover landing.

The outreach team is planning encounter events with the Solar System Ambassadors, the Solar System Educators, the Girl Scouts and other partner organizations established with the project since its beginning. New relationships are being formed with the museums, planetariums and science centers who will host events on the day and evening of encounter, July 4 2005.

Kepler Development Progresses

The Kepler Mission to explore the structure and diversity of planetary systems and search for Earth-size planets outside our Solar System is proceeding through development and dealing with the many issues that are part of a project in this early phase.

The System Requirements Review (SRR) took place in October. Areas identified as needing attention included science operations center development, data validation and characterization of stars, and the participating scientist program. The results included clarifying ambiguity in several high level science requirements, getting a better handle on end-to-end data accountability and system level test planning, and maturing the ground segment activity that was behind schedule due to late start and staffing. Issues from the SRR will be resolved as the project moves forward in the development of the spacecraft and the photometer. The next major milestone is the Preliminary Design Review in the fall of 2004.



Artist's concept of the Kepler spacecraft.

Education and Public Outreach Highlights

The new Kepler Mission public web page is now online at http://www.lawrencehallofscience.org/kepler. It has basic information about the mission and a link for "Solar System Transit" resources.

Edna DeVore and Alan Gould conducted a session, "Bringing Extrasolar Planets to Teachers, Students and the Public," at the American Geophysical Union conference in San Francisco Dec. 8, 2003. There were about 30 attendees.

Dave Koch gave a talk at Stony Creek Elementary School in Denver to 2 groups of 50 5th and 6th graders. Gibor Basri gave a talk for about 60 amateur astronomers at Eastbay Astronomical Society meeting in Oakland at the Chabot Space and Science Center.

The Kepler E/PO team met with staff from the Space Science Institute to discuss the Kepler portion of the Origins traveling museum exhibit and affirm the learning goals of the project. The Kepler component will use a model solar system to show how planets can be detected by the transit method with sensors and light meters to display brightness of "star" in the box.

Dawn Awaiting Confirmation

The Dawn Mission Critical Design Review was conducted October 14-16 at Orbital Sciences Corp. in Northern Virginia. Since that time, the project has held two very successful table top reviews on requirements and schedule, issued a startup contract with Max Planck for optics and electronic parts, continued to work with other vendors to initiate contracts, completed many required documents, and started mission studies with the launch vehicle selected by NASA, the Delta II Heavy. The project is awaiting confirmation by NASA to enter the implementation phase.

Education and Public Outreach Highlights

Colorado science educators shared their expertise to help develop Dawn mission educational materials. On November 21, 2003, the group met during the Colorado Science Teacher Convention in Denver to preview materials for *The History and Science of NASA's Dawn Mission*, the first in a series of mission-related educational modules. NASA's education and public outreach efforts rely on the professional insights of educators and value the feedback as an integral part of developing quality, effective learning activities for the classroom.

Discovery Dispatch

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