Discovery Dispatch

A Quarterly Newsletter of the NASA Discovery Program

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A Note From the Program Manager

I would like to express my deepest sympathies for those who have lost family members or friends in the heinous and cowardly attacks on the World Trade Center and the Pentagon, and in the crash in rural Pennsylvania on September 11, 2001. I would also like to express my utmost gratitude to those who came to the rescue, to those who are fighting the terrorists on their own ground around the world, and to those who are fighting them here at home in the United States.

I want every member of the Discovery team to keep their personal safety in mind at all times and to use common sense in conducting business for the Discovery Program as the war against international terrorism progresses. I encourage everyone to utilize telecommunication and electronic mail as much as possible until the situation here and abroad has stabilized. I know how difficult it can be to sort through the information and, more importantly, the misinformation that we all receive through the news media on a daily basis.

In contrast to these horrific recent events, it's been an exciting quarter for our Discovery missions. Thanks to the help of our friends at KSC and Boeing, Genesis had a picture-perfect launch from Cape Canaveral Air Force Station on August 8, and the spacecraft is on its way toward insertion into its halo orbit around L1 in November. Stardust continues its journey toward a Wild 2 encounter in January 2004. All ASPERA-3 hardware has been delivered to Sweden for integration with the rest of the instrument which will be launched on ESA's Mars Express in 2003, and Mars Netlander, the second Discovery Mission of Opportunity, has successfully passed its Phase A Confirmation Review. CONTOUR is well into integration and test in preparation for launch next July, and MESSENGER and Deep Impact are progressing well toward their Critical Design Reviews next Spring. And finally, we are looking forward to the selection of the next Discovery mission by the end of this year.

The NEAR Shoemaker Mission Team has been honored as this year's recipient of the prestigious National Air and Space Museum Trophy, awarded annually for outstanding achievements in the field of Aerospace Science and Engineering. The Trophy will be presented at a black tie affair at the National Air and Space Museum in Washington, DC on November 13. Congratulations once again to the NEAR Shoemaker Mission Team for representing NASA and the Discovery Program with this outstanding achievement.

In these troubled times, I want to wish everyone a very happy holiday season and hope that you and your families will be safe throughout the coming new year.

Dave Jarrett

Inside

Genesis — On its Way to Capture Solar Wind

After a flawless launch on August 8 at 12:13:40 p.m. EDT, the Genesis spacecraft began its mission to "catch a piece of the sun." At 64 minutes, 12 seconds into the mission, the Genesis spacecraft separated from the Delta rocket's third stage. Soon after separation, Genesis' solar arrays unfolded and pointed toward the sun. The spacecraft's signal was successfully acquired by the NASA Deep Space Network complex at Goldstone, California, 85 minutes after launch.

Launch of the Genesis spacecraft aboard a Delta 2 rocket.

Kennedy Space Center maintains a photo archive of images that show mission progress from the time of spacecraft arrival at Cape Canaveral in May until the time of launch.

Discovery Home Page

http://discovery.nasa.gov

Two weeks after launch, the spacecraft was performing well. The covers of the Genesis Ion Monitor (GIM) and Genesis Electron Monitor (GEM) were successfully opened. After a period of outgassing, the GEM and GIM were turned on. Instrument checkout was also successfully completed. The science algorithm WIND, which will be used to automatically determine the solar wind regime and deploy or stow the solar wind collector arrays accordingly, was enabled, with stellar results. The algorithm correctly determined a solar wind speed of 380 km/sec, a proton density of less than one per cubic centimeter, and temperature of 90,000 Kelvin. The spacecraft's measurements were confirmed by comparison with data from the ACE spacecraft, currently in the vicinity of Genesis' destination, L1. A correction to the algorithm was necessary to measure coronal mass ejections.

Around the middle of September, it was discovered that the temperature of the Sample Return Capsule (SRC) was higher than expected. The SRC backshell opening was closed to 10 degrees to allow outgassing of contaminants. It will remain in this condition until after L1 orbit insertion. The temperature will be monitored as the SRC backshell, canister, and collector arrays are systematically deployed.

Education and Public Outreach Highlights

The Genesis mission web site features a new electronic field trip to a cleanroom. The interactive field trip virtually walks you into NASA's cleanest room at Johnson Space Center, and takes you through several interactives, including suiting up in a bunny suit, using a liquid particle counter, and several group activities such as attaching collector wafers onto the array frame. The field trip is part of a NASA Genesis cleanroom trilogy, including a newly-released middle school education module titled "Dynamic Design: The Cleanroom" and a video, "Cleanroom Technology." Science: it's a blast! Dynamic Design: Launch and Propulsion debuts on the Genesis web site at the end of October. In this new standards-aligned education module, middle school students learn about the history of rocketry, how rockets are launched, and how and why specific rockets are chosen for varying payloads. Working in teams, students manipulate variables that may affect the performance of a launch vehicle and experience the diverse aspects of launching a rocket. The module culminates in a competition in which students apply what they have learned about rockets and build a launch vehicle that flies as high as possible.

Would you like to be kept informed of events in the Genesis mission as they develop? The mission offers a monthly electronic newsletter that features mission updates, items of interest, and opportunities to participate in mission activities. Click here to subscribe to Genesis e-news.

Discovery Missions Learn from Deep Space 1

When NASA's Deep Space 1 spacecraft successfully navigated past comet Borrelly on September 22, it gave researchers the best look ever at a comet and changed some of their long-standing assumptions. Without any of the normal protective dust shields used by spacecraft that are intended to go into the little-known comet environment, DS1 flew just 1,400 miles (2,200 kilometers) from Borrelly and took the best-resolution pictures of any comet to date.

"It's mind-boggling and stupendous," said Laurence Soderblom, the leader of DS1's imaging team and a geologist with the U.S. Geological Survey, Flagstaff, Ariz. "These pictures have told us that comet nuclei are far more complex than we ever imagined. They have rugged terrain, smooth rolling plains, deep fractures and very, very dark material."

DS1 completed its primary mission of testing ion propulsion and 11 other advanced, high-risk technologies in September 1999. NASA extended the mission, taking advantage of the ion propulsion and other systems to undertake this uncertain but exciting encounter with the comet. Images and other data collected by DS1 will remake what scientists know about the Sun-orbiting ice balls and help planners for upcoming missions.

The varied terrain of comet Borrelly.

The three Discovery missions heading for comets will all benefit from the encounter by DS1. Stardust has the same optical navigator and flight software as DS1 to track the comet nucleus during flyby. These worked exceptionally well, as the exciting images returned by DS1 showed. Also, Stardust's project scientist, responsible for computing the cometary dust environment and nucleus brightness for choosing camera exposure times, performed these functions for Borrelly, supporting the DS1 science and

navigation team. Stardust has gained valuable flight experience from this collaboration and is now better prepared for its comet Wild 2 encounter in 2004.

The Comet Nucleus Tour, or CONTOUR, mission is on target to launch in July 2002 to begin its journey to encounter at least two very diverse comets. The CONTOUR team is taking advantage of the DS1 experience. According to Mission Manager Bob Farquhar at The Johns Hopkins University Applied Physics Lab, which manages the mission for NASA, they will be meeting with comet expert Don Yeomans and navigation team lead Bobby Williams from JPL to discuss lessons learned from the DS1 encounter.

The success of Deep Space 1 has significantly boosted confidence in the Deep Impact mission, which will blast a small probe into comet Tempel 1 on Independence Day 2005. Researchers will be able to study the material ejected from the comet's nucleus, thought to hold secrets of solar system formation. Mike A'Hearn, a University of Maryland astronomer and Principal Investigator for Deep Impact, now has greater confidence that his team can actually hit the target as planned. "The images from Deep Space 1 will play a crucial role in refining our predictions of the targeting environment for Deep Impact," said A'Hearn, who was at JPL for the DS1 flyby. "My preliminary look at the data from Deep Space 1 suggests that our predictions for Borrelly were not far off and that, therefore, we can rely on our nominal predictions for Tempel 1, rather than our worst case models, and that we should not have a problem hitting the nucleus," he said.

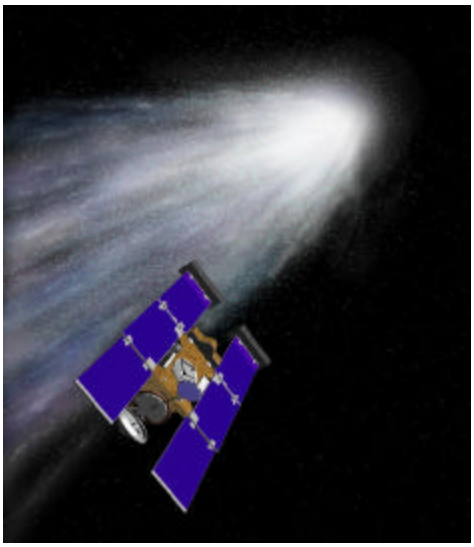
Deep Space 1 survived the gas and dust inside the coma of comet Borrelly that NASA was concerned might have destroyed the craft before it got a chance to take pictures. The probe was not designed for such a flyby and, because it was travelling at 36,900 mph (16.5 kilometers per second), it was defenseless against the powerful impact of even a small bit of dust.

"The fact that DS1 survived the encounter despite having no shielding against the dust in the coma gives us confidence that our flyby, which is shielded against dust, also will not be destroyed by the dust in the coma," A'Hearn said.

Some 30 black-and-white pictures of comet Borrelly's nucleus were produced when Deep Space 1 flew past the comet in a maneuver that mission managers did not expect to succeed. The hardy craft also made infrared images and recorded data of magnetic fields and other emissions from the comet. "The images and other data we collected from comet Borrelly are going to make great contributions to scientists' efforts to learn more about these intriguing members of the solar system family," said mission manager Marc Rayman.

Stardust Continues to Cruise

The Stardust spacecraft continues its journey toward comet Wild 2 with all systems in excellent shape. On October 2nd, Stardust became the first mission to travel past the 2.35 AU mark (218 million miles or 351 million kilometers) from the Sun on only solar power. By November 2001, Stardust will have traveled 1.2 million miles (two billion kilometers) around the solar system since its launch on February 7, 1999. The furthest point that the spacecraft is expected to reach is 2.72 AU from the Sun (253 million miles or 407 million kilometers) in mid-April 2002, before coming around for its expected comet encounter in January 2004. The NEAR spacecraft previously held the record at 2.185 AU (203 million miles or 327 million kilometers) for the furthest distance traveled by a solar-powered spacecraft. Stardust flew past that mark in mid-August.



Stardust spacecraft

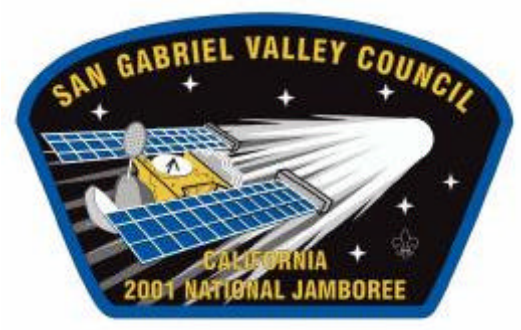
Stardust's only power supply on its long journey to the vicinity of the asteroid belt and back are two solar arrays, which were deployed shortly after the spacecraft's launch. One nickel-hydrogen battery a little bigger than a car battery stores the solar power generated by the solar arrays for use during eclipses and peak power operations.

Education and Public Outreach Highlights

The Stardust outreach team has been busy sharing the science and the excitement of the mission with the public at large throughout the U.S. The Stardust web site has been redesigned and updated. Exhibits including a model of the spacecraft and aerogel samples have been on display at the Muncie Planetarium and Science Center (Muncie, ID), the Ellison Onizuka Space Center (Hilo, Hawaii), the Newark Museum of Science (Newark, NJ), the Baltimore Museum of Science and History (Baltimore, MD), and the Bell Planetarium and Science Center (Minnesota).

Stardust was featured in a number of television documentaries and films, including "Impacts of Comets" on The Learning Channel, Children of Stardust" on Discovery Channel BBC,

"Stardust - "Mission to a Comet" on the Discovery Channel (US), "The Human Edge of Space" on National Geographic T.V., and "Impacts of Small Bodies: Asteroids and Comets" by Pioneer Films. Stardust participated in the Juan de Fuca Festival (Port Angeles, WA), Space Congress (Cocoa Beach, FL), Travis Air Show (Vacaville, CA), and the Women in Science conference in Cheyenne, WY. Also, Stardust worked with local San Gabriel Valley Boy Scout troops, about 4500 strong, on their chapter patch for the Boy Scout National Jamboree in Washington, D.C.



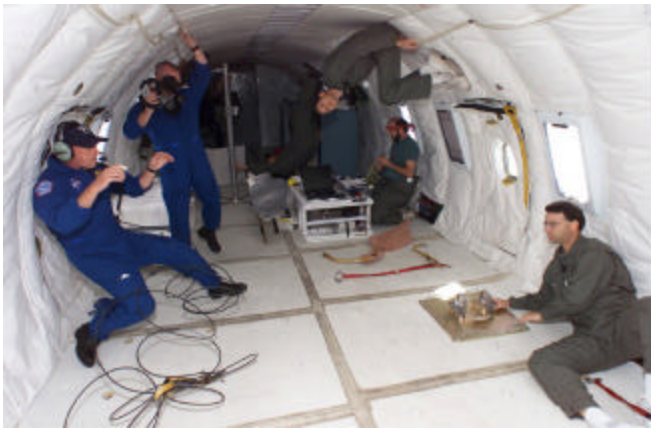
CONTOUR On Track for 2002 Launch

The Comet Nucleus Tour, or CONTOUR, mission to study the diversity of comets is poised to become NASA's next Small Body investigation. Activity has been non-stop as the instruments and spacecraft are being prepared for launch. As with NEAR, the CONTOUR spacecraft is being built by APL. Some recent accomplishments are described below.

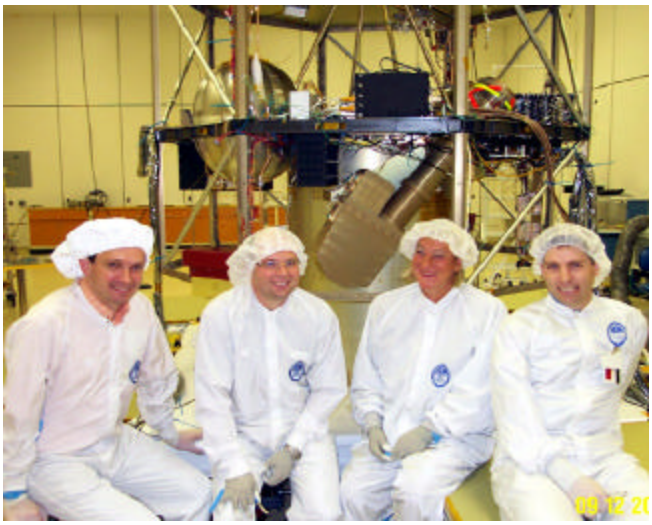
In mid-August, the vibration testing for the power switching unit was conducted. This component essentially controls the power to all other components on the spacecraft. This test simulates the launch environment. A pre-ship review on the Traveling Wave Tube Amplifier was held to make sure that all the required testing had been completed and that all specifications were met. The overall performance of the unit was found to be very good.

Toward the end of the month, several items were integrated and tested on the spacecraft, including the power switching unit and the second flight oscillator. Several tests were run at the spacecraft level, exercising the command and telemetry functions of the power system as a whole. These were performed not only by the integration and test team, but also by the mission operations team members. This is a key part of the early coordination with the operations team to provide them hands-on experience with the spacecraft well before launch.

A deployment test for the CONTOUR Remote Imaging Spectrograph (CRISP) instrument cover was performed. The CRISP instrument has a cover to protect sensitive optics from contamination during ground handling, the Earth phasing orbits and the solid rocket motor firing. After the solid rocket has been fired, and the spacecraft is out of Earth orbit, this cover will be deployed. The cover release mechanism was designed such that the cover would be ejected safely away from the spacecraft. As part of the qualification of this deployment mechanism, a test was conducted onboard NASA Johnson Space Center's KC-135 aircraft. This aircraft does a series of maneuvers that create a simulated low zero gravity environment so that various experiments can be conducted. The picture below shows an instrument scientist from Cornell University deploying the cover with a crew member from the KC-135 poised to catch it. The cover is located about mid-way between them. The people in the background are other experimenters on the plane. The test proved that the design of the cover release mechanism was successful. (Read more about the KC-135.)



Tests being perfomed aboard NASA's KC-135 aircraft.



Three CIDA team members with the CONTOUR mission system engineer.

On September 10th, the CIDA (Comet Impact Dust Analyzer) instrument team arrived at the Baltimore-Washington International airport with their instrument safe and sound, just ahead of the tragic events which closed the nation's airports for the next two days. (CIDA was developed by von Hoerner & Sulger, GmbH, and is a rebuild of the instrument flying on the Stardust mission.) The instrument requires a very clean environment and was in a nitrogen purge container throughout the shipment. On Wednesday morning instrument delivery check-out took place, and the integration of CIDA on the spacecraft began. The integration procedure was complete by the end of Friday, and the German

team flew home. The picture below shows three of the CIDA team members with the CONTOUR mission system engineer in front of the integrated instrument in the APL clean room.

At the end of the month, the Spacecraft Payload Attach Fitting (SPAF) was fit checked with the Delta launch vehicle PAF at Boeing's facility in Huntington Beach, California. These two items form the interface between the spacecraft and the launch vehicle. This fit check is to ensure that all will go smoothly during the final mating at the launch site next summer. The SPAF is a large structure that will form the central support for the spacecraft and will house the spacecraft's solid rocket motor.

A two-week long test began with the JPL Deep Space Network (DSN) using their Compatibility Test Trailer (CTT), a mobile test facility specifically for testing spacecraft during integration. This provides an early verification that the RF Communications on the spacecraft are compatible with the receiving stations for the DSN. In parallel to that testing, the Goddard Space Flight Center Neutral Gas and Ion Mass Spectrometer (NGIMS) team delivered a brassboard unit of their instrument. This brassboard is identical with the flight unit for interfaces to the spacecraft, allowing integration testing and verification with the spacecraft in parallel with the flight unit calibration and environmental testing.

In October, considerable progress was made on the CRISP instrument. The opto-mechanical assembly was delivered and integration of the entire instrument, including IR detector and tracking mirror assembly, has taken place. Tests run during the assembly process check alignments, flatness, focusing, etc. The tests must be run over temperature ranges, in vacuum, and in cleanroom conditions. Testing is proceeding well, and measured performance to date has been within specifications.

Education and Public Outreach Highlights

CONTOUR has produced a short animation, illustrating the spacecraft's orbit and comet encounters. Also, the project has created a brochure that describes the science objectives, instruments and mission timeline

MESSENGER Development Proceeding

MESSENGER will investigate key scientific questions regarding Mercury's characteristics and environment, including determining the nature and origin of Mercury's magnetic field, its geological history, the planetary formational processes that led to its high metal/silicate ratio, the structure and state of its core, and the radar-reflective materials at the poles.

MESSENGER's objectives include mapping the elemental and mineralogical surface composition, globally imaging the surface at a resolution of hundreds of meters or better, determining the structure of the magnetic field, measuring the libration amplitude and gravitational field structure, and characterizing exosphere neutrals and accelerated magnetosphere ions.

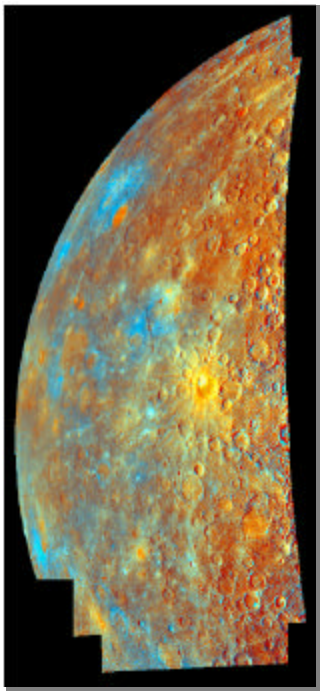
The spacecraft is scheduled for a March 2004 launch. It will perform two flybys of Venus in June 2004 and March 2006, then two flybys of Mercury in July 2007 and April 2008. Mercury Orbit Insertion will be on 6 April 2009 and orbital operations last for one year.

The science team held meetings in September at APL. The science and engineering disciplines are working closely to ensure that complementary efforts will be ongoing. The major challenge at this time is mass margin.

Education and Public Outreach Highlights

MESSENGER has developed a theme-based approach to education and public outreach. Their main themes are: Comparative Planetology, an examination of the diversity of worlds in the solar system; The Solar System Through History, exploring what was discovered about the solar system by past generations; and Framing Pathways to Answers: The Scientific Process in Action. MESSENGER Stories will be developed to explore the topics in each theme.

A recent activity was the Challenger Center's Window on the Universe program held in the District of Columbia during the week of October 15, 2001. The program is meant to take underserved communities to the frontier of space exploration. The week was planned to coincide with the opening of the Voyage exhibition on the National Mall on October 17, 2001. Voyage is an outdoor, permanent scale model of the solar system created by Challenger Center, the Smithsonian Institution and NASA. Voyage is meant to give visitors' a better understanding of the Earth's place in the solar system and the Sun's place among the stars.



Window on the Universe educational materials that were developed to bring the Voyage experience into the classroom were adopted by the District of Columbia Public Schools (DCPS) as the space science strand of their 6th grade curriculum. In preparation for Window on the Universe Week, 75 DCPS educators were trained on the use of these materials. During the week, 44 scientists and engineers from 15 area research organizations visited over 7,000 students in 230 area 6th grade classrooms. Four MESSENGER scientists and engineers participated in the program. Four Family Science Events held at three area high schools and the National Air and Space

Museum saw participation by 1,100 parents and students.

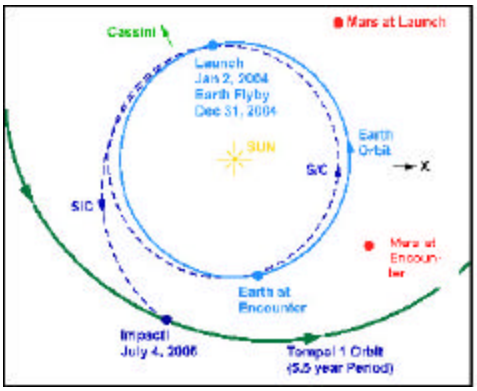
Window on the Universe is integrated into the MESSENGER E/PO plan, with MESSENGER R&D staff participating as members of the Window on the Universe National Team that travels to Window communities. There are currently eight communities in the program, including Nogales, Arizona, Tuskegee, Alabama, Muncie, Indiana, Moscow, Idaho, Washington, DC, Broken Arrow, Oklahoma, Labette County, Kansas, and Marquette, Michigan. The DC initiative in October 2001 marked the beginning of MESSENGER staff participation in the program.

Deep Impact Development Progresses

Deep Impact will deliver a 350 kg impactor at 10 km/s to open the interior of a comet nucleus. Planned to launch in January 2004, it will encounter comet P/Tempel 1 in July 2005. The flyby spacecraft will observe the impact, crater development, ejecta and the final crater with visible and IR multi-spectral instruments.

Design of the spacecraft is proceeding well. The project is aggressively preparing for detailed subsystem design reviews in November and December. The spacecraft, instruments, and flight software will be scrutinized in a Critical Design Review in January 2002. JPL delivered the first element of flight hardware to Ball Aerospace this month. Ball is now completely staffed up, and their software development is slightly ahead of schedule.

Deep Impact's proposed "10/10 technology flight of opportunity" will not be flown because the Ultra-low Power Serial Bus experiment of Martin Fraeman of APL was not selected in NASA's New Millennium Program downselect.



Education and Public Outreach Highlights

Deep Impact collaborated with other missions to create a space kit for the Girl Scouts, which will be available within the next couple of months. It contains a special section on comets.

Two educational activities for teachers have just been released: one on cratering and one produced by McREL on strengthening student skills in collaboration, research and critical decision making. Students will have the opportunity to gather data to make decisions on problems that are current to the Deep Impact science team.

A new educational module called "Why We Explore Comets" is in the test stage. It begins by teaching the very basics of comet science and lets the students duplicate the experience of scientists over time as they learned about comets by watching the sky, incorporating math and science into observations, adding new technology and finally making the journey into space to visit these mysterious bodies.

Discovery Dispatch

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