Discovery Dispatch

A Quarterly Newsletter of the NASA Discovery Program

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A Note from the Program Manager

Dear Friends & Colleagues of the Discovery Program,

As the following year unfolds, the missions of the Discovery Program shift into high gear. ASPERA-3, the Discovery Program's first Mission-of-Opportunity, arrives at Mars in December 2003 aboard ESA's Mars Express. Stardust begins 2004 with its rendezvous with Comet Wild 2 in January. MESSENGER follows with a promising launch to Mercury in May. Genesis returns to Earth with an amazing mid-air helicopter capture in the skies above Utah in September, bringing home particles of the Sun - the first sample-return mission since the Apollo Program! The year is rounded out with the launch of Deep Impact to explore the interior of Comet Tempel 1 as the New Year approaches in December. Dawn and Kepler will also intensify in activity as they gear up in their development phase. And a new Discovery mission will be born to explore yet-unknown mysteries of the solar system…

It has been an honor, a privilege, and a most-enjoyable experience for me to work with some of the most talented people in the space exploration business on the Discovery Program for the last four and a half years. After much deliberation, I have accepted a position within the Physical Sciences Research Division of the Office of Biological and Physical Research at NASA Headquarters. I will miss the scientific adventure of exploring the evolution of the solar system as your missions unfold and unlock these mysteries. The scientific returns have been - and will continue to be - truly unlimitless and almost unimaginable.

I wish all of you the best of luck in the exciting year - and years - to come. The Discovery Program has been an exciting scientific adventure for me, culminated by the unprecedented landing of the NEAR Shoemaker spacecraft on Eros. I am sure that, with the talent, spirit, and enthusiasm of the Discovery team, the best is yet to come!

Sincerely,
Dave Jarrett
Discovery Program Manager

Discovery Home Page

http://discovery.nasa.gov

Management Changes for Discovery

The NASA Discovery Program Office and the Discovery Program Support Office at JPL are in the midst of some major changes.

Dave Jarrett, Discovery Program Manager since February 1999, is leaving California to return to NASA Headquarters in Washington D.C. to work in the Office of Biological and Physical Research. Dave has worked closely with each mission to deal with the many challenges of sending very complex spacecraft on unique missions of exploration while adhering to a strict cost-capped budget. His attention to detail and lively sense of humor will be missed by everyone in the Discovery family who has had the opportunity to work with Dave over the past 4-1/2 years. Here is what a few of them had to say about their Discovery experience:

Dave Jarrett

Tom Duxbury, Stardust project manager at JPL, says, "I have had the pleasure of working closely with Dave Jarrett for 4-1/2 years as the Stardust Project Manager within Dave's Discovery Program. Dave is someone that I always felt comfortable sharing good as well as bad news with. His reaction was always to determine how he might help. Dave and Kate Wolf, the Discovery Program analyst, were an excellent team to work all programmatic issues with. I will miss Dave's presence in the Discovery office but know that his capabilities will be put to good use in NASA's Office of Biological and Physical Research."

Bob Farquhar, the trajectory wizard who has worked with Dave on the

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NEAR, CONTOUR, and MESSENGER missions, says, "Dave is always fun to work with, he's an easy going, friendly guy. He never missed any of the parties that we had for the NEAR mission, and he always had a good time. He always wondered about how I picked the dates, like Valentine's Day for the NEAR encounter with Eros. He asked, 'Can't you get something to be on my birthday?' Dave was one of the few people in NASA management that stuck around for the entire CONTOUR problem and gave a lot of support to the people here at APL. Dave, more than anyone else, helped us get through all the explanations afterward."

Mary Chiu, the CONTOUR project manager at APL, says, "Dave was certainly the most competent and effective NASA manager that I ever worked with. He had a way of asking just the right questions at the right time to keep informed about what was REALLY going on in a project. I'm not sure how he did this at times, but he did! His communication skills were commendable - he was always ready to talk about any matter - good or bad - without overreacting or getting upset. Most times, he was truly a help in getting things accomplished - he seemed to know what needed to be done at a certain point and then went about getting it done. He was an enabler for a project - not just an oversight manager. That is rare anywhere! He was also a fun person - you always had to be just a little wary you weren't falling into to some kind of practical joke! I felt really lucky to work with Dave on CONTOUR!"

The Discovery Program Support Office was created at JPL in April 1999 to support Dave and the program by providing technical expertise, arranging mission reviews, and coordinating education and public outreach. The support office initially consisted of 5 staff members and an academic part time student. Bob Metzger was the office manager until January 2002, when he moved into a new position at JPL and was replaced by Dick Coffin in December 2002. Barbara Cantu serves as office administrator, Mike Marcucci provides engineering support, Shari Asplund coordinates the education and public outreach efforts, and part-time college student Andy Hernandez updates the web site, program library and provides other office support.

In May of this year, Dr. Ed Weiler, NASA Associate Administrator for Space Science, made the decision to replace the support office at JPL with a support contractor to provide a greater degree of engineering, design, and mission assurance support to the program office. Aerospace, with offices in Virginia and California, will be supporting both the Discovery Program and the New Frontiers Program. The Aerospace folks came on board in early August and are meeting with the mission teams to quickly come up to speed on the status and the issues of each mission. Many challenges face these ambitious missions, so the expertise and support of the Aerospace staff is a welcome addition.

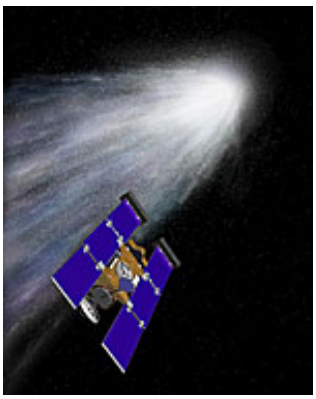
A Personal Note from Shari Asplund

I am fortunate that I am going to stay on and continue to coordinate the Discovery Program education and public outreach efforts with the missions. Andy will continue on as our webmaster. I have very much enjoyed working with Dave and everyone else in our small office for the past 4-1/2 years, and I will miss them all. I will organizationally move into JPL's Education Office as part of the NASA Solar System Education Forum group. Change is inevitable but it's best to view it as an opportunity for new experiences and positive growth. I wish great happiness and future success to my former Discovery colleagues.

Stardust Continues Toward Close Encounter with Comet Wild-2

The Stardust flight team held a very successful Encounter Workshop at the University of Washington in mid-August, as they continue to finalize plans for the Comet Wild 2 encounter in January 2004. Among the numerous topics were encounter sequence and timeline decisions, optical navigation, and imaging strategy for the spacecraft's closest approach.

The Deep Space Network communications with the spacecraft continue to indicate it is healthy with all subsystems operating normally.



Artist's rendering of the Stardust spacecraft.

On Wednesday July 23, Stardust successfully completed its second orbit around the sun and has started its third and final orbit. Trajectory Correction Maneuver 9 was successfully completed on July 16. The one meter per second burn took about forty-three seconds to complete. Post-burn analysis indicates the maneuver was right on the money. After the maneuver, the Cometary Interplanetary Dust Analyzer (CIDA) instrument was returned to operations. CIDA was powered off for Deep Space Maneuver 3, which occurred back on June 17 and 18. The analyzer will now remain operational until after the Comet Wild 2 encounter.

In late June, the Navigation Camera images taken about 1 month earlier were successfully transmitted to Earth. The images indicate NavCam performance is still very good.

Stardust has traveled over 2.9 billion kilometers (1.8 billion miles) since its February 7, 1999 launch. At present, it is hurtling through the cosmos at 124,300 kilometers per hour (77,200 miles per hour). The spacecraft will return to Earth in January 2006 to make a soft landing at the U.S. Air Force Utah Test and Training Range.

Its sample return capsule, holding microscopic particles of comet and interstellar dust, will be taken to the planetary material curatorial facility at NASA's Johnson Space Center, Houston, Texas, where the samples will be carefully stored and examined. Stardust's cometary and interstellar dust samples will help provide answers to fundamental questions about the origins of the solar system.

Education and Public Outreach Highlights

At a recent National Oceanic and Atmospheric Administration meeting, Stardust Principal Investigator Don Brownlee spoke to over 200 invited guests about the mission. He talked about the challenges that a 'class 5' solar flare presented to both the Stardust spacecraft and the team two years ago.

The Stardust Education and Public Outreach team gave a talk to Disneyland personnel and their families as part of a JPL tour. A cube of aerogel has been on display at Disneyland since 2000.

A space exploration documentary produced by Film Oasis highlighting Stardust and several other NASA missions has been distributed internationally in France, Australia, Asia, Portugal and Spain and will be shown in the United States late this year.

The Stardust Education and Public Outreach (E/PO) team, including its Educator Ambassadors and partner planetariums, participated in several Space Day activities throughout the United States in May. JPL Ambassador Bonnie Walters, from the Mesa Union Elementary School in Camarillo, California, organized speakers from JPL and other industry partners to speak to over 600 students on space exploration.

Genesis Solar Wind Collection Continues

The Genesis spacecraft continues its mission collecting solar wind material expelled from the Sun. Launching two years ago, on August 8, 2001, current telemetry from the spacecraft indicates that all subsystems are doing well.

There are three collector arrays aboard Genesis that are exposed to, or hidden from, the solar wind, one 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 'high solar speed' collector array to be deployed 50% of the time, and the E-Array, which handles coronal mass ejections, was unshaded for the remaining 50% of the time.

The temperature of some sample return capsule components is higher than expected, however appropriate actions are being taken to assure that the mission will be completed safely.

Education and Public Outreach Highlights

The July 26 issue of "New Scientist" contains a comprehensive article on the Genesis mission and the extraordinary mid-air recovery technique that will be used upon its return.

A specially modified helicopter with a boom and winch underneath snags the parafoil chute attached to a model Genesis sample return capsule in mid-air during successful trials of this novel capsule recovery technology.

The Genesis team is hard at work planning events for educators, students and the public to share the excitement when the sample return capsule comes back to Earth in September 2004. Stay tuned to learn more about how to participate in mission events.

MESSENGER Launch Moves to May 2004

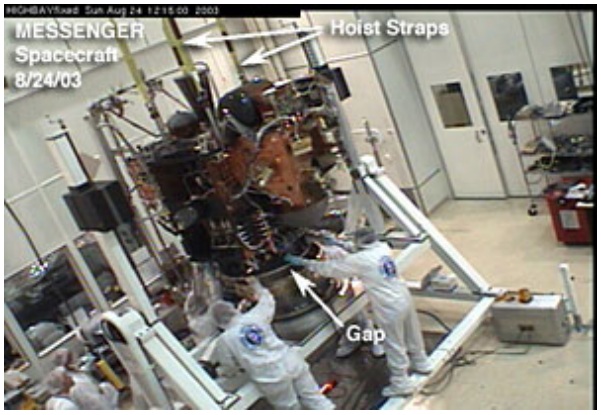
As the MESSENGER mission team works nearly around the clock to assemble and test the spacecraft and its science instruments, the decision was made to go to the backup launch date of May 11, 2004, rather than March. Delays in the delivery of key spacecraft and instrument hardware significantly reduced the project's schedule reserve to the point where project management decided it was in their best interest to slip the launch to the May backup launch opportunity. NASA agreed that the additional time was necessary for adequate testing of the spacecraft prior to launch of this very important planetary mission.

MESSENGER's new web site "went live" in August, with an exciting News Center feature that is documenting the installation and testing of the instruments and subsystems with live images and daily movies.

In August the MESSENGER assembly team completed final installation of the Mercury Dual Imaging System, known as MDIS, which actually consists of two cameras. The wide-angle camera has a 10.5 ° field of view and can image Mercury through 12 different filters across the wavelength range of 400 to 1,100 nanometers (visible and near-infrared light). Multispectral imaging will help scientists investigate the diversity of rock types that compose Mercury's surface. MESSENGER is also equipped with a narrow-angle camera that can take black-and-white images at 7 times higher resolution (1.5 ° field of view) to allow an extremely detailed analysis of surface features on Mercury.

In July the team installed and tested the electronics box for MESSENGER's Magnetometer, a necessary step before the instrument itself can be installed. Eventually the Magnetometer sensor will be mounted on a 3.6-meter (nearly 12-foot) boom that

will keep it away from the spacecraft's magnetic field. Mercury's magnetic field (at the surface of the planet) is about 1,000 times weaker than Earth's. The Magnetometer will characterize Mercury's magnetic field in detail from orbit over four Mercurial years — each 88 Earth days, helping scientists determine the field's exact strength and how that strength varies with position and altitude. This will provide crucial clues to help determine the internal source of Mercury's magnetic field.



On August 24 the MESSENGER assembly team rotated the spacecraft into a vertical position, attached hoist cables to an overhead crane, and lifted it just inches off the Turnover Fixture for a few minutes. The crane also serves as a scale to give an accurate weight for the spacecraft. Controlling the weight of a spacecraft is one of the hardest challenges faced by any design and assembly team. Every kilogram (or pound) is precious. Each kilogram MESSENGER weighs will require 233 kilograms of fuel on the launch vehicle to get the spacecraft on the path to Mercury. (A kilogram equals 2.2 pounds.)

Also in July, the team integrated MESSENGER's Power Distribution Unit, two Integrated Electronics Modules, small deep-space transponder, reaction wheel assemblies, digital Sun sensors, two star-tracker cameras, radio frequency switches/low-gain antennas, and two scientific instruments, the Mercury Laser Altimeter (MLA) and X-Ray Spectrometer. The MLA will characterize Mercury's surface topography and allow scientists to better understand the planet's interior structure. Also, by detecting small distortions in Mercury's overall shape, MLA measurements can help the team answer one of the mission's key science questions: Does Mercury have a molten core?

Education and Public Outreach Highlights

MESSENGER Fellows

In June the first MESSENGER Fellowship Training Workshop was conducted at Challenger Center for Space Science Education. The workshop is one of the central aspects of the MESSENGER Educator Fellowship Program (MEFP). MEFP is designed to disseminate information about the mission to students across the nation. To accomplish this, a group of Educator Fellows — master science teachers — will be recruited through a national announcement of opportunity every two years.

In April of 2003, 19 educators were selected into the MESSENGER Fellowship Program. Each Fellow is required to conduct training workshops on the MESSENGER Education Modules (MEMs) for a minimum of 120 teachers per year. At the end of the Fellows two-year Fellowship they will have the option to reapply. Over the 11-year program period more than 27,000 teachers are to be trained, which can easily translate into classroom activities for more than 1,000,000 students across the country.

MESSENGER Educator Fellows gather at their June workshop.

The MESSENGER Education Modules (MEMs) are conceptually-based pre-K to 12th grade educational materials which consist of lessons with inquiry-based activities that cover topics in comparative planetary science, solar system studies through history, and the process of designing, constructing, and sending a spacecraft to another planet. Module development will continue throughout the 11-year program timeline for the MESSENGER mission. The MEMs are available for all teachers on the mission website.

Solar System Ambassadors Program

Sean Solomon, Ralph McNutt and Stephanie Stockman conducted a 90-minute online training for the Solar System Ambassadors. MESSENGER provided a Powerpoint presentation and MESSENGER fact sheet as resources for the 300 ambassadors that will also be available to MESSENGER Fellows.

MESSENGER at the Local Museums

Tom Watters gave a talk to about 50 visitors on June 25 entitled "The MESSENGER Mission to Mercury" as part of the National Air and Space Museum's Curator's Choice Program. Tom also gave the Fellows a presentation on the MESSENGER program and the difficulties encountered in designing and building a spacecraft intended to operate in the challenging Mercurian environment. He also gave the Fellows a tour of the Planets Gallery in the National Air and Space Museum.

Stephanie Stockman gave an overview of the MESSENGER mission for "MESSENGER Thursday" at the Maryland Science Center in Baltimore, MD. The audience included a group of local

educators and a group of teachers in Western Kentucky who participated via a phone link and web cast.

MU-SPIN

Fourteen students affiliated with the Minority University – Space Interdisciplinary Network arrived at APL in May to begin supporting the mission in a variety of technical areas. The students are from City University of New York, South Carolina State University, Tennessee State University, University of Texas El Paso and Elizabeth State University. They will be supporting mission design, operations, integration and test, and other areas.

Deep Impact Coming Together

Deep Impact's instrument platform has been fully integrated with the flyby spacecraft and the full electrical functionality has been verified. The focus now is on completing the spacecraft for handover to the project's flight system test team. Further testing of the instruments will take place as part of the testing of the entire flight system.

A major achievement was to carry out a complete, end-to-end test of the file transfer protocol, an internet-like protocol which will be flown for the first time by Deep Impact. Previous missions have communicated with the ground using "packets" of data. These are typically all of a fixed size, with a "data file," such as an image, being built up from many separate packets as they are received at the ground station. This sometimes involves sorting out data to several different files from a single packet. This test involved sending a complete file from the ground support equipment at JPL, through a secure communications line to the spacecraft at Ball Aerospace and Technologies Corp. (BATC) in Boulder, CO, processing through the spacecraft computer, and sending the file back to JPL. Although this test could not involve the Deep Space Network, since the spacecraft is still on the ground, it gave the team great confidence that this new telemetry mode will work well. It also gave them optimism about running the test program "remotely", i.e., as they will fly the mission, with the tests being conducted from JPL in California while the spacecraft is at BATC in Colorado.

Education and Public Outreach Highlights

Send Your Name to a Comet

The Deep Impact mission has the opportunity for individuals to send their name to Comet Tempel 1. Participate in the mission by adding your name to the list of those that will be written on a CD-ROM and attached to the Impactor spacecraft that will make a crater in Comet Tempel 1, allowing the Flyby spacecraft to look deep inside the comet for clues to the formation of our solar system. Join the more than 250,000 who have participated in the mission and receive a certificate of acknowledgment.

Sign up for DeepNews, the project's news letter currently released monthly.

The Deep Impact spacecraft being assembled at Ball in Colorado.

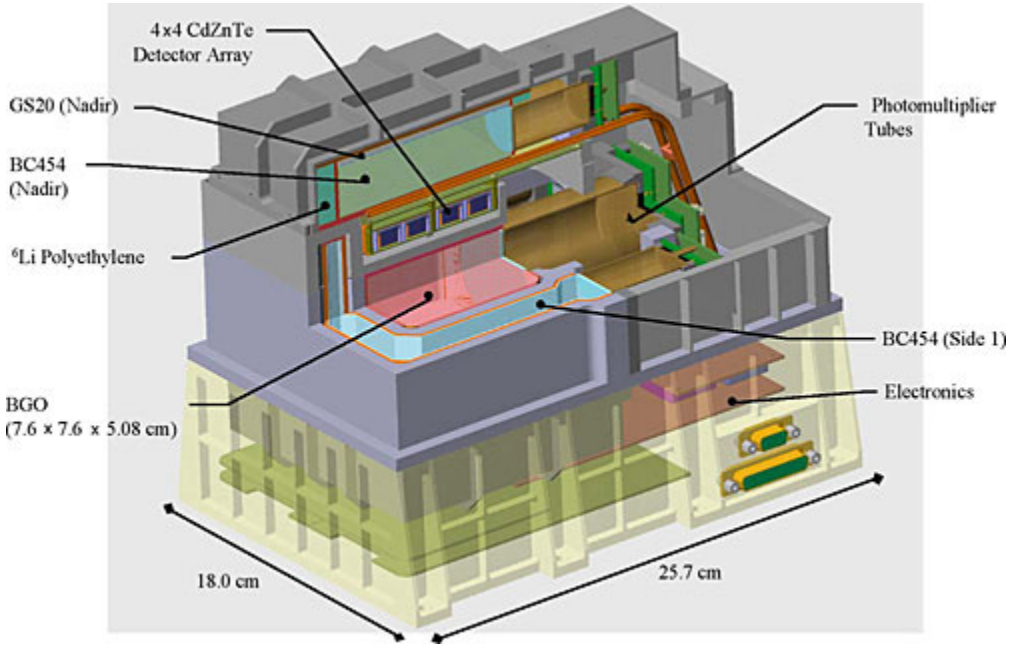
Deep Impact Principal Investigator Mike A'Hearn and team members Bill Blume and Maura Rountree-Brown hosted 58 ambassadors and educators for a training and question and answer session on Aug. 6, 2003.

Dawn Prepares for Important Review

The Dawn mission is currently in the formulation phase, preparing to demonstrate at its Preliminary Design Review (PDR) that it is ready to proceed with the implementation phase. As part of the preparation for PDR, design reviews of four of the five scientific instruments have been completed. These are the Visible and Infrared Mapping Spectrometer (VIR), Gamma Ray and Neutron Detector (GraND), magnetometer, and laser altimeter. All instruments passed their reviews with flying colors. The review of the fifth instrument, the framing camera, is scheduled in September. Much of the work on the camera will now take place at the Max Planck Institut fur Aeronomie (MPAe) in Katlenburg-Lindau, Germany.

This summer the team also completed testing of the solar cells that will power the Dawn spacecraft and its ion propulsion system. Mission success depends greatly on the efficiency of these cells. When the spacecraft journeys away from the Sun, the illumination drops and the arrays cool. The cooler arrays are more efficient,

compensating somewhat for the drop in illumination, but the combined effects have not previously been well characterized. Since most outer solar system missions have used radioactive thermal generators, the data on this low intensity, low temperature effect (LILT) is sparse.



Cut-away view of the GRaND instrument showing gamma ray and neutron sensors along with structural and electronic components.

Kepler Development Continues

Kepler's recent accomplishments include completion of two trade studies and decisions regarding implementation for on-board photometry and increasing the passband. Also the review of the draft Project Plan was completed and a peer review of the ground segment development was conducted. The Brashears optics contract was executed. Preparations for the System Requirements Review are underway.

Education and Public Outreach Highlights

Kepler Mission EPO team is at work on a number of efforts:

- a presentation at the Adler Planetarium in Chicago on June 14 by Kepler Deputy Principal Investigator David Koch to the Astro-Science Workshop for high school students.

- a Kepler exhibit that will be part of the Space Science Institute's large traveling exhibit on the search for habitable worlds beyond Earth. 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.

- presentations at the American Astronomical Society Division of Planetary Sciences meeting in Monterey, CA in September on middle and high school science and on precision photometry for detecting planet transits.

Kepler spacecraft with components labeled.

- planning for a Kepler presentation at the Oct 8-11 Conference of the Alliance of Western Planetarium Associations at the Clark Planetarium in Salt Lake City, UT.

- working with Chuck Bueter who is creating of a " Transit of Venus" planetarium show for the Great Lakes Planetarium Association that will have a small section about the Kepler mission.

- activities for classrooms to be pilot tested at Girl Scout events that will help participants understand how the transits method of planet discovery works.

Mars Express On Its Way

The Mars Express spacecraft launched on June 2nd and is in a trajectory that will take it to Mars in late December. This first European Space Agency probe to head for another planet will enter into orbit around Mars, where it will perform detailed studies of the planet's surface, its subsurface structures and its atmosphere using seven scientific instruments. One of the instruments, ASPERA-3, is funded in part by NASA as a Discovery Mission of Opportunity.

The ASPERA-3 Near-Earth Verification (NEV) Report for the period June 24 through July 13 showed all sensors and the Data Processing Unit operating nominally. The Electron Spectrometer (ELS) sensor activation occurred on July 1 and the instrument is functioning to the degree that it was tested. The Ion Mass Analyzer (IMA) temperatures at the beginning of NEV activities were higher than expected so sensor operations were limited to two hours. The MU temperatures were lower than expected. However, for both units the temperatures were within operational limits. It is expected that the IMA temperature will decrease and the MU temperature will increase with changing of the solar aspect angle.

During the launch the scanner is locked. The locking mechanism was released on July 23. The execution of the release commands was monitored and confirmed by the observation of the expected increase in the LCL current. After the release the scanner is ready for operation, however it was not operated because the temperature was too low (-22°). While the scanner is qualified to be operational for temperatures down to -25°, it was found unnecessarily risky to perform initial operations at such low temperatures. The temperatures during nominal operations are expected to be above -5°. The scanner is warmed to this

The Mars Express Orbiter on top of the Soyuz

temperature by operating the sensor assembly for at least 8 hours. The first scanner operations are planned to be performed during interplanetary cruise (IC) calibrations in October.

In early July controllers carrying out routine checks on the Mars Express spacecraft noticed a power glitch and found it was operating at 70% power. However, they believe it will have no impact on the state of the spacecraft or the mission objectives.

At the end of August, Mars Express was in interplanetary cruise more than 20 million kilometers (12 million miles) from Earth with all platform subsystems (thermal, power, attitude and orbit control, on-board data handling) behaving in a nominal manner. Near-Earth spacecraft commissioning has been successfully completed, and spacecraft activities are now focusing on the preparations for lander ejection and Mars orbit insertion.

Discovery Dispatch

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