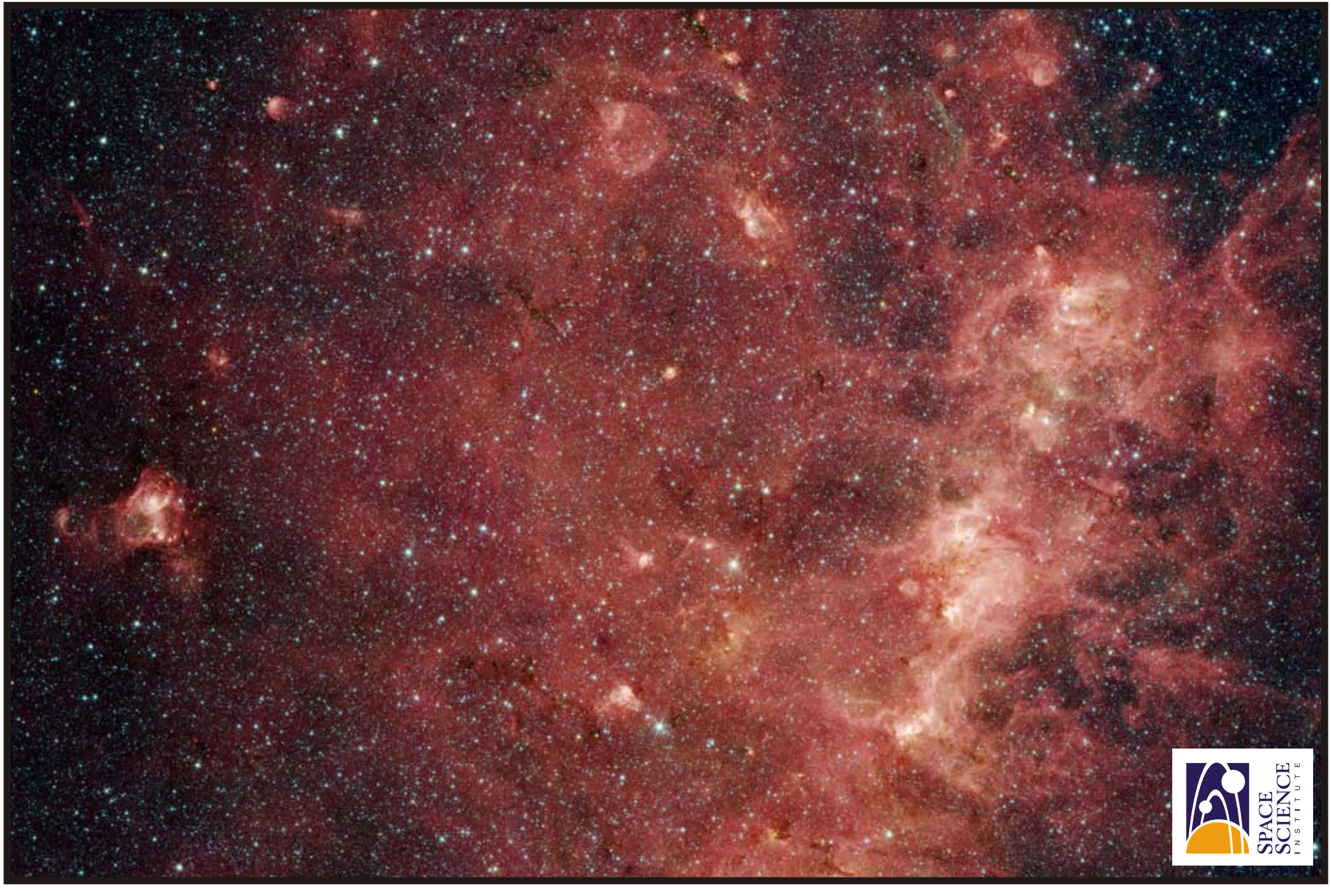
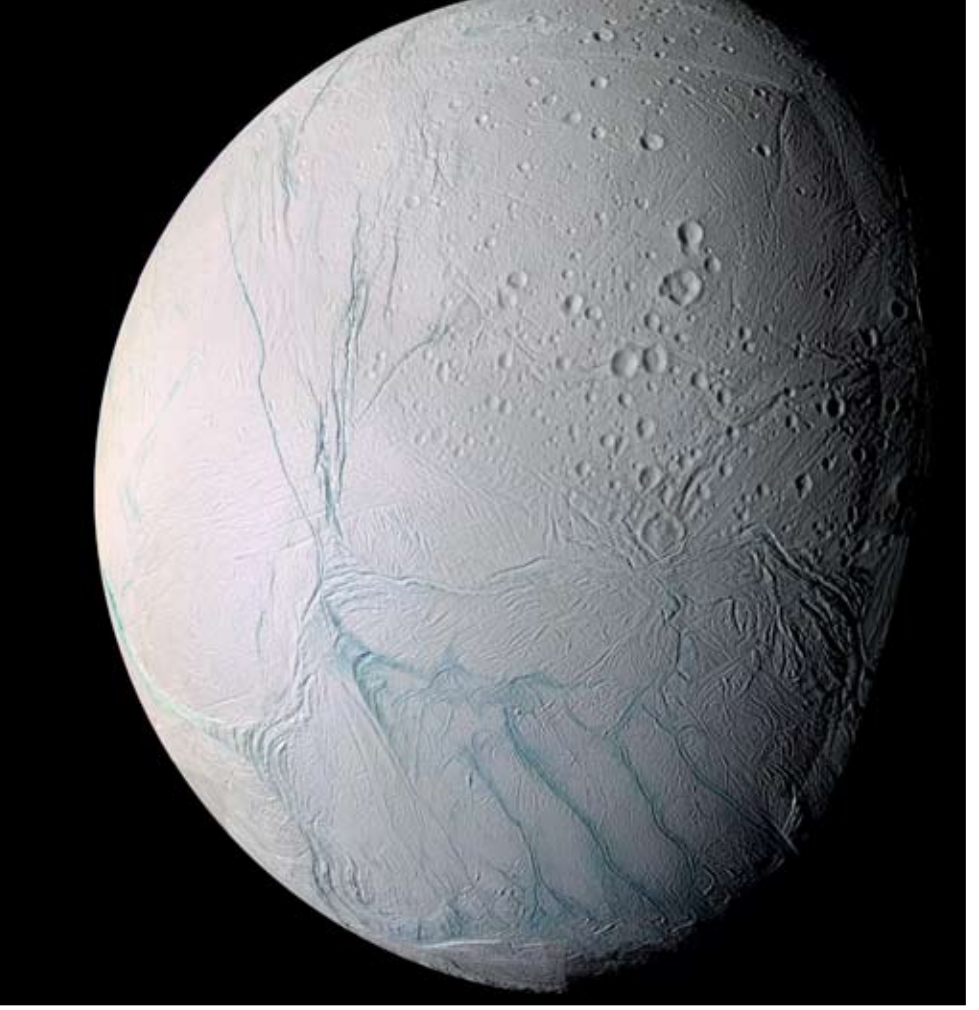
Space Science Institute . 4750 Walnut Street . Suite 205 . Boulder, Colorado 80301 . 720.974.5888 . www.spacescience.org

ANNUAL REPORT 2006



SPACE SCIENCE INSTITUTE



Our Vision

The Space Science Institute is a thriving center of talented, entrepreneurial scientists, educators, and other professionals who make outstanding contributions to humankind's understanding and appreciation of planet Earth, the Solar System, the galaxy and beyond.

About Us

The Space Science Institute (SSI) is a nonprofit, public benefit corporation founded in 1992. Our purpose is to create and maintain an environment where scientific research and education programs can flourish in an integrated fashion. SSI has five major branches: Research, Flight Operations, Education, Business Operations, and Information Systems and Technology (IST). SSI's Research Branch scientists are participants in a broad array of science activities that include earth science, planetary science, and astrophysics. The Flight Operations branch manages the Cassini spacecraft's imaging camera experiment and provides spectacular images of Saturn and its moons and rings to the public. SSI's Education branch produces traveling exhibitions, conducts professional development workshops for formal (classroom-based) and informal (museum-based) educators, and develops award-winning educational films, videos, and websites for the public. The Business Operations branch strives to create an efficient working environment and provides the necessary infrastructure that allows the organization to carry out its day-to-day tasks and meet its regulatory and contractual obligations. And finally, the IST branch is responsible for maintaining the technical infrastructure, connecting SSI's resources to the outside world, and developing software for a variety of educational projects.

SSI also provides unique opportunities for exceptional scientists and educators to carry out their work at off-site locations defined by personal choices about where to live. We collaborate with universities and corporations, as well as with U.S. government agencies. By broadly developing these collaborations locally, but also regionally, nationally, and internationally, SSI enhances the global vision and impact of science and technology. Our strategic partnerships and alliances enable us to implement a variety of high-quality projects and positions us to bring exciting scientific discoveries to the public through our research and education programs, thereby helping to cultivate a greater appreciation and understanding of science.

cover:: GLIMPSE Project, Spitzer Space telescope. Courtesy NASA
top left:: Enceladus, a moon of Saturn. Courtesy, Cassini/NASA/ESA

Message from the Director

Excite. Explore. Discover. These words aptly describe our efforts in both science research and education. In fact, they define the essence of our mission: to integrate world-class research with high-quality education within a single institution. The Board of Directors is currently composed of eight members representing experience and expertise in a range of business, science, and educational areas. Their guidance and vision – along with that of senior management – have created an environment that continues to draw world-class scientists to the Institute and enables us to develop education and outreach programs that benefit millions of people worldwide. This past year has seen SSI grow from $4.3M to over $4.8M in grant and contract funding – an increase of more than 10% – most of which comes from NASA and the National Science Foundation (NSF).

SSI has a robust scientific Research Branch, with scientists participating in robotic missions such as the Mars Exploration Rovers, in flight missions such as Cassini and the Spitzer Space Telescope and the Hubble Space Telescope (HST), and in ground-based observation programs using facilities located across the world. SSI researchers have been awarded a number of research and analysis grants and also serve on a number of scientific boards and committees helping to plan future missions.

SSI's Flight Operations branch is home to Cassini's imaging laboratory. Cassini is a flagship mission to Saturn, supported by both the American and European planetary exploration programs. The Cassini spacecraft operated successfully throughout the past year, enriching our lives and our astronomical literature with breath-taking images and new scientific discoveries.

In 2006, SSI's Education branch conducted numerous workshops for educators. The 5,000 square-foot MarsQuest and the 3,000 square-foot Alien Earths exhibitions continued their national tours. We are also developing the Giant Worlds traveling exhibition, which will begin its tour in 2008. The past year also saw the debut of SSI's Planets exhibit at Boulder's recently opened innovative pedestrian mall called Twenty Ninth Street. SSI continues to enhance its documentary film production capabilities and develop applications of internet and multimedia technologies to facilitate social learning experiences.

Having our headquarters located in Boulder, Colorado, enables us to maintain strong collaborations with a number of the major players in the research, education, and aerospace industries, including the University of Colorado, NOAA's Space Environment Center, the National Center for Atmospheric Research, Lockheed Martin Astronautics, and Ball Aerospace. However, our impact goes far beyond Colorado. We seek and encourage strong ties to corporations, foundations, and institutions in Colorado and elsewhere.

The upcoming year is one of great promise. New scientific discoveries will be made and new education programs will be launched that engage the public and excite their imaginations about the wonder and beauty of the universe. Come join our voyage of discovery.

With warmest regards,

Paul B. Dusenbery, Ph.D.
Executive Director

Research

Research scientists at SSI participate in a broad array of space science activities. Our research program (both on-site and off-site) includes earth science, planetary science, and astrophysics. Our research team's expertise continues to expand, and now includes investigations of phenomenon on Earth, in atmospheres and on surfaces of other bodies in our Solar System, and in our galaxy – including the early stages of the life cycles of stars and nascent planetary systems around other stars. Our scientists also study quasars and other distant galaxies.

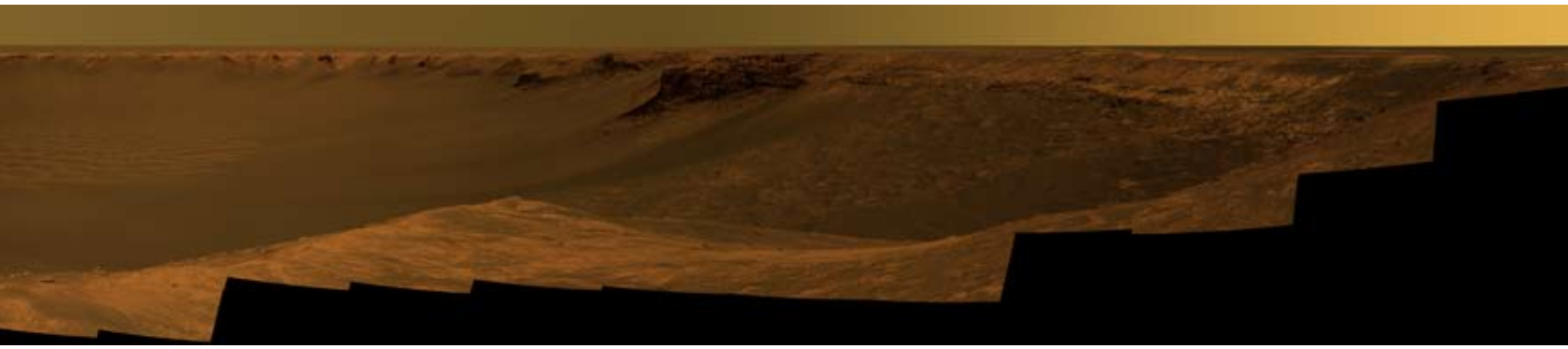
SSI researchers are intimately connected to the operations of current space facilities such as the Spitzer and Hubble Space Telescopes, and are deeply engaged in future space science projects and missions, including the James Webb Space Telescope. SSI is also home to the central laboratory for imaging science for the Cassini mission to Saturn – the current flagship planetary mission for both the American and European planetary exploration programs. Many SSI researchers continue to focus on Mars research, with participation in the Mars Reconnaissance Orbiter mission, which successfully entered Mars orbit in March 2006, and Mars Express, which is currently in Mars orbit. The Mars Exploration Rovers are still beaming back to Earth incredible imagery and data. Our researchers are also actively engaged in developing future Mars exploration missions.

SSI's off-site and on-site scientists form a network of entrepreneurial researchers who are each supported by a number of grants and contracts. Our structure allows dynamic, collaborative efforts among fields of research that are typically separated in academic institutions. This year, SSI researchers began work on an instrument project that uses our institution's unique strengths and common scientific threads; we look forward to development of this project. We will continue to search out other new and creative opportunities to make discoveries which contribute significantly to our understanding of the universe around us.

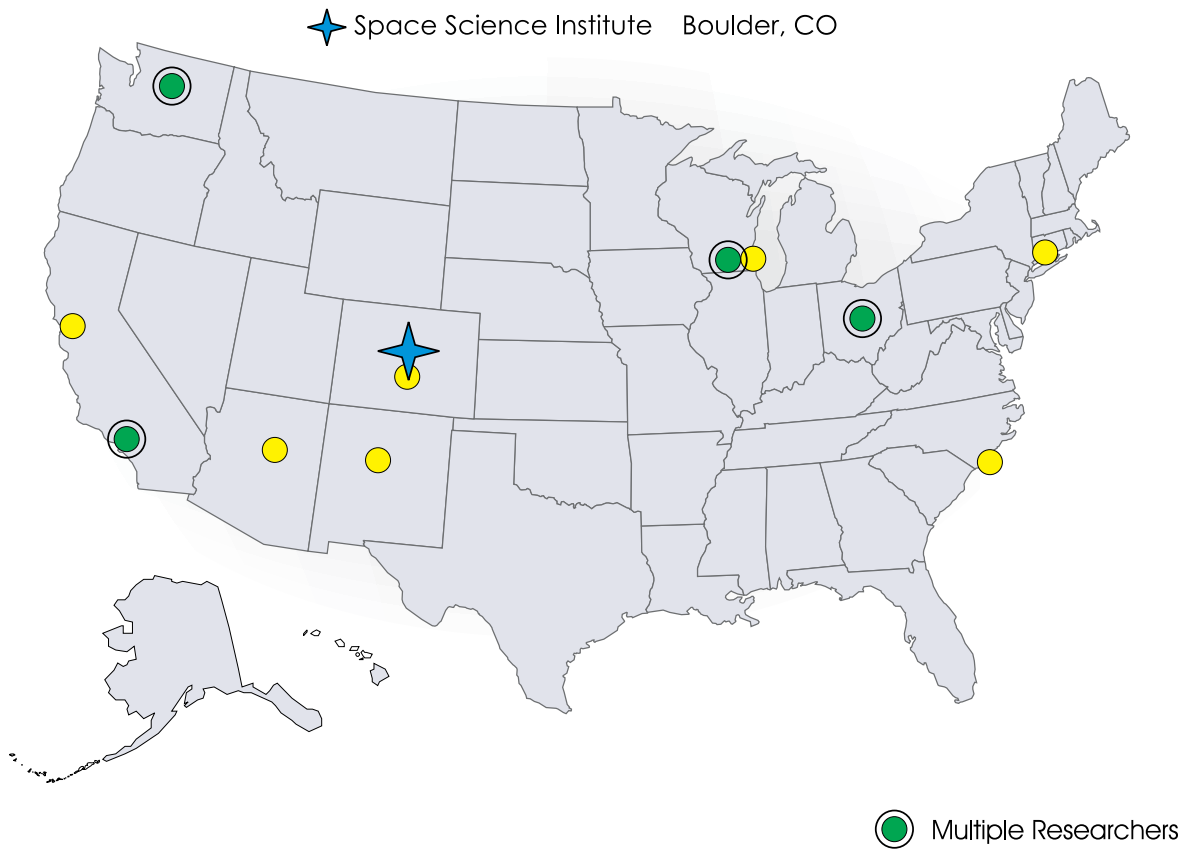
SSI's Off-Site Research Option

SSI has been a pioneer in remote employment, a mode that is both family- and environmentally-friendly. The long-distance nature of most scientific collaborative research is conducive to remote employment, since interactions can be readily accomplished via the internet and phone, supplemented by occasional travel. Access to fast computers and scientific data sets no longer require large institutional support, and most journals are fully accessible over the internet, mitigating the need for institutional libraries. Instrument development, which requires large institutional support, can be done in collaboration with existing facilities such as those at Lockheed Martin Astronautics and Ball Aerospace.

top:: A panorama of the Victoria Crater on Mars taken by the Spirit Rover. Courtesy, NASA

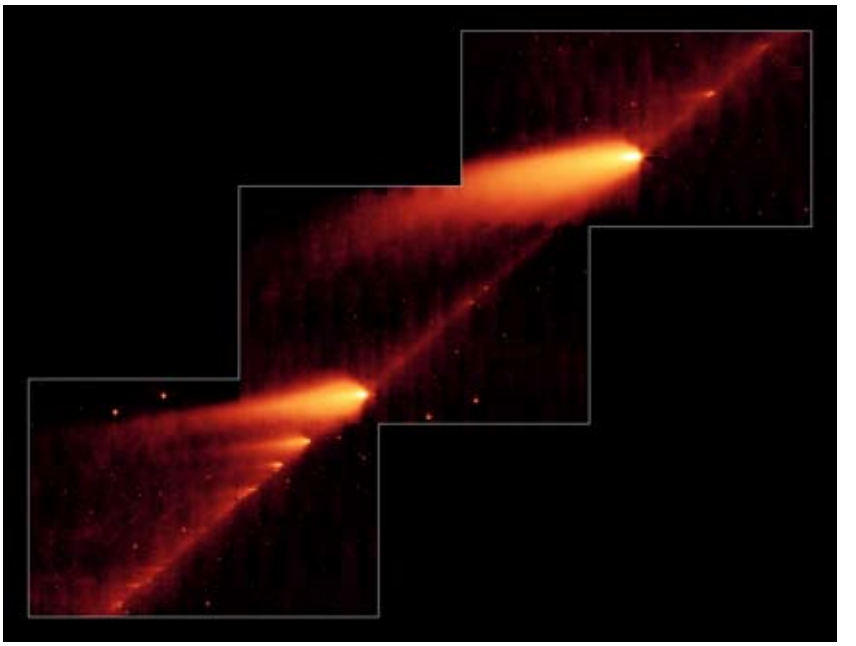


Space Science Institute's Off-Site Researchers



The map above shows where SSI's off-site researchers are located across the United States. SSI's off-site option continues to be one of our fastest-growing areas. SSI management, however, is aware of the potential challenges of rapid growth. We continue to develop our administrative support in ways that will enable our institution and our researchers to grow and thrive.

2006 Research Highlights



Images of a Crumbling Comet Yield Clues to Composition

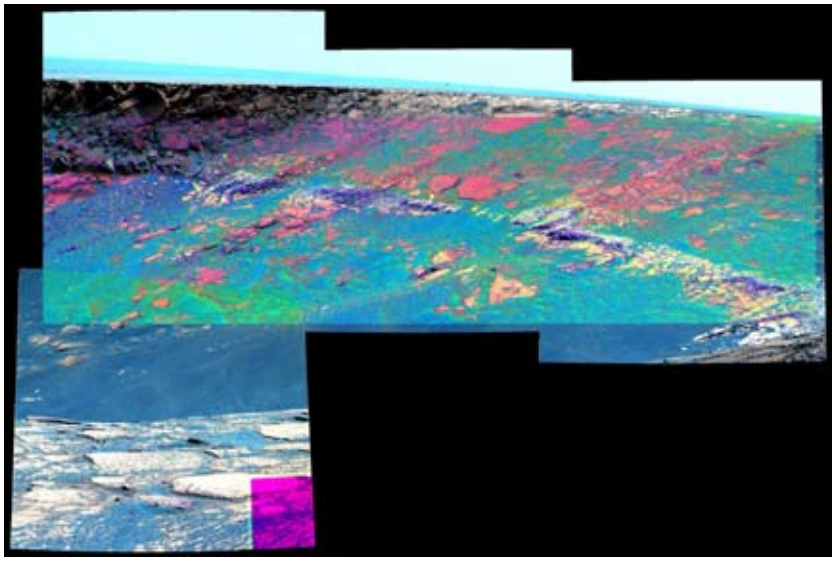
SSI Researcher Mike Sitko (Cincinnati, Ohio Office) and colleagues observed the infrared (heat) radiation from the "crumbling comet" Schwassmann-Wachmann 3, using NASA's Spitzer Space Telescope. This instrument, effectively a "telescope in a thermos bottle," is capable of making the most precise measurements for this type of electromagnetic radiation. The spectra Sitko and colleagues obtained of the comet's brightest 2 fragments are providing scientists with a rare view of the material once hidden beneath the surface of the comet. Sitko commented, "This is like the Deep Impact mission to comet Tempel 1, but with nature doing the excavating, without the cost associated with sending a spacecraft to the comet." Their analysis is providing information on the sizes and mineral content (silicates, organic molecules, water ice, and others) of the solid grains being shed by the comet.

Award-winning Asteroid Research

SSI Researcher Brian D. Warner (Colorado Springs, Colorado Office), who frequently teams with SSI Researcher Alan Harris (La Canada, California Office), has been awarded the inaugural Chambliss Amateur Achievement Medal by the American Astronomical Society (AAS). The AAS cited Warner "for his many contributions to the photometric study of asteroids. His skillful observations using multiple CCD-equipped telescopes at Palmer Divide Observatory have resulted in the publication of more than 200 asteroid light curves. His discovery of numerous binaries in the main belt has overturned the idea that binary asteroids form only through tidal interactions with planets. Warner encourages and supports other asteroid observers, both amateur and professional, through his ongoing development of the software MPO Canopus, his regular writing in the Minor Planet Bulletin, and his book A Practical Guide to Light Curve Photometry and Analysis, now in its second edition (Springer, 2006). His efforts have facilitated a 21st-century renaissance in precision measurements of asteroid light curves."

top left:: Comet Schwassmann - Wachmann 3. Courtesy Spitzer Space Telescope/NASA
bottom left:: Image of asteroid 243 Ida taken by the Galileo spacecraft. Ida is the second asteroid ever encountered by a space-craft. It appears to be about 52 kilometers (32 miles) in length. Courtesy NASA.
bottom middle:: Brian Warner at his Palmer Divide Observatory, Colorado Springs, Colorado
top right:: Decorrelation stretch image of the inner rim of Victoria Crater. Courtesy NASA/JPL
bottom right:: MARCI image of Mars. Courtesy NASA/JPL/Malin SSS

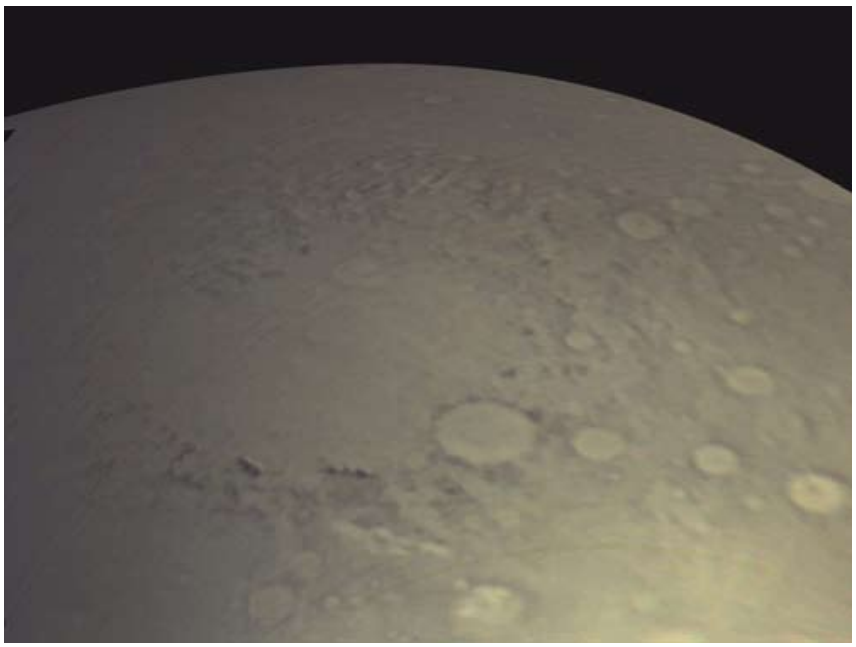
Multispectral Mars



SSI researchers Bill Farrand (Boulder, Colorado Office) and Mike Wolff (Brookfield, Wisconsin Office) are members of the Mars Exploration Rover (MER) science team and have made substantial contributions in the form of planning science activities for the rovers (Spirit and Opportunity) and helping with the operation of both MER Pancam cameras. The rovers have been very successful in their primary mission of seeking a better understanding of the history of water on the martian surface. Recently, the Opportunity rover arrived at the largest crater yet encountered by either rover, the 740 meter diameter Victoria crater. Bill Farrand has been characterizing the multispectral visible and near infrared reflectance properties of rocks at both MER sites. This picture is a decorrelation stretch image showing color differences between layers on the inner rim of Victoria crater.

MARCI mapping at Mars

SSI researchers Todd Clancy (Bald Head Island, North Carolina Office), Mike Wolff (Brookfield, Wisconsin Office), and Steve Lee (Boulder, Colorado Office) participate as Co-Investigators on MARCI (MARs Color Imager), an imaging experiment onboard the Mars Reconnaissance Orbiter (MRO). MARCI was developed by Malin Space Science Systems. The picture shown here is one of the first views of Mars acquired by MARCI. In the primary science phase of the MRO mission, MARCI will routinely acquire daily global maps of the planet. These data will be used to help track storms, monitor clouds, characterize water vapor transport, and track seasonal changes in surface albedo (bright and dark) patterns.

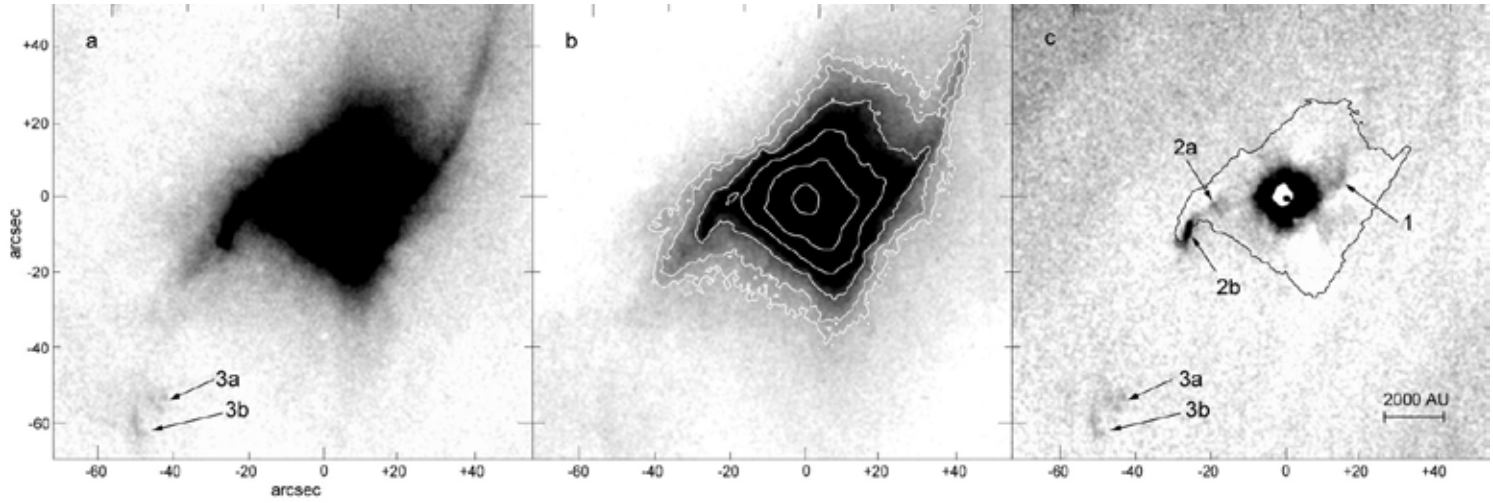


Studies of a Nearby Galaxy

The Large Magellanic Cloud (LMC), a large diffuse patch of white easily seen with the naked eye in the Southern Hemisphere, is the nearest external galaxy to our own. The Surveying the Agents of a Galaxy's Evolution (SAGE) project team, including SSI researchers Barbara Whitney (Madison, Wisconsin Office) and Michael Wolff (Brookfield, Wisconsin Office), has surveyed the entire LMC with the Spitzer Space Telescope, obtaining more than 300,000 images at seven wavelengths to create a stunning and extensive LMC map. The team is using the data to study the life cycle of matter: from the formation of stars from diffuse gas and dust, to the injection of material from evolved stars back into the interstellar medium.

Jets from Young Stars

SSI Researcher Mary Barsony (Sebastopol, California Office) and her collaborators used the 6.5-meter Baade telescope at Las Campanas Observatory located in Chile to study a young stellar object (YSO). This particular "protostar" – which is the brightest known YSO and closest protostar to Earth – is surrounded by a dusty infalling envelope that is invisible to our eyes. However, by imaging at near-infrared wavelengths, the walls of a cavity in this infalling envelope can be seen. By subtracting images taken at different wavelengths, faint tendrils can be detected emerging from the central region of the YSO. These tendrils are the signature of a precessing jet, the first time this phenomenon has been imaged within the envelope of such an object.



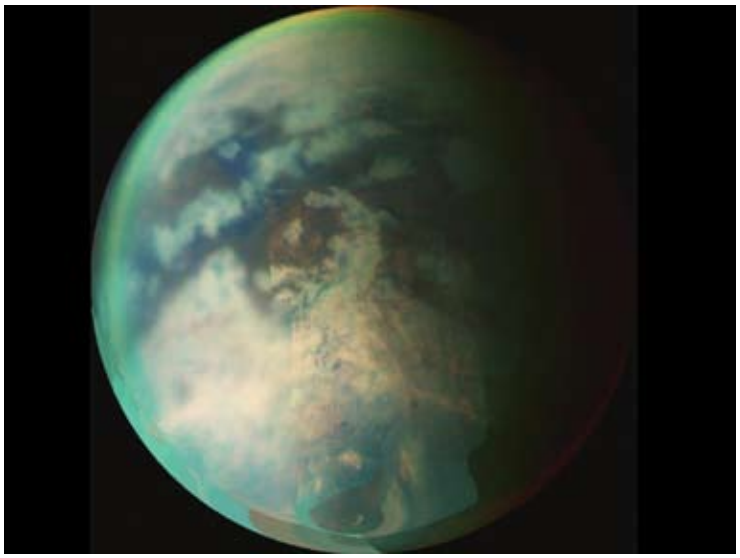
top left:: Image of the Large Magellanic Cloud. Courtesy NASA/Spitzer Space Telescope/SAGE
bottom left:: Near-infrared image of a young stellar object. Courtesy University of Chicago Press
top right:: Quasar 3C454.3. Courtesy Spitzer Space Telescope, NASA
bottom right:: This infrared image is a composite of several images taken during two separate Titan flybys on Oct. 9 and Oct. 25, 2006. Courtesy Cassini/NASA/ESA

Catching a Quasar in the Act

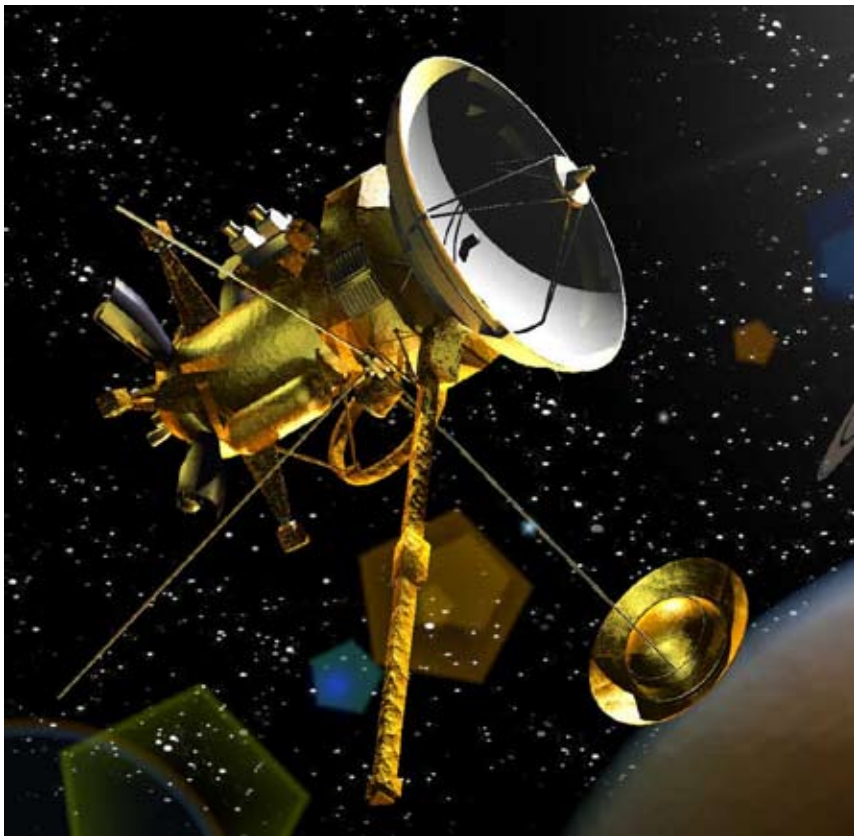
SSI researcher Ann Wehrle (LaCanada, California Office) and a colleague are investigating the May 2005 flare in quasar 3C454.3 which was briefly the brightest quasar in the sky, brightening by a factor of 100. They used the Spitzer Space Telescope for about an hour a day for 30 days to follow the changing spectrum as the quasar faded. Surprisingly, the spectral changes were complex: the quasar was expected to fade first at short wavelengths, then longer wavelengths, but instead the quasar doubled in brightness during the 30 days of observations, then faded again. Additional observations are scheduled for winter 2006 and summer 2007. Quasars are thought to be the active nuclei of young galaxies. They are billions of light-years away and several hundred billion times brighter than normal stars.

SSI/Bear Fight Center

The planetary science research program led by Thomas B. McCord operates at a facility called the Bear Fight Center (BFC), located near Winthrop, WA. Dr. McCord is a science investigator in five NASA and European Space Agency (ESA) missions to various Solar System objects. He is also actively involved in the planning of several future missions for NASA and ESA. The space missions include Cassini (orbiting Saturn), Mars Express (orbiting Mars), Rosetta (in transit to a comet), Dawn (to be launched July 2007 to Vesta and Ceres), and Chandraayn 1 (to orbit the Moon). Several young scientists were hired recently to work on various projects at BFC and to develop new projects of their own: Dr. Jean-Philippe Combe and Dr. Georgiana Kramer. Finally, BFC is developing an active education and public outreach program within its local community.



Cassini Flight Operations



The Cassini Imaging Central Laboratory for Operations (CICLOPS) is located at SSI's Boulder, Colorado office. It is the nerve center for the imaging team of the Cassini mission to Saturn. All images produced by the two powerful telescopic cameras onboard Cassini (the Imaging Science Subsystem) make their way across more than a billion and a half kilometers (1 billion miles) of space to be archived by CICLOPS and made available to researchers across the globe. CICLOPS is also the home of activities related to the planning of images to be taken by Cassini. Staff work with the spacecraft's flight plan to optimize the imaging opportunities (and thus the scientific return) of the mission while at Saturn, capturing the planet, its icy moons, and dazzling rings.

The Cassini-Huygens mission continues to change the way we view the outer Solar System. Since arriving at Saturn in the summer of 2004, the intrepid spacecraft has completed more than a dozen close flybys, providing new perspectives and a wealth of data about the planet's unique collection of moons. Cassini has monitored powerful lightning-generated radio outbursts and cloud activity produced by giant storms on Saturn that dwarf those on Earth. The Huygens probe landing on haze-shrouded Titan, and Cassini's continuing survey from space, have provided tantalizing glimpses of a world that is at once remarkably earthlike and also frigid and alien. The startling revelation that Saturn's small, icy moon Enceladus may possess underground reservoirs of liquid water has widened the range of environments that might be hospitable for life.

Images taken by Cassini are selected for release to the public at CICLOPS. Chosen images and movie sequences are processed to ensure quality, including the best possible color. The final products are posted to the CICLOPS website (http://ciclops.org) and sent to NASA's Jet Propulsion Laboratory (JPL), for simultaneous distribution to the waiting world. Also posted on the CICLOPS site are imaging news stories, upcoming mission events, public discussions, Saturn-inspired artwork, and more.

Cassini's landmark exploration of the ringed planet, its mysterious moons, stunning rings, and complex magnetic environment will continue through at least July 2010, and perhaps beyond. CICLOPS and the Cassini mission have begun planning in earnest for the extended two-year tour (July 2008–July 2010). Many discoveries—and many sights—remain to be seen.

top:: Courtesy NASA/ESA

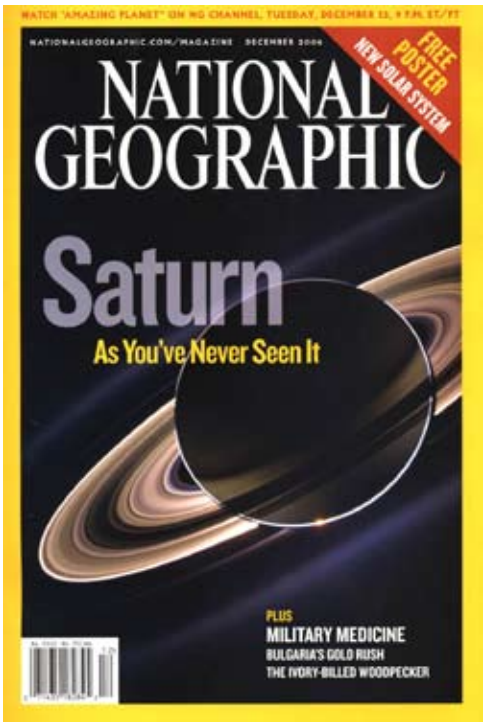
The Cassini-Huygens mission is a cooperative project of NASA, the European Space Agency, and the Italian Space Agency. The Jet Propulsion Laboratory, a division of the California Institute of Technology in Pasadena, manages the Cassini-Huygens mission for NASA's Science Mission Directorate, Washington, D.C.

Cassini / Saturn Research

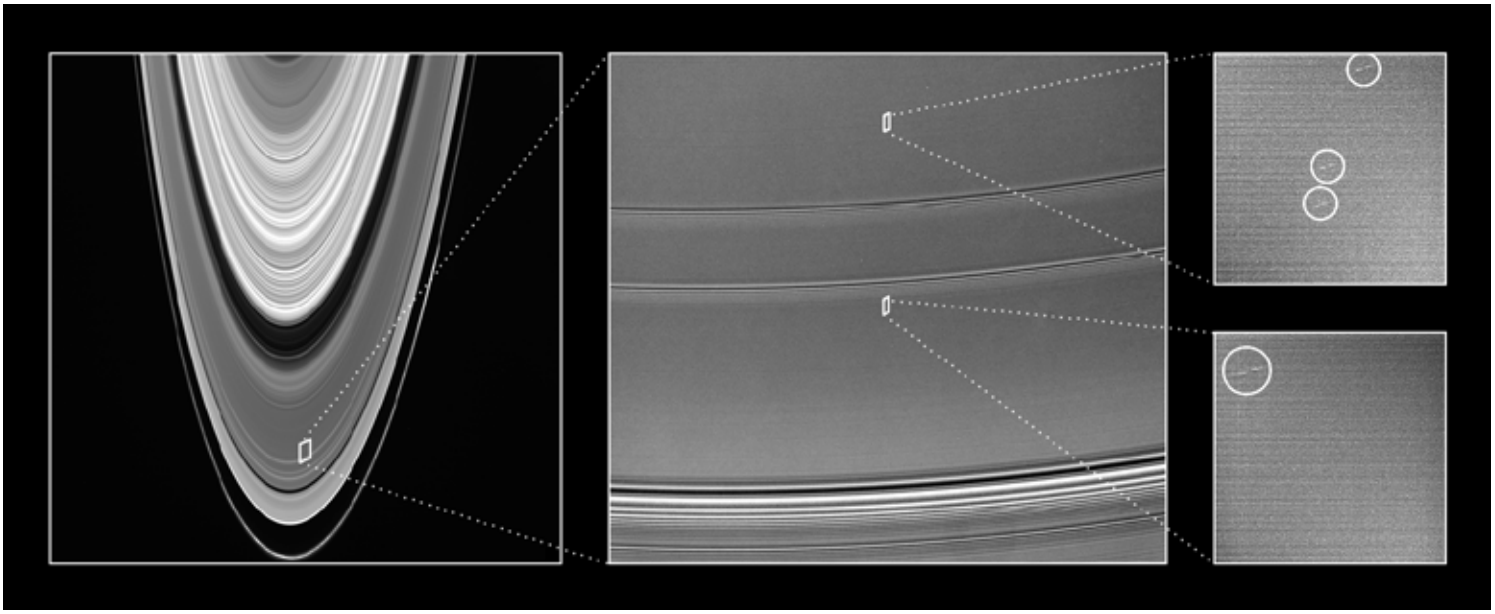
Led by Carolyn Porco, the Cassini Imaging Team headquarters came to SSI in August 2003. Fourteen scientists from the United States and Europe comprise the imaging team that uses Cassini's cameras to investigate many unique features of the Saturn system.

The Imaging Team continues to publish findings from their investigations, deepening our knowledge about Saturn and the processes by which planets—and whole planetary systems—form and develop with time.

In 2006, Cassini imaging investigations were celebrated on the cover of the prestigious journal Science, as well as the beloved National Geographic. Images produced by CICLOPS were, as in 2005, noted as some of the most stunning photography of the year (from any planet).

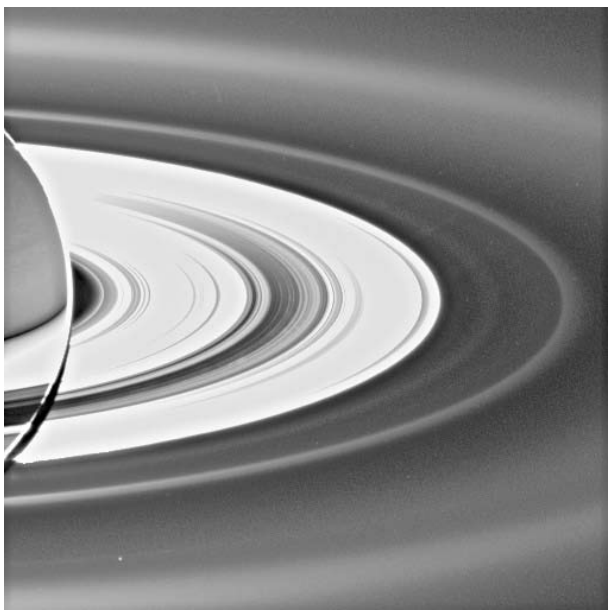


2006 Cassini Highlights



Propeller-shaped Features in the Rings Hint at Unseen Moonlets

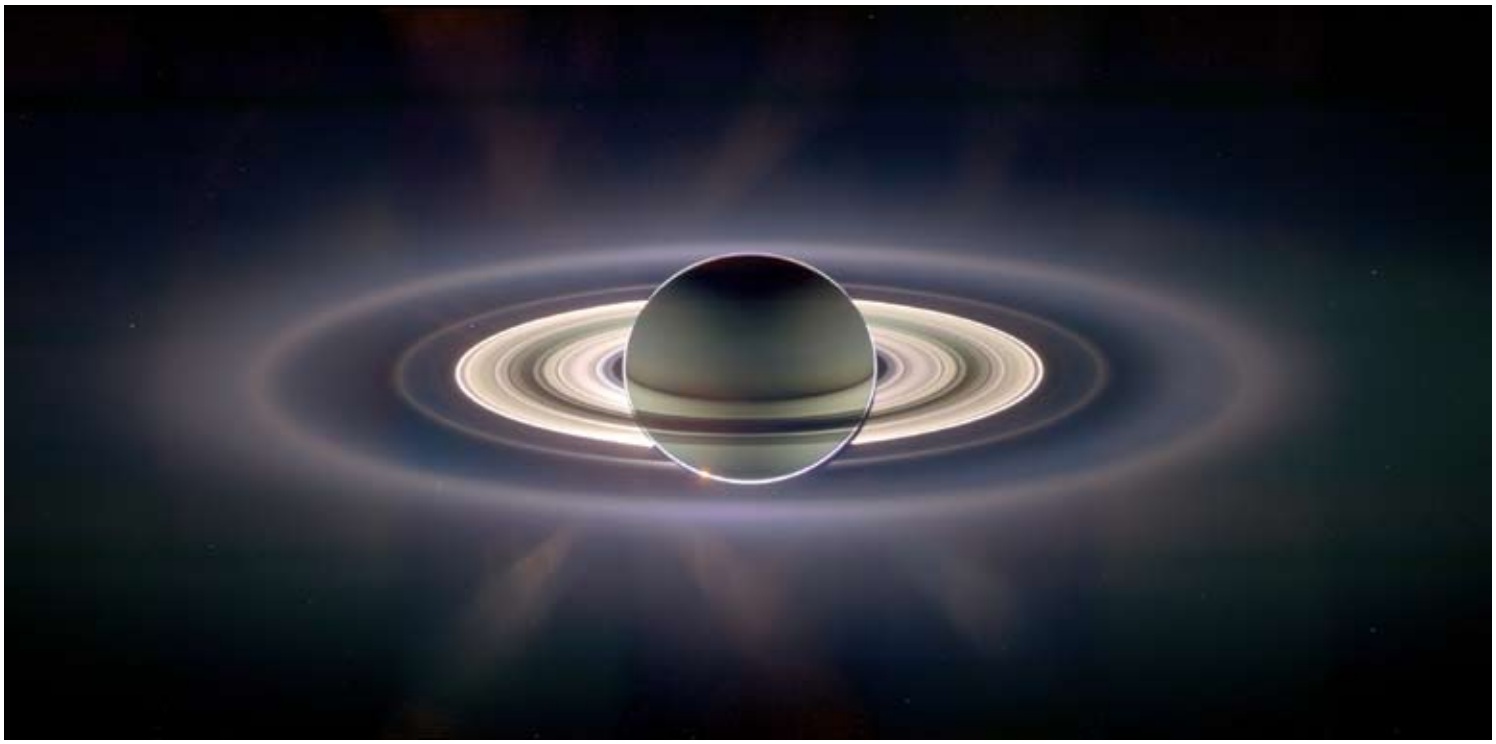
Careful analysis of Cassini's highest resolution images of the rings revealed four faint, propeller-shaped double-streaks in an otherwise bland part of the mid-A Ring. Imaging scientists believe the "propellers" provide the first direct observation of the dynamical effects of moonlets approximately 100 meters (300 feet) in diameter. The propeller moonlets represent a hitherto unseen size-class of particles orbiting within the rings.



New Faint Rings Discovered

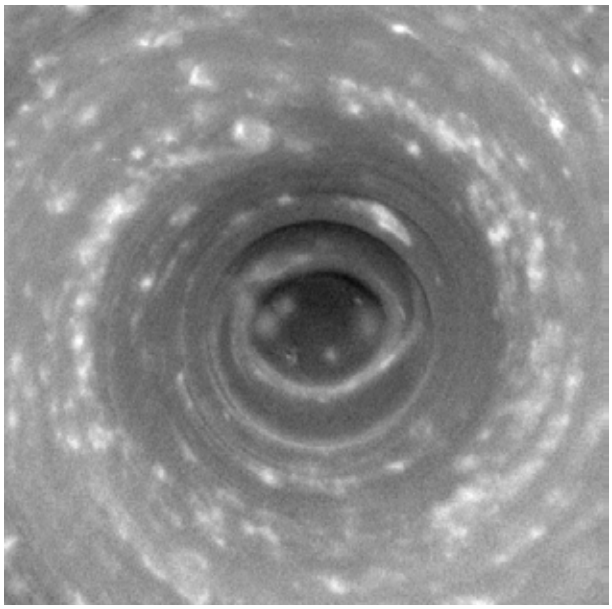
With the Sun almost directly behind Saturn, Cassini spied previously unknown faint rings of material coincident with the orbits of several small moons that orbit near the outer edge of the main ring. While it is not unexpected that impact events on these small moons might kick particles off the moons' surfaces and inject them into Saturn orbit, it is surprising that these structures are so well-defined.

all on page:: Courtesy Cassini Imaging Team and NASA/JPL/SSI



In Saturn's Shadow

With giant Saturn hanging in the blackness and sheltering Cassini from the Sun's blinding glare, the spacecraft viewed the rings as never before, capturing this marvelous panoramic view in September, 2006. The images in this mosaic were acquired as the spacecraft drifted in the darkness of Saturn's shadow for about 12 hours, allowing a multitude of unique observations of the microscopic particles that comprise Saturn's faint rings, and even a glimpse of the far-off Earth. This is one of the outstanding science images of 2006.



Great Storm at Saturn's South Pole

In October, 2006, Cassini stared deep into the swirling, hurricane-like vortex at Saturn's South Pole. Such a storm, with a well-developed eye ringed by towering clouds, is a phenomenon never before seen on another planet. The "hurricane" spans a dark area inside a thick, brighter ring of clouds. It is approximately 8,000 kilometers (5,000 miles) across, or two thirds the diameter of Earth.

Education & Public Outreach

SSI's Education Branch is involved in a variety of innovative projects that promote inquiry, science literacy, and foster collaboration between scientists and educators to bring the knowledge and excitement of scientific discovery to audiences across the country. Events, such as planetary and astrophysics missions, are catalysts for learning the content and process of science, consistent with national and state education standards. In addition, our programs help cultivate a greater appreciation and understanding of science in the general public. They span a range of audience needs and delivery methods, including traveling museum exhibitions; award-winning educational films, videos, and websites; hands-on teaching resources and activities; educator workshops; outreach to underserved audiences, such as girls' groups, Hispanic, Native American and rural communities; and successful partnership building between scientists and educators.

Guiding Principles

- Plan strategically for continued innovation
- Integrate science research and science education
- Contribute significantly to educational research
- Ensure scientific accuracy in all activities
- Evaluate all products and disseminate results
- Cultivate mutually beneficial partnerships in science and education communities
- Excite learners of all ages, ethnicities, and learning modalities with the thrill of scientific discovery

Our programs in 2006 impacted many people (locally, nationally, and even internationally):

- 300,000 visitors to SSI museum exhibits both nationally and internationally
- 360,000 visitors to SSI educational websites
- 300 participants in educator workshops, virtual workshops, and conference presentations
- 37,000 downloads of SSI educational materials, activities, and resources distributed online

SSI's educational projects include large-scale, institutional-level efforts supported by the National Science Foundation and NASA, as well as smaller-scale programs that focus on individual scientists seeking educational support for their research projects. This strategic approach allows SSI to leverage the needs and effectiveness of both kinds of endeavors and allows our staff to explore new educational methods and effectively "scale up" those that show promise.

In keeping with that strategy, SSI is pursuing new directions for educational programming: the continued development of increased documentary film production capabilities; an innovative Twenty Ninth Street Mall public outreach project in Boulder's newest pedestrian mall; and applications of internet and multimedia technologies to facilitate social learning experiences. SSI and its partners are leading the way to a new generation of educational innovation, which bridges the worlds of science research and science communication.

top:: Visitors learn how scientists find planets in the Alien Earths exhibition. Space Science Institute
bottom:: Young visitors to Yale's Peabody Museum investigate a model of the Solar System. Space Science Institute

2006 Education and Public Outreach Highlights

Alien Earths Exhibit

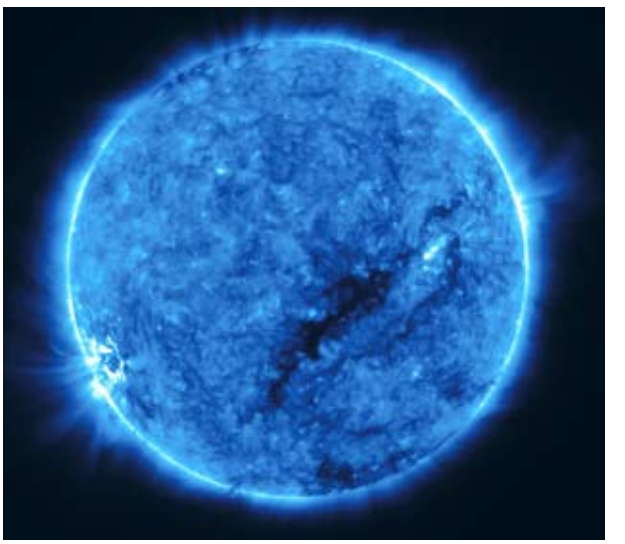
With funding from NSF and NASA, the Space Science Institute and its partners developed a 3,000 square-foot traveling exhibition, called Alien Earths. It brings the science behind the search for planets and life elsewhere in the Universe to students and public audiences across the United States. Alien Earths has four interrelated exhibit areas: Our Place in Space, Star Birth, Planet Quest, and Search for Life. In early 2005 it began its initial 3-year tour (managed by the Association of Science-Technology Centers) to 9 host museums and science centers, starting at the Lawrence Hall of Science in Berkeley, California. In 2006, Alien Earths traveled to the Museum of Science and Technology in Syracuse, NY and Yale's Peabody Museum in Hartford, CT. So far it has reached over 222,000 people. In addition to the exhibit, the project includes in-person and virtual workshops for educators and docents at host sites, as well as a cutting-edge public website (www.alienearths.org) that features exciting web interactives and dynamic exhibit content that will help visitors answer the question, Are we alone?

SSI has also begun to market an interactive solar system design program called Planet Families that was originally created for the Alien Earths exhibit. Using a real physical model, it enables visitors to build their own solar systems, and then watch as their planets and star interact. A multi-player, online version was launched in 2006.

Mars Outreach

SSI's MarsQuest exhibition has been on tour for over five years. In 2005, it left the U.S. for two venues in England: one in Newcastle-upon-Tyne and another in Manchester. In Fall 2006, MarsQuest returned to the United States for a booking at the Museum of Discovery and Science in Fort Lauderdale, FL. In 2006, SSI collaborated with NASA's Phoenix Mars Lander mission to develop a new Phoenix component for MarsQuest. The Phoenix lander will explore the Martian arctic. It is equipped with a digging arm and instruments for determining the chemical composition of soil samples. The Phoenix exhibit component consists of a model of the lander that has a working digging arm. Visitors use joysticks to control the arm and test a sample of simulated Martian soil. This engaging interactive joined MarsQuest late in 2006. MarsQuest Online (www.marsquestonline.org) continues to track the MER rovers with its real-time rover image galleries, and will be adding a global 3D flyover capability in late 2007.

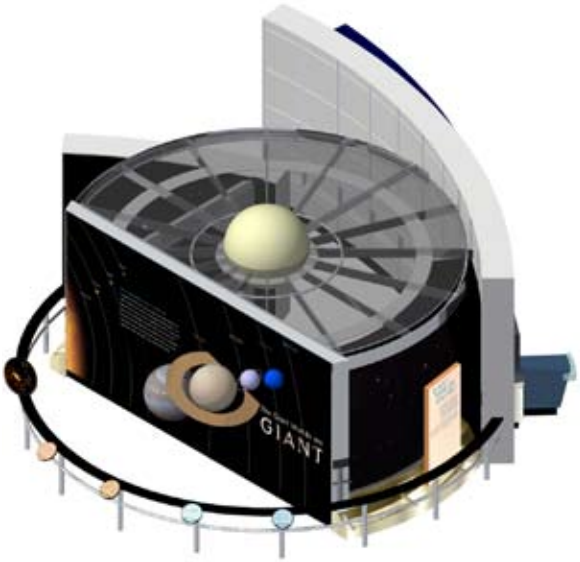
Space Weather Outreach



SSI has been funded by both NSF's Upper Atmospheric Research Section and NASA's Living With A Star program to develop a variety of education products related to space weather research programs. It managed the tour of the Space Weather Center exhibit (developed in partnership with GSFC and funded by both NASA/GSFC and NSF) that recently ended a successful three-year tour. Workshops for museum educators and docents were conducted at several host sites. SSI also created the Family Guide to the Sun, which is used for community-based programs and education workshops. SSI recently redesigned the Space Weather Center Web site (www.spaceweathercenter.org), which was originally launched in 1999. It has become one of the most comprehensive and popular space weather resources available online. The new Space Weather Center website balances engaging activities with telling the broader story of space weather effects. Visitors can also access additional resources, such as a space weather FAQ, links, and a glossary. Over 500 domains link to the site, including NASA, schools, and sites on the aurora.

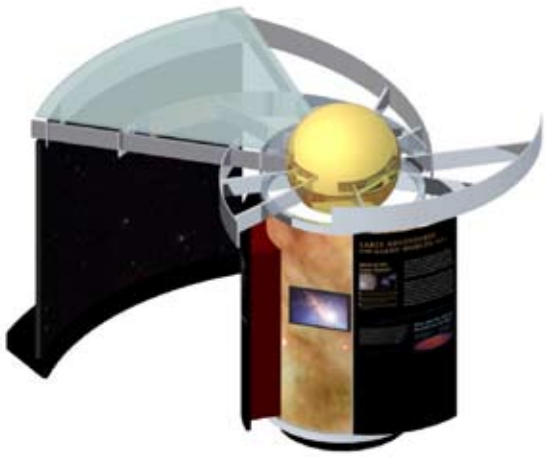
top left:: Phoenix Lander model. Space Science Institute
bottom left:: NASA's STEREO mission takes a close-up image of the Sun's turbulent surface. Courtesy NASA/STEREO
top right:: The Great Escape screen capture. Space Science Institute
bottom right:: Giant Worlds exhibit designs. Space Science Institute

The site strongly emphasizes interactive activities and games, including The Great Escape (a combination maze and word search based on stellar structure), Matter Sorter (a Tetris-like game that explores the four states of matter), and even an E-Cards system that enables visitors to send images and personalized messages to their friends and family directly from the website. The research background of the education team allows for the creation of extremely sophisticated, simulation based games. For instance, Magneto Mini-Golf uses research-grade plasma "particle pusher" algorithms to model the behavior of charged particles in electric and magnetic fields. This is done in the context of a mini-golf game, providing an engaging framework to teach visitors about charged particle motion. These activities have been extremely successful, and while designed for "informal education" environments, they are also commonly used in classroom settings.



Giant Worlds Exhibit

NSF has provided major funding to SSI to develop Giant Worlds: A Voyage to the Outer Solar System, which is a 3,500-square-foot traveling exhibition about the giant planets in our Solar System that will begin a three-year national tour in 2008. Giant Worlds will bring recent discoveries and cutting-edge planetary science to museums and science centers around the country, particularly mid-sized venues that serve both urban and rural areas. Visitors will witness the beginnings of our Solar System; send a probe through the crushing atmosphere of Jupiter; explore the beautiful rings of Saturn; and enter an immersive environment that takes them on a grand tour of these giant planets with their rings, moons, and enormous magnetic field regions. The Association of Science-Technology Centers (ASTC) will manage the national tour. NASA's Cassini mission to Saturn and the upcoming Juno mission to Jupiter are partners in this project. Over 450,000 people are expected to visit the exhibit during its three-year tour, including students, educators, and families.

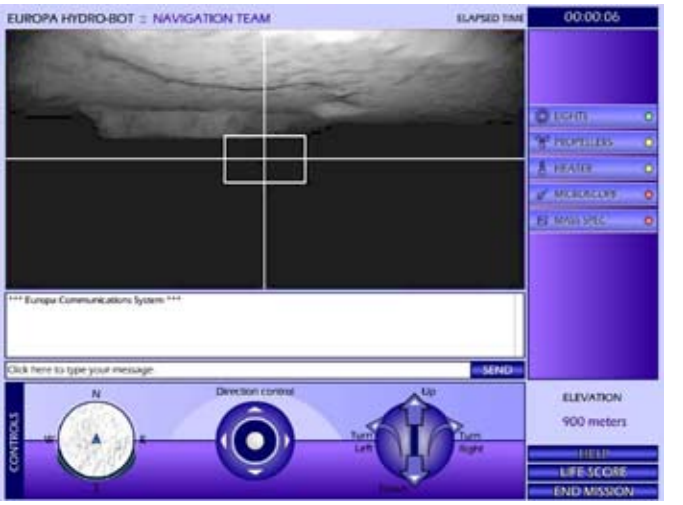


Space-Faring: The Radiation Challenge

It is 70 years in the future. You are half-way to Mars in your interplanetary spacecraft when suddenly, a coronal mass ejection erupts from the Sun's surface – a billion tons of solar plasma coming at you at a million miles per hour. Don't panic… for we know a little something about space radiation, what it can do to astronauts, and how to protect ourselves.

This is the subject of SSI Educator Brad McLain's "Radiation and Human Spaceflight" project, which is producing 2 high-definition educational videos and complementary classroom activities for middle and high school students. This project integrates space weather with biology and technology to provide a standards-aligned, richly multidisciplinary educational experience for teachers and students alike. The final products will debut May 2007 at the annual Project ASTRO conference. Project partners include Marshall Space Flight Center, the Astronomical Society of the Pacific, Clark Planetarium, and numerous scientists and film production staff.

Europa-Sim: Hydrobot Life-Seeker



SSI Educator Brad McLain's "Europa-SIM: Hydrobot Life-Seeker" project is nearing completion. This NASA-funded, Web-interactive is a multi-player game-like simulation originally designed to prototype an actual hardware interactive. It engages three or more players in a highly coordinated hydrobot mission to search for "life clues" in the sub-surface ocean on Jupiter's moon, Europa. The game contains embedded educational value targeting middle school aged kids and focusing on astrobiology science content.

The simulator has been tested with numerous middle school focus groups through the Challenger Learning Center of Colorado and Fiske Planetarium, two of the partners on the project. Thanks to SSI Programmer Evaldas Vidiguris' many talents, it has received rave reviews from girls and boys alike. Look for this interactive to be launched on SSI's website in mid-2007.

top left:: Collage from the Space-Faring project. Space Science Institute
bottom left:: Europa-Sim screen shot. Space Science Institute

Space Science Institute
Summary Statement of Financial Position
as of December 31, 2006 and 2005

	2006	2005
Assets		
Assets		
Cash and cash equivalents	$ 439,076	$ 253,630
Accounts receivable	673,211	701,428
Prepaid expenses and deposits	64,868	86,258
Net furniture, equipment, and property	172,708	131,247
Total assets	$ 1,349,863	$ 1,172,563
Liabilities and Net Assets		
Liabilities		
Accounts payable and accrued liabilities	$ 247,267	$ 256,286
Capital lease obligations	269	27,037
Deferred revenues	502,354	284,969
Line of credit	405,000	372,224
Other	-	-
Total liabilities	1,154,890	940,516
Net assets		
Unrestricted	121,924	198,213
Temporarily restricted	73,049	33,834
Total net assets	194,973	232,047
Total liabilities and net assets	$ 1,349,863	$ 1,172,563

Summary Statement of Activities
for the years ended December 31, 2006 and 2005

	2006	2005
Support and revenue		
Grants, contracts, and cooperative agreements	$ 4,791,240	$ 4,344,790
Contributions	-	-
Equipment	-	-
Exhibit income	81,682	108,036
Interest income	330	864
Other income	-	9,250
Gain on disposal of equipment	-	-
Total support and revenue	4,873,252	4,462,940
Expenses		
Program services	4,833,629	4,512,696
General and administrative	76,697	28,008
Total expenses	4,910,326	4,540,704
Change in net assets	(37,074)	(77,764)
Net assets, beginning of year	232,047	309,811
Net assets, end of year	$ 194,973	$ 232,047

The summary financial information does not include sufficient detail or disclosures to constitute presentation in conformity with accounting principles generally accepted in the United States of America. If the omitted detail or disclosures were included, they might influence the user's conclusions about the Organization's financial position, changes in net assets, and cash flows. Accordingly such information should be read in conjunction with the Organization's audited financial statements for the years ended December 31, 2006 and 2005, from which the summarized information was derived. A copy is available upon request.

Publications and Activities 2006

R. Todd Clancy

PROFESSIONAL ORGANIZATIONS & SERVICE

American Geophysical Union, Member
AAS Division of Planetary Sciences, member
ALMA North American Science Advisory Committee (ANASAC)
MEPAG Science Analysis Group (SAG), Goals and Objectives for the Human Exploration of Mars (HEM)
Mars Fundamental Research Program (MFRP) Review Panel
Mars Extended Mission Senior Review Panel

PUBLICATIONS

Clancy, R.T., M.J. Wolff, B.A. Whitney, B.A. Cantor, and M.D. Smith, Mars equatorial mesospheric clouds: Global occurrence and physical properties from Mars Global Surveyor TES and MOC limb observations, G. Geopyhs. Res., in press, 2007.

Wolff, M.J., M.D. Smith, R.T. Clancy, N. Spanovich, B.A. Whitney, M.T. Lemmon, J.L. Bandfield, D. Banfield, A. Ghosh, G. Landis, P.R. Christensen, J.F. Bell III, and S.W. Squyres, Constraints on dust aerosols from the Mars Exploration Rovers using MGS overflights and Mini-TES, J. Geophys. Res., E12S17, doi:10.1029/2006JE002786, 2006.

Montmessin, F., R.M. Haberle, F. Forget, R.T. Clancy, J.P. Bibring, and Y. Langevin, On the origin of perennial water ice at the South Pole of Mars: A precession-controlled mechanism?, submitted to J. Geophys. Res., 2006.

MEETINGS AND CONFERENCE PROCEEDINGS

Clancy, R.T., B.J. Sandor, G.H. Moriarty-Schieven, and M.D. Smith, Mesospheric Winds and Temperatures from JCMT Sub-millimeter CO line Observations during the 2003 and 2005 Mars Oppositions, Mars Atmosphere Modelling and Observations Workshop, Granada, Spain, Feb 24-March 1, 2006.

Clancy, R.T., M.J. Wolff, B.A. Whitney, and B.A. Cantor, Mars equatorial mesospheric clouds, Mars Atmosphere Modelling and Observations Workshop, Granada, Spain, Feb 24-March 1, 2006.

Clancy, R.T., B.A. Sandor, and G.H. Moriarty-Schieven, Roiling Times in the Venus lower thermosphere: From retrograde zonal to SSAS in a week (and more…), Chapman Conference: Exploring Venus as a Terrestrial Planet, Key Largo, FL, Feb 13-16, 2006

Paul B. Dusenbery

PROFESSIONAL ORGANIZATIONS & SERVICE

Proposal Reviewer, National Science Foundation
Proposal Reviewer, National Aeronautics and Space Administration
Journal of Geophysical Research
Member, 29th Street Education Project
Member of AGU, AAS, DPS, NSTA, and ASCD

MEETINGS AND CONFERENCE PROCEEDINGS

Dusenbery, P., Curtis, L., Harold, J., SSI booth, ASTC, Louisville, KY, October 2006

PUBLICATIONS

Dusenbery, P., Inspiring Tomorrow's Scientists, Guest opinion, Daily Camera, Boulder, CO, September, 2006.

William Farrand

PROFESSIONAL ORGANIZATIONS & SERVICE

Geological Society of America, Member
American Geophysical Union, Member
American Society of Photogrammetry and Remote Sensing, Member
American Astronomical Society, Division of Planetary Sciences, Member

PUBLICATIONS

S. W. Squyres, A. H. Knoll, R. E. Arvidson, B. C. Clark, J. P. Grotzinger, B. L. Jolliff, S. M. McLennan, N. Tosca, J. F. Bell, III, W. M. Calvin, W. H. Farrand, T. D. Glotch, M. P. Golombek, K. E. Herkenhoff, J. R. Johnson, G. Klingelhöfer, H. Y. McSween, A. S. Yen (2006) Two years at Meridiani Planum: Results from the Opportunity rover, Science, 313, 1403-1407.

Farrand, W.H., J.F. Bell III, J.R. Johnson, S.W. Squyres, J. Soderblom, D.W. Ming (2006) Spectral variability among rocks in visible and near infrared multispectral Pancam data collected at Gusev Crater: Examinations using spectral mixture analysis and related techniques. J. Geophys. Res.: Planets, 111, E02S15, 10.1029/2005JE002495.

Squyres, S. W.; Arvidson, R. E.; Bollen, D.; Bell, J. F., III; Brückner, J.; Cabrol, N. A.; Calvin, W. M.; Carr, M. H.; Christensen, P. R.; Clark, B. C.; Crumpler, L.; Des Marais, D. J.; d'Uston, C.; Economou, T.; Farmer, J.; Farrand, W. H. and 38 others. (2006) Overview of the Opportunity Mars Exploration Rover Mission to Meridiani Planum: Eagle Crater to Purgatory Ripple. J. Geophys. Res., Vol. 111, No. E12, E12S12, 10.1029/2006JE002771.

Ruff, S.W., P.R. Christensen, D.L. Blaney, W.H. Farrand, J.R. Johnson, J.E. Moersch, S.P. Wright, S.W. Squyres (2006) The rocks of Gusev Crater as viewed by the Mini-TES instrument. J. Geophys. Res.: Planets, 111, E12S18, 10.1029/2006JE002747.

Johnson, J.R., W.M. Grundy, M.T. Lemmon, J.F. Bell III, M.J. Johnson, R. Deen, R.E. Arvidson, W.H. Farrand, E. Guinesss, A.G. Hayes, K.E. Herkenhoff, F. Seelos IV, J. Soderblom, S.W. Squyres (2006) Spectrophotometric properties of materials observed by Pancam on the Mars Exploration Rovers: 2. Opportunity. J. Geophys. Res.: Planets, 111, E12S16, 10.1029/2006JE002762.

Arvidson, R. E.; F. Poulet; R.V. Morris; J.-P.Bibring; J.F. Bell III; S.W. Squyres; P.R. Christensen; G. Bellucci; B. Gondet; B.L. Ehlmann; W.H. Farrand; R.L. Fergason; M. Golombek; J.L. Griffes; J. Grotzinger; E.A. Guinness; K.E. Herkenhoff; J.R. Johnson; G. Klingelhöfer; Y. Langevin; D. Ming; K. Seelos; R.J. Sullivan; J.G. Ward; S.M Wiseman; M. Wolff (2006) Nature and origin of the hematite-bearing plains of Terra Meridiani based on analyses of orbital and Mars Exploration rover data sets. J. Geophys. Res.: Planets, 111, E12S08, 10.1029/2006JE002728.

Weitz, C.M., R.C. Anderson, J.F. Bell III, W.H. Farrand, K.E. Herkenhoff, J.R. Johnson, B.L. Joliff, R.V. Morris, S.W. Squyres, R.J. Sullivan (2006) Soil grain analyses at Meridiani Planum, Mars, J. Geophys. Res.: Planets, 111, E12S04, 10.1029/2005JE002541

MEETINGS AND CONFERENCE PROCEEDINGS

Farrand, W.H. and M.D. Lane (2006) Multi-dataset analysis of surface units and landforms on the Northern Plains of Mars, Lunar and Planetary Science XXXVII, #1499.

Farrand, W.H., B.L. Jolliff, J.F. Bell III, and J.R. Johnson (2006) Visible/near infrared spectral trends between Meridiani Planum surface materials: Comparisons between spherules, basaltic sands, outcrop rinds and cobbles, Lunar and Planetary Science XXXVII, #1707.

Farrand, W.H. and M.D. Lane (2006) Multi-dataset characterization of unusual landforms and surfac cover units on the northern plains of Mars, Geol. Soc. America, Annual Meeting, Paper #123-14.

Farrand, W.H., J.W. Rice, and T.D. Glotch (2006) Multi-sensor mapping and multispectral analysis of the Mawrth Vallis region of Mars. American Geophysical Union, Fall Meeting, paper #P22A-06.

Heidi B. Hammel

PROFESSIONAL ORGANIZATIONS & SERVICE

American Astronomical Society (AAS), Division for Planetary Science (DPS), Member
- AAS George Van Biesbroeck Prize Committee (2006 - present)
- DPS Prize Subcommittee (2005 - present)
- DPS Web Site Developer, Administrator; see http://www.aas.org/~dps (1995 - 2006)

American Association for the Advancement of Science, Elected Member-at-large for
- Section D (Astronomy) (2002 - present)

International Astronomical Union, Member
American Geophysical Union, Member
Association for Women in Science, Member
AURA, Board of Directors (2003-present)
The Planetary Society, Board of Directors (2005-present)
NASA Astrophysics Subcommittee (2006 - present)
NASA Science Investigations
- Interdisciplinary Scientist, James Webb Space Telescope (2002 - present); also JWST (formerly NGST) Interim Science Working Group (2001 - 2002)
- Team Member and Chair of Giant Planets Sub-panel, NASA Science and Technology Definition Team, Terrestrial Planet Finder – Coronograph Mission (2005 - 2006)

Organizing Committees for Scientific Meetings, both Science (SOC) and Local (LOC)
- SOC, Planetary Atmospheres, Baltimore, MD, November 2007
- LOC, Astrophysics in the Next Decade: JWST and Concurrent Facilities, Tucson, AZ, September 2007
- SOC, Workshop On Science Associated With The Lunar Exploration Architecture, Tempe, AZ, November 2006
- SOC, An International TPF/Darwin Workshop: Star Planet Interactions and implications for Habitability, Pasadena, CA, November 2006
- Organizer, "Uranus at Equinox" Workshop, Pasadena, CA, May 2006

PUBLICATIONS

Sromovsky, L. A., P. M. Fry, H. B. Hammel, I. de Pater, K. A. Rages, and M. R. Showalter. Dynamics, evolution, and structure of Uranus' brightest cloud feature. Submitted to *Icarus* (2007).

Lynch, D. K., R. W. Russell, H. B. Hammel, and M. L. Sitko. Mid-infrared spectroscopy of Phobo and Deimos. Submitted to *Icarus* (2007).

Fitzsimmons, A., A. M. Zalucha, J. Elliot, J. Thomas-Osip, H. B. Hammel, T. R. Marsh, V. S. Dhillon, F.W. Taylor, and P. G. J. Irwin. The 2003 Nov 14 occultation by Titan of TYC-1343-1865-1. I. High-cadence multi-colour occultation lightcurves. Submitted to *Astron. & Astrophys.* (2007).

Zalucha, A. M., A. Fitzsimmons, J. Elliot, J. Thomas-Osip, H. B. Hammel, T. R. Marsh, V. S. Dhillon, F.W. Taylor, and P. G. J. Irwin. The 2003 Nov 14 occultation by Titan of TYC-1343-1865-1. II. Analysis of light curves. Submitted to *Icarus* (2007).

Goldman, B., M. C. Cushing, M. S. Marley, É. Artigau, K. S. Baliyan, V. J. S. Béjar, J. A. Caballero, N. Chanover, M. Connelley, R. Doyon, T. Forveille, S. Ganesh, C. R. Gelino, H. B. Hammel, J. Holtzman, S. Joshi, U. C. Joshi, S. K. Leggett, M. C. Liu, E. L. Martín, V. Mohan, D. Nadeau, R. Sagar, and D. Stephens. CLOUDS search for variability in brown dwarf atmospheres. I: Infrared spectroscopic time series of L/T transition brown dwarfs. Submitted to *Astron. & Astrophys.* (2007).

Hammel, H. B., and G. W. Lockwood. Suggestive correlations between the brightness of Neptune, solar variability, and Earth's temperature. *GRL*, in press (2007).

Hammel, H. B., and G. W. Lockwood. Long-term atmospheric variability on Uranus and Neptune. *Icarus* **186**, 291-301 (2007).

Gardner, J. P., J. C. Mather, M. Clampin, R. Doyon, M.A. Greenhouse, H. B. Hammel, J. B. Hutchings, P. Jakobsen, S. Lilly, K. Long, J. I. Lunine, M. J. McCaughrean, M. Mountain, J. Nella, G. H. Rieke, M. J. Rieke, H.-W. Rix, E. P. Smith, G. Sonneborn, M. Stiavelli, H. S. Stockman, R. A. Windhorst, and G. S. Wright. The James Webb Space Telescope. *Space Science Review* **123**, 485-606 (2006).

Hammel, H. B., M. L. Sitko, D. K. Lynch, R. W. Russell, T. Hewagama, and L. Bernstein. Mid-infrared ethane emission on Neptune and Uranus. *Ap. J.* **644**, 1326-1333 (2006).

de Pater, I., H. B. Hammel, S. G. Gibbard, and M. R. Showalter. New dust belts of Uranus: One ring, two ring, red ring, blue ring. *Science* **312**, 92-94 (2006).

de Pater, I., S. Gibbard, and H. B. Hammel. Evolution of the dusty rings of Uranus. *Icarus* **180**, 186-200 (2006).

MEETINGS AND CONFERENCE PROCEEDINGS

Hammel, H. B. Mid-IR Observations of the Outer Planets. AAS Winter meeting 2007; *Bull. Amer. Astron. Soc.* **38**, 1223-1224 (2007).

Hammel, H. B., M. L. Sitko, G. S. Orton, T. Geballe, D. K. Lynch, R. W. Russell, and I. de Pater. Distribution of Ethane and Methane Emission on Neptune. AAS Winter meeting 2007; *Bull. Amer. Astron. Soc.* **38**, 936 (2007).

Lynch, D. K., R. J. Rudy, R. W. Russell, S. Masuk, Venturini, C. C., M. L. Sitko, H. B. Hammel, R. C. Puetter and R. B. Perry. The 0.5-13 μm Spectrum of V4332 Sagittarii in 2006. AAS Winter meeting 2007; *Bull. Amer. Astron. Soc.* **38**, 907 (2007).

Rages, K. A., H. B. Hammel, and I. de Pater. Neptune from Keck: Tracking down the scatterers. DPS Fall meeting 2006; *Bull. Amer. Astron. Soc.* **38**, 555 (2006).

Martin, S. I. de Pater, J. Kloosterman, S. Gibbard, and H. B. Hammel. Multi wavelength imaging of Neptune at high spatial resolution. DPS Fall meeting 2006; *Bull. Amer. Astron. Soc.* **38**, 502 (2006).

Norwood, J., N. Chanover, and H. Hammel. Constraints on the distribution of methane in Uranus' atmosphere. DPS Fall meeting 2006; *Bull. Amer. Astron. Soc.* **38**, 502 (2006).

Hammel, H. B., and G. W. Lockwood. Long-term atmospheric variability on Uranus and Neptune. DPS Fall meeting 2006; *Bull. Amer. Astron. Soc.* **38**, 502 (2006).

Dean Hines, Ph. D

PROFESSIONAL ORGANIZATIONS & SERVICE

Geological Society of America, Member
NASA Science Investigations: NICMOS/HST Instrument & Science Team; MIPS/Spitzer Instrument and Science Team; FEPS Legacy Program Data Lead, PI, Co-I on HST & Spitzer GO Programs
American Astronomical Society (1986 – present)
Spitzer Science User Panel (2005 – present)
NASA Infrared Telescope Facility (IRTF) TAC Member (2006 – present)
Spitzer TAC Panel Member (2006 – present)
Chandra TAC Panel Member (2006 – present)
Referee for Astrophysical Journal (ApJ), Astrophysical Letters (ApJL), Publications of the Astronomical
Society of Japan (PASJ)

PUBLICATIONS

Author/coauthor of 93 refereed publications on spectro- and imaging polarimetry, infrared astronomy, space-based instrumentation, quasars and other ultraluminous galaxies, evolved stars, and planetary debris disks (16 in 2006).
Shi, Y., et al. 2007, "Thermal and Nonthermal Infrared Emission from M87," ApJ, 655, 781
Ganguly, R., et al. 2007, "Hubble Space Telescope Ultraviolet Spectroscopy of 14 Low-Redshift Quasars," AJ, 133, 479
Meyer, M.R., et al. 2006, "The Formation and Evolution of Planetary Systems: Placing Our Solar System in Context with Spitzer," PASP, 118, 1690
Su, K.Y.L., et al. 2006 "Debris Disk Evolution Around A Stars," ApJ, 653, 675
Shi, Y., et al. 2006 "9.7 mm Silicate Features in AGNs: New Insights into Unification Models," ApJ, 653, 127
Egami, E., et al. 2006, "A Large Mass Of H2 In The Brightest Cluster Galaxy In Zwicky 3146," ApJ, 652, L21
Jiang, L., et al. 2006 "Probing the Evolution of IR Properties of z~6 Quasars: Spitzer Observations," AJ, 132, 2127
Pascucci, I.,, et al. 2006, "Formation and Evolution of Planetary Systems: Upper Limits to the Gas Mass in Disks Around Sun-like Stars," ApJ, 651, 1177
Richards, G.T. et al. 2006, ApJS, "Spectral Energy Distributions and Multiwavelength Selection of Type 1 Quasars," 166, 470
Schneider, G., et al. 2006, "Discovery of an 86 AU Radius Debris Ring Around HD 181327," ApJ, 650, 414
Smith, P.S., et al. 2006, Spitzer Far-Infrared Detections of Cold Circumstellar Disks," 644, L125
Batcheldor, D., et al. 2006, "The NICMOS Polarimetric Calibration," PASP, 118, 642
Hines, D.C., et al. 2006, "Spitzer Observations of High-Redshift QSOs," ApJ, 641, L85

Silverstone, M.D., et al. 2006, "Formation and Evolution of Planetary Systems (FEPS): Primordial Warm Dust Evolution from 3 to 30 Myr around Sun-like Stars," ApJ, 639, 1138

Gordon, K.D., et al. 2006, "Spitzer MIPS Infrared Imaging of M31: Further Evidence for a Spiral-Ring Composite Structure," ApJ, 638, L87

Hines, D.C., et al. 2006, "The Formation and Evolution of Planetary Systems (FEPS): Discovery of an Unusual Debris System Associated with HD 12039," ApJ, 638, 1070

MEETINGS AND CONFERENCE PROCEEDINGS

Grady et al. 2006 "Young Vega and Altair Analogs: Rotationally-Enhanced Activity in HD 169142 and HD 135344," American Astronomical Society Meeting Abstracts, 209,219.08

Simpson et al. 2006, "HST NICMOS Polarization Observations of Massive YSOs," American Astronomical Society Meeting Abstracts, 209, 105.04

Padgett et al. 2006, "The Taurus Spitzer Legacy Project," American Astronomical Society Meeting Abstracts, 209, 30.16

McGraw et al. 2006, "The Quest for Precision Ground-Based Astronomy:The CCD/Transit Instrument with Innovative Instrumentation (CTI-II)," American Astronomical Society Meeting Abstracts, 209, 22.11

Hines et al. 2006, "Spitzer Observations of Cygnus A and Pictor A," American Astronomical Society Meeting Abstracts, 209, 08.03

Birkinshaw et al. 2006, IR and X-ray Cores In Low-redshift Active Galaxies," AAS/High Energy Astrophysics Division, 9, 07.23

Stapelfeldt et al. 2006, "Statistics Of 24 Micron Field Asteroids In Spitzer Space Telescope Legacy Science Datasets," AAS/Division for Planetary Sciences Meeting Abstracts, 38, 58.06

Bouwman et al. 2006, "The formation and evolution of planetary systems: placing our solar system in context," Planet Formation, 14

Philip James

PROFESSIONAL ORGANIZATIONS & SERVICE

American Physical Society (Fellow); American Geophysical Union, American Astronomical Society, Sigma Xi (member).

PUBLICATIONS

Bonev, P.B., G.B. Hansen, D.A. Glenar, P.B .James, and J.E. Bjorkman. Near-perihelion global dust storms and the stability of the perennial south polar cap on Mars. *Planetary and Space Science* (in press).

Benson, J.L., P.B. James, B.A. Cantor, and R. Remigo. Interannual variability of water ice clouds over major Martian volcanoes observed by MOC. *Icarus* **184**, 365-372 (2006).

Benson, J.L., D.A. Glenar, P.B. James, and M.J. Wolff. Properties of Mars aphelion volcano clouds from combined Mars Global Surveyor MOC and TES measurements. Submitted to Icarus.

Malin et al. MARCI / CTX instrument paper(s). Submitted to J. Geophys. Res.

James, P.B.. P.C. Thomas, M.J. Wolff, and P.B. Bonev. MOC observations of four Mars year variations in south polar residual cap of Mars. Submitted to Icarus.

MEETINGS AND CONFERENCE PROCEEDINGS

Fourth International Conference on Mars Polar Science and Exploration
October 2-6, 2006. Davos. Swotzerlamd

B. P. Bonev, P. B. James, G. B. Hansen, D. A. Glenar, and J. E. Bjorkman. Near perihelion global dust storm and the stability of the perrenial south polar cap on Mars.

Malin, M.C., J.F. Bell, W. Calvin, B.A. Cantor, M.A. Caplinger, R.T. Clancy, A.S. Hale, R,M. Haberle, P.B. James, S.W. Lee, P.C. Thomas, and M.J. Wolff. Polar observations of Marci / CTX cameras on MRO.

P. C. Thomas, P.B. James, Malin, M.C., B.A. Cantor. South polar residual cap: stratigraphy of deposition and erosion.

P. B. James, B. P. Bonev, and M. J. Wolff. Interannual variability in residual south cap albedo: MOC observations.

AGU Fall Meeting
December 5-9, 2005. San Francisco, CA.

P.B. James, Bonev, B.P., Hansen, G.B., and Wolff, M. Effects of Atmospheric Dust on Sublimation of the Martian Residual South Polar Cap. (Invited).

Thomas McCord

PUBLICATIONS

Brown, R.H., Baines, K.H., Bellucci, G., Buratti, B.J., Capaccioni, F., Cerroni, P., et al.. (2006) Observations in the Saturn system during approach and orbital insertion, with Cassini's Visual and Infrared Mapping Spectrometer (VIMS). *Astronomy & Astrophysics*, 446(2), 707-716.

Brown, R.H., Clark, R.N., Buratti, B.J., Cruikshank, D. P., Barnes, J.W., Mastrapa, R.M.E., et al. (2006) Composition and physical properties of Enceladus' surface. *Science*, 311(5766), 1425-1428.

Filacchione, G., Capaccioni, F., McCord, T.B., Coradini, A., Cerroni, P., Bellucci, G., et al. (2006). Saturn's icy satellites investigated by Cassini-VIMS I. Full disk properties: 350-5100 nm reflectance spectra and phase curves. *Icarus*, in press.

Spencer, J. R., Grundy, W. M., Dumas, C., Carlson, R. W., McCord, T. B., Hansen, G. B., et al. (2006) The nature of Europa's dark non-ice surface material: Spatially resolved high spectral resolution spectroscopy from the Keck telescope. *Icarus,* 182(1), 202-210.

MEETINGS AND CONFERENCE PROCEEDINGS

Adriani, A., Moriconi, M., Colosimo, F., Coradini, A., Filacchione, G., Orosei, R., et al. (2006) Determination of the haze layer parameters in the Saturn atmosphere from Cassini VIMS images. *37th Lunar and Planetary Science Conference*, #1584.

Filacchione, G., Coradini, A., Capaccioni, F., Cerroni, P., Bellucci, G., Brown, R.H., et al. (2006). VIS-NIR spectral properties of Saturn's minor icy moons. *37th Lunar and Planetary Science Conference*, #1271.

Hapke, B. W., Nelson, R. M., Brown, R. H., Spilker, L. J., Smythe, W. D. Kamp, L. et al. (2006). Cassini observations of the opposition effect of Saturn's rings 2. Interpretation: Plaster of paris as an analog of ring particles. *37th Lunar and Planetary Science Conference*, #1466.

McCord, T. B., Hansen, G. B., Buratti, B. J. Clark, R. N. Cruikshank, D. P., D'Aversa, E., et al. (2006). Titan: Surface composition from Cassini VIMS. *37th Lunar and Planetary Science Conference*, #1398.

Moriconi, M., Adriani, A., Gardini, A., Coradini, A. Filacchione, G., Orosei, R., et al. (2006). Considerations on the Titan topography based on the Cassini-VIMS measurements in the near-infrared range. *37th Lunar and Planetary Science Conference*, #1579.

Nelson, R.M., Hapke, B. W., Brown, R. H., Spilker, L. J., Smythe, W. D., Kamp, L., et al. (2006). Cassini observations of the opposition effect of Saturn's rings 1. *37th Lunar and Planetary Science Conference*, #1461.

Pieters, C., Board;man, J., Buratti, B. J., Clark, R. N., Green, R., Head, J. W. III, et al. (2006). Global mineralogy of the moon. A cornerstone to science and exploration. *37th Lunar and Planetary Science Conference*, #1630.

Rodriguez, S., Le Mouélic, S., Sotin, C., Clénet, H., Clark, R. N., Buratti, B. J., et al. (2006). Possible detection of local enrichment in water ice in the VIMS observations of the Huygens landing site. *37th Lunar and Planetary Science Conference*, #1326.

Sotin, C., Rodriguez, S., Le Mouélic, S., Tobie, G., Buratti, B. J., Brown, R. H., et al. (2006) Cassini/VIMS observations of Titan: Geological implications. *37th Lunar and Planetary Science Conference*, #1598.

Tosi, F., Coradini, A. Capaccioni, F., Cerroni, P., Filacchione, G., Bellucci, G., et al. (2006). Iapetus, Phoebe and Hyperion: Are they related? *37th Lunar and Planetary Science Conference*, #1582

Brad McLain

PUBLICATIONS

McLain, B. & McLain, S. (Producers & Directors). (2006).Everest ER [Motion picture]. USA: McLain Arts & Communication, ACME Industrial Imagination, Himalayan Rescue Association.
McLain, B. (2006). Kids To Space, Survival in Space chapter. Apogee Books & Collector's Guide Publishing, Edited by Lonnie, Schorer. Ontario.
McLain, B. & Unkart, S. (2006, October) Digital storytelling: Communicating reflection. Presented at the Northern Rocky Mountain Educational Research Association Annual Meeting, Sun Valley, ID.
McLain, B. (In preparation). Europa-SIM: Social Inquiry-Based Learning through an Online Science Exploration Simulation
McLain, B., Curtis, L., Dusenbery, P. (2006). Mars Exploration Update [Video]. USA:Space Science Institute.

MEETINGS AND CONFERENCE PROCEEDINGS

McLain, B. (2006). Space Exploration Educators Conference, Presenter, Space Center Houston.
McLain, B. (2006). Alien Earths Education Workshop. Louisville Science Center. Louisville, KY.
McLain, B. (2006). Alien Earths Virtual Workshop. Yale-Peabody Museum.

Carolyn Porco

PROFESSIONAL ORGANIZATIONS & SERVICE

Division for Planetary Sciences, AAS, 2006, member.
Member, Board of Advisors, Poptech Institute.
Visiting Committee for the Dept. of Earth and Planetary Sciences, Harvard University, Member, 2006.
Co-Leader, Enceladus Focus Group, 2006-

PUBLICATIONS

Cooper, N.J., Murray, C.D., Porco, C.C., Spitale, J.N. (2006). Cassini ISS Astrometric Observations of the Inner Jovian Satellites, Amalthea and Thebe. Icarus, 181, 223-234.

Porco, C.C. et al. (2006). Cassini Observes the Active South Pole of Enceladus. Science 311, 1393-1401.

Tiscareno, M.S., Burns, J.A., Hedman, M.M., Porco, C.C., Weiss, J.W., Dones, L., Richardson, D., Murray, C.D. (2006). 100-metre-diameter Moonlets in Saturn's A-ring from Observations of "Propeller" Structures. Nature 440, 648-650.

Mitchell, C.J., Horanyi, M., Havnes, O., Porco, C.C. (2006). Saturn's Spokes: Lost and Found. Science 311, 1587-1589.

Li, L., Ingersoll, A.P., Vasavada, A.R., Simon-Miller, A.A., DelGenio, A.D., Ewald, S.P., Porco, C.C., West, R.A. (2006). Vertical Wind Shear on Jupiter from Cassini Images, J. Geophys. Res. 111, E04004.

Spitale, J., Jacobson, R.A., Porco, C.C., Owen, W.M., Jr. (2006). The Orbits of Saturn's Small Satellites Derived from Combined Historic and Cassini Imaging Observations. Astron. J. 132, 692-710.

Jacobson, R.A., Spitale, J., Porco, C.C., Owen, W.M. (2006). The GM Values of Mimas and Tethys and the Libration of Methone. Astron. J. 132, 711-713.

Vasavada, A.R., Hörst, S.M., Kennedy, M.R., Ingersoll, A.P., Porco, C.C., DelGenio, A.D, West, R.A. (2006). Cassini imaging of Saturn: Southern hemisphere winds and vortices. J. Geophys. Res., 111, E05004, doi:10.1029/2005JE002563.

Li, L., Ingersoll, A.P., Vasavada, A.R., Simon-Miller, A.A., Achterberg, R.K, Ewald, S.P., Dyudina, U.A., Porco, C.C., West, R.A., Flasar, F.M. (2006). Waves in Jupiter's Atmosphere Observed by the Cassini ISS and CIRS Instruments. Icarus 185, 416-419.

Roatsch, Th., Wählisch, M., Scholten, F., Hoffmeister, A., Matz, K.-D., Denk, T., Neukum, G., Thomas, P., Helfenstein, P., Porco, C. (2006). Mapping of the icy Saturnian satellites: First results from Cassini-ISS. Planetary and Space Science 54, 1137-1145.

Giese, B., Neukum, G., Roatsch, T., Denk, T., Porco, C.C. (2006). Topographic modeling of Phoebe using Cassini images. Planetary and Space Sciences, 54, 1156-1166.

Tiscareno, M.S., Nicholson, P.D., Burns, J.A., Hedman, M.H., Porco, C.C. (2006). Unravelling Temporal Variability in Saturn's Spiral Density Waves: Results and Predictions. Astrophys. J. Lett. 651, L65-L68.

MEETINGS AND CONFERENCE PROCEEDINGS

About 45 abstracts of presentations given at LPSC, European Geophyscial Meeting, Europlanet Science Conference, Division for Dynamical Astronomy of the AAS, Division for Planetary Sciences of the AAS, and the AGU.

Including:

"Saturn's Rings and its Icy Moon Enceladus: Latest from Cassini". Invited lectures to both the Dept. of Astronomy, Univ. of California at Berkeley, and to the Lawrence Livermore National Laboratory at Livermore, California, February 2/3, 2006.

"Enceladus: Water, Warmth, Organics … and Life?" Colloquium given to SETI Institute, Mountain View, CA, July 13, 2006.

"Enceladus: Water, Warmth, Organics … and Life?" **Keynote presentation given to the International Geophysics and Remote Sensing Symposium, IEEE, Denver, CO, July 31, 2006.**

"The Case for Enceladus". Invited presentation to the Committee on the Evolution of Life, Space Studies Board, National Academy of Sciences, Boulder, CO September, 2006.

"Eyes on Enceladus: Cassini ISS Images Suggest Subterranean Liquid Water and a Complicated Past**". Invited presentation to the DPS meeting, Pasadena, Ca, October, 2006.**

"The Geysers of Enceladus: An Overview of Cassini Results". **Invited presentation to the American Geophysical Union meeting, San Franciso, CA, December 2006.**

Brad Sandor

PROFESSIONAL ORGANIZATIONS AND SERVICES

American Geophysical Union, member.
Division of Planetary Sciences (DPS is a division of the American Astronomical Society), member.
Served as a reviewer for journal papers submitted to Icarus and the Journal of Geophysical Research. Service
Served as a judge for a local elementary school science fair.

MEETINGS AND CONFERENCE PRCEEDINGS

Clancy, R.T., Sandor, B.J., and Moriarty-Schieven, G. (2006) Roiling Times in the Venus Lower Thermosphere: From Retrograde Zonal to SSAS in a Week (and more...). Chapman Conference: Exploring Venus as a Terrestrial Planet.

Sandor, B.J., Clancy, R.T., and Moriarty-Schieven, G. (2006) Venus H2O and SOx above the Clouds: Measurements and Analysis from ungoing Ground-Based Microwave Observations. Chapman Conference:
Exploring Venus as a Terrestrial Planet.

Sandor, B.J., Read, W.G., and Waters, J.W. (2006) Connecting UARS and Aura MLS Upper Tropospheric H2O Data.
EOS Aura Science and Validation Team Meeting.

Michael L. Sitko

PROFESSIONAL ORGANIZATIONS AND SERVICE

Cincinnati Observatory Center: Board of Directors & Education Committee
Member: International Astronomical Union, American Astronomical Society, Division for Planetary Sciences, Astronomical Society of the Pacific, Meteoritical Society, Planetary Society
Referee for Science, Astronomical Journal, Astrophysical Journal, Icarus,

PUBLICATIONS

Lynch, D.K., Woodward, C.E., Geballe, T.R., Russell, R.W., Rudy, R.J., Venturini, C.C., Schwarz, G.J., Gehrz, R.D., Smith, N., Lyke, J.E., Bus, S.J., Sitko, M.L., Harrison, T.E., Fisher, S., Eyres, S.P., Evans, A., Shore, S.N., Starrfield, S., Bode, M.F., Greenhouse, M.A., Hauschildt, P.H., Truran, J.W., Williams, R.E., Perry, R.B., Zamanov, R., and O'Brien, T.J. (2006) Early Infrared Spectral Development of V1187 Scorpii (Nova Scorpiii 2004 No. 2). Astrophysical Journal, 638, 987-1003.

Hammel, H.B., Lynch, D.K., Russell, R.W., Sitko, M.L., Bernstein, L.S., and Hewagama, T. (2006) Mid-Infrared Ethane Emission on Neptune and Uranus. Astrophysical Journal, 644, 1326-1333.

MEETINGS AND CONFERENCE PROCEEDINGS

Sitko, M.L., Whitney, B.A., Wolff, M.J., Polomski, E.F., Lynch, D.K., Russell, R.W., Harker, D.E., and Lisse, C.M. (2006). Infrared Spectroscopy of Comet 73P/Schwassmann-Wachmann 3 using the Spitzer Space Telescope. *Division for Planetary Sciences Meeting 38*, #0606

Harker, D.E., Woodward, C.E., Sitko, M.L., Wooden, D.H., Russell, R.W., and Lynch, D.K. (2006). Mid-IR Gemini-N Observations Of Fragments B and C of Comet 73P/Schwassmann-Wachmann 3. *Division for Planetary Sciences Meeting 38,* # 1204.

Russell, R.W., Lynch, D.K., Sitko, M.L., Carpenter, W.J., Kimes, R.L., and Polomski, E.F. (2006) 3-13 Micron Spectroscopy of Comet 73P/Schwassmann-Wachmann 3 (2006). *Division for Planetary Sciences Meeting*, *38*, #1209.

Lynch, D.K., Rudy, R.J., Russell, R.W., Mazuk, S., Venturini, C.C., M.L. Sitko, Hammel, H.B., Puetter, R.C., and Perry, R.B. (2006). The 0.5-13 μm Spectrum of V4332 Sagittarii in 2006. *American Astronomical Society Meeting 209*, #09.05

Hammel, H.B., Sitko, M.L., Orton, G.S., Geballe, T., Lynch, D.K., Russell, R.W., and de Pater, I. (2006). Distribution of Ethane and Methane Emission on Neptune. *American Astronomical Society Meeting 209*, #25.17.

Grady, C.A., Schneider, G., Hamaguchi, K., Sitko, M., Carpenter, W., Collins, K., Williger, G., Woodgate, B., Petre, R., Nuth, J., III, Hines, D., Henning, T., Quirrenbach,

Menard, A., and Wilner., D. (2006). Young Vega and Altair Analogs: Rotationally-Enhanced Activity in HD 169142 and HD 135344. *American Astronomical Society Meeting 209*, #219.08

OTHER PRESENTATIONS

"Comet SW3: A Deeper Impact", Cincinnati Observatory Center Friends of the Observatory, 06/06.
"Comet SW3: A Deeper Impact", University of Cincinnati Quarknet, 07/06.
"Comet Schwassmann-Wachmann3: The Great Crumbling Comet" - ", Cincinnati Observatory Center – ScopeOut 2006, 09/06
"The Fate of the Universe: Big Rip or Big Crunch?" – Cincinnati-area Mensa Society, 12/06

Ann Wehrle

PUBLICATIONS

McHardy, I., Lawson, A., Newsam, A., Marscher, A. P., Sokolov, A. S., Urry, C. M., Wehrle, A. E. (2006) Simultaneous X-ray and infrared variability in the quasar 3C273 - II. Confirmation of the correlation and X-ray lag. Monthly Notices Royal Astronomial Society, 375, 1521-1527.

MEETINGS AND CONFERENCE PROCEEDINGS

Londish, D., Wehrle, A. E., Unwin, S. C., Jones, D. L.; Meier, D. L., Piner, B. G. (2006) QSO astrophysics with the Space Interferometry Mission in Blazar Variability Workshop II: Entering the GLAST Era ASP Conference Series, Vol. 350, Proceedings of the Conference Held 10-12 April, 2005 at Florida International University, Miami, Florida, USA. Ed. H. R. Miller, K. Marshall, J. R. Webb, and M. F. Aller. San Francisco: Astronomical Society of the Pacific, p. 225
Brown, R.H., Baines, K.H., Bellucci, G., Buratti, B.J., Capaccioni, F., Cerroni, P., et al.. (2006) Observations in the Saturn system during approach and orbital insertion, with Cassini's Visual and Infrared Mapping Spectrometer (VIMS). *Astronomy & Astrophysics*, 446(2), 707-716.
Brown, R.H., Clark, R.N., Buratti, B.J., Cruikshank, D. P., Barnes, J.W., Mastrapa, R.M.E., et al. (2006) Composition and physical properties of Enceladus' surface. *Science*, 311(5766), 1425-1428.
Filacchione, G., Capaccioni, F., McCord, T.B., Coradini, A., Cerroni, P., Bellucci, G., et al. (2006). Saturn's icy satellites investigated by Cassini-VIMS I. Full disk properties: 350-5100 nm reflectance spectra and phase curves. *Icarus*, in press.
Spencer, J. R., Grundy, W. M., Dumas, C., Carlson, R. W., McCord, T. B., Hansen, G. B., et al. (2006) The nature of Europa's dark non-ice surface material: Spatially resolved

high spectral resolution spectroscopy from the Keck telescope. *Icarus,* 182(1), 202-210

Adriani, A., Moriconi, M., Colosimo, F., Coradini, A., Filacchione, G., Orosei, R., et al. (2006) Determination of the haze layer parameters in the Saturn atmosphere from Cassini VIMS images. *37th Lunar and Planetary Science Conference*, #1584.

Filacchione, G., Coradini, A., Capaccioni, F., Cerroni, P., Bellucci, G., Brown, R.H., et al. (2006). VIS-NIR spectral properties of Saturn's minor icy moons. *37th Lunar and Planetary Science Conference*, #1271.

Hapke, B. W., Nelson, R. M., Brown, R. H., Spilker, L. J., Smythe, W. D. Kamp, L. et al. (2006). Cassini observations of the opposition effect of Saturn's rings 2. Interpretation: Plaster of paris as an analog of ring particles. *37th Lunar and Planetary Science Conference*, #1466.

McCord, T. B., Hansen, G. B., Buratti, B. J. Clark, R. N. Cruikshank, D. P., D'Aversa, E., et al. (2006). Titan: Surface composition from Cassini VIMS. *37th Lunar and Planetary Science Conference*, #1398.

Moriconi, M., Adriani, A., Gardini, A., Coradini, A. Filacchione, G., Orosei, R., et al. (2006). Considerations on the Titan topography based on the Cassini-VIMS measurements in the near-infrared range. *37th Lunar and Planetary Science Conference*, #1579.

Michael Wolff

PROFESSIONAL ORGANIZATIONS & SERVICE

American Astronomical Society (including Division of Planetary Science)
American Geophysical Union
Mars Reconnaissance Orbiter Participating Scientist Review Panel, Atmospheres
Hubble Space Telescope Time Allocation Committee

PUBLICATIONS

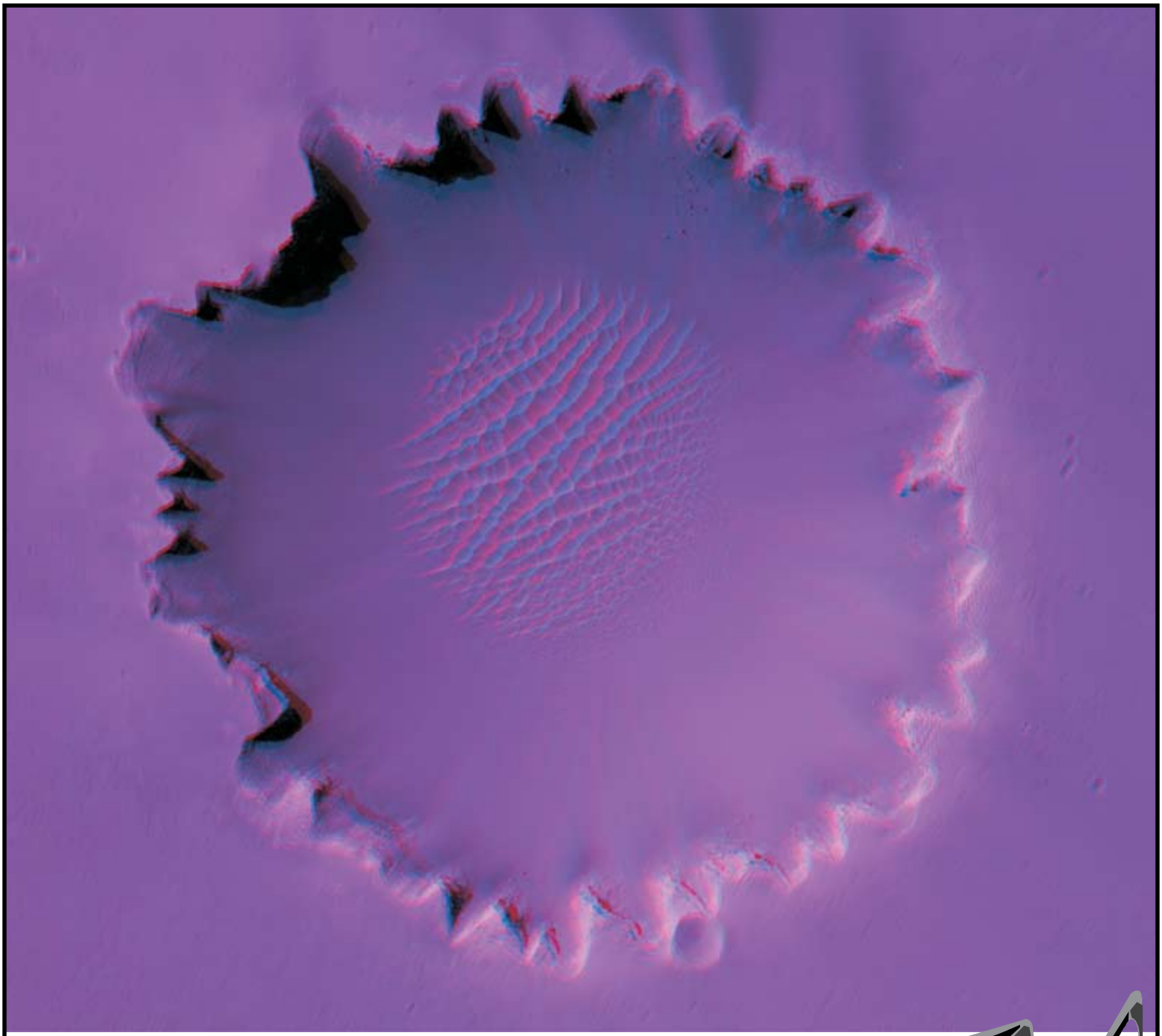
Clancy, R. T., M. J. Wolff, M. J., B. A. Whitney, B. A. Cantor, and M. D. Smith, Mars Equatorial Mesospheric Clouds: Global Occurrence and Physical Properties from Mars Global Surveyor TES and MOC Limb Observations, Journal of Geophysical Research – Planets, in press. 2006.

Wolff, M. J. and 11 co-authors, Constraints on dust aerosols from the Mars Exploration Rovers Using MGS Overflights and Mini-TES, Journal of Geophysical Research - Planets, 111, E12S17, 2006.

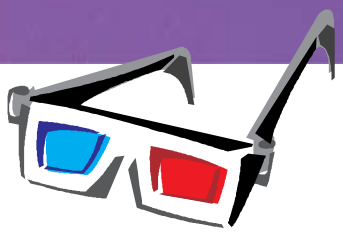
Smith, M. D., M. J. Wolff, and 4 co-authors, One Martian year of atmospheric Observations using MER Mini-TES, Journal of Geophysical Research - Planets, 111, E12S13, 2006.

Squyres, S. W., and 54 co-authors (including M. J. Wolff), Overview of the OpportunityMars Exploration Rover Mission to Meridiani Planum: Eagle Crater to Purgatory Ripple, Journal of Geophysical Research - Planets, 111, E12S12, 2006.

Churchwell, E. B., 21 co-authors, and M. J. Wolff, The Bubbling Galactic Disk, Astrophysical Journal, 649, 759-778, 2006.
Bell III, J. F., D. Savransky, D., and M. J. Wolff, Chromaticity of the Martian sky as observed by the Mars Exploration Rover Pancam instrument, Journal of Geophysical Research - Planets,
111, E12S05, 2006.
Kaydash, V. G., M. A. Kreslavsky, Yu. G. Shkuratov, G. Videen, J. F. Bell, J. F., and M. J. Wolff, Measurements of winds on Mars wit Hubble Space Telescope images in 2003 opposition, Icarus, 185, 97-101, 2006.
Soderblom, J. M., J. F. Bell, M. Y. H. Hubbard, M. Y. H., and M. J. Wolff, Martian phase function: Modeling the visible to near-infrared surface photometric function using HST-WFPC2 data, Icarus, 184, 401-423, 2006.
Spanovich, N., M. D. Smith, P. H. Smith, M. J. Wolff, P. R. Christensen, and S. W. Squyres, Surface and near-surface atmospheric temperatures for the Mars Exploration Rover landing sites, Icarus, 180, 314-320, 2006.
Arvidson, R. E., and 65 co-authors (including M. J. Wolff), Overview of the Spirit Mars Exploration Rover Mission to Gusev Crater: Landing site to Backstay Rock in the Columbia Hills," Journal of Geophysical Research - Planets, 111, E02S01, 2006.
Sofia, U. J., K. D. Gordon, G. C. Clayton, K. Misselt, M. J. Wolff, N. L. J. Cox, and P. Ehrenfreund, Probing the Dust Responsible for Small Magellanic Cloud Extinction," Astrophysical Journal, 636, 753—764, 2006.



NASA's Mars Reconnaissance Orbiter has imaged Victoria Crater using both red and blue filters. To see the topography in 3D, view this image through glasses with a red filter for your left eye, and a blue or blue-green filter for your right eye.



WWW.SPACESCIENCE.ORG

SPACE SCIENCE INSTITUTE

Space Science Institute . 4750 Walnut Street . Suite 205 . Boulder, Colorado 80301 . 720.974.5888 . www.spacescience.org