Planetary Science Institute

NEWSLETTER

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Morgan Freeman Visits PSI

Morgan Freeman with just some of the PSI staff he met in October (L-R): David Crown, Les Bleamaster, Michael Snowden, Bill Hartmann, Dan Berman, Elizabeth Turtle, Morgan, Kelly Yoder, Mark Sykes, Emily Joseph, Mary Lolos, Frank Chuang and Carol Neese.

Morgan Freeman, Oscar-winning actor, producer, and director, visited our offices October 11 to discuss "Rendezvous with Rama" — a movie he is producing and starring in, based on the science fiction classic by Arthur C. Clarke. In the story, a giant cylinder enters the solar system at hypervelocity and we rush to explore its mysteries before it leaves — or will it stay? Morgan wants the film to get the science right (we think he came to the right place).

Welcome back anytime, Morgan!

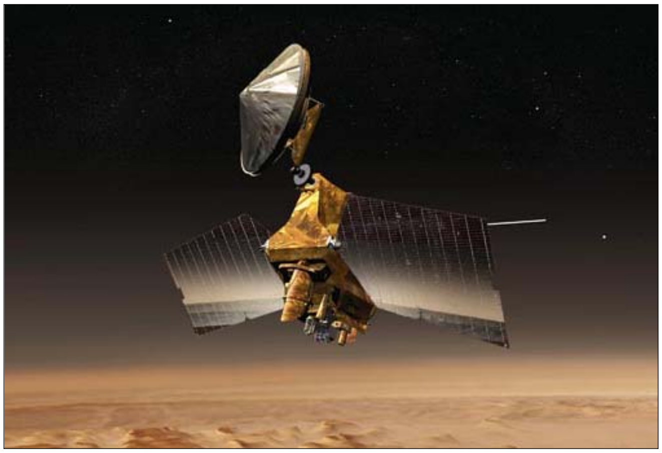
At right, Bill Hartmann shows Morgan a simulation, created by Pasquale Tricarico, of "Rama" entering the solar system in 2131, and the subsequent flyby and rendezvous described in the Arthur C. Clarke novel.

Left, Morgan discusses his ideas with David Crown, Les Bleamaster, Dan Berman, Bill Hartmann, David Lien, Elizabeth Turtle, Bea Mueller, Mark Sykes and Nalin Samarasinha.

Inside this issue:

It's All About the Details: The HiRISE Camera on Mars Reconnaissance Orbiter

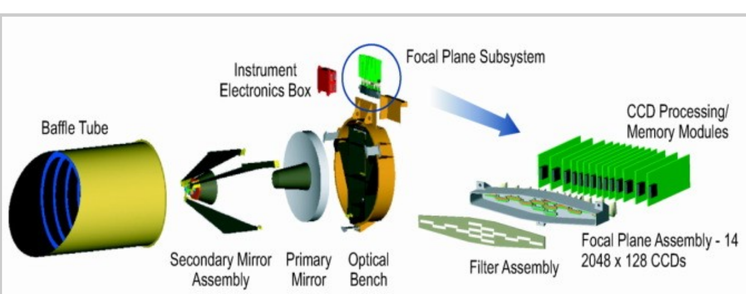
by Frank Chuang



Artist's conception of NASA's Mars Reconnaissance Orbiter flying over Nilosyrtis Mensae, Mars, after it reaches its science orbit in January, 2006. The HiRISE camera is the large gold tube-shaped instrument on the spacecraft, pointing down at the Martian surface. Credit: NASA/JPL

August 12, 2005 — On a clear morning at Cape Canaveral, the Mars Reconnaissance Orbiter (MRO) was launched on an Atlas 5 rocket, sending one of the highest-resolution cameras ever made to study the surface of Mars. The High Resolution Imaging Science Experiment (HiRISE) instrument on board the MRO will be able to capture features on the surface that are less than a meter across. This level of clarity is up to three times better than the Mars Orbiter Camera (MOC) on the Mars Global Surveyor (MGS) spacecraft. HiRISE, along with the five other MRO science instruments, falls in line with the goals of NASA to build upon previous Mars missions and find sites that show evidence for past aqueous or hydrothermal activity through the interpretation of geologic features. HiRISE will also play a pivotal role in finding the best sites for future landers that will explore and ultimately bring samples back to Earth for laboratory analysis. PSI Senior Scientist Cathy Weitz (Co-Investigator on HiRISE) and I will target and analyze images returned from the camera.

HiRISE is a telescopic camera containing three mirrors which direct light onto an assembly composed of 14 staggered charge-coupled devices (CCDs). (CCDs are sensors that digitally record an image as a grid of pixels, as in ordinary digital cameras. They are more efficient at capturing light than photographic film, hence their popularity with astronomers.) These CCDs record images at a variety of wavelength bands: two in blue-green colors, ten in red colors, and two in near-infrared colors. The human eye can detect light at wavelengths in the visible portion of the light spectrum, such as red and blue-green, but not in the near infrared. However, there is valuable information in the near infrared that can help determine the types of minerals on the surface, whether water is present, and other important geologic characteristics. When images in each of the three bands are combined, a colorized image can be produced to see the distribution of surface types in an area.



Schematic diagram of the HiRISE instrument components. The camera has a 50 cm aperture with a set of secondary and primary mirrors that focuses light energy into the optical bench and onto the Filter Plane Assembly consisting of 14 CCDs. Credit: NASA/JPL/University of Arizona

The HiRISE science team is composed of 14 planetary scientists and engineers who have different roles and responsibilities during the two-year MRO Primary Science Phase. Science themes to be covered by team members are: seasonal processes; fluvial and hydrothermal processes; polar geology; landscape evolution; volcanism; periglacial, glacial, and weathering processes; layering processes and stratigraphy; and aeolian processes. Several team members will also be involved with HiRISE system operations, producing science data products.

At Lockheed Martin Space Systems in Denver, workers hoist the HiRISE telescopic camera for installation onto the Mars Reconnaissance Orbiter spacecraft, Dec. 11, 2004. HiRISE was built by Ball Aerospace and Technology Corp., Boulder, for the University of Arizona, Tucson. Credit: NASA/JPL/Ball Aerospace

The science goals the team hopes to achieve using HiRISE are too numerous to mention; however, Cathy Weitz is responsible for geologic layering and stratigraphy, so it will be used here as an example. Prior to the MGS mission, little was known about rock layers other than what was exposed in the walls of Valles Marineris. Some layers that appeared in earlier Viking and Mariner images as alternating light-to-dark bands were later seen in MOC images as flat areas covered by dark debris (dark-toned) versus steeper areas with little dust cover (light-toned). Thus, some observed layers were not truly multiple layers. However, many MOC images did show true layering in Valles Marineris, which was seen as fine, meter-scale, light-toned interior deposits. HiRISE may reveal even finer layers and/or perhaps geologic contacts, which could help elucidate the processes that emplaced these units. Other information such as multi-band color could reveal compositional differences between layered units and help further constrain their origin. Stereo coverage of layered wall rock would allow measurement of their slopes and thicknesses, which could be used to tell whether the rocks may have formed in an underwater environment such as a lakebed or as a volcanic ash blanket covering the pre-existing surface.

(continued on page 5)

Dr. Beatrice Mueller Moves to PSI

This summer Beatrice Mueller moved to PSI, as a Senior Scientist, from the National Optical Astronomy Observatory (NOAO), also in Tucson. Her main research area is physical studies of small bodies in the solar system, (comets, asteroids, and Kuiper Belt objects) mostly using imaging.

Born and raised in Switzerland, near Zurich, Beatrice attended an all-girls high school, focusing on languages. By the end of high school, she knew she wanted to go into science, and astronomy captured her imagination as the science with the most unsolved mysteries.

Astronomy is not offered as a major at the Federal Polytechnic University (ETH — the same university Einstein attended) but as a minor when studying physics. In 1983, Beatrice graduated with a diploma (a degree between a Bachelor of Science and a Masters) in physics, one of seven women out of over a hundred men. Her diploma thesis was on UV spectra of symbiotic stars. She worked as an assistant to her thesis professor until she moved to Bamberg (Germany) in 1985 to begin graduate school. Beatrice wrote her graduate thesis about a white dwarf star, studying its composition with spectroscopy, and graduated in 1989.

In Bamberg, she met Dr. Juergen Rahe who was heading the comet group, and it was while helping to organize the Bamberg comet meeting that she met an important person for her future career, Dr. Michael Belton from NOAO. For the time being, not finding a post-doctoral position in Europe, Beatrice worked for a year babysitting the crippled Hipparcos spacecraft, doing attitude control, at the European Space Operations Center (ESOC). And although Beatrice met a lot of interesting people from all over Europe and the U.S. at ESOC, it was not research, and, therefore, not what she wanted to do for the rest of her life.

Juergen, having moved to NASA to head one of the grant programs, now urged Beatrice to apply for a NASA grant doing physical studies of comets, with Mike Belton as her advisor. In 1990, she received a three-year grant to work in Tucson with Mike at NOAO. She had planned to return to Europe after her stint as a post-doctoral student, but she stayed to work on other grants and on the Galileo Mission with Mike, who was head of the Imaging Team. About this time, Beatrice received a grant from the Swiss government and also started to write NASA grants together with Nalin Samarasinha (PSI and NOAO).

On the home front, in 1997, Beatrice married Tod Lauer, an extragalactic astronomer at NOAO, and they have two terrific daughters, Sandra, age 8, and Annika, 5.

After Mike retired from NOAO (but not from science; he has his own company, Belton Space Explorations), that meant Nalin and Beatrice were now the only solar systems people at NOAO. She joined PSI, in July 2005, with a grant from the National Science Foundation (NSF). Beatrice said, “PSI's work environment is very conducive for planetary scientists and is a great match for me and my research.” And PSI is very glad to have her.

Welcome, Beatrice!

Sykes Elected Fellow of AAAS

PSI Director Mark Sykes has been elected a Fellow of the American Association for the Advancement of Science (AAAS), in the Astronomy section. He is honored "for distinguished public contributions to the vitality of the United States program of solar system exploration through unceasing advocacy of its scientific and social goals." Each year the AAAS elects members whose "efforts on behalf of the advancement of science or its applications are scientifically or socially distinguished." Sykes will be presented with a certificate and rosette at the Association's annual meeting in St. Louis in February 2006.

The American Association for the Advancement of Science (AAAS), founded in 1848, is the world's largest general scientific society, and publisher of the journal, *Science* (www.sciencemag.org).

Bravo, Mark!

Four at PSI Receive Five NASA Grants

Four PSI scientists learned in November that they received grant awards totaling over $940,000 from NASA. These grants are from NASA's Planetary Geology and Geophysics program (PG&G) and fund five separate projects:

Elisabetta Pierazzo received awards for two studies: the first involves an international team studying the mechanics of impact cratering on Earth and other bodies in the solar system. Title: “Validation and Benchmarking of Impact Codes: a Broadbased Effort of the Impact Cratering Modeling Community.” Total Funding: $206,706.00.

Elisabetta’s other project will examine impacts on surfaces in North America, Africa, Asia and Australia. Title: “Effects of Lithologies on Impact Cratering: Numerical Modeling of Known Terrestrial Craters.” Total funding: $201,294.00.

Leslie Bleamaster will map tectonic features, volcanoes and lava flows that have shaped the surface of Venus. Title: “Volcano-Tectonism of Helen Planitia, Venus.” Total funding: $196,131.00.

Lijie Han will study Jupiter's moon Europa and simulate the complex geology of its outer icy shell, which covers an ocean that may contain life. Title: “Numerical Modeling of Convection in Europa’s Icy Shell with Salinity and its Impact on Surface Features.” Total funding: $204,315.00.

David O'Brien will study the migration of the giant planets after their formation and their effects on the history of the solar system. Title: “Exploring the Collisional and Dynamical Implications of Current Outer Planet Migration Models.” Total funding $133,953.00.

Congratulations to all our award-winning scientists!

Director's Note

Movies are an important medium that can have a great influence on what people learn, whether it is about history or physical reality. They extend our experience into locations where we have little direct personal experience, such as space and the surfaces of other planets. Unfortunately, people might not realize that what they sometimes see in movies is just plain wrong (as in the movie "Armageddon" showing the surface of an asteroid that looks suspiciously like Superman's Fortress of Solitude!). When the science content is correct, science fiction can be truly educational. As we learned during his day-long visit at PSI, Morgan Freeman wants "Rendezvous with Rama" to be as realistic as possible. In addition, he has innovative ideas about using his film, during and after production, as a means of engaging broad input from students and professionals, regarding the science questions and issues arising in the course of the film. This would benefit the film and serve as a dynamic educational tool for grade school through graduate school. It would also be a lot of fun.

Morgan was gracious with his many fans at PSI (enduring many photo-ops) and impressive in the science discussions with the research scientists. Our scientists also enjoyed themselves generating simulations and making calculations regarding the physics of events in Arthur C. Clarke's classic novel. In fact, they found unexpected aspects to events that added to some of the mystery of the story. It was a real pleasure meeting Morgan and we all look forward to seeing him again.

Best Wishes for a Happy Holiday Season and a Joyful 2006!

Mark Sykes
December 2005

PSI is pleased to acknowledge the Wells Fargo Foundation for generously awarding a $2,500 grant to our California Science Education Field Trip Program in Fall, 2005. Our sincere thanks and appreciation go out to the Wells Fargo Foundation.

The Bigger, Better Planetary Geosciences Laboratory, and New Field Equipment

by Frank Chuang

The Planetary Geosciences Laboratory (PGL), often dubbed the "Mars Lab" because many of our PSI scientists study the Red Planet, was established in 2003 when PSI moved to its current facility at 1700 E. Fort Lowell Road. The lab serves as a central resource for planetary datasets, including NASA digital spacecraft data on CD-ROM, various USGS topographic, geologic, and shaded relief maps, hardcopy prints of Viking and Lunar Orbiter photos, and much more. Complementary to these data is laboratory computer equipment to process and geo-rectify spacecraft images, develop Geographic Information Systems (GIS) databases, compile statistical data, and output high-resolution map products for scientific and educational use. The lab also has additional workspace that can be used by visiting scientists, interns, and PSI staff.

Recent expansion of PSI to the new "west wing" has resulted in the re-organization of space, allowing the laboratory to further expand on the first floor. This expansion, along with the purchase of new computer hardware, software, and peripherals from our NSF equipment grant (see Spring 2005 newsletter), has significantly upgraded and increased the laboratory's capabilities for geoscience research. We have added another high-powered Windows workstation, allowing us to support more lab users at any given time. Many of the new software packages, such as ArcGIS ArcView 9.0, are installed as 'floating' network licenses, meaning that users are not tied to using the software on a specific workstation. As PSI grows, we will do our best to have lab resources as flexible as possible to meet increasing user demand.

Under the direction of PSI Senior Scientist David Crown and Research Associate Frank Chuang (Lab Manager), the PGL has grown into a valuable asset for the Planetary Geosciences (PG) Group. In addition to the updated computer equipment, the NSF grant has allowed acquisition of new field equipment to support our many field studies, including a Trimble differential GPS (Global Positioning System) unit, a 3-D laser profiling package, and a Panasonic Toughbook CF-73 semi-rugged laptop computer.

This past summer, the GPS unit and laptop computer were used by PSI's Mary Bourke for two field projects in Australia. In the southern Dalhousie region, the GPS was used to collect cross-sectional elevation data on recently formed mound springs. These features range from remnant limestone-capped mesas to shallow four-year-old ground depressions. In central Australia, the GPS was used to collect elevation profiles across the modern and paleo-channels of the Finke River Gorge. These data will be used to calibrate digital terrain models so that landscape evolution models can be run to test hypotheses of formation.

This fall, the GPS unit and laser profiling system were used in Hawaii Volcanoes National Park to record growth of active lava flows emplaced in the most recent phase of the ongoing Pu`u `O`o eruption which began in 1983. This project, led by PSI's Steve Anderson, involved scientists from PSI (David Crown), USGS, NASA/JPL, Proxemy Research Inc., and the University of Pittsburgh.

HiRISE Camera on MRO *(continued from page 2)*

HiRISE will be "The People's Camera" to the extent that everyone from the science community to the general public will be able to submit image requests at any time via the internet. The team will have a user-friendly request website called HiWeb, which has a clickable and zoomable image data map that shows all current and previous Mars mission data so that users can make informed requests. Users may also perform a variety of searches for data in a given region on Mars. The current plan calls for ~1% of the Martian surface to be covered at 25 cm per pixel to 1.3 m per pixel during the Primary Science Phase (PSP), including color imaging and ~1000 stereo pairs. Once PSP is complete, the volume of HiRISE data is expected to be in the hundreds of gigabytes, and quite possibly, tens of terabytes! Users will be able to view HiRISE grayscale and color images through HiWeb and then download them in a variety of formats. All of the most current data will be available through HiWeb and subsequent data distribution to NASA's Planetary Data System (PDS) will generally occur every six to twelve months after the start of the Primary Science Phase.

Two other cameras are also on board MRO, the Context Camera (CTX) and Mars Color Imager (MARCI). Both cameras were built by Malin Space Science Systems and may be used in conjunction with HiRISE to provide complete regional-to-local scale images of a given area on Mars. CTX will acquire grayscale images with a spatial resolution of ~6 m per pixel at a swath width of ~30 km. MARCI will acquire daily global color images for at least one Martian year at five visible and two ultraviolet wavelengths. The remaining three MRO science instruments are the Compact Reconnaisance Imaging Spectrometer for Mars (CRISM), Mars Climate Sounder (MCS), and Shallow Radar (SHARAD).

These are exciting times in the Mars science community with so much new information coming from each new mission. With the superior capability of HiRISE and the other instruments on the MRO, there is no question that scientists will discover more details about the past history of Mars. As for me, while in graduate school, I felt very fortunate to be able to study images sent back from the then-active Galileo spacecraft. Now, the chance to work on another active mission and perform image targeting operations will be a new, exciting challenge!

Learn more about the MRO mission and the HiRISE instrument at their respective websites http://marsprogram.jpl.nasa.gov/mro and http://marsoweb.nas.nasa.gov/HiRISE . Or email Frank at chuang@psi.edu.

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The ***Friends of PSI*** are people like you — excited by the new worlds revealed in our exploration of the solar system and beyond, seeing the Earth as a planet for the first time, and wanting to participate in the expansion of human presence beyond the Earth. PSI scientists are active participants in this adventure. They travel to remote and dangerous regions on Earth to study processes found on other planets as well. They participate in missions to the Moon, Mars, Saturn, and asteroids. They model the formation of the solar system and how planets can grow around other stars. They identify the location and nature of space resources to sustain the expansion of permanent human presence on the Moon, Mars, and beyond.

PSI scientists are helping to create the next generation of explorers, and reaching out to the public through lectures, books, and art. Please join us in this adventure by becoming a *Friend of PSI* and renewing your membership annually.

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Thank you!

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