PLANETARY SCIENCE INSTITUTE

NEWSLETTER

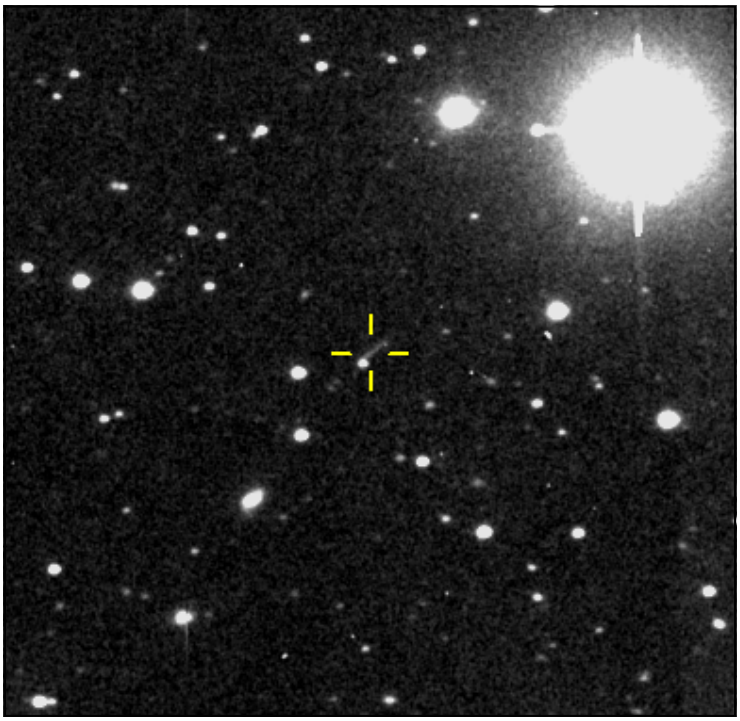
Winter 2004 Vol. 5 , No. 4

Something Near, Something Far: *A Tale of Discovery and Momentary Excitement*

By Gil Esquerdo

Anyone trying to make astronomical observations in the desert southwest during the summer thunderstorm season knows how futile that can be. For this reason, most observatories in the area do not fill their schedules during that time, focusing instead on maintenance and engineering of telescopes and instruments. For our joint program with Apache Point Observatory (APO) to search for new trans-Neptunian objects (TNOs*), this means a few months of relatively quiet, if unproductive, time. This September, as the weather was starting to improve, the fates conspired to provide a particularly exciting 24 hours for the project.

The small telescope we use (with a 20-inch-diameter light collecting mirror) belongs to the Sloan Digital Sky Survey project (SDSS). This telescope is normally used to monitor the brightness of reference stars during the course of that survey. Since the Sloan survey does not operate during the week nearest the full moon, we have an arrangement to use the telescope for our project during that time.



One of three discovery images of the near-earth asteroid 2004 RY10. The short streak is the image of the asteroid as it moved during the 5-minute-long exposure. The bright point near the end of the streak is a star in the background.

Also, every year the mirrors for the two survey telescopes are removed and given a new coat of reflective aluminum. The recoating of the 20-inch mirror is done at APO (New Mexico), but the large 100-inch mirror for the main survey telescope must be trucked approximately 500 miles to Kitt Peak (outside Tucson), the closest facility for coating a mirror that large. This summer, to our advantage, that didn't happen until late August, and for the first time we were able to use the 20-inch telescope when the moon wasn't around to interfere.

**Trans-Neptunian Objects are icy objects similar to asteroids or comets that reside beyond the orbit of Neptune.*

An observing plan was devised and sent to the observatory. The typical end-of-monsoon weather prevented observing on a number of nights, but the plan was used on the evening of September 6th. Once the automated observing was done, John Barentine of APO did the first level of processing on the images and sent them to PSI for software detection of moving objects in the data.

Since I had been up late that night at another observatory south of Tucson, I began downloading the images as they arrived, giving each one a quick visual inspection for overall quality and anything obvious. While looking at the sixth trio of images, a faint, telltale streak of light was apparent near the middle of the images, a streak that indicated a fast-moving nearby asteroid.

After measuring the rough position of the object, an inspection of the database of the Minor Planet Center (MPC) in Cambridge, MA (the international clearing house for all things cometary or asteroidal)

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that position or moving with that speed and direction. Thus began the quest to accurately measure the new object and submit the observations to the MPC.

At 7 a.m., nearly two hours after first spotting the trail (and an hour-and-a-half after I should have been to bed), the observations were submitted. A quick reply came from Tim Spahr, the near-Earth Asteroid specialist for the MPC, announcing that the object we found was indeed new! It was then posted to the MPC website to encourage other observers to make follow-up observations.

After a good day's sleep, additional messages from the MPC showed that in reporting the new object at 7 a.m. we had beaten the LINEAR near-Earth asteroid survey project to the discovery by an hour. Additional observations made around the world over the next 24 hours secured the orbital path of the asteroid enough to warrant the assignment of an official designation — 2004 RY10. This asteroid is in an orbit that crosses the earth once every 4.1 years. Furthermore, there is no possibility that it will cause concern for the earth in the foreseeable future.

But wait, there's more

This tale would be exciting enough if it were to end there, but the images from September 6th still needed to be inspected for what we had originally been searching for, namely objects orbiting in the outer solar system. The basic image calibrations had been started about the time we received the good news from the MPC, then fed into the moving-object-detection software which automatically searches for faint, slow-moving objects.

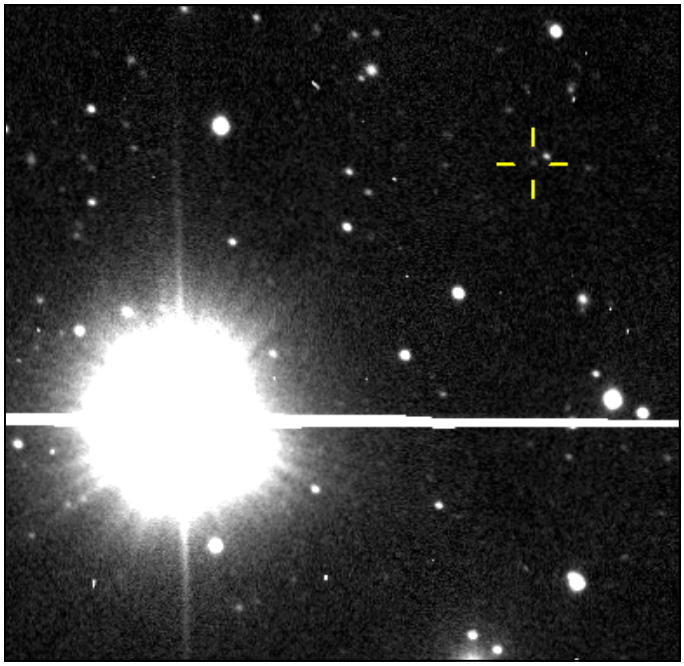
While validating the detections, a faint, very slow-moving object was picked up by the software. Then the position of this new object was checked against the list of known asteroids and comets at the MPC. When the result came back with "no known match", we began a series of checks we have developed to insure we do not report false detections. All attempts to identify the slow-moving object came up empty until I realized a selection on the MPC checker service hadn't been requested ... the one that included planets and their moons.

With that additional request, we had a result: our "slow-mover" turned out to be one of the small, outer moons of the giant planet Uranus. This moon, named Sycorax, was originally discovered in 1997 by long-time PSI collaborator Brett Gladman, using the 200-inch telescope on Mt. Palomar, CA. We had unintentionally rediscovered this moon with a telescope ten times smaller and with a light gathering power 100 times less than the telescope originally used to discover the object.

While not one of the objects we were looking for, the detection of Sycorax proved that a small telescope is capable of finding objects in the outer solar system. This one night, with the discovery of an object near the Earth, and the detection of one far from it, has encouraged us to continue our work, as well as refine the project.

We are beginning to explore sources of funding that would enable us to buy our own telescope for this project. The telescope we have identified is actually just a little smaller than the one we are using now (18-inch mirror as opposed to 20-inches), but will have a much larger field of view, and it will be a better match for the type of work we are doing. Also, we will be able to use all of the time available on this telescope for our project. The great benefit will be the ability to use the time when the moon is not interfering with the observations, since that results in fainter detections. So wish us luck with our fundraising, and we will keep you posted as the survey progresses.

The Apache Point Observatory/Planetary Science Institute Trans-Neptunian Object Survey is a rather informal collaboration between Gil Esquerdo and Carol Neese of PSI and John Barentine of APO/SDSS.



One of our "rediscovery" images of the moon Sycorax. The very bright object in the lower left is the planet Uranus.

Patient Rewards

The observer who brims with sagacity
Need never resort to pugnacity.
He'll take those off-nights,
And the 'scopes with small sights,
'Cause it ain't so much size,
as tenacity.

Anne Raugh, 2004

G. K. Gilbert Award for Bill Hartmann

The Planetary Geology Division of the Geological Society of America awarded their highest honor—the G.K. Gilbert 2004 award—to PSI's own Bill Hartmann on November 9 in Denver. The award is presented annually for outstanding contributions to the solution of fundamental problems in planetary geology in the broadest sense, which includes geochemistry, mineralogy, petrology, geophysics, geologic mapping, and remote sensing.

The citation speech, by meteoriticist Hap McSween, mentioned Bill's work on using counts of impact craters on different planetary surfaces to establish a system for estimating ages, which was used successfully to predict ages of lunar and Martian lava samples.

In recent years, Bill has received a spate of awards, including the first Carl Sagan medal from the American Astronomical Society in 1998 , and the Runcorn-Florensky medal from the European Geophysical Society in 2002.

Congratulations, Bill!

Bill claims he was not inebriated, but merely feeling playful in this pose shortly after the award ceremony in Denver.

PSI's Mary Bourke and Les Bleamaster celebrate with Bill moments after the Gilbert plaque was awarded.

Meet Dr. Sumita Jayaraman

One of the newest members of PSI is Sumita Jayaraman who started her college education in Delhi, India, with a Bachelor's degree in Physics. Over the next decade she acquired a penchant for collecting graduate degrees — in Physics, Astronomy and Computer Engineering, from the Indian Institute of Technology, Bombay; University of Florida, Gainesville; and University of California, Santa Cruz, respectively.

Eventually, the "professional student" actually turned professional and joined the astronomy research division at Vanguard Research, Inc. Throughout this period she indulged in her primary area of research, interplanetary dust, and worked with IRAS (Infrared Astronomical Satellite), COBE (Cosmic Background Explorer) and MSX (Midcourse Space Experiment) data on the infrared emission from the dust in the inner solar system. Many numerical simulations later came the discovery of a ring of dust around the Earth's orbit. So, while the farthest reaches of the universe are being explored, it is gratifying to know that there are hidden treasures right under our noses, so to speak. By this time, the complexity of the zodiacal cloud began to intrigue her, and as with most research, the final outcome was a longer list of questions than at the beginning.

After a brief digression into data calibration, which included stellar spectral modeling, she is happily back into the zodiacal dust environment, except this time it is with an aim to understand the parallels between the dust disk in our solar system and disks around other stars. With the outer solar system disk still to be explored, and the new data on disks around other stars streaming in, she has the feeling a lifetime of work awaits.

Of course, Sumita does venture outside the world of astronomy, with literacy and education being passions that stem from a got-to-change-the-world activism. She has been involved with literacy projects in India for the past seven years that mainly target first-generation learners — children and adults who have never had access to a school. Eradication of child labor, women's empowerment and income generation are some other issues she has tried to understand and support.

And, sandwiched between the two passions of astronomy and literacy, are her husband and two young children — a 4-year-old tornado, and a toddler who *thinks* she is 4 years old. So, like many others of her generation, juggling would be a natural alternative for a career track. Still, she claims she is grateful for the opportunity to take the 'telecommuting' concept to the extreme from her home office in California and does hope to visit Tucson in the near future to share her work and views with the people at PSI.

We are very happy to welcome Sumita to the PSI family!

New at PSI: Dr. Matthew Staid

Dr. Matthew Staid recently joined the PSI research staff from the U.S. Geological Survey in Flagstaff, AZ, where he was a Research Geologist for the past four years. He will continue to pursue his research in planetary geology with PSI part-time from Napa, CA, where he and his wife (Melissa Staid, Ph.D., Brown University, 1999) own an aerial imaging business. Matt's planetary research centers on the application of visible, infrared and thermal spectroscopic data to geologic studies of the Moon and Mars. This research uses remote interpretations of surface mineralogy to explore the geologic formation of planetary surfaces, the evolution of interior source regions, and the geologic processes that have altered planetary surfaces over time. In addition to his planetary research, Matt's interest in remote sensing instruments and analytical techniques have also led him to pursue a wide variety of terrestrial applications, ranging from studies of planetary analogs to agricultural and environmental applications and imaging system design.

Matt received a B.S. in Engineering/Geological Sciences from Cornell University in 1993 where he began working with satellite data as part of the NASA EOS project. Matt's interest in remote sensing and spectroscopy led him to attend graduate school at Brown University where he received his M.S. in 1995 and Ph.D. in 2000 under the guidance of Professor Carle Pieters. At Brown, Matt worked on the DoD-NASA Clementine mission activities, instrument calibrations, and scientific analyses of lunar data. His doctoral thesis used Clementine and other lunar data to explore the geologic history of volcanism on the Moon and the relationship between remote sensing data and the returned lunar samples. During this time, Matt also pursued terrestrial applications of remote sensing through a wide range of projects with Professor John Mustard at Brown and as an engineer and consultant working with the aerospace industry.

As part of the USGS Astrogeology Team in Flagstaff, Matt broadened his planetary research to include geologic studies of Mars through the interpretation of data from current missions. This work focused on the application of spectroscopic techniques to the analysis of Mars Global Surveyor Thermal Emission Spectrometer (TES) data to interpret surface mineralogy. At the USGS, he also continued his lunar studies through the NASA Planetary Geology and Geophysics Program, conducting a global study of lunar volcanism based data from the Clementine Near-Infrared (NIR) camera. These studies have provided new information about the unique mineralogy of the last major phases of lunar volcanism and global associations between lunar basalt composition and crustal thickness. Matthew plans to continue planetary research as a scientist with PSI through continued studies of the Moon and Mars. He is also a team member on two current lunar instrument proposals and hopes to continue to participate in mission activities in the future.

We are very pleased to welcome Matt Staid to the PSI research staff.

Director's Notes

The Growth Continues

As the reader can see from this issue alone, PSI continues to grow, adding new scientists with almost every month. I continue to receive calls, and people still corner me at conferences to talk about the possibility of joining PSI. There is even interest in extending PSI to other countries.

This growth has spurred the need to finally bring our accounting under one roof at our corporate headquarters in Tucson. Consequently, we have begun the search for a Financial Officer to oversee accounting, grants administration, benefits and human resources.

Even without this move we are bursting at the seams of our recently purchased building, requiring us to lease nearby space to house more offices and a conference room for meetings and workshops. Ultimately we need to find, or build, a yet larger facility that will provide a long-term home for our corporate headquarters and Tucson-based researchers and visitors.

PSI continues to be very successful in winning federal grants and contracts, but strict rules governing how that money may be spent prevents us from using any of it for a building fund. You can help us by sending your tax-deductible contribution to PSI. Please feel free to contact me with any questions at sykes@psi.edu or 520-622-6300. Thank you for your support.

Wishing one and all a safe and prosperous New Year!

Happy Holidays!

Mark Sykes
December 2004

Dr. Nader Haghighipour Joins PSI

Dr. Nader Haghighipour joined PSI in the summer of 2004 as an Associate Research Scientist. He is a dynamicist with interests in dynamics of dust particles in a planet-forming nebula, the dynamical evolution of our solar system, and extrasolar planets.

After receiving his Ph.D. in Celestial Mechanics, General Relativity, and Gravitation, from the University of Missouri, Columbia, Nader joined the faculty of the University of California, Irvine, where he established an undergraduate course in Astrobiology. After spending one year at Northwestern University, he joined the Department of Terrestrial Magnetism (DTM) at the Carnegie Institution of Washington in fall 2001. During his tenure at DTM, he studied the dynamics of dust particles and their interactions with a circumstellar disk in the vicinity of density enhanced structures of a nebula. The results of his research indicate that the combined effect of gas drag and pressure gradients can cause small solid grains to decouple from the gas in a short time, and rapidly approach the center of the gas-density structure on the mid-plane. Such fast migrations may enhance the rate of collision and coalescence of dust particles, and affect their growth to larger objects.

Nader has also been studying the stability of extrasolar multi-planet systems in order to identify the regions of space where habitable planets can have long-term stable orbits. Since the radial velocity technique does not constrain masses of extrasolar planets, his focus has been on mapping the parameter space of such planetary systems, and determining regions where planets can have stable orbits long enough for life to develop.

In association with PSI, he will extend his studies to the formation and dynamical evolution of planets in and around binary star systems. Since approximately 50% of stars are members of binaries, and 20% of extrasolar planets are around members of binary stars, questions regarding the effect of the gravitational force of one of the stars of a binary on the circumstellar disk around the other star — and also the formation of planetesimals, and eventually planets in such systems — are now of particular interest.

Nader works jointly for the Institute for Astronomy at the University of Hawaii as an assistant astronomer/NASA Astrobiology fellow where he has started a research project on exploring different mechanisms of delivery of water to terrestrial planets, particularly in and around binary star systems.

PSI extends a warm welcome to Nader Haghighipour.

Friends of PSI

The ***Friends of PSI*** are people like you — folks interested in the excitement and knowledge brought about by astronomy and planetary science. The scientists at the Planetary Science Institute pursue fundamental research in planetary science, geology, and astronomy. PSI is also involved in many educational activities including school field trip programs, popular articles and lectures, research internships for undergraduates, and training and mentoring young researchers at the graduate and postdoctoral levels.

Friends receive a quarterly newsletter detailing the activities of PSI's science and education programs. Additionally, the newsletter contains new scientific discoveries at PSI, as well as features on PSI scientists and their activities.

So join us today with your yearly membership contribution, or become a supporting or sustaining member by joining at one of the tax-deductible categories listed below.

- ***Meteorite Member*** ($35): Receive the newsletter plus personal invitations to "members only" Institute events.
- ***Asteroid Member*** ($200): All of the above plus your choice of one of the following: A multicolor print of an original painting by W. K. Hartmann, or a signed copy of *A Traveler's Guide to Mars*, Bill's beautiful and fascinating overview of modern Mars research, illustrated by detailed photographs from the Mars Global Surveyor mission.
- ***Planet Member*** ($750): All of the above plus an exclusive invitation to an annual private dinner and highlights of astronomy talk with Institute scientists.
- ***Star Member*** ($5,000): All of the above plus an invitation to a night of observing at the Skywatcher's Inn, hosted by PSI scientists. This outing includes naked eye and telescopic viewing of the night sky at a prime dark-sky observatory near Benson, AZ.
- Or you can become a ***Supporting Member*** ($10,000 or more) or a ***Sustaining Member*** ($20,000 or more) and receive all of the above as well as provide additional funds to be used by PSI scientists in research and educational activities.

To make your tax-deductible donation, please complete the form on page 6 and send to the Tucson address.

Thank you!

Visit our website for information on current research projects & educational programs:

www.psi.edu

***or email us at*:**
psikey@psi.edu

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For complete membership benefits, see page 5.

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PLANETARY SCIENCE INSTITUTE Newsletter Published Quarterly

1700 E. Ft Lowell, Suite 106
Tucson, AZ 85719-2395
Phone: 520/622-6300
Fax: 520/622-8060
www.psi.edu

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