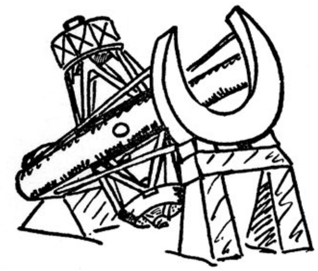
e Big Eye



The Newsletter of the Friends of Palomar Observatory Vol. 2, No. 1

Solar System Now Has Eight Planets

The International Astronomical Union (IAU) recently downgraded the status of Pluto to that of a “dwarf planet,” a designation that will also be applied to the spherical body discovered last year by California Institute of Technology planetary scientist Mike Brown and his colleagues. The decision means that only the rocky worlds of the inner solar system and the gas giants of the outer system will hereafter be designated as planets.

The ruling effectively settles a year-long controversy about whether the spherical body announced last year and informally named “Xena” would rise to planetary status. Somewhat larger than Pluto, the body has been informally known as Xena since the formal announcement of its discovery on July 29, 2005, by Brown and his co-discoverers, Chad Trujillo of the Gemini Observatory and David Rabinowitz of Yale University. Xena will now be known as the largest dwarf planet.

“I’m of course disappointed that Xena will not be the tenth planet, but I definitely support the IAU in this difficult and courageous decision,” said Brown. “It is scientifically the right thing to do, and is a great step forward in astronomy.

“Pluto would never be considered a planet if it were discovered today, and I think the fact that we’ve now found one Kuiper-belt object bigger than Pluto underscores its shaky status.”

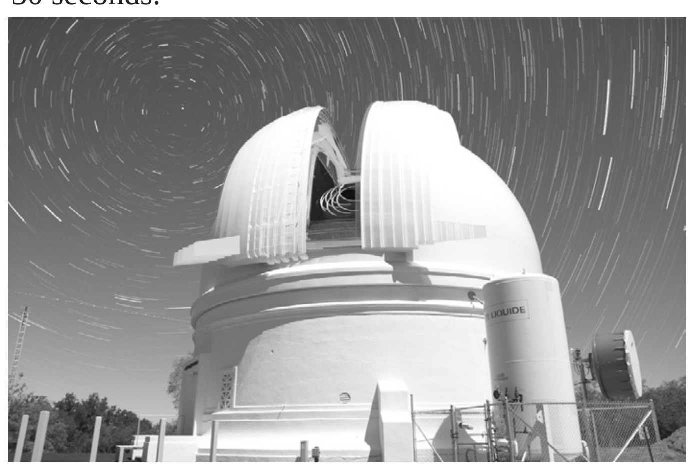
Pluto was discovered in 1930. Because of its size and distance from Earth, astronomers had no idea of its composition or other characteristics at the time. But having no reason to think that many other similar bodies would eventually be found in the outer reaches of the solar system--or that a new type of body even existed in the region--they assumed that designating the new discover as the ninth planet was a scientifically accurate decision.

Continued on page 4

Palomar’s Astronomical Bandwidth

For the past three years, astronomers at the California Institute of Technology’s Palomar Observatory in Southern California have been using the High Performance Wireless Research and Education Network (HPWREN) as the data transfer cyberinfrastructure to further our understanding of the universe. Recent applications include the study of some of the most cataclysmic explosions in the universe, the hunt for extrasolar planets, and the discovery of our solar system’s tenth planet. The data for all this research is transferred via HPWREN from the remote mountain observatory to college campuses hundreds of miles away.

Funded by the National Science Foundation, HPWREN provides Palomar Observatory with a high-speed network connection that helps enable new ways of undertaking astronomy research consistent with the data demands of today’s scientists. Specifically, the HPWREN bandwidth allows astronomers to transfer a 100MB image from a telescope camera at Palomar to their campus laboratories in less than 30 seconds.



Samuel Oschin Telescope with HPWREN antenna

Continued on page 2

"The Palomar Observatory is by far our most bandwidth-demanding partner," says Hans-Werner Braun, HPWREN principal investigator, a research scientist with the San Diego Supercomputer Center at UC San Diego. "Palomar is able to run the 45 megabits-per-second HPWREN backbone flat out and will be able to utilize substantially more bandwidth in the future. The current plan is to upgrade critical links that support the observatory to 155 Mbps and create a redundant 45 Mbps path for a combined 200 megabits-per-second access speed at the observatory."

Last summer astronomers making use of the Palomar 48-inch Samuel Oschin Telescope announced the discovery of what some are calling our solar system's tenth planet. The object has been confirmed to be larger than Pluto. The telescope uses a 161-million-pixel camera – one of the largest and most capable in the world. HPWREN enables a large volume of data to be moved off the mountain to each astronomer's home base. Modern digital technology with pipeline processing of the data produced enables astronomers to detect very faint moving and transient objects.

To find these objects, the telescope takes a relatively short exposure of a section of the sky. It then goes off and images a pre-arranged sequence of such target fields. After a period of time it comes back and repeats the sequence. Then it does it again after another interval. Any objects that are visible in all three images, but move consistently with respect to the background star field, are solar system objects such as asteroids, comets or Kuiper Belt objects. Because of the large amount of data, pipeline processing is used both to detect such objects and to calculate their preliminary orbits from the initial triplet data. Sedna and the tenth planet, 2003UB313, were found using this technique, as were a large number of Near Earth Asteroids by the Jet Propulsion Laboratory's Near-Earth Asteroid Tracking (NEAT) program.

The Nearby Supernova Factory piggybacks their hunt for a certain type of exploding star, known as Type Ia supernovae, with the data collected by the NEAT program, and they then use the observations of these supernovae as "standard candles" for measuring the accelerating expansion of the universe. To date the survey has discovered about 350 supernovae, including 90 Type Ia supernovae. Greg Aldering of the University of California's Lawrence Berkeley Laboratory says "The recent discovery that the expansion of the universe is speeding up has turned the fields of cosmology and fundamental physics on their heads. The QUEST camera and the speedy HPWREN link are giving us an unprecedented sample of supernovae for pursuing this exciting discovery. The Palomar supernovae will be compared with supernovae from the Hubble Space Telescope and other telescopes to try to determine what is causing this acceleration."

One of the universe's most mysterious and explosive events is the phenomenon known as a gamma-ray burst (GRB). They are briefly bright enough to be visible billions of light years away, but they are difficult to study because they are very short lived and take place at seemingly random locations and times.

Astronomers rely on satellites like Swift which detects a GRB and immediately relays the information to observers worldwide via the Gamma-Ray Burst Coordinates Network.

If a gamma-ray burst occurs when it is dark and clear at Palomar, the observatory's robotic 60-inch telescope immediately slews to the coordinates provided and images the fading optical glow of the explosion. "The rapid response by the Palomar 60-inch telescope is possible only because of HPWREN. With it we have observed and categorized some of the most distant and energetic explosions in the universe," remarks Shri Kulkarni, MacArthur Professor of Astronomy and Planetary Science and director of the Caltech Optical Observatories. These observations have allowed astronomers to reach new frontiers by classifying the bursts and theorizing about their origins.

For the last decade astronomers have been using indirect methods and giant telescopes (like the Keck in Hawaii) to make their first discoveries of planets outside our solar system (called exoplanets). The *smallest* telescope at the Palomar Observatory is performing its own search for exoplanets. With a small telescope it is possible to detect a giant Jupiter-sized world that lies close to its parent star. By looking at a great many stars each night the HPWREN-powered Sleuth Telescope hopes to catch such a planet in the act of passing directly in front of its star. Such an eclipse,

continued on page 3

Astronomical Bandwidth *coninued from page 2*

known as a transit, dims the light of the star by about one percent.

Sleuth is an automated telescope, capable of observing target areas of the night sky without much human interaction. All the required actions are scripted in advance, and a computer running this script is placed in charge of the telescope. The observer can then get a good night's sleep and receive the data in the morning. The automated nature of this procedure allows for remote observing, so the observer need not even be on the mountain.

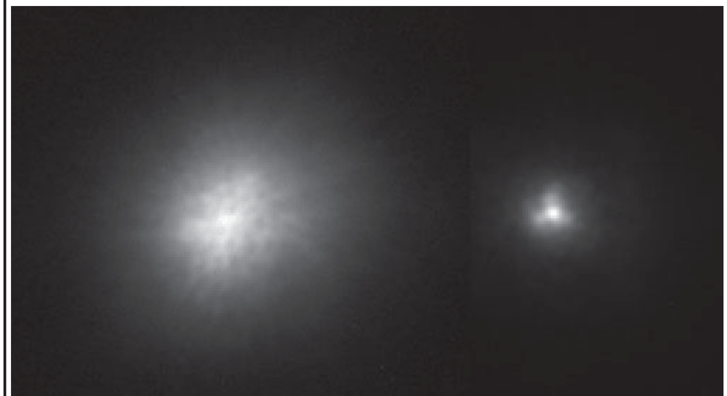
"Living in the modern age of astronomy has made observing much more efficient. Every night we transfer about 4 gigabytes of data via HPWREN from Sleuth to Caltech in Pasadena. It is on my computer and analyzed before I arrive at work in the morning," says Caltech graduate student Francis O'Donovan. "The ability to process the previous night's data enables us to quickly check the quality of that data. We can then ensure the telescope is operational before beginning the next night's observations."

"The current HPWREN funding supports research into an understanding, prioritization, and policy-based re-routing of data network traffic, something the bursty and predominantly night-time high-volume observatory traffic is very useful for," explains Braun. "This being alongside other research and education traffic, also including continuous low-volume sensor data with tight real-time requirements, creates an ideal testbed for this network research as well."

The High Performance Wireless Research and Education Network program is an interdisciplinary and multi-institutional UC San Diego research program led by principal investigator Hans-Werner Braun at the San Diego Supercomputer Center and co-principal investigator Frank Vernon at the Scripps Institution of Oceanography. HPWREN is based on work funded by the National Science Foundation. The HPWREN web site is at http://hpwren.ucsd.edu

HPWREN
High Performance Wireless Research & Education Network

Adaptive Optics Moves Forward



Last June marked an important milestone for the Palomar adaptive optics laser-guide star program. Above, left is an image that shows a blurred star taken through the 200-inch Hale Telescope. The image on the right reveals a much sharper image of the same star. It was the first such corrected image obtained at Palomar to make use of an artificial laser guide-star.

By projecting a laser into the sky astronomers have created an artificial laser-guide star for use in adaptive optics. To do so, they shine a narrow sodium laser beam up through the atmosphere. At an altitude of about 60 miles, the laser beam makes a small amount of sodium gas glow. The reflected light from the glowing gas serves as the artificial guide star for the adaptive-optics system. The adaptive-optics system can correct for blurring of light caused by moving air in Earth's atmosphere.

The laser beam is too faint to be seen except by observers very close to the telescope, and the guide star it creates is even fainter. It can't be seen with the unaided eye, yet it is bright enough to allow astronomers to make their adaptive-optics corrections.

This image above was obtained the night of June 13. The Hale Telescope will soon be making use of this program to produce some amazing images. Look for them soon.

Members of the Friends of Palomar Observatory, who renew their membship will receive an exclusive magnet showing the laser beam projecting out from Palomar's huge 1000-ton dome.

__Eight Planets__, continued from page 1

However, about two decades later, the famed astronomer Gerard Kuiper postulated that a region in the outer solar system could house a gigantic number of comet-like objects too faint to be seen with the telescopes of the day. The Kuiper belt, as it came to be called, was demonstrated to exist in the 1990s, and astronomers have been finding objects of varying size in the region ever since.

Few if any astronomers had previously called for the Kuiper-belt objects to be called planets, because most were significantly smaller than Pluto. But the announcement of Xena's discovery raised a new need for a more precise definition of which objects are planets and which are not.

According to Brown, the decision will pose a difficulty for a public that has been accustomed to thinking for the last 75 years that the solar system has nine planets.

"It's going to be a difficult thing to accept at first, but we will accept it eventually, and that's the right scientific and cultural thing to do," Brown says.

In fact, the public has had some experience with the demotion of a planet in the past, although not in living memory. Astronomers discovered the asteroid Ceres on January 1, 1801--literally at the turn of the 19th century. Having no reason to suspect that a new class of celestial object had been found, scientists designated it the eighth planet (Uranus having been discovered some 20 years earlier).

Soon several other asteroids were discovered, and these, too, were summarily designated as newly found planets. But when astronomers continued finding numerous other asteroids in the region (there are thought to be hundreds of thousands), the astronomical community in the early 1850s demoted Ceres and the others and coined the new term "minor planet."

Xena was discovered on January 8, 2005, at Palomar Observatory with the NASA-funded 48-inch Samuel Oschin Telescope. Xena is about 2,400 kilometers in diameter. A Kuiper-belt object like Pluto, but slightly less reddish-yellow, Xena is currently visible in the constellation Cetus to anyone with a top-quality amateur telescope.

Brown and his colleagues in late September announced that Xena has at least one moon. This body has been nicknamed Gabrielle, after Xena's sidekick on the television series.

Xena is currently about 97 astronomical units from the sun (an astronomical unit is the distance between the sun and Earth), which means that it is some nine billion miles away at present. Xena is on a highly elliptical 560-year orbit, sweeping in as close to the sun as 38 astronomical units. Currently, however, it is nearly as far away as it ever gets.

Pluto's own elliptical orbit takes it as far away as 50 astronomical units from the sun during its 250-year revolution. This means that Xena is sometimes much closer to Earth than Pluto--although never closer than Neptune.

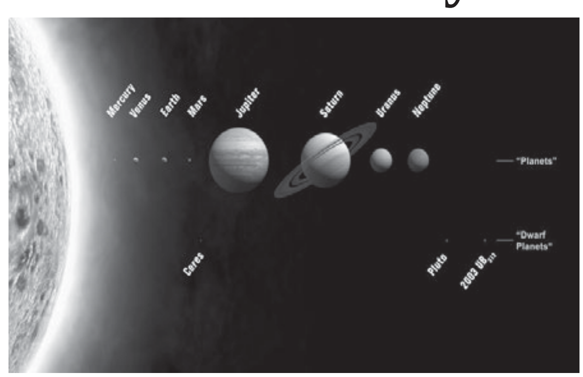
Gabrielle is about 250 kilometers in diameter and reflects only about 1 percent of the sunlight that its parent reflects. Because of its small size, Gabrielle could be oddly shaped.

Brown says that the study of Gabrielle's orbit around Xena hasn't yet been fully completed. But once it is, the researchers will be able to derive the mass of Xena itself from Gabrielle's orbit. This information will lead to new insights on Xena's composition.

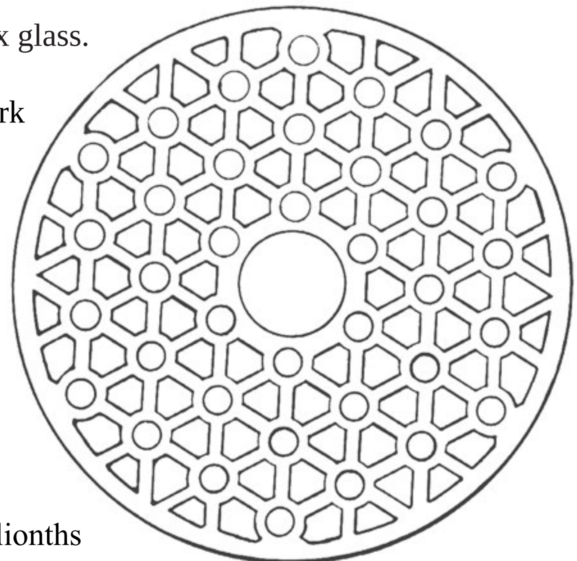
Based on spectral data, the researchers think Xena is covered with a layer of methane that has seeped from the interior and frozen on the surface. As in the case of Pluto, the methane has undergone chemical transformations, probably due to the faint solar radiation, that have caused the methane layer to redden. But the methane surface on Xena is somewhat more yellowish than the reddish-yellow surface of Pluto, perhaps because Xena is farther from the sun.

Brown and Trujillo first photographed Xena with the 48-inch Samuel Oschin Telescope on October 31, 2003. However, the object was so far away that its motion was not detected until they reanalyzed the data in January of 2005.

The New Solar System



Did You Know?



* The Hale Telescope's 200-inch primary mirror is made of Pyrex glass.

* The mirror was cast by Corning Glassworks in upstate New York in 1934. It cooled for more than 10 months.

* The mirror's waffle-like backside was created by numerous ceramic blocks that had to be sandblasted out of the glass after it had cooled.

* The 20 ton-mirror was ground and polished at Caltech in Pasadena. 5.5 tons of glass were removed in preparing the surface in an effort that took more than 180,000 man hours.

* The surface of the finished mirror is accurate to within two millionths of an inch. Caltech called it "The most daring optical job ever attempted by man."

* When the mirror was shipped to Palomar in 1947 a worker noticed what appeared to be a thin crack in the disc's center hole. Upon closer inspection it was discovered that it wasn't a scratch. It was the signature of the mirror's chief optician Marcus H. Brown.

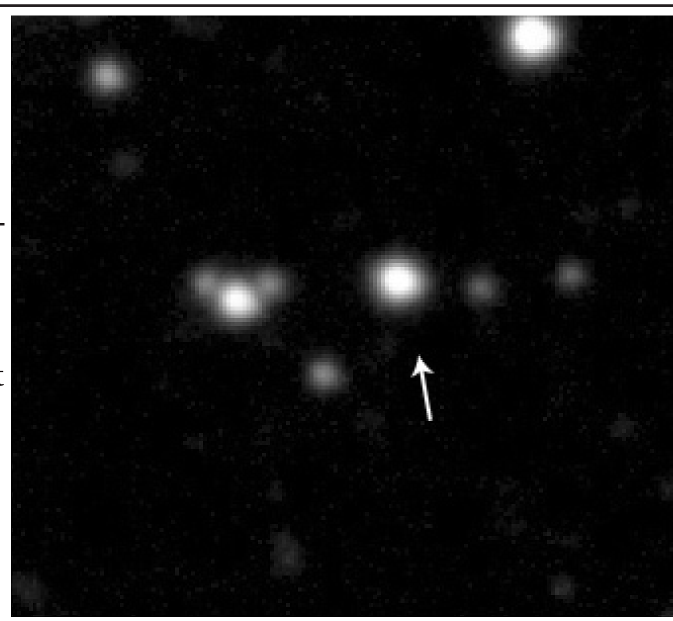
* The final adjustments to the mirror's shape included the addition of several fishing scales to pull the mirror's outer edge into perfection.

* The mirror's reflective surface is made of a thin layer of aluminum that weighs less than half an ounce and is replaced on average every year and a half.

Mickey and Pluto?

Caltech astronomer Tom Jarrett recently imaged Pluto (arrowed) using Palomar Observatory's 200-inch Hale Telescope using its Wide-field Infrared Camera.

Curiously when this image of Pluto was recorded it happened to be close in the sky to a grouping of three stars (left of Pluto) that calls to mind a cartoon mouse that is associated with the animated dog named Pluto.



Friends of Palomar Observatory
P.O. Box 200
Palomar Mountain, CA 92060-0200

Friends of Palomar Observatory Annual Membership Application

Student/Senior Citizen Member $30   Individual Member $45   Family Membership $75

Name ____________________________________   **Address** ________________________________

City _________________ **State** ___ **Zip** ______   **Phone** ___________________________________

Email ___________________________________

Check   Visa   Mastercard   (circle one)   **Credit Card #** ____________________________

Expiration Date __________________________   **Signature** ________________________________

For questions call (760) 742-2111, e-mail friendsofpalomar@astro.caltech.edu, or visit
www.friendsofpalomarobservatory.org