The Big Eye

The Newsletter of the Friends of Palomar Observatory Vol. 3, No. 2

Observatory Escapes Poomacha Fire

Caltech's historic Palomar Observatory in northern San Diego County was threatened by the Poomacha Fire which began on October 23 and moved up the slopes of Palomar Mountain for several days.

The flames came within two miles or so of the facility which houses an interferometer and five telescopes including the 200-inch Hale Telescope, the largest in the world for many decades.

The observatory was closed and the on-site staff evacuated in stages. As the flames made their closest approach, a dozen fire trucks, some from the Los Angeles County Fire Department, took up positions on the observatory property. A few key Observatory staff then returned to provide support to the firefighters. Firefighters utilized the entire observatory as a rest area and staging area for attacking the fire.

Shortly after the outbreak of fire power and phone lines were cut to Palomar Mountain, leaving the observatory

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Sharpest Images Ever

Astronomers from the California Institute of Technology and the University of Cambridge have developed a new camera that produces much more detailed pictures of stars and nebulae than even the Hubble Space Telescope, and it does all this from here on Earth.

Until now, images from ground-based telescopes have been invariably blurred by Earth's atmosphere. Astronomers have developed a technique, known as adaptive optics (AO), to correct the blurring, but so far it has only worked successfully in the infrared, where the smearing is greatly reduced. However, a new noise-free, high-speed camera has been developed at the Institute of Astronomy in Cambridge that, when used behind the infrared Palomar Adaptive Optics System, at last makes very high resolution imaging possible in ordinary visible light.

The camera works by recording partially corrected adaptive optics images at high speed (20 frames per second or more). Software then checks each image to sort out which are the sharpest. Many are still significantly smeared by the atmosphere, but a small percentage of them are unaffected. These are combined to produce the final high-resolution image that astronomers want. The technique is called "Lucky Imaging" because it depends on the chance fluctuations in the atmosphere sorting themselves out and providing a set of images that is easier for the adaptive optics system to correct.

This work was carried out on the 200-inch (5.1 meter) Hale Telescope on Palomar Mountain. Like all other ground-based telescopes, the images it normally produces are typically 10 times less detailed than those of the Hubble Space Tele-

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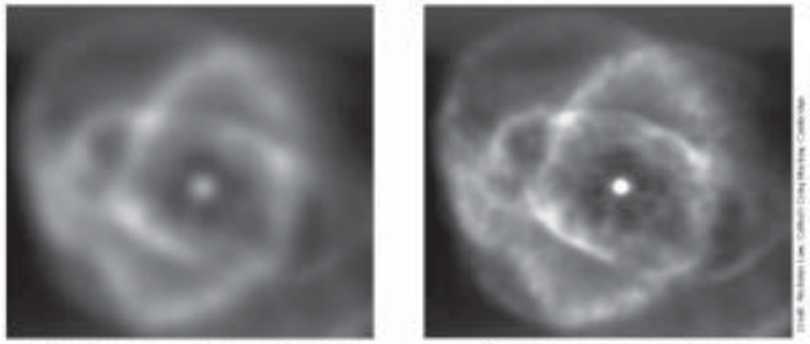
scope. Palomar's adaptive-optics system produces superb images in the infrared, but until now, its images in visible light have remained markedly poorer than Hubble images. With the new Lucky Camera, astronomers were able to obtain images that are twice as sharp as those produced by the Hubble Space Telescope—a remarkable achievement.

The images produced in the study are the sharpest direct images ever taken in visible light either from the ground or from space. "The system performed even better than we were expecting. It was fantastic to watch the first images come in and see that we were easily doing better than Hubble," says Nicholas Law, a postdoctoral scholar at Caltech and principal investigator for the instrument.

Most astronomical objects are so far away that astronomers are desperate to see more and more detail within them. The new pictures of the globular star cluster M13, located 25,000 light years away, are sharp enough that astronomers are able to find stars as little as one light-day apart. A light-year is the distance light travels in one year (almost 6 trillion miles). A light-day is the distance light travels in just one day. Stars in the vicinity of the solar system are much farther apart –the nearest star to our solar system is over four light-years away.

The astronomers also observed very fine detail in objects such as the Cat's Eye Nebula (NGC 6543). It is eight times closer to earth than M13, allowing filaments that are only a few light-hours across to be resolved.



The use of the camera at Palomar was a demonstration of the potential of visible-light adaptive optics and offers a glimpse of the detailed imagery to come. Astronomers at Caltech and the Jet Propulsion Laboratory are currently developing the first-ever astronomical adaptive-optics system fully capable of capturing visible-light images. The new system, known as PALM-3000, will routinely allow the 200-inch telescope at Palomar to outperform the Hubble Space Telescope at even blue wavelengths. Using state-of-the-art deformable mirrors, sensors, and a powerful laser, the upgraded Palomar adaptive-optics system will provide finer correction of the atmospheric blurring than any present adaptive optics system, allowing long-exposure images with the same fine detail as the "lucky" images taken recently.

Caltech's Richard Dekany, principal investigator for PALM-3000, says that the upgraded instrument could be available as early as 2010. "These Lucky Imaging results underscore the science potential of diffraction-limited visible-light observations on large ground-based telescopes," he explains.

To get even sharper pictures, astronomers will need to use bigger telescopes.
The results open up the possibility of further improvements on even larger telescopes, such as the 10-meter Keck telescopes on the top of Mauna Kea in Hawaii or in the future even larger telescopes, such as the Thirty Meter Telescope (TMT).

Working on the Lucky Imaging project were Law, Dekany, Mike Ireland, and Anna Moore from Caltech and the Palomar 200-inch crew. Other team members included Craig Mackay from Cambridge, James Lloyd from Cornell University, and Peter Tuthill, Henry Woodruff, and Gordon Robertson from the University of Sydney.

Images are available at http://www.astro.caltech.edu/palomar/AO/luckycam.html.

Palomar Stories: John Strong

In 1947 John Strong had been invited to come to Caltech from John Hopkins University to supervise the first aluminization process of the 200-inch disk. He was thrilled to work on the big telescope. First order of business was to get all the bugs worked out of getting the aluminizing chamber to seal with no leaks and finding pumps big enough to draw the vacuum they needed. When they were finally ready to put the thin coat of aluminum on the giant Pyrex disk to turn it into a 200-inch mirror the first attempt failed.

John Strong had discovered in his research that the worst contaminant was microscopic traces of oil from human skin. If there were any areas of the disk that weren't perfectly free from all traces of oil, the aluminum would not coat the disk properly. John Strong had brought with him, cases of a Wildroot Cream Oil hair tonic. He said, "In order to get glass clean", as he unpacked cases of hair tonic, "you first have to get it properly dirty." He set to work applying his Wildroot Cream Oil treatment to the Pyrex disk. He and the opticians wiped the surface clean just before the overhead crane lowered the bell jar onto the base of the aluminizing chamber. It was a success! First Light was three nights before Christmas 1947.

This Palomar Story, like the one on Marcus Brown in the last issue, was adapted from The Perfect Machine, by Ronald Florence – on sale in the Observatory Gift Shop.

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potentially cut off from the world. The observatory is fortunately equipped with back-up generators and is a partner in the High Performance Wireless Research and Education Network (HPWREN). HPWREN allowed the observatory staff to coordinate with the firefighting efforts and with Caltech in Pasadena. The ability outside personnel to monitor weather conditions on the observatory site and for observatory staff to communicate to the outside world using Voice-Over-Internet Protocol was invaluable.

The observatory provided water from its own 1 million-gallon water tank for fire units operating in the nearby community. The facility has its own generator that allowed the firefighters to access the water when there was no power on the rest of the mountain.

The floor of the Hale Telescope's large dome served as a bunkhouse for many firefighters, as did the dorm where astronomers normally stay when they are observing.

Two US Marine bulldozers were assigned to the Observatory to improve the firebreaks around the Observatory.

Two Palomar Observatory employees, Dan Zeiber and Greg Van Idsinga, are also members of the Palomar Mountain Volunteer Fire Department and spent the week fighting the fire along with thousands of other firefighters under the direction of CAL FIRE and the Cleveland National Forest.

Dan McKenna, the Deputy Site Manager, worked with the staff to assess any potential damage to the observatory's sensitive optics and cameras from ash contamination and brought the telescopes back into operation by early November.

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Friends of Palomar Observatory Annual Membership Application

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