

## Contact List

**Kitt Peak Visitor Center**—318-8726  
Nick Petrosino, Supervisor  
npetrosino@noao.edu  
318-8732

**NOAO Public Outreach**  
Rich Fedele, Manager  
rfedele@noao.edu  
318-8163  
Robert Wilson,  
Sr. Program Coordinator  
rwilson@noao.edu  
318-8440

### Kitt Peak Docent Program

950 N Cherry Ave  
Tucson, AZ 85719

**Docent Forum:** <http://groups.yahoo.com/group/docentforum/>

**Docent Calendar:** <http://groups.yahoo.com/group/docentforum/>

### Volunteering at Kitt

**Peak:** <http://www.noao.edu/outreach/kpoutreach.html>

[www.noao.edu](http://www.noao.edu)



## Next Docent Meeting Monday, June 19

The next docent meeting will be held on Monday, June 19. The meeting will convene at 6:00 in the main conference room and will feature dinner and a speaker. Docents should visit the docent forum calendar to schedule their hours. Docents who do not have web access may contact Nick Petrosino. See the URL for the docent calendar at lower left.

«First Name» «Last Name»  
«Mailing Address»  
«City» «State» «Zip Code»

## Kitt Peak Docent Program

# DOCENT NEWS

Number 104

June 2006



## PROGRAMS, EVENTS FOR JUNE

### Points of Interest:

- The docent meeting is scheduled for Monday, June 19, featuring dinner and speaker Ron Probst on NEWFIRM.
- June 3: Asteroid 2004 DC near-Earth flyby at 0.026 AU
- June 4: Venus Express, science phase begins
- June 5 to 9: Fragments of Comet SW3 at perihelion
- June 10: Asteroid 2003 YN107 near-Earth flyby at 0.022 AU
- June 17 to 24: Grand Canyon Star Party
- June 18: Mars passes 0.6 degrees from Saturn
- June 21: Summer Solstice 12:26 UT
- June 21: Mercury at its greatest eastern elongation

For additional information about these points of interest, visit <http://www2.jpl.nasa.gov/calendar/>.

June is off to a optimistic start with four reservations for New Scope Night and ten for Stars and Music, unlike the May 6th program that had to be cancelled. Both programs run on Saturday, June 3rd. Lunar adventure is also scheduled for that night but does not have any reservations. People interested in that program might be persuaded to attend Stars and Music instead.

On the down side, the first of the imaging workshops, presented by Robert Reeves, has been cancelled for attendance. Two similar workshops are still scheduled though, one of them this month on the 24th and 25th with Travis Rector demonstrating the finer points of Photoshop for image processing.

On June 10th NOAO makes an appearance at a vendor fair for the Civil Air Patrol. Their cadets take courses in space science and astronomy, and the officer in charge of

coordinating the event asked that NOAO set up a booth. Dee Stover, an engineering tech at NOAO, and two docents have volunteered to represent the observatory at the fair and pitch the public programs, especially the Youth Group Overnight.

Eleven days later on Wednesday, June 21st from 10:00 to 6:00 Pima County School Superintendent's Office is hosting an Educational Resources Fair, sponsored by KB Home. NOAO is registered to present public and educational outreach programs, especially Project and Family Astro.

Docents who would like to assist with the educator fair may contact the docent coordinator. The event is likely to be well attended, so two volunteers in addition to staff would ensure adequate coverage of the booth and frequent breaks.

## LSST TO GO TO CHILE

A press release from LSST (Large Synoptic Survey Telescope) announced that Cerro Pachon has been chosen as the site for the world's most powerful survey telescope. The selection was made following two years of extensive testing at four possible sites.

Just as with the selection of Kitt Peak as the site of the National Observatory, many factors were considered in the search for a perfect place to build this observatory. Among those factors were seeing, percentage of clear nights, and existing facilities.

LSST, which is scheduled to see first light in 2012, is an 8-meter telescope of an unusual design. It employs an 8.4-meter primary, a 3.4-meter secondary, and a 5.2-meter tertiary mirror. This folded light path results in a short telescope structure and therefore a

stable imaging platform.

LSST also achieves a field of view of ten square degrees, many times that of existing large telescopes. Its wide field of view coupled with state-of-the-art imaging capability will allow LSST to image the entire night sky every three nights, producing an astounding thirty terabytes of data each night, gathered by its three-billion pixel camera.

Of interest to people everywhere who might be curious about what this telescope finds is the fact that the data are not proprietary. LSST data will be available to anyone anywhere through conventional web sites.

For a detailed description of the potential of this amazing telescope, visit <http://www.lsst.org/> or [www.noao.edu](http://www.noao.edu) and find the link to the LSST web site.

## SCIENTISTS PREDICT HOW TO DETECT A FOURTH DIMENSION OF SPACE

Scientists at Duke and Rutgers universities have developed a mathematical framework they say will enable astronomers to test a new five-dimensional theory of gravity that competes with Einstein's General Theory of Relativity.

Charles R. Keeton of Rutgers and Arlie O. Petters of Duke base their work on a recent theory called the type II Randall-Sundrum braneworld gravity model. The theory holds that the visible universe is a membrane (hence "braneworld") embedded within a larger universe, much like a strand of filmy seaweed floating in the ocean. The "braneworld universe" has five dimensions -- four spatial dimensions plus time -- compared with the four dimensions -- three spatial, plus time -- laid out in the General Theory of Relativity.

The framework Keeton and Petters developed predicts certain cosmological effects that, if observed, should help scientists validate the braneworld theory. The observations, they said, should be possible with satellites scheduled to launch in the next few years.

If the braneworld theory proves to be true, "this would upset the applecart," Petters said. "It would confirm that there is a fourth dimension to space, which would create a philosophical shift in our understanding of the natural world."

The scientists' findings appeared May 24, 2006, in the online edition of the journal Physical Review D. Keeton is an astronomy and physics professor at Rutgers, and Petters is a mathematics and physics professor at Duke. Their research is funded by the National Science Foundation.

The Randall-Sundrum braneworld model -- named for its originators, physicists Lisa Randall of Harvard University and Raman Sundrum of Johns Hopkins University -- provides a mathematical description of how gravity shapes the universe that differs from the description offered by the General Theory of Relativity.

Keeton and Petters focused on one particular gravitational consequence of the braneworld theory that distinguishes it from Einstein's theory.

The braneworld theory predicts that relatively small "black holes" created in the early universe have survived to the present. The black holes, with mass similar to a tiny asteroid, would be part of the "dark matter" in the universe. As the name suggests, dark matter does not emit or reflect light, but does exert a gravitational force.

The General Theory of Relativity, on the other hand, predicts that such primordial black holes no longer exist, as they would have evaporated by now.

"When we estimated how far braneworld black holes might be from Earth, we were surprised to find that the nearest ones would lie well inside Pluto's orbit," Keeton said.

Petters added, "If braneworld black holes form even 1 percent of the dark matter in our part of the galaxy -- a cautious assumption -- there should be several thousand braneworld black holes in our solar system."

But do braneworld black holes really exist -- and therefore stand as evidence for the 5-D braneworld theory?

The scientists showed that it should be possible to answer this question by observing the effects that braneworld black holes would exert on electromagnetic radiation traveling to Earth from other galaxies. Any such radiation passing near a black hole will be acted upon by the object's tremendous gravitational forces -- an effect called "gravitational lensing."

"A good place to look for gravitational lensing by braneworld black holes is in bursts of gamma rays coming to Earth," Keeton said. These gamma-ray bursts are thought to be produced by enormous explosions throughout the universe. Such bursts from outer space were discovered inadvertently by the U.S. Air Force in the 1960s.

Keeton and Petters calculated that braneworld black holes would impede the gamma rays in the same way a rock in a pond obstructs passing ripples. The rock produces an "interference pattern" in its wake in which some ripple peaks are higher, some troughs are deeper, and some peaks and troughs cancel each other out. The interference pattern bears the signature of the characteristics of both the rock and the water.

Similarly, a braneworld black hole would produce an interference pattern in a passing burst of gamma rays as they travel to Earth, said Keeton and Petters. The scientists predicted the resulting bright and dark "fringes" in the interference pattern, which they said provides a means of inferring characteristics of braneworld black holes and, in turn, of space and time.

"We discovered that the signature of a fourth dimension of space appears in the interference patterns," Petters said. "This extra spatial dimension creates a contraction between the fringes compared to what you'd get in General Relativity."

Petters and Keeton said it should be possible to measure the predicted gamma-ray fringe patterns using the Gamma-ray Large Area Space Telescope, which is scheduled to be launched on a spacecraft in August 2007. The telescope is a joint effort between NASA, the U.S. Department of Energy, and institutions in France, Germany, Japan, Italy and Sweden.

The scientists said their prediction would apply to all braneworld black holes, whether in our solar system or beyond.

"If the braneworld theory is correct," they said, "there should be many, many more braneworld black holes throughout the universe, each carrying the signature of a fourth dimension of space."

*James Todd, Duke University  
james.todd@duke.edu*

*Carl Blesch  
Rutgers, The State University of New Jersey  
cblesch@ur.rutgers.edu*

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Sun	Mon	Tue	Wed	Thu	Fri	Sat
				1 <i>Aubrey</i>	2 <i>Doug, Jerry L.</i>	3 <i>Jim O., Kelly, Mark</i>
4 <i>Anna</i>	5 <i>Bill, Eugene Guerrero MS 13</i>	6 <i>Aubrey, John P.</i>	7 <i>Sheila, Punch</i>	8 <i>Richard G.</i>	9 <i>Doug, Jerry L.</i>	10 <i>Jim O., Larry L.</i>
11 <i>Anna</i>	12 <i>Anna, Bill</i>	13 <i>Joyce, Aubrey</i>	14 <i>Sheila, Punch</i>	15 <i>Jon P., Bob K.</i>	16 <i>Doug, Jerry L. Oro Valley 65</i>	17 <i>Jim O., Eugene Yoeme Pueblo 15</i>
18 <i>Larry L.</i>	19 <i>Bill Docent Meeting</i>	20 <i>Joyce, Aubrey</i>	21 <i>Sheila, Punch</i>	22 <i>Jon P.</i>	23 <i>Vance, Doug Oro Valley 50 San Simon Sch</i>	24 <i>Jim O.</i>
25 <i>Eugene, Bill</i>	26 <i>Jon P.</i>	27 <i>Joyce, Aubrey</i>	28 <i>Sheila, Punch</i>	29 <i>Richard G.</i>	30 <i>Doug Kids First Sch. 25</i>	

## TRAINING WITH THE CORONADO TELESCOPES

Seven docents have responded to the call for volunteers to operate the Coronado telescopes for the public. Three training dates are available: Monday, June 5th; Wednesday, June 7th; and Friday, June 9th. If any of the seven volunteers are not able to attend those sessions, they may make special arrangements with the docent coordinator to be trained at a later date, but every effort should be made to attend one of the scheduled dates.

Operation of the mount is quite simple and training will not take long. Each volunteer will prepare the telescopes for use, power up the mount, enter the required information on the hand paddle, and find the Sun. Then the mount will be returned to its stow position and powered down. The telescopes will also be returned to their stow configuration.

Operation of the dome is even simpler than the operation of the mount. But given the time it takes for the shutter to open

and close, the training will not involve repeatedly operating that mechanism. Instead it will be demonstrated at the beginning and end of training.

Initially the telescope will be available to visitors in the morning and most of them will come from the 10:00 tour. Those guests will be told of the telescope at the conclusion of the tour and given to option of walking to it by themselves. It is important, therefore, that a schedule be developed and adhered to.

The observatory itself needs cleaning in preparation for regular use by guests. Any of the volunteers who would like to assist with that task are welcome to do so. Interested docents may contact the docent coordinator for further details. All seven volunteers should contact the coordinator to confirm their attendance in the training sessions.