

V I E W

PISGAH ASTRONOMICAL RESEARCH INSTITUTE

Volume 7 Number 1 Spring 2007



Photos courtesy of Dr. Mel Blake, Copyright 2007 M. Blake

Lunar eclipse and PARI photo contest

The evening of March 3 North Carolina will experience one of nature's most spectacular phenomena, a total lunar eclipse. PARI is co-sponsoring a contest with the Transylvania Times for the best eclipse pictures, either photographs or drawings. For details, visit www.pari.edu.

In this issue's Astronomer's Corner, Dr. Bob Hayward describes how eclipses occur. For those in Western North Carolina, this particular eclipse will actually begin before Moonrise at 6:24 p.m. At that time, the Moon will be totally within the Earth's shadow and will begin to emerge at 6:58 p.m. The process will continue until we see the full Moon at 9:54. We encourage you to go out and experience this event--- and don't forget the contest!

AAS annual meeting



PARI sent several representatives to the annual meeting of the American Astronomical Society (AAS), including Rosalie McGurk and Dr. Michael Castelaz. Rosalie is a student at the University of Washington (Seattle) and was a summer intern at PARI, sponsored by Sherry and Richard Austin. At the AAS meeting Rosalie reported on her summer work which involved developing methods for observing unexplored star clusters.



PARI Science Educator Christi Whitworth and Astronomer Mel Blake with lunar eclipse photos taken by Dr. Blake.

Space Day scheduled May 5

PARI's annual Space Day open house is scheduled for Saturday, May 5, and will feature a host of activities including an opportunity to visit the StarLab planetarium. Check the web site, www.pari.edu, for activity details and directions.

PARI Calendar

- Feb. 24 Space Science Lab Saturday Session
- Mar. 16 Evening at PARI
- Mar. 17-18 Volunteer Weekend
- Mar. 23 Brevard Middle School Career Day at PARI
- Apr. 20 Evening at PARI
- Apr. 28 Space Science Lab Student Graduation
- May 4 Homeschool Day
- May 5 Space Day
- May 12 ROBOTS workshop - Charlotte
- May 18 Evening at PARI
- May 19 ROBOTS workshop - Elizabeth City
- May 26 ROBOTS workshop - Chapel Hill

PARI attends its first annual Grassroots Museum meeting



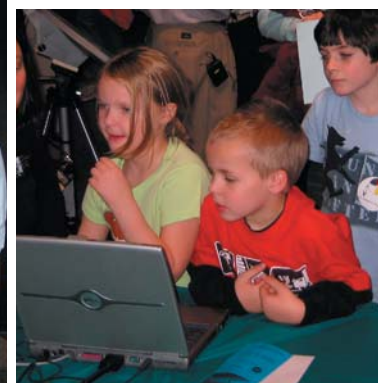
PARI was recently awarded membership in the NC Grassroots Museum Collaborative and attended the group's annual meeting in February. During a working session PARI President Don Cline discussed a project with Betsy Bennett (standing), director of the NC Museum of Natural Sciences, and Ruth Haas (seated), Director of the Cape Fear Museum and current president of the Grassroots Collaborative. At the right are Fran Nolan, Grassroots executive director, and Mark Sinclair, Director of the Catawba Science Center. The Collaborative is discussing ways PARI can provide interactive science displays to museums throughout North Carolina.

PARI takes teacher workshops statewide



PARI is conducting a series of workshops throughout the state, training teachers to use PARI's 4.6 meter radio telescope ("Smiley") to encourage an interest in science among 6th, 7th and 8th grade students. The program is part of an initiative named ROBOTS that was developed by the NC Mathematics and Science Education Network and funded by a National Science Foundation grant. This photo shows workshop participants at Fayetteville State University. Workshops were conducted recently at NC State University and Winston-Salem State University, and will soon be scheduled in Charlotte, Chapel Hill and Elizabeth City.

Astronomy Days at the NC Museum of Natural Sciences



PARI was featured at a special exhibit during Astronomy Days at the NC Museum of Natural Science in Raleigh. In addition to explaining PARI and its various programs, PARI staff and volunteers helped museum visitors use the Internet to remotely operate "Smiley," the 4.6 meter (15ft) radio telescope located on the PARI campus.

How Many Eclipses?

astronomer's corner

Dr. Bob Hayward, Astronomer/Educator

A look ahead to 2007: This year there are a total of four eclipses. They start with a total lunar eclipse of the Moon on March 3. The end of this eclipse will be visible from North Carolina; the Moon will be in eclipse as it rises. About two weeks later, on March 19, there is a partial eclipse of the Sun visible from eastern Asia and parts of northern Alaska. Following a gap of almost six months we have another total lunar eclipse on August 28 which begins in the wee hours of the morning such that the Moon will be in totality as it sets. Finally, there is another partial solar eclipse on September 11 visible from parts of South America, Antarctica and the South Atlantic.

Now, let's analyze the above data and see if we can find a pattern. We note that there are two pairs of eclipses separated by a little bit less than six months. Is this just coincidence or is there a physical explanation for it? There is, of course, a reason. Let's first review the mechanism of eclipses. The Moon orbits the Earth approximately every $29\frac{1}{2}$ days with respect to the Sun. Thus, full moons are $29\frac{1}{2}$ days apart as are new moons. We call these alignments of the Earth, Sun and Moon syzygy. The Moon's orbit is tilted just over 5° to the ecliptic, the plane of the Earth's orbit. Thus, there are two places, or nodes, where the Moon's orbit crosses the ecliptic, the ascending node where the Moon is moving up from below the ecliptic and the descending node where it is moving downward. At new moon the Moon passes between the Earth and the Sun...sort of. An eclipse occurs only if the Moon is close to the ecliptic, i.e., close to a node in its orbit. Otherwise, it will be above or below the Sun as viewed from the Earth and there will be no eclipse. Likewise, a lunar eclipse occurs when the Moon moves into the Earth's shadow which also lies in the ecliptic. This occurs only at full moon and only if the Moon is close to a node; otherwise we have a full moon without an eclipse since the Moon passes above or below the Earth's shadow in space.

If we draw a line between the ascending and descending nodes of the Moon's orbit, we call this the line of nodes. As the Earth makes its annual journey around the Sun, the line of nodes lines up with the Earth-Sun line twice a year. Thus, we have two times during the year when we can have eclipses, i.e., two eclipse seasons. In other words, the Moon passes through each node of its orbit once every $29\frac{1}{2}$ days but, unless it is near syzygy, there will be no eclipse. Solar eclipses occur if new moon occurs during a 36-day period centered on the Moon's passage through either node. Since the month is only $29\frac{1}{2}$ days long, there must be a solar eclipse in each eclipse season! There could be two! Lunar eclipses occur if full moon occurs during a 24-day period around a node passage. Thus, there could be one and only one lunar eclipse per eclipse season and there could be an eclipse season with no lunar eclipses. Since there are two eclipse seasons per calendar year, we can have as many as four solar eclipses and as many as two lunar eclipses. We have to have at least two solar eclipses per year. We do not have to have even one lunar eclipse.

But, go back a few years. In 1982 there were four solar eclipses and three lunar eclipses! In view of the above, that is not possible. But there's a fly in the ointment. Each year the line of nodes of the Moon's orbit slips backwards about 19° . This means the intervals between eclipse seasons is about nine days short of six months. Thus, it is possible to have parts of three eclipse seasons in a calendar year (early January, mid-year and late December). The upshot of that is that we could possibly have a total of seven eclipses in a given year, either five solar and two lunar or, like 1982, four solar and three lunar. The geometry of the situation does not permit five solar and three lunar eclipses in a calendar year.

So, in 2007, enjoy two eclipse seasons with a lunar and a solar eclipse in each.

References: Observer's Handbook 2007, The Royal Astronomical Society of Canada. HM Nautical Almanac Office, <http://www.eclipse.org.uk/eclbin/query.cgi>

PARI needs your help!

PARI is a public, not-for-profit foundation. Financially, we are dependent upon contributions and grants for our educational and research programs, and for the many operating expenses associated with maintaining the campus and our facilities.

If you have recently contributed, we thank you for your support. If not, please help support PARI and our mission with a contribution. PARI is a 501 c(3) organization and all donations are tax deductible to the full amount allowed by law.

A financial contribution automatically makes you a member of Friends of PARI. Membership levels and benefits include:

Student Member	\$10.	Member level for full time students. E-mail copy of the PARI Newsletter.
Associate Member	\$50.	Receive Quarterly Issues of the PARI Newsletter.
Member	\$100.	All of the above plus a PARI key chain with light.
Sponsor	\$200.	All of the above plus a PARI coffee mug. Use of the PARI Astronomy Library.
Supporter	\$500.	All of the above plus a PARI hat and a PARI lapel pin.
Mentor	\$1,000.	All of the above plus an invitation to one of the quarterly night astronomy sessions at PARI.
Advisor	\$2,000.	All of the above plus use of the Internet controlled remote optical imaging Space Observatory.
Benefactor	\$5,000.	All of the above plus "Guest Astronomer Program." Spend a day working with the astronomy staff, learning how to operate a radio telescope.

All donors at the level of \$5,000 and above will receive recognition on a plaque at PARI.

Please provide the requested information below and mail it with your contribution to:

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The Pisgah Astronomical Research Institute (PARI) is a not-for-profit public foundation established in 1998. Located in the Pisgah Forest 30 miles southwest of Asheville, NC, the PARI campus is a dark sky location for astronomy and was selected in 1962 by NASA as the site for one of the first U.S. satellite tracking facilities. Today, the 200 acre campus houses radio and optical telescopes, earth science instruments, 30 buildings, a fulltime staff and all the infrastructure necessary to support STEM (science, technology, engineering and math) education and research. PARI offers educational programs at all levels, from K-12 through post-graduate research. The institute is affiliated with the 16-campus University of North Carolina system through PARSEC, a UNC Center hosted at PARI, and is a member of the NC Grassroots Museum Collaborative. For more information about PARI and its programs, visit www.pari.edu.

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