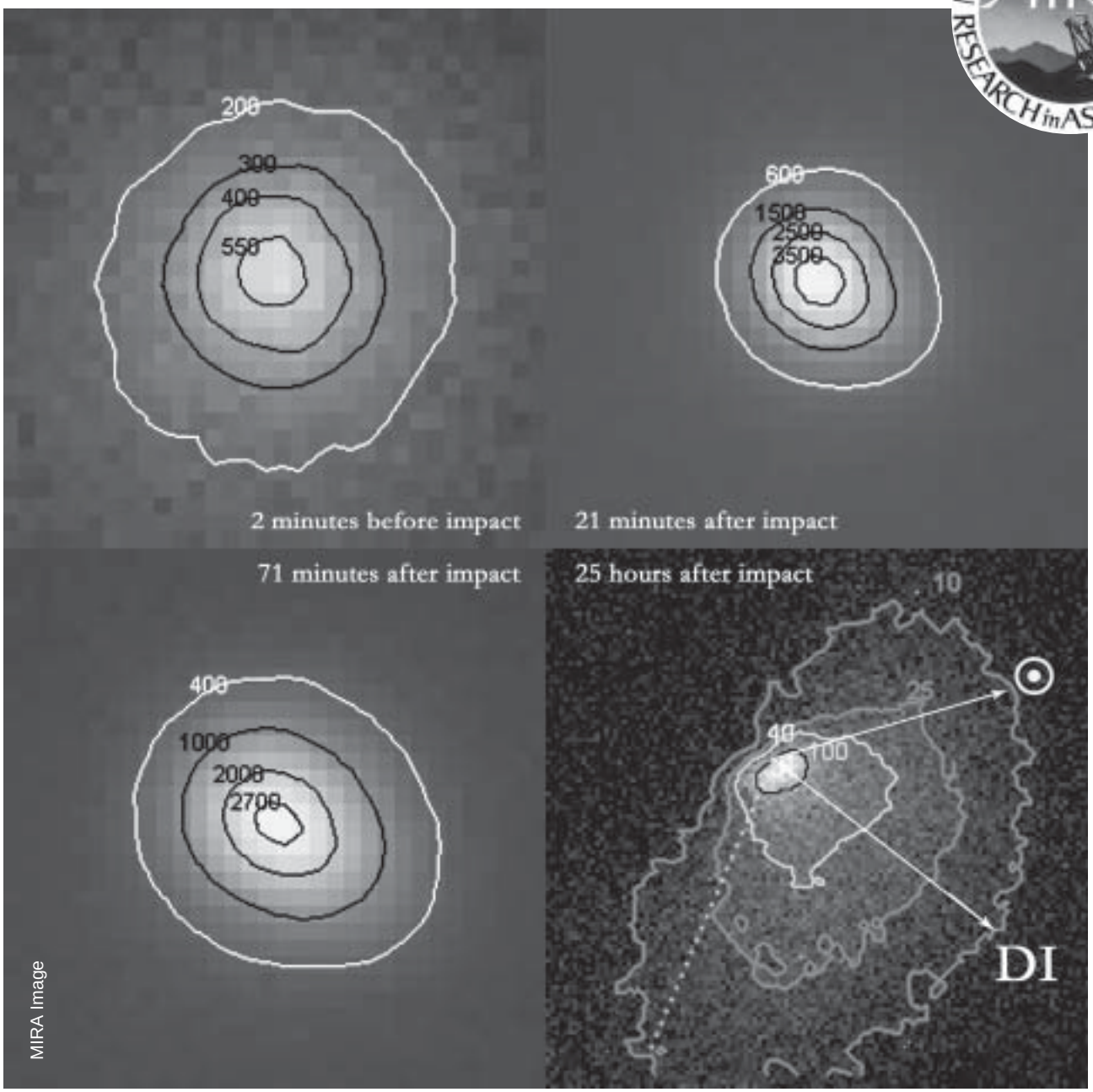
SUMMER 2006
VOLUME 29, NO. 2

MIRA NEWSLETTER



Analyzing the Deep Impact Data

(See "On the Cover," page 2)

Contents

MIRA Receives Two Grants

by Holly Keifer

The Pebble Beach Company Foundation has donated $2000 in support of MIRA's major education programs. MIRA does outreach to grade school students, has internship programs for high school students, hosts regular tours of our observing facilities, hosts public star parties, and maintains a web based education program enjoying 15,000 hits per day. MIRA distributes at no cost to educators a recently completed educational CD on the science of asteroids that pass dangerously close to earth titled "Are We Doomed?" With so much to do we appreciate the generous support of the Pebble Beach Company Foundation.

Yellow Brick Road Benefit Shop has contributed $1000 in support of our public lecture series. These events are very well attended, usually filling one of Monterey Peninsula College's large lecture halls to capacity and indicate an enormous public interest in astronomy in this community. The series is a regular opportunity for world-renowned scientists to share current findings and answer questions on advancements in astronomy as they occur. We are grateful for Yellow Brick Road's ongoing support and for the many good works they help sponsor throughout Monterey County.

With all this going on, are you sure that you and your family are taking full advantage of all that MIRA has to offer? The year ahead will provide many opportunities to participate, so watch your newsletter and make a visit to MIRA a regular event!

Casey Dreier, MIRA researcher, works on the stellar atmospheres program.

Calendar of Events

Saturday, 8 July, 7:30pm Free public lecture by Dr. Stephen Thorsett of Lick Observatory on "Great Balls of Fire: Gamma Ray Bursters, the Most Powerful Explosions in the Universe." Monterey Peninsula College, Lecture Forum 102.

Sunday, 9 July, and Sunday, 16 August, 2:30-4:00pm Free tours of MIRA's Oliver Observing Station on Chews Ridge. Open to the public. Reservations are required; please call 883-1000.

On the Cover

Readers of recent issues of the *MIRA Newsletter* will know that MIRA astronomers observed NASA's "Deep Impact" mission to crash a projectile into the nucleus of Comet Tempel 1 on 4 July 2005. Our analysis of the data is now complete, and the composite image on the cover shows a small sample of what we learned.

The upper left, upper right, and lower left panels are CCD images of the comet, all at the same scale, with contour plots superimposed on them. Note that the contours are roughly circular in the image made just before impact, and that after impact the contours become increasingly elliptical. This is due to the material being ejected from the nucleus of the comet by the force of the impact. The elongation of the images is in the direction of plume ejection.

The fourth image is a composite of several images made on the night following the impact. Its scale is reduced relative to the other three in order to show the broad fan of ejected material spreading out from the comet nucleus. The bright pre-impact image of the comet has been subtracted so that the very faint ejecta fan may be seen. Measuring the distance from the position of the comet nucleus to the edge of the fan shows how far the particles have traveled in 25 hours, and thus their velocity.

A very interesting result is that the velocity in the direction of the sun (the arrow pointing to the symbol ⊙) is lower than in the direction of the original ejection (DI). This is the effect of solar radiation pressure on the particles, slowing them down. In the direction of the dotted line, where this pressure accelerates the particles because they are moving away from the sun, the fan is quite broad. From the effect of the solar radiation on the particles, we can calculate that their average diameter is 7.6 microns (about the diameter of a human red blood cell). Quite a feat of measurement, considering the comet was almost 81,000,000 miles from earth at the time!

Q&A

This feature is inspired by the questions we have received over the years from interested readers. If you have a question about an astronomical topic, please send it to us.

Q: Which way do the planets go around the sun?

– Holly Keifer, MIRA technician.

A: This is one of those simple questions that has many levels of answers. Almost all levels reveal yet another layer of anthropomorphic, and sometimes social, provincialism.

The simple answer: counter-clockwise.

Seems easy enough. And, if you look at most images picturing the solar system, that is the direction you'll see. But this answer presupposes two arbitrary facts: folks in the northern hemisphere set the standards and everybody's clocks have hands that rotate on dials and they all go in the same direction. The answer 'counter-clockwise' is meaningful only if one adds from which direction the solar system is viewed; counter-clockwise as viewed from the south is clockwise as viewed from the north. If Australian aborigine scientists had invented those mechanical clocks that flip over numbers, they would have no clue what our answer meant. Our first answer only makes sense if you come from the 'correct' hemisphere and use European clocks.

Dr. Chien-Shiung Wu (photo by Manny Warman)

We could say that if we are standing on the edge of a circle, looking toward the center, the direction of our right hand would be the counter-clockwise direction. Now we need to come up with the understanding of what 'right' and 'left' mean. This is the same problem with which we started: clockwise and left are totally arbitrary, but very necessary, conventions.

On the earth, we can appeal to biology, which has a preference for certain 'handedness' of the shapes of biologically-active molecules but that requires our aborigine scientists to be pretty advanced in biology. By the way, earth-based organic systems prefer left-handed amino acids but right-handed sugars. Change the directionality and you can convert a food to a poison. For example, left-handed limonene is an anti-viral agent in humans, and the right-handed form is used in industrial cleaners and degreasers. But, as far as we know, this works only for life on earth.

The deeper question is how do we describe the direction of the planets' motions around the sun to aliens far, far away. An advanced civilization of uncertain biology and unknown conventions is the thought experiment we will use to see if we can explain directionality in fundamental terms.

Right-left/clockwise-counter-clockwise directionality is needed to describe many fundamental phenomena. For example, many of the relationships in electricity and magnetism require such directionality to describe. As mentioned above, molecules can be arranged in either sense of rotation and, in non-organic systems, are equally likely in either configuration. Does the biochemistry of our aliens use right- or left-handed molecules? Or can you evolve organic systems that don't care?

Until the middle of the 20th century, physicists thought that there was no way to solve that problem and you couldn't tell if you were observing nature in a mirror or not. Tsung-Dao Lee and Chen Ning Franklin Yang, Chinese students who crossed paths at the University of Chicago, developed a theory that the weak force would not conserve parity (which is what physicists call right-left symmetry in physical processes). The weak force is one of the four fundamental forces and was discovered by an Italian professor, Enrico Fermi, who was also at the University of Chicago at the time.

This theory was not well received as it seemed improbable that nature would distinguish between handedness, violating parity, and no everyday phenomenon can be described differently if seen in a mirror (which reverses the handedness). But Chien-Shiung Wu, a Chinese physicist at Colombia University, showed in 1956 that when supercooled atoms of radioactive cobalt-60 were aligned in a magnetic field, they emitted more strongly in one direction than another. This came as a big shock to the physics community which believed that the conservation of parity was self-evident. A Nobel laureate said that Wu's experiments "have been designed with great elegance and have, by virtue of their elegance, a high esthetic quality." The next year, Lee and Yang received the Nobel Prize but Wu, who showed their theory had correctly predicted the breaking of parity, did not. Did I mention that she was also known as Madam Wu by an admiring physics community?

So, if our aliens have discovered the weak force and have someone as competent as Madam Wu to do the experiment, we can convey to them which way the planets go around our sun. Maybe in their civilization the female experimentalist will win the prize.

MIRA Docent Tom Lougheed Moves On

by Holly Keifer and Kimberly Postgate

Astronomy might be thought to be a lonesome life: solitary scientists gazing into the night while the world slumbers. In fact, however, as the Friends of MIRA know, personal interaction is one of the most rewarding aspects of the field.

MIRA and the MIRA amateur club have been fortunate to enjoy the support and friendship of Tom Lougheed. Familiar to anyone who has come for Friends' Night observing on Chews Ridge and many, many local school children, Tom has tirelessly served the cause of bridging the gap between the practicing scientist and the curious public.

After enjoying his many talents for 15 years, the MIRA community must bid Tom farewell for a time. MIRA caught up with him for a chat before he leaves for the next stage of an exciting career.

Tom Lougheed prepares to show the sun to fourth-graders at the Santa Rita School in Salinas

MIRA – Tell us about your background and how you became interested in astronomy.

Tom – I became interested in astronomy as a child, but because I grew up in the rainy part of the Pacific Northwest, it was mostly out of books. I did have two telescopes as a child, which did not get nearly enough use. Later on, both in junior college and at university, I had a key to the institution's telescope, which is when my interest in sky gazing really took off.

MIRA – How did you first come to MIRA?

Tom – I contacted MIRA when I first moved to the area, because it was the local observatory, and came to the public lectures. As the MIRA amateur club [now the MIRA Observers Group--Ed.] became more active, I participated. I was occasionally asked to bring a telescope to a school or Cub Scout event and things took off from there. I started organizing some of the sidewalk astronomy events in the area. Then it was discovered that I was willing to answer questions that people e-mailed in to the observatory. I have also hosted observing nights for business groups and private parties, for people who are willing to donate money to the observatory.

MIRA – Tell us more about your work here at MIRA.

I answer astronomy questions e-mailed to both the MOG and MIRA. I arrange visits to local schools and scouting groups. I unlock the facilities at MIRA when the astronomy club wants to meet there. I am one of the telescope bringers/wranglers for any event that requires teachers.

MIRA – Where will you be going now?

Tom – Off to graduate school at Washington State University, in the town of Pullman, WA. That's on the extreme eastern edge of the state. Although the western part of Washington is a rain forest (a cool jungle), the eastern part of the state is dry. The middle, in fact, is a desert. I'll be just beyond the eastern edge of the desert, on the Palouse Prairie, which is a dark place at night with mostly clear skies.

MIRA – What will you be doing next?

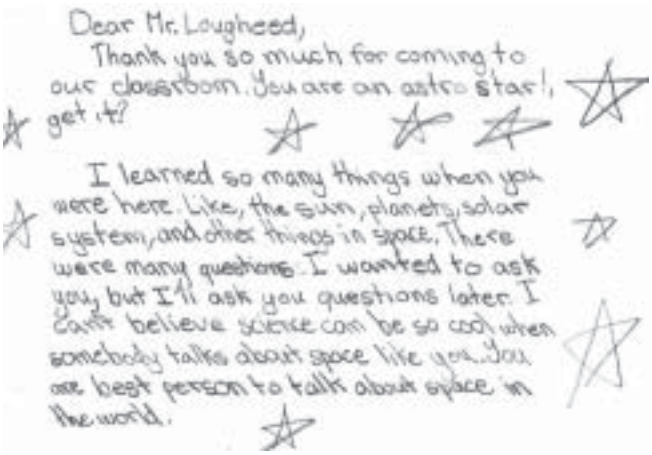
Tom – I will be studying for a Ph.D. in Mathematics so that I can teach at the college level. I very much like working with younger children but don't like the disciplinarian part of being a grade school teacher. For my Ph.D. I'm going to specialize in mathematics education. I hope that will keep me in close contact with grade school students and their teachers for the rest of my career. One prospect for my research project at WSU is for me to work with the grade school students on the Coleville Indian Reservation. A consortium of universities and colleges including WSU has a long-standing relationship with the reservation schools and the Coleville United Tribes. My pet notion is that most children find math easier if they can immediately use the math for something they find useful that is outside of their math class, perhaps in their astronomy lessons.

In about five years I expect to finish my Ph.D. and then plan to find a teaching post at some small, secular college in a small town somewhere in the west. I'm hoping for a school that is so small that its math and science departments are combined. Then I can teach astronomy and introductory physics as well as math.

Tom's modest description of his work with MIRA really does not do justice to how indispensable he has become. His comprehensive knowledge in so many scientific disciplines is matched only by his dedication to helping others (even the littlest among us) understand and appreciate the wonders of nature and the mysteries

of mathematical theory. His career will definitely be one to watch.

Thank you, Tom, for working to ensure that our youth get a good start in math and science. MIRA wishes that all your skies are dark and cloudless; please keep in touch!



Dear Mr. Lougheed,
Thank you so much for coming to our classroom. You are an astro star!, get it?

I learned so many things when you were here. Like, the sun, planets, solar system, and other things in space. There were many questions I wanted to ask you, but I'll ask you questions later. I can't believe science can be so cool when somebody talks about space like you. You are best person to talk about space in the world.

MIRA echoes the sentiments of this fourth-grade student as we bid farewell to docent Tom Lougheed.

Calling All Volunteers

by Holly Keifer

MIRA is blessed to be located in an area where the general public takes an avid interest in astronomy and science. The challenge is to successfully reach all those interested citizens and to actively encourage scientific curiosity in the young. The loss of Tom Lougheed is felt acutely and it is not easy to fill his shoes. There is so much to do and the energies of the remaining docents will be stretched dreadfully thin.

- **Are you excited by recent developments in the space sciences?**
- **Do you have a general science or teaching background with at least a smattering of astronomy?**
- **Do you enjoy sharing your knowledge of science with the public?**
- **Have you always wished to spend time observing the night sky?**
- **Do you have or can you operate a field telescope?**

If you answered yes to any question above, MIRA and the Monterey Observers Group has a place for you! Please call soon and join the satisfying world of the docent.

Phone Kim or Holly at (831) 883-1000.

MIRAbilia

The familiar MIRA logo has been updated with a new two-color scheme, and a fresh supply of MIRA T-shirts has been produced, so we are taking this opportunity to remind our Friends of the full line of MIRAbilia. Proceeds from sales of these items go to the MIRA Education Fund.

MIRA logo T-shirt	$15
Field Trips to the Stars T-shirt	$15
MIRA lapel pin	$4
MIRA mousepad	$6
MIRA patches	$5
MIRA postcards	2 for $1
MIRA caps (only 2 left!)	$6

Call Kim or Holly at 883-1000 to order any of these items, or drop by the Hamming Astronomy Center to see them. A supply of these items will also be brought to the 8 July lecture (see Calendar, p. 2).

Holly Keifer (l.) shows off the Field Trips to the Stars T-shirt, while Kim Postgate sports the MIRA logo model.

Membership Renewal

June is the month when we invite our Friends to renew their membership in the Friends of MIRA. Renew now to continue receiving the *MIRA Newsletter*, lecture and event announcements, and to continue your support of astronomy research and education on the Central Coast!

The Summer Sky

by Dr. Whitney Shane, MIRA's Charles Hitchcock Adams Fellow

Fixed Stars

These days astronomers spend most of their time sitting at computers, even when observing, or in meetings. However, most telescopes still require that we find a clock star[1] at the beginning of each night, and for many of us, this is about the only time we really need to look at the night sky. Thus even the most constellationally challenged among us is usually able to identify a few bright stars, and Vega will be among these.

As the brightest star in the northern sky, Vega has, at least in the past, had another important function. In the second century AD Ptolemy, building on observations made four centuries earlier by Hipparchus, classified stars into six categories, or "magnitudes", according to their brightnesses. Imagine an astronomer now using 400 year old observations! He called the brightest stars first magnitude and the faintest that he could see sixth magnitude. This magnitude scale continued to be used, largely unchanged, until the nineteenth century. Early in that century John Herschel (Or was it William? Authorities disagree!) determined, rather surprisingly at the time, that a difference of one magnitude corresponded not to a fixed brightness difference but to a fixed brightness ratio, and that this ratio was about 2.5.

Sir William Herschel (1738-1822), by Lemuel Francis Abbott (l.) and his son Sir John Herschel (1792-1871), by Julia Margaret Cameron.

The method used by Herschel was quite simple. He observed stars of different magnitudes and placed diaphragms over his telescope objective so that the brightnesses appeared equal. He could then determine the brightness ratio corresponding to a magnitude difference. Using more precise measurements, Pogson, in about 1850, found that a difference of five magnitudes corresponded very closely to a brightness ratio of 100. This led him to propose the magnitude scale which we still use in which a difference of one magnitude corresponds to a brightness ratio of the fifth root of 100, or 2.512. Some astronomers, among them Walraven, who established one of the important color systems, have made the sound suggestion that we use instead the base of the system of natural logarithms, $e = 2.718$. Unfortunately this suggestion came so late that adopting it would have resulted in too much confusion.

There remained the need for a zero point for the magnitude scale, and this is where Vega enters the picture. What could have seemed more logical than to adopt the brightest star in the northern sky for this purpose and to assign it magnitude 0.0? This scale, or a closely related one, was used in the early photometric surveys, such as the Bonner Durchmusterung and the Harvard Photometry and its important revision. The disadvantages of this plan soon became apparent. All stars, including Vega and even the sun, may be slightly variable, so it is unwise to fix the magnitude system to a single star. Also, Vega is not always above the horizon and thus not available for comparison. Both problems were solved by adopting a collection of stars near the north celestial pole, the North Polar Sequence, as standards. The magnitudes of these stars were very carefully and laboriously measured by Sears at the Mount Wilson Observatory, using photographic methods, and they served as primary standards for some decades.

Photoelectric photometry and, later, CCD photometry greatly increased both the ease and the accuracy of magnitude determinations, although many puzzles remain (as we at MIRA are currently discovering to our dismay). This has encouraged the International Astronomical Union, which is responsible for such things, to adopt a set of primary standards, ten stars of different spectral type, widely spread over the sky. Vega is not one of these stars, and it is surprising to note the variety of values quoted for the magnitude of this former standard. Meanwhile extensive sets of secondary standards have been established, both in the Selected Areas [see the Winter 2005 *MIRA Newsletter*, p. 6--Ed.] and elsewhere. Most astronomers seem to agree that the most reliable

[1]A 'clock star' is a known star on which the telescope is centered at the beginning of the night to synchronize the telescope coordinates with the sky coordinates--Ed.

of such sequences is in the open cluster Messier 67. What they cannot agree upon is the correct magnitudes of these stars.

Before the twentieth century essentially all photometric measurements were made visually, and not much was done to compensate for the differences in color sensitivity of different instruments and observers. Photographic plates, with or without color filters, and later photoelectric and CCD detectors made it possible to define color systems almost at will, and the result has been a multiplicity of color systems, each with its own advantages and disadvantages. All of these systems follow the Pogson rule. For the zero point we return to Vega, now adding five more stars, all with the same spectral type, A0 dwarf. It has been agreed that in all color systems, except sometimes where only a single spectral line is measured, the mean of these stars shall always have the same value. Thus once the color sensitivity of an instrument (detector, filter and telescope) has been established, the magnitude scale can be accurately defined. Since no two instruments are the same, we have to determine the corrections needed to convert the magnitudes measured with each instrument to whatever color system we have decided to adopt. Determining these corrections with sufficient accuracy is only one of the many complications of modern astronomical photometry.

Planets

Mercury will be easily visible from the northern hemisphere for only a brief period in early August, when it can be seen in the east-northeastern morning sky.

Venus will be very low in the east-northeastern morning sky during most of the quarter, and toward the end of September it will be lost in the morning twilight. On August 26 it will be in very close conjunction (4 arc minutes) with Saturn.

Mars can still be observed low in the west in the evening in early July, but it will soon be lost in the evening twilight and will not reappear until December. Mars will be occulted by the moon on July 27 and August 25, but it is too close to the sun for observation and the occultations could not be seen from our part of the world in any case.

Jupiter is stationary on July 6 when it can be seen in the southwest during the evening hours. By the end of September it will be very low in the southwest and almost lost in the evening twilight.

Saturn is visible briefly in the evening twilight in the west-northwest at the beginning of July. It is in conjunction on August 7 but reappears in the east-northeast in the morning sky later in the month. By the end of September it will be fairly high in the morning sky.

Uranus, which is in Aquarius, will be in opposition on September 5. The series of lunar occultations continues, occurring on July 14, August 11 and September 7, but these are still visible only from the far southern hemisphere.

Neptune will be in opposition on August 11, but it will be rather far south and the moon will be nearly full on that night.

Meteor Showers

The Perseids, everyone's favorite meteor shower and by far the best of the summer quarter, will be with us for a couple of days around August 12, but this year it will be spoiled by the nearly full moon.

The only other summer meteor shower of note is the southern delta-Aquarids which peaks about the beginning of August and lasts for one or two weeks (depending on whom you like to believe). This is the most active of a complex of five, presumably related, showers which are observable throughout July and August. The early part is observable without much interference by the moon.

A few other weak showers later in the summer will be of interest only to specialists.

Comets

The much fragmented 73P/Schwassmann-Wachmann 3 still dominates the comet pages. I counted 65 fragments, each with a nicely determined orbit. The brightest components, B and C, will fade from ninth magnitude in July to eleventh or fainter in September. The fragments will spend the summer wandering around in Cetus, where they will become increasingly accessible for observation in the morning sky as the summer progresses.

Comet 4P/Faye will be in Piscus and thus well placed for observation. It is still brightening and is predicted to reach ninth magnitude by September.

Another ninth magnitude comet, which is now just passing maximum brightness, is 41P/Tuttle-Giacobini-Kresak. This comet will be passing through Virgo in July and thus observable, rather low down in the west during the evening hours.

Comet 71P/Clark will reach its maximum brightness of twelfth magnitude in July when it will be in Sagittarius, rather far south but well enough observable.

Two recently discovered thirteenth magnitude comets can also be observed, C/2004 B1 (LINEAR) in the early summer and C/2005 E2 (McNaught) later on.

Eclipses

There will be a partial lunar eclipse on 7 September , visible from the Indian Ocean and surrounding land masses, extending north into Siberia. On 22 September there will be an annular solar eclipse, commencing on the northern coast of South America and moving across the South Atlantic to a point well south of South Africa. Neither eclipse will be visible from North America.

Friends of MIRA Membership

I would like to become a Friend of MIRA and receive the quarterly MIRA Newsletter.
Enclosed is my membership donation of $_____
In addition, I am making a special contribution of _____

$2500 Associates Circle	$100 Sponsor
$1000 Associate	$50 Family
$500 Patron	$35 Member
$250 Sustaining	$15 Student

MIRA *welcomes corporate and business members. Contributions are tax deductible as allowed by law.*

Name_____

Address_____

City, State, Zip_____

Phone/e-mail_____

Welcome to our new Friends

Mrs. Zelda Rosenthal

Thanks!

Friend of MIRA Rod Norden prepares to view the eclipse of 29 March 2006.

Staff

Gordon Jones, Chair, Board of Directors
Dr. Wm. Bruce Weaver, Astronomer & Director
Kimberly Postgate, Administrator
Dr. Arthur Babcock, Astronomer
Bill Bishop, Volunteer Systems Administrator
Dr. Craig Chester, Astronomer
Dr. Martin Cohen, Astronomer
Casey Dreier, Researcher
Donna Dulo, Docent
Ivan J. Eberle, OOS Caretaker
Tamara Jamila Homan, Docent
Brian Jacobson, Docent
Holly Keifer, Technician
Tom Lougheed, Docent
Jim Neeland, Volunteer Systems Administrator
Claas Shane, Librarian
Dr. Whitney Shane, Astronomer & Charles Hitchcock Adams Fellow
Dr. Russell Walker, Astronomer

* * *

The Monterey Institute for Research in Astronomy owns and operates the Oliver Observing Station under permit from the U.S. Dept. of Agriculture-Forest Service.

* * *

The Monterey Institute for Research in Astronomy owns and operates the Richard W. Hamming Astronomy Center and the Ralph Knox Shops through an arrangement with the U.S. Dept. of Education.

Visit our Web site and *Field Trips to the Stars:*
www.mira.org
E-mail us at mira@mira.org

Monterey Institute for Research in Astronomy
200 Eighth Street
Marina, CA 93933

(831) 883-1000
(fax) (831) 883-1031
www.mira.org

NON-PROFIT ORG.
U.S. POSTAGE
PAID
PERMIT NO. 16
MARINA, CA 93933