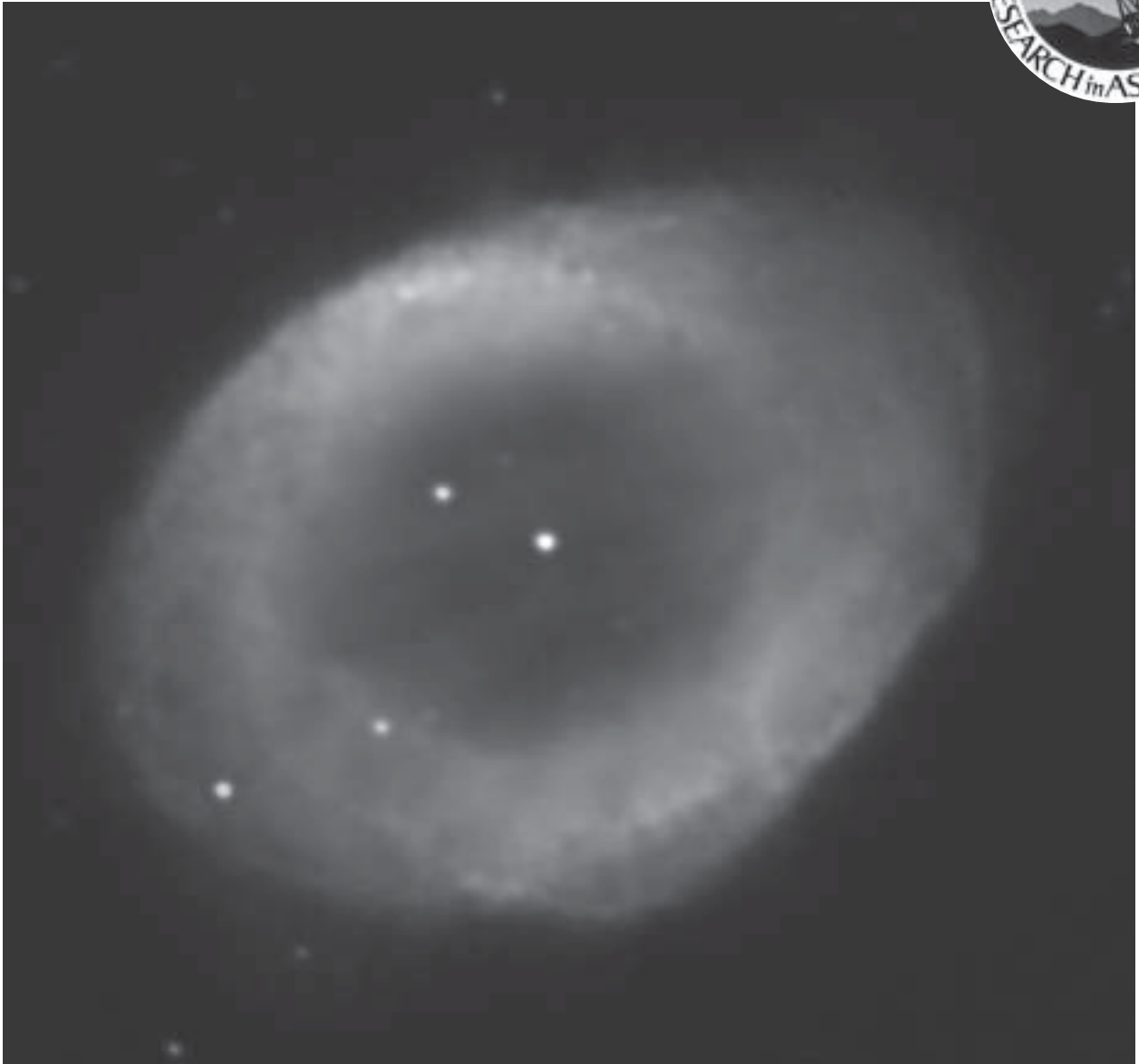

WINTER 2006
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MIRA

NEWSLETTER



The Ring Nebula (M57)

(See "On the Cover," p. 3)

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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.

Roland Knarr asks,

If the disc of Mars, as your web site says, subtends only 24 arc seconds (you seem to use different numbers here depending upon Mars' distance from Earth), would you please explain to me how we can see Mars with the naked eye, if it subtends so small an arc? Sixty arc seconds is the smallest arc that most human eyes can see.

Dr. Whitney Shane replies,

Your question brings up a point that is perhaps too often ignored by astronomers, who deal with these matters on a daily basis and tend to take them for granted. The basic point is the distinction between detection and resolution.

Although it seems like turning the question on its head, we might describe the human eye by comparing it to a digital camera. In both cases, an image is formed by a lens or a system of lenses. There is an array of photosensitive elements (which we call "pixels", meaning picture elements) placed in the image plane. In the case of the eye, this is the retina and the "pixels" are the rods and cones. Matching an array to the resolution of the optical system requires that there be about two pixels for every resolution element, which is the size of the image of a point source of light. Ideally this will be the diffraction-limited image (if the optics are perfect, resolution improves with aperture), but in most cases it will be somewhat larger due to imperfections in the optics. In the case of astronomical telescopes unsteadiness in the atmosphere is almost always the limiting factor. In order for us to resolve an object, that is, to see it as being more than just a point of light, it must be larger than this resolution limit. Mars is smaller than this, so we are able to see it, like all the other visible planets and stars, only as an unresolved point.

Fortunately it is not necessary that we resolve an object

Calendar of Events

Sunday, 10 December, 4pm MIRA Holiday Pot Luck, Hamming Astronomy Center.

Saturday, 13 January, 7:30pm The Chesley Bonestell Memorial Lecture. Dr. Mark Sykes of the Planetary Sciences Institute will speak on "Whither Pluto?" Free and open to the public. Monterey Peninsula College, Lecture Forum 102.

in order that we should see it, for if that were so we should see nothing in the night sky but the moon and perhaps a few of the brightest nebulae. In order for us to see an unresolved source it is necessary only that we receive enough light from it to activate those few pixels upon which it falls. We will fail to see the source only when the light level at the pixels falls below some threshold. In the case of a digital camera this is generally set by the noise level, but the eye is a little more complicated. If the object is resolved, then the light will be spread out over a larger number of pixels and the object will have to be brighter in order that any of the pixels reach the threshold.

Knowing the brightness of the sun, the distance of Mars from the sun and from the earth, and the fraction of the incident light that is reflected (actually scattered) from the surface of Mars, we can calculate how bright it should appear, and we find that this is in good agreement with our measurements. Mars then appears in the sky as a bright, sometimes very bright, but, to the unaided eye, unresolved point of light.

Thank you for the question.

Pluto Controversy to be Subject of 2006 Bonestell Lecture

Dr. Mark Sykes, a planetary astronomer at the Planetary Sciences Institute in Tucson, Arizona, will deliver the 2006 Chesley Bonestell Memorial Lecture, "Whither Pluto?" 13 January at Monterey Peninsula College (see the Calendar of Events on this page).

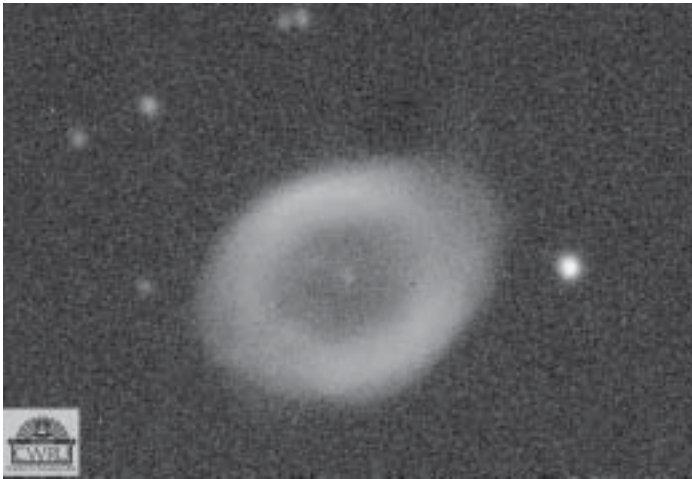
Dr. Sykes is a vigorous opponent of the International Astronomical Union's recent decision to define "planet" in such a way as to exclude Pluto. He is a sponsor of two petitions for professional astronomers against the IAU definition. He will speak on the background, current status, and future of this surprisingly controversial issue.

On the Cover

As we never tire of pointing out, the reason the original MIRA astronomers chose Chews Ridge as the site for their research observatory was the superb astronomical conditions there.

Not only are the skies dark, despite some encroaching light pollution, but the atmosphere is also remarkably steady. The latter quality, which astronomers call *seeing* is at least as important as transparency for astronomical observations.

Compare the image of the Ring Nebula on the cover, made with the MIRA 36-inch telescope, with this one:

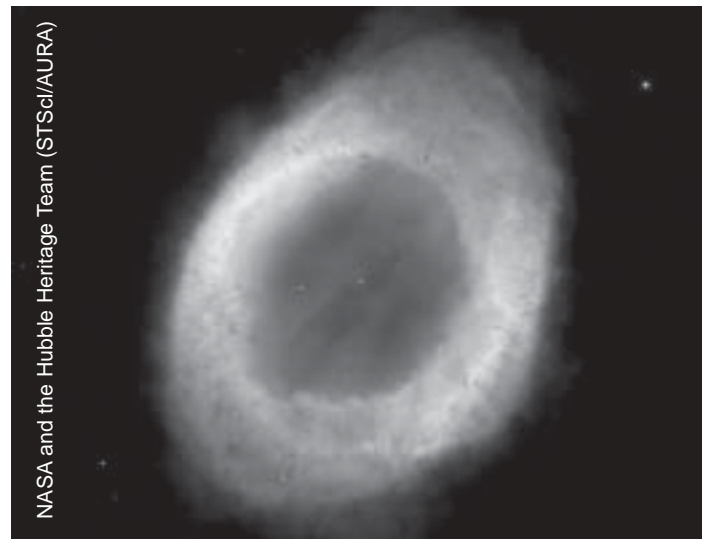


This second image was made at Warner & Swasey Observatory at Case Western Reserve University in Cleveland. It was made with a 36-inch telescope (the same size as MIRA's) with a CCD camera.

The difference between the two images can be attributed to the seeing conditions at the two sites. The skies in the

eastern half of the United States are typically unsteady, producing fuzzy images with bloated stars. Not only are the fuzzy images made in poor seeing conditions esthetically unpleasing, they are scientifically less efficient. Note how difficult it is to see the central star in the CWRU image as opposed to MIRA's. This is because the light from the bloated star image is more diffuse, and thus more difficult to detect. The same size telescope will perform much better in good seeing, reaching fainter objects with the same exposure time.

If a steady atmosphere is better than an unsteady one, it is better still to have no atmosphere at all, and this is one of the reasons we launch telescopes into earth orbit. Compare the Hubble Space Telescope's image of the Ring Nebula with the other two:



Note how small (and thus concentrated) the stellar images are, even compared with those in the MIRA image.

Discount Subscriptions to *Sky & Telescope* Available to Friends of MIRA

Friends of MIRA receive a substantial discount by subscribing to *Sky & Telescope* through the Friends. The regular one-year rate is \$42.95; the FOM rate is \$32.95. Send your check, made out to Sky and Telescope, to the MIRA office. If this is a renewal, please enclose your renewal form; if it is a new subscription, please include the mailing address at which you would like to receive the magazine.

Deep Impact Paper to Appear in *Icarus*

Readers of recent MIRA *Newsletters* will remember that the Deep Impact mission, when a NASA spacecraft launched an 820-pound projectile into the nucleus of comet Tempel 1, was observed by a team of MIRA astronomers. Our results will be published early next year in a special issue of *Icarus: International Journal of Solar System Studies*.

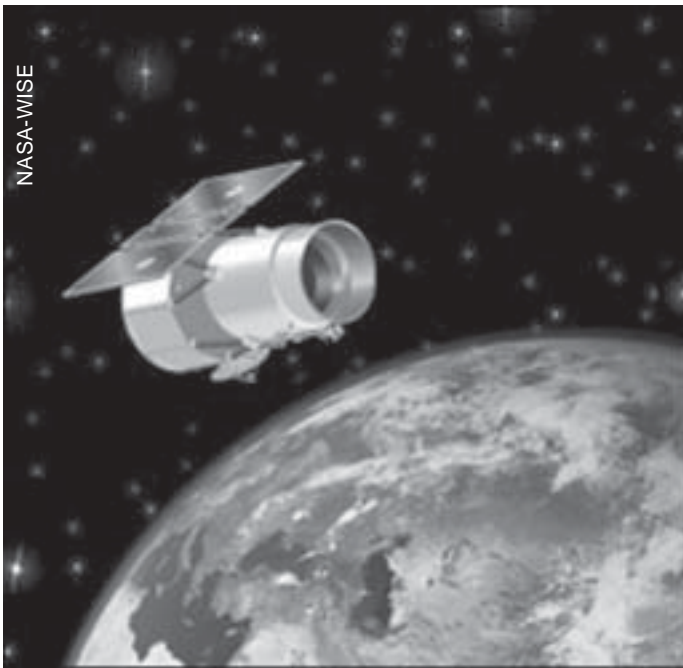
MIRA Confirmed for Space Launch

by Dr. Wm. Bruce Weaver

On 13 October, NASA approved the construction and launch of the Wide-field Infrared Survey Explorer (WISE). The Principal Investigator is Ned Wright of UCLA and two MIRA astronomers, Drs. Russell Walker and Martin Cohen, are Co-investigators. Launch is currently scheduled for November 2009. The satellite will take about 1.5 million images in four infrared colors over seven months. Since the instrument is sensitive to the infrared (heat), it is cooled to within

WISE a better look at the global structure of our Galaxy.

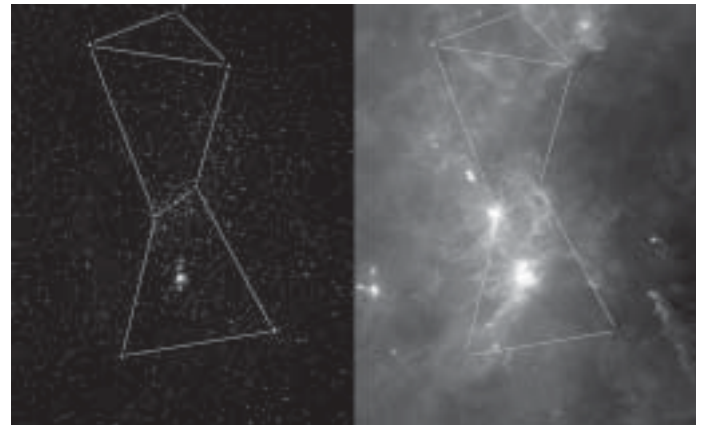
Other studies include measurements of nearby young stars, brown dwarfs (stars with too low a mass to initiate fusion in their cores), the nuclei of active galaxies, and clusters of galaxies for the study of dark



An artist's conception of the WISE satellite in earth orbit.

15 degrees of absolute zero (-430° F) with solid hydrogen.

WISE is designed to survey the entire sky with 500 times the sensitivity of previous survey missions. The previous IR survey mission, the Infrared Astronomical Satellite (IRAS), operated in 1983 and that team was led by Dr. Walker. IRAS had limited resolution so it avoided the plane of the Milky Way where all the sources would be blurred together. WISE will have a much higher resolution that will provide a detailed look at this exciting area. Infrared light penetrates the obscuring interstellar dust, permitting



The constellation Orion is visible light (left) and in the infrared. Left image by Howard McCallon; right by NASA/IRAS.

energy. The resulting survey will be a roadmap for the forthcoming second-generation space telescope, which will operate in the infrared.

Of particular interest to the MIRA team are the solar system objects that WISE will observe. These include the debris trails left by comets and the earth, and the interplanetary dust that reflects the zodiacal light. We will determine the sizes of more than 100,000 asteroids and the sizes of asteroids that cross the orbit of the earth. During this past summer, we did computer studies to establish how quickly we can calculate the orbit of such asteroids as they whiz by so we don't lose them before we can pinpoint their path near the earth.

Of course, there are many hurdles yet to pass: NASA budget cuts, construction of the state-of-the-art infrared sensors, and the launch atop a Delta II. But we're excited. I wonder if we can sneak a MIRA sticker on board?

Volunteer Opportunities in MIRA's Education Programs

When the founders of MIRA incorporated in 1972, they gave themselves a dual mission: research and education in astronomy. MIRA's diverse programs in education range from our popular series of free public lectures to the interactive web site Field Trips to the Stars, the CD "Near-Earth Objects: Are we Doomed?", distributed free to every eighth-grade science teacher in California, our summer intern program, summer tours of the Oliver Observing Station, educational programs offered through the Lyceum of Monterey County, and much more.

We often get requests from schools (ranging from elementary schools to the Naval Postgraduate School), scout groups, and others for astronomy programs, either at the Hamming Astronomy Center, in the school, or at some dark-sky site in the region. We are happy to grant such requests, but can do so only to the extent that volunteers are available to staff these programs. At the moment, unfortunately, we are rather short-handed and are anxious to identify new volunteers who can help us in our mission.



The Weaver Student Observatory.

While some of these programs are produced by professional astronomers from MIRA and elsewhere, our educational and public service role offers many opportunities for involvement by amateur astronomers and other folks interested in sharing astronomy with the public.

MIRA can make available to volunteers an extensive range of materials and equipment for use in educational programs. At the head of this list is the Weaver Student Observatory on MIRA's Marina campus. This facility was constructed especially for the educational and public service role. It contains a 14" Schmidt-Cassegrain telescope on a sophisticated computer-controlled mounting. We have a variety of eyepieces and filters for use on this instrument, including a hydrogen-alpha solar filter. The telescope can also be used with MIRA's CCD and video cameras. Training will be offered to anyone interested in working with this instrument.

We also have smaller telescopes usable in the field, an extensive collection of slides and an excellent astronomical library that can be used as educational resource material.

If you are interested in helping MIRA in these important programs, please call Holly Keifer at 883-1000 or send e-mail to mira@mira.org



The Winter Sky

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

Fixed Stars

One of the more spectacular objects in the winter sky is the Rosette Nebula and its associated open cluster, located in the constellation Monoceros. This modest constellation lies right in the Milky Way but contains no bright stars. The object itself is located close to the galactic plane, in a region with many faint stars. This may explain how it missed being included in Messier's list, as the cluster, at any rate, is bright enough. The cluster and the surrounding nebula are listed separately in the NGC, the former as number 2244 and the latter as 2237. The complex is located two degrees due east of the fourth magnitude double star epsilon Monocerotis. It is 17 degrees due west of Procyon and nine degrees east and a little south of Betelgeuse. This should make it fairly easy to find despite the large star density in the region.

Both the cluster and the nebula are quite large, making them favorable objects for a small telescope. The cluster has about 100 members, which is quite a lot for an open cluster, and the apparent diameter is a little less than a half degree. The brightest member has spectral type O5, which makes it a very hot star indeed, and it is apparent magnitude 6. The brightest star in the region is, however, not a member of the cluster. The nebula surrounds the cluster and is thus considerably larger, more than one degree in diameter. It forms a complete ring, but with much irregularity in detail. Dust can be seen as absorption patches, particularly in the northwest quadrant. Much of the light in the nebula comes from ionized hydrogen, so it is most easily seen using a suitable H-alpha filter. With or without a filter it remains a faint and difficult object. In view of its apparent size, a low magnification is recommended.

The estimated distance to the Rosette Nebula is 1880 pc. Such estimates are ordinarily based on the apparent

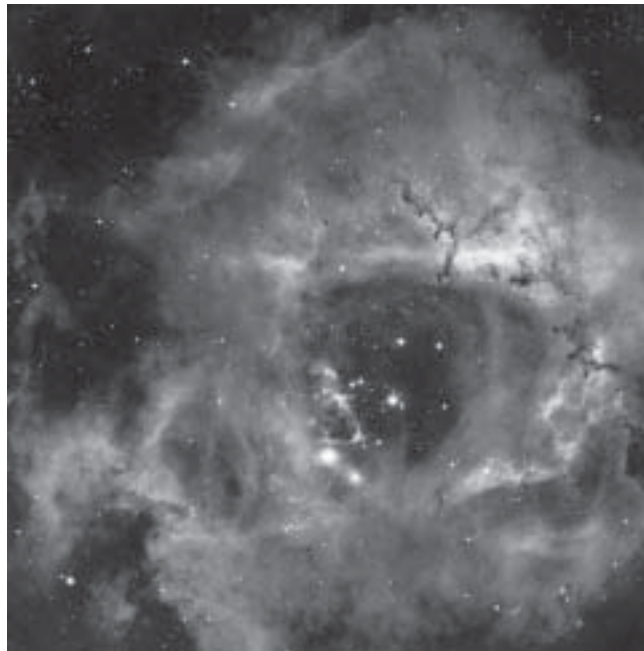
brightnesses of the cluster stars, whose absolute brightnesses can be derived from their spectral types. In dealing with clusters, where there are several stars all at the same distance, these so-called spectroscopic parallaxes can be quite accurate. Monoceros lies very close to Orion and Taurus, both regions of heavy and nearby obscuration, so it is surprising that we can see anything so distant. However, all of this obscuration is very irregular in its distribution, so we evidently have the good fortune of looking through an opening. We can estimate the extinction from the reddening of the starlight, comparing the measured color to the color expected from the spectral type. We find an extinction of about two magnitudes.

The star cluster is probably no older than its brightest star, in this case an O5 star, with a maximum age of about two million years. Although the gas and dust making up the nebula have no doubt been around for much longer than this, the nebula, in its present form, is no older than the cluster. It is probably a good deal younger, as it takes a while for the stars to have their full effect. It is old enough, however, that the central part has been cleared of gas by the heat and pressure of

the stellar radiation. This has not yet happened in the Trapezium region in Orion, which is therefore probably younger. Estimates of the age of the Rosetta nebulosity seem to run around one hundred thousand years.

Planets

Mercury will emerge from behind the sun late in January and will be easily observable from the northern hemisphere until the middle of February. At its best it will be seen about seven degrees below Venus in the west southwestern evening twilight. It will appear again in early March in the morning sky, but this apparition is much more favorable for southern observers.



The Rosette Nebula. Image by T.A. Rector, R. Wolpe, M. Hanna (AURA/NOAO/NSF).

Venus will be visible in the western evening sky during the whole winter quarter, gradually increasing in size and in brightness as the quarter proceeds, tempting some writers (not this one) to excesses of poetic exuberance. A lunar occultation on 20 January will be visible only far in the southern hemisphere.

Mars rises about 90 minutes before the sun at the beginning of the quarter, and, although it is gradually approaching opposition, which it will reach at the end of the year, its visibility scarcely improves as the quarter progresses.

Jupiter is in Ophiuchus, where it will remain for most of the year. It will be in the morning sky, rising somewhat before morning twilight in early January and earlier as we get into March. It remains too far south for easy observation.

Saturn is also going nowhere, spending the whole year in Leo. It is in opposition on 10 February, so that from January through March it is visible for almost the whole night. Its northern declination make it well placed for observation. A lunar occultation will take place near the beginning of each month. The first one, on 6 January, will be visible from Alaska, among other places.

The series of lunar occultations of Uranus continues, but none is visible from our region.

Meteor Showers

Winter is always a poor season for meteor showers, and that is particularly true this year. The only substantial winter shower is the Quadrantids, which peaks on 4 January, just one day after full moon. The predicted peak is around sunset on 3 January, so those who enjoy searching for meteors in the moonlight should do best in the evening hours, although meteors could be sighted, if at all, at any time during the night.

The only named shower which escapes the moonlight is the exceedingly weak delta Leonids. This extends from 15 February to 10 March, with a peak, of sorts, on 25 February. This stream may be associated with the minor planet (4450) Pan.

The International Meteor Organization has introduced a new shower, called Antihelion, which lasts the whole year, has a Zenithal Hourly Rate of 3 (greater than the delta Leonids, at any rate) and a radiant which follows the antisolar point. It is, in fact, a collection of many minor elliptical streams, some of which may be distinguished by weak maxima and identifiable radiants. Those observers who like spending their winter nights lying on the ground and staring upwards will probably be best rewarded by noting these objects.

Comets

Comet C/2006 L1 (Garradd), discovered in June, 2006, brightened much more rapidly than predicted during recent months and should have reached a maximum brightness at magnitude 8 in early December. It is now fading rapidly and should reach magnitude 13 by March. Until that time it remains well placed for observation during the evening hours. It will be slowing down during January and February as it moves from Perseus into Andromeda.

The periodic comet 4P Faye (2006) is now fading and will also be magnitude 13 by March. It will still be well observable in the evening sky, moving from Cetus into the region between Taurus and Orion.

Comet C/2006 M4 (SWAN), which was magnitude 5 in November, will have faded to magnitude 11 by January. It will be almost stationary in Aquarius where it will be observable in the evening sky until February, when it will disappear into the evening twilight.

Periodic comet P/2001 Q2 (Petriew) 2007 will reach maximum brightness of magnitude 10 in February. It will be near the western edge of Aquarius at the beginning of the year, but will move eastward rapidly and enter Taurus early in April. Thus it will remain visible, if rather low, in the evening sky at least until that time.

Periodic comet 2P Encke (2007) will increase rapidly in brightness during the quarter, reaching magnitude 7 by early April. It is almost stationary in Pisces and thus will become increasingly difficult to observe in the western evening sky, even as the comet brightens.

Comet C/2006 L2 (McNaught), which is magnitude 12 and fading slowly, became easily observable in December and is now a morning object. During the quarter it will move from Hercules northeastward into Cepheus.

Finally, the periodic comet 29P/Schwassmann-Wachmann 1 (2004), which is almost always observable at around magnitude 13, will be in the region between Taurus and Perseus and accessible during most of the night, later on during the evening hours.

Eclipses

There will be a total lunar eclipse on 3 March, but it will be visible mainly from Europe and Africa. From our neighborhood we will see only the very end of the eclipse, with the moon almost fully illuminated, at moonrise.

A partial solar eclipse (not a terribly exciting event even under the best of circumstances) will take place on 19 March, but it will be visible almost exclusively in east Asia.

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I would like to become a Friend of MIRA and receive the quarterly MIRA Newsletter.

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Welcome to our new Friends

George and Barbara Krusi
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Laurie Shaffi

Thanks!



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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.

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