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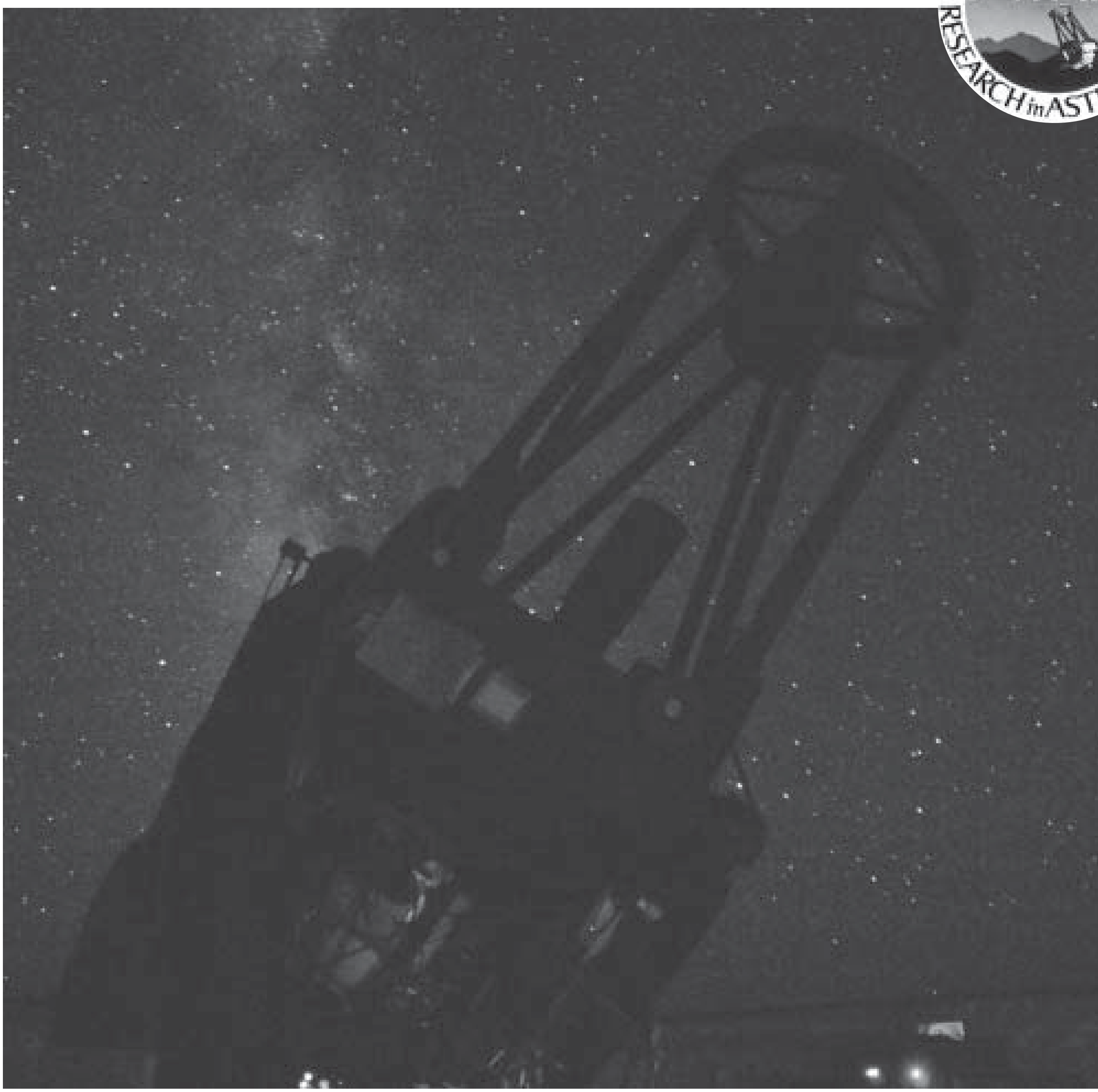
MIRA NEWSLETTER



The 36" MIRA Telescope at Work

(See "On the Cover," page 2)

Contents

Calendar of Events

Sunday, 8 October, 2:30-4:00pm Free tour of MIRA's Oliver Observing Station on Chews Ridge. Open to the public. Reservations are required; please call 883-1000.

Saturday, 14 October, 7:30pm Free public lecture by Dr. Sean Casey of SOFIA (Stratospheric Observatory for Infrared Astronomy) on "SOFIA: The Astronomer's Redeye" Monterey Peninsula College, Lecture Forum 102.

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

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.

Jeffrey Van Middlebrook asks a series of questions about the ever confusing concepts of cosmology. Here is a sampling of the questions and the answers.

Q: If all matter began at the Big Bang, then all light from that matter was also reflected back towards the origin of that expansion.

A: It helps to think of it more like an expanding ball of (very) hot gas. As it expands, it cools. It starts out opaque and, as it expands, it cools and becomes transparent.

Q: The only way that we here on earth could not be privy to the light from every aspect of the Universe's expanding boundary would be if the expansion were proceeding faster than the speed of light which we know is impossible.

A: One source of confusion is that time and distance are linked. At any time you make an observation, you see different distances at different times in 'universal' time. The farther away you look, the farther back in time you're seeing. Hence the most distant objects are seen near the birth of the Universe; which, amusingly enough, is when the Universe was pretty small. These most distant objects were born soon after the beginning of time and we expect to soon be able to observe back to when the Universe was opaque – which is as far in space-time as we will be allowed to look. In the microwave region of the spectrum, we detect the radiation from the opaque period, so far away that the energy is redshifted to the appearance of radiation from a body of a temperature of 3 degrees above absolute zero.

Q: With more powerful telescopes, we should be able to see the leading edge of the expanding Universe.

A: Looking far away is looking back in time. The light coming from that distance is very redshifted. The next generation space telescope is designed to work in the far infrared so these highly redshifted objects – the first galaxies formed – can be observed.

Finally, there is the issue of the edge of the Universe. We believe there is no edge. The basic concept is that there is no special place in the Universe; wherever you are, you make the same cosmological measurements. The father of the modern Big Bang theory, George Gamow, explained it as analogous to a two-dimensional being living on the surface of a balloon. No matter where on the balloon you are, it looks the same as anywhere else. As the balloon expands (the expanding Universe), the spots on the balloon (i.e., galaxies) move away from each other. Finally, there is no edge to this two-dimensional surface.

A more physics-way way of thinking about it is that there cannot be any space without light/matter because these are needed to establish a coordinate system. But, like all the other concepts in the Alice in Wonderland world of modern cosmology, this is a bit hard to think about.

Thanks for the questions.

On the Cover

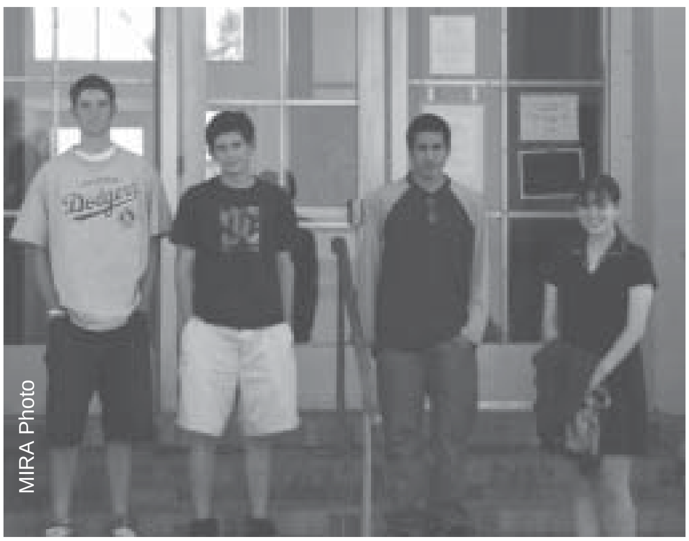
Friend of MIRA Ken Hess captured this image of the MIRA telescope silhouetted against the summer Milky Way. We are looking south in the picture, toward the center of the galaxy and the star clouds of Sagittarius.

MIRA's Class of 2006

During the summer of 2006, MIRA welcomed its largest group of high school interns ever. Stacy Little, from Carmel Valley High School, and Josh Altamirano, Nate Byrne, and Shaun Stenstrom, all from Monterey High's MAOS program, worked for two months at the Hamming Astronomy Center and the Oliver Observing Station.

Stacy concentrated on reduction of spectrographic observations with Dr. Bruce Weaver, while Josh, Nate, and Shaun worked with Dr. Arthur Babcock and Casey Dreier on a photometry project using MIRA's specialized H-alpha filter set.

At the end of the summer, each intern made an oral presentation to the assembled MIRA astronomers on the summer's work.



MIRA interns (l. to r.) Nate Byrne, Shaun Stenstrom, Josh Altamirano, and Stacy Little on a visit to Lick Observatory.

Arthur Babcock and Shaun Stenstrom in the OOS control room.

Laptop Needed for OOS

Do you have an old laptop cluttering up your closet? If it is working condition, MIRA could use it for calibrating and maintaining instruments on the telescope observing floor.

All of the observing at the Oliver Observing Station is now conducted from the warm control room. This keeps image-destroying heat near the telescope to a minimum and the astronomers more eager to observe in mid-winter.

However, some critical functions, like focussing the spectrograph and general instrument maintenance can only be done on the observing floor. Most of these functions require computer connections to the instruments, which are now 60 feet away.

With a portable computer on the observing floor, the astronomer can tap into the telescope network while working on the observing floor. Luckily, the computer can be fairly old as its primary task is displaying data from other computers.

Maybe you stashed it in the garage?

Dr. Bruce Weaver on Small Telescopes

A recent article in Scientific American *prompted MIRA's Director to write to the magazine about one of his favorite topics. His letter, reproduced below, is scheduled to appear in the magazine's November issue.—Ed.*

Mario Livio's "Hubble's Top 10" makes the excellent point that the Hubble Space Telescope is an important adjunct to a constellation of ground-based telescopes, not, as the public often believes, a replacement for them. A second point, often lost even on professional astronomers, is that Hubble's research in many cases builds on the work of small, not giant, telescopes.

For example, the first three items on Livio's list are based on the discoveries of small telescopes: Shoemaker-Levy 9 was discovered with a 0.4-meter Schmidt telescope; the first extrasolar planet was found with a 1.5-meter telescope, and most of the early finds were spotted via a 0.6-meter telescope; and Supernova 1987A was discovered with a 0.3-meter telescope, with the only precursor data gathered by a 0.6-meter Schmidt.

The lower cost of operating small telescopes permits astronomers the latitude to undertake riskier or longer-term research, which results in unexpected discoveries, the exciting hallmark of astronomy. Unfortunately, the modest dollars needed for maintenance, instrumentation and use of such telescopes—a small fraction of the costs of large ones—have for the most part been diverted to big telescope projects.

O Pluto, We Hardly Knew Ye

by Dr. Wm. Bruce Weaver

A feature of the Tonight Show is Jay Leno interviewing folks on the street about current events. Usually these interviews reveal how little attention many Americans pay to current events. However, when, in a recent show, Pluto was mentioned, almost all the respondents knew of the *Pluto Controversy*.

How did a modest planet, so far away that it takes light nine hours to make the round trip, become so famous?

Pluto was discovered 18 February 1930 by Clyde Tombaugh by comparing multiple exposures of parts of the sky. As he described at MIRA's second annual Chesley Bonestell Memorial Lecture in 1989, this discovery was early in his task of scanning the many photographic plates taken at Lowell Observatory in search of a ninth planet.

However, Pluto did not solve the mass distribution problem pointed out a score of years later by Dutch-born American astronomer Gerard Kuiper. Kuiper pointed out that the average mass density of the Solar System decreases smoothly from the Sun outwards until Neptune, when it suddenly falls to near zero. He postulated a mass of comet nuclei surrounding the Solar System just outside Neptune's orbit.[1] Any of these bodies that strayed inside the orbit of Neptune would eventually be perturbed into the inner Solar System to quickly evaporate or be ejected into interstellar space. It seems that few, if any, of the objects will become short-period comets[2] themselves but their source is fragments from collisions among the now estimated 70,000 such objects.

Back when the underworld got a little respect: Charon about to receive his fee for transporting the newly dead to Hades.

The Kuiper Belt seemed like a pretty safe prediction, because any such objects would be so small and so distant as to be impossible to detect. But science marches on and, in 1992, the first such object was discovered. Since then, hundreds have been identified.

Perhaps now you've guessed the problem facing the International Astronomical Union (IAU). It was only a matter of time until a Kuiper Belt object larger than Pluto was found. After the year 2000, objects with diameters larger than 1000 kilometers were starting to be discovered. In 2003, Michael Brown described in a MIRA public lecture how he and his collaborators measured the diameter of Quaoar, then the largest such object discovered. Finally, in 2003, Brown and co-workers discovered Xena (2003 UB313) which, with a diameter of about 2400 kilometers, appears to be slightly larger than Pluto.

As it happens, Xena was just renamed Eris by the IAU. Eris, the Greek goddess of discord, chaos, and strife, seems an excellent choice for the cause of the current Pluto dilemma.

How can Pluto be a planet and Eris not? It seems unlikely that Eris will be the last outer Solar System object discovered that is larger than Pluto. The IAU was the

[1]This makes sense from a gravitational point of view. Newton pointed out that any mass distribution acts the same as a point mass located at the center of the distribution on a body outside the distribution.

[2]Long-period comets are thought to come from the more distant Oort cloud, a spherical cloud of comet nuclei stretching out into interstellar space.

international body stuck with answering this question. At the tri-annual meeting in Prague this summer, the general assembly passed Resolution 5a in an attempt to define a planet.

(1) A planet is a celestial body that (a) is in orbit around the sun, (b) has sufficient mass for its self-gravity to overcome rigid body forces so that it assumes a hydrostatic equilibrium (nearly round) shape, and (c) has cleared the neighborhood around its orbit.

The resolution then goes on to define a dwarf planet as a round object that circles the sun but has not cleared its orbit of debris and is not a satellite. This makes the round, 1000-kilometer diameter asteroid Ceres a dwarf planet. This result was pointed out in a 2002 MIRA public lecture by Dr. Gibor Basri, who suggested that Ceres be returned to planet status because of its spherical shape.

Do we really need a logically consistent definition of a planet?

The IAU reduced the number of planets to eight because including Pluto would result in a constantly changing number of marginal objects categorized as planets. Many astronomers, including MIRA asteroid expert Dr. Russell Walker, have formally protested. They point out that, among other problems, this definition excludes any planets circling other stars.

The critical clause is the third; it is this that keeps any spherical, non-satellite body from being classified as a planet. Besides being quite indirect and vague, it ignores the fact that the earth has created a dust ring around the sun in its orbit and a dust cloud trails the earth as it orbits the sun. This was discovered by Sumita Jayaraman, previously a MIRA astronomer now at the Planetary Science Institute, and is currently being studied by her and Dr. Russell Walker using the NASA infra-red Spitzer Space Telescope..

The core of the dilemma, I feel, is historical. Pluto was never like the other planets. It was tiny in the outer Solar System where the other planets are huge. Its orbit is highly tilted to the orbital plane of the other planets. Its orbit is highly elliptical compared to the nearly-round orbits of the other planets, and, most peculiar of all, its orbit takes it inside the orbit of Neptune. It was the only planet so small that the center of mass of rotation with its satellite is outside its surface, technically making Pluto-Charon a double (dwarf) planet rather than a planet and a satellite.

The public outcry – isn't it great that people care so much about astronomy? – may be based in two responses: the seemingly arbitrary overturning of the long-held Pluto status and the appearance of a self-appointed association of astronomers ganging up on a tiny, distant, underdog world.

One solution I have not heard is to arbitrarily classify Pluto as a planet. Ralph Waldo Emerson's contempt for petty consistency may be well applied to the seeming need for a logically consistent definition of a planet. The classification of Pluto as a planet, or a dwarf planet, or a trans-Neptunian Plutino seems of little practical use except to textbook writers. The basis for the arbitrary definition, should one be required for a definition by fiat, is merely its historical classification.

What is clear is that the controversy surrounding this issue is not over. Bumper stickers have already appeared. I love it.

New Format for MIRA Web Page

If you haven't visited *www.mira.org* recently, drop in for a look at our new format. There are new features as well, such as a page on the MIRA intern program.

An especially useful new feature is the opportunity to join the Friends of MIRA, renew your membership, or simply make a donation.

Wen encourage you to bookmark our informative web page and use it often!

Monterey Peninsula Volunteer Services Awards Grant to MIRA

MIRA has received a grant of $500 from Monterey Peninsula Volunteer Services in support of our educational programs.

MPVS operates a thrift shop at 655 Broadway in Seaside. Donations of salable items to the shop allow MPVS to support non-profit organizations throughout the Monterey Peninsula. We encourage our Friends to visit the shop and familiarize themselves with MPVS operations.

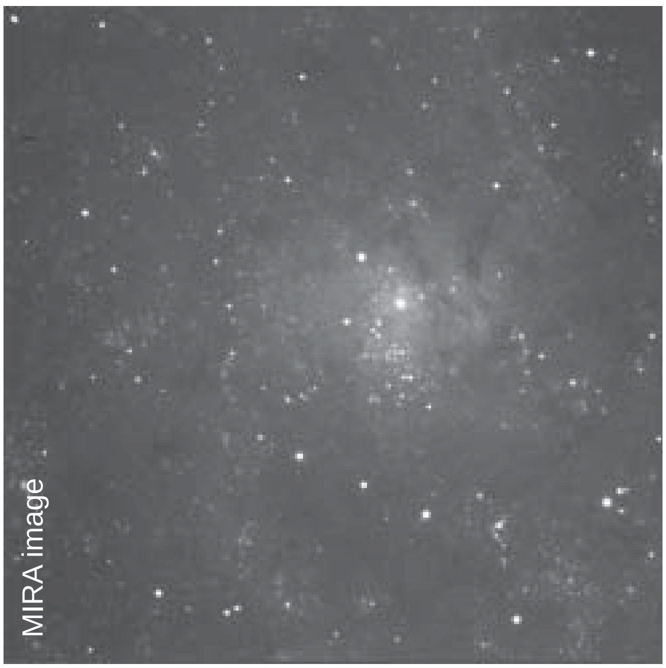
The Fall Sky

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

Fixed Stars

During the fall the Milky Way arches over the evening sky so that there is not much room for galaxies, except for some in the southern galactic hemisphere. The brightest of these, visible to us poor folk in the northern hemisphere, is the Great Andromeda Galaxy, Messier 31. This and the Milky Way are the dominant members of the Local Group, a rather modest group of galaxies which, on a larger scale, is a sort of distant outlier of the Virgo Cluster. The third member, in size, of the Local Group is Messier 33 in Triangulum. This galaxy and the nearby M31 pass close to the zenith during the fall evening hours.

Messier 33 appears quite large, but it is not a very prominent object in the night sky, just as is its host constellation, Triangulum. In fact, it is hard to imagine any three stars which, together, could not form a constellation with this name. M33 can be found about half way between the bright stars Mirach and Hamal. A small telescope is sufficient (after all, Messier could find it), but a dark sky is required because it is an exceedingly diffuse object.



A short (30 seconds) exposure of the central portion of M33 with the MIRA 36-inch telescope.

In fact, M33 is quite small, as galaxies go. It is typical of the so-called late type spirals, in which the spiral arms show a loosely wound pattern which is rather disorganized. In this case, two well defined inner arms branch out to form as many as ten arm-like structures in the outer part. To further complicate matters, the inner and outer parts are thought to lie in planes tilted with respect to one another. This is not unusual, even for more regular spiral galaxies. M31 and M51 both show this effect. Its cause is not yet fully understood.

Despite what they are called, the late type spirals are galaxies in an early stage of evolution. (This is what happens when you start giving things descriptive names before you know what they are.) These galaxies are relatively rich in gas because there has not been time to convert much of it into stars. This leads to a high rate of star formation, and we can see this in M33 where there are a large number of very bright (and thus very young) stars. These often are found in large clusters which usually contain lots of ionized hydrogen. We might call these super-clusters. The brightest of these has even made it into the NGC, where it is listed as NGC604. With a moderate sized telescope and under good conditions, it should be possible to see some of these clusters as bright knots in the otherwise not very prominent spiral arms.

As such a galaxy ages, the gas will be converted into stars and the star formation rate will decrease. If this is all that happens, then the galaxy will turn into a typical dwarf irregular and will fade into relative obscurity. If it encounters other small galaxies, it may accrete them and become more massive, adding mainly older stars which will end up in the halo or the central bulge. This will increase the gravitational force, which will cause the whole galaxy to rotate more rapidly and the spiral arms to take on a more orderly and more tightly wound pattern. In other words, as it ages it will become an earlier type galaxy. If, on the other hand, it should have the misfortune to encounter a larger galaxy, like M31, it will be entirely gobbled up, and we will have to remove it from our observing lists.

Whatever the fate of M33, we can be sure that it will not last long in its present state, so interested observers are urged to get out their telescopes and observe it while it is still a fine example of a late type spiral.

Planets

Our first opportunity to observe Mercury during the fall quarter will be a brief and unfavorable one around the middle of October, when it can be seen low in the southwestern evening sky. It will then pass in front of the sun on November 8, when we will have a rare opportunity to observe a transit. These occur, on the average, only once every 7½ years, and in this case we will be able to observe the whole transit from our area. It will begin at 1:12 pm PST and end at 4:10 pm. The usual precautions pertain when observing the sun. The safest method is to look at a projected image. Following this event we will have the best opportunity for observing Mercury in the usual way when it reaches western elongation on November 25. It will then be visible in the east southeastern morning sky. Mercury will remain visible in the morning sky until the middle of December, with a conjunction with Mars on December 9 and with Jupiter on December 10. All three planets will be within one degree of one another. Such a grouping will not occur again until the year 2050.

Venus will not become visible until the beginning of December, when it will appear low in the southwest evening sky.

Mars is in conjunction with the sun on October 23 and will remain out of sight until its conjunction with Mercury and Jupiter in early December. It will then become more easily observable in the east southeastern morning sky as the year ends.

Jupiter will disappear in the evening twilight early in October and is in conjunction with the sun on November 21. It will reappear in the morning sky in early December, when it is in conjunction with Mercury and Mars, and it will remain low in the southeastern morning sky for the rest of the month.

Saturn is visible in the eastern sky after midnight in October. It rises earlier as the quarter progresses and is stationary on December 6, when it will be visible for most of the night. On December 10 Saturn will be occulted by the moon, the first of a series of occultations. This one will be visible mainly from the North Atlantic.

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

Meteor Showers

The fall quarter, which is known for its wealth of meteor showers, gets off to a bad start with the Draconids on October 9 coinciding with the full moon.

The Orionids, on the other hand, peak on October 21, just before new moon, and thus should be well observable. They can be seen for most of the night. In addition to the main peak, there is talk of a secondary peak two or three days earlier.

The Southern Taurids on November 5 will also coincide with the full moon, but the Northern Taurids around November 12 will be free from moonlight, at least in the evening hours.

The Leonids, strongly concentrated around November 17, are free from interference from the moon. After the impressive displays of a few years ago, this shower seems to have returned to its normal level. There are still, however, predictions of outbursts with possible zenith hourly rates of up to 100 or more. The Leonids are best observed after midnight.

The alpha-Monocerids are usually a weak shower, but there have been occasional brief but very intense outbursts, as in 1995. The peak is expected on November 21, close to new moon, and this shower is best observed in the morning hours.

The Geminids, one of the year's best showers, will not be much troubled by moonlight this year. It is quite concentrated, peaking on December 14. It can be observed all night, but there will be some moonlight after midnight.

The Ursids, which peak briefly on December 22, is a poorly observed shower generally lacking in bright meteors. It does, however, produce an occasional outburst. The moon is favorable and the best time for observation is in the morning hours.

Comets

Bright comets seldom announce their arrival long in advance, so those which we can predict usually are not spectacular. Among the fall comets, the brightest is C/2006 M4 (SWAN). This comet reaches seventh magnitude in October, but it will be passing through Bootis, where it will be observable only with the greatest difficulty in the morning or evening twilight. By December it will be in Aquilla where it will be a little more accessible in the evening sky, but it will have faded to tenth magnitude.

Comet 4P/Faye will be much more accessible and observable during the whole night, remaining in or near Piscus for the whole quarter and retaining nearly its maximum brightness of ninth magnitude.

Comet 177P/2006 M3 (Barnard 2) is also very well placed for observation, moving from Cepheus through Cassiopeia during the quarter but fading from tenth magnitude in October to sixteenth in December.

Another comet well placed for observation is P/2006 HR30 (Siding Spring) which will spend the whole quarter in Cygnus and will thus be visible until at least midnight. It is predicted to be eleventh magnitude, but this is uncertain and it may turn out to be considerably fainter.

A much more difficult object is C/2006 L2 (McNaught), which moves from Virgo into Serpens Caput during October and is thus only just visible in the evening sky. Its magnitude should be about thirteen.

Eclipses

There will be no more eclipses during 2006.

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.*

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Welcome to our new Friends

David Buckingham
Sally and Lilly Burns
Anthony Caronia
Erin Justice
The Lenz family (Debby, Eberhard, Julian and Daniel)

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.

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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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