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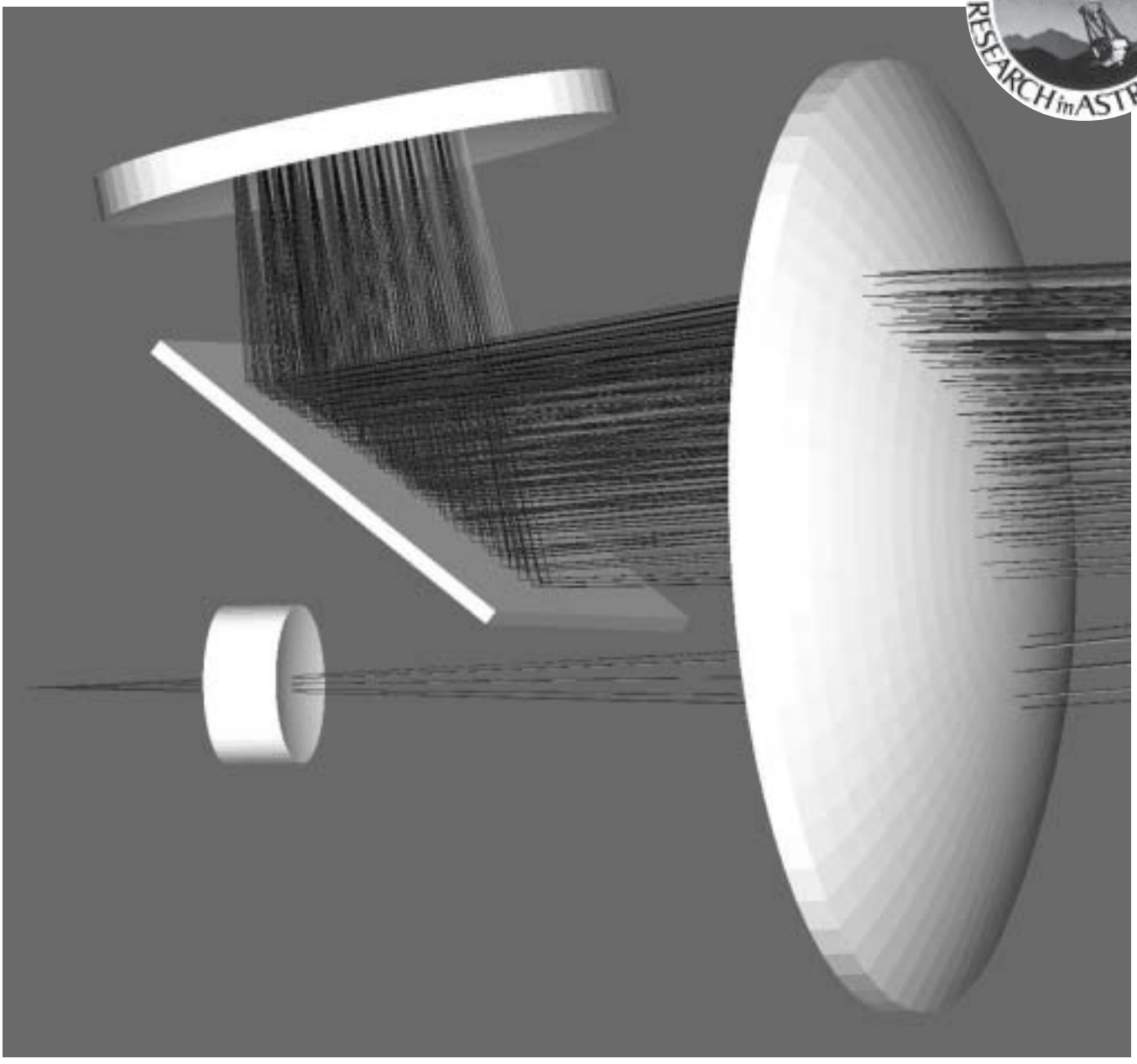
MIRA NEWSLETTER



Designing the MIRA High-Resolution Spectrograph

(See article, p. 4)

Contents

American Astronomical Society Supports Modifications to Guidance/Acquisition Package

The Guidance/Acquisition Package, or GAP, as MIRA astronomers refer to it, is one of the distinctive features of the MIRA 36-inch telescope. It was designed to permit the mounting of several different instruments at the same time, and to switch easily among them. This feature promotes both safety (mounting and dismounting delicate instruments is when they tend to get damaged) and ease of use (an instrument always in place need not be readjusted or recalibrated every time a researcher wants to use it). An especially interesting capability of the GAP is the ability to switch from spectroscopy to direct imaging literally in a matter of seconds. This function was put to good use during MIRA's observations of the Deep Impact event (see the *MIRA Newsletter*, Fall and Winter, 2005, and Summer, 2006).

But instrumentation in astronomy never holds still for very long, and the GAP needs to be modified in order to carry new instruments, and to adapt it more effectively to some instruments already in use. The American Astronomical Society has granted $6,334 for this purpose. The work will be performed by DFM Engineering, the original builders of the MIRA telescope.

Chapman Foundation Grant to Support MIRA's Interns

Readers of the *MIRA Newsletter* know that MIRA offers intensive internships to interested high school and college students. This activity will benefit from the generous gift of $5,000 by the Chapman Foundation. The funds will be used to defray the costs of nights at the telescope for student research projects.

Calendar of Events

Saturday, 14 July, 7:30pm. Free public lecture by Dr. Greg Laughlin on "Discovering Your Own Exoplanet." Hamming Astronomy Center.

Sunday, 29 July, 2:30-4:00pm. Free tour of the Oliver Observing Station on Chews Ridge. *Tours are free and open to the public. Reservations are required, however; call 883-1000.*

Sunday, 12 August. Perseid Meteor Shower Star Party at Oliver Observing Station. *Friends of MIRA only. Reservations are required; call 883-1000.*

Discover Your Own Extra-Solar Planet! Learn How at 14 July Lecture.

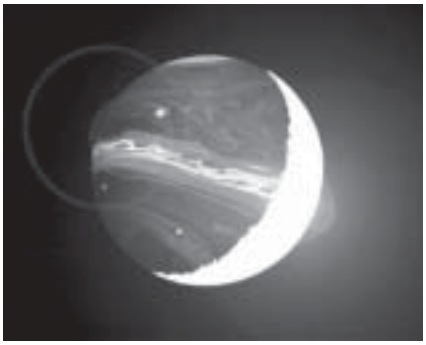
Planets circling stars other than our sun are now being discovered at an astounding rate. As of this writing, 209 have been discovered. By the time you read this, it will probably be more.

How long before we discover a planet that could harbor life? How long before we discover a planet that *has* life? Not long, predicts Dr. Greg Laughlin of Lick Observatory, who will deliver a MIRA lecture on "Discovering Your Own Exoplanet" on 14 July.

These planets are being discovered so rapidly that analyzing the data is lagging behind. Dr. Laughlin's group has developed a computer program, which can run on most computers, that permits lay persons to analyze these data to search for yet undiscovered planets.

Join us in learning the latest developments in the exciting field of exoplanets and how to discover your own on your home computer.

Since Monterey Peninsula College is undergoing massive construction projects this summer, this presentation will be held at the MIRA Hamming Astronomy Center on Saturday, 14 July, at 7:30pm.



Artist's conception of an extra-solar planet. From www.oklo.org.

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.

In this issue, we are pleased to present two questions:

Michelle Lee asks,

Hi this is Michelle and I'm doing a research project on shooting stars.

1) Why do shooting stars exist?

2) How do shooting stars form?

3) What is the point of shooting stars?

4) What do shooting stars do to Earth or the atmosphere?

Dr. Bruce Weaver replies,

'Shooting stars' is a folk name for meteors. Lumps of rocks, mostly left over from the formation of the solar system, float through interplanetary space until the gravity of a planet attracts them to crash into the planet. The object in space is referred to as a meteoroid. After it strikes the earth, for example, it is called a meteorite. The flash you see in the sky is called a meteor.

MIRA's educational CD "Are We Doomed?" explores the effects of objects from space striking the Earth.

The flash of light occurs because the meteoroid is traveling many miles per second. The friction with the earth's atmosphere causes it to burn. An object the size of a grain of sand can cause a sizable flash of light.

The point of shooting stars is a more metaphysical question. One idea is to entertain us; another, that they fill us with wonder about astronomy. Of course, if everyone is inside watching TV or outside under the glare of street lights, their burning up will be of no use to anyone.

As for your last question, really large meteoroids can, and have, affected the Earth in quite dramatic and destructive ways. Fortunately, this doesn't happen very often! See the Summer, 2004, issue of the *Newsletter* (available on our website, www.mira.org).

Cath Tendler-Valencia asks,

My moon calendar says June 30 is a full moon, and a blue moon, the second one this June, since one occurred on June 1. *The Monterey County Herald* claims the full moon is May 31 rather than June 1. Why is there a discrepancy?

Dr. Arthur Babcock replies,

The discrepancy arises from the difference between civil time (in our case, PDT) and Universal Time (Greenwich Mean Time).

If one looks on the U. S. Naval Observatory site (as I just have), one is told that a full moon occurs on June 1 at 01:04 UT. But in the Pacific Time zone, we are 7 hours behind Universal Time (when daylight savings time is being observed—8 hours otherwise), and so for us it is still May 31 when the full moon occurs. My pocket calendar, which the publisher must have optimized for North America, gives the date of the full moon as May 31.

It makes a lot of sense to give the dates of moon phases in UT—that way, anyone in the world can convert the time to local time, so long as you make it clear that you're using UT. But if you're confident that nearly all your readers are in your time zone (as, I suppose, *The Herald* is), it may be convenient to convert UT to local time.

By the way, there has been a great deal of discussion of the meaning of the term "blue moon." Many people use the term to designate a second full moon in a given calendar month. But the Farmer's Almanac originally used the term to designate a fourth full moon in a given quarter. *Sky & Telescope* published an article about the problem, which you can read here:

http://skytonight.com/observing/objects/moon/3304131.html?page=1&c=y

Thank you for the questions.

Optical Design Number Two for the MIRA High-Resolution Spectrograph

by Dr. Wm. Bruce Weaver

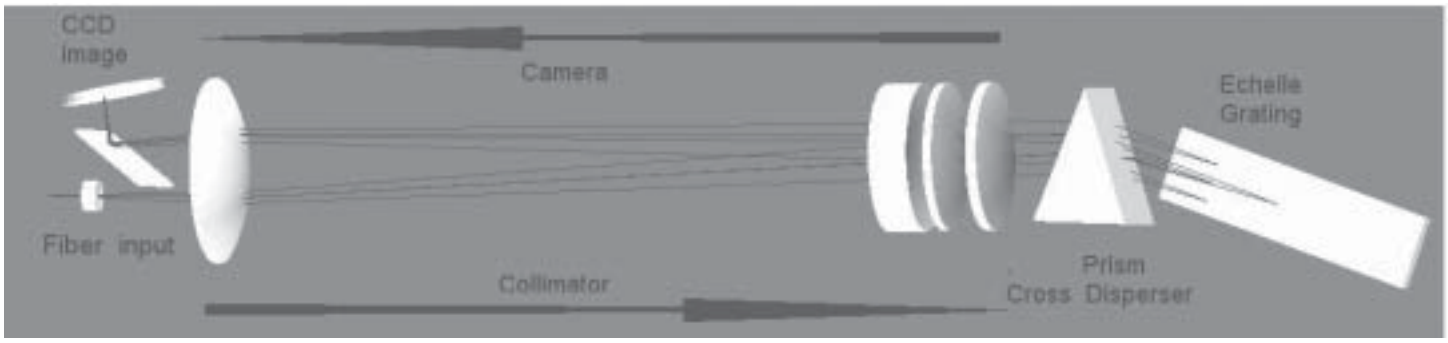
The first design, donated by Friend of MIRA Malcolm MacFarlane, was an excellent one that exactly matched our specifications. Unfortunately, once the design was completed, we realized that fabrication would exceed our budget. In typical MIRA fashion, we're trying to build a world-class spectrograph for about 10% the usual price.

On the suggestion of Dr. Steve Vogt of Lick Observatory, we considered a double pass system where the same optics act both as the collimator, which makes the light parallel in preparation for the grating that will break the light into its colors, and the camera, which will focus the light on the Charge-Coupled Device (CCD). The CCD has now become the standard light detector for astronomers.

The light will be brought from the focus of the telescope by a glass fiber 50 microns (two one-thousandths of an inch) in diameter. In the diagram below, the light from the fiber enters at the lower left. The lenses then serve to collimate the rays of light. Only the rays for red light are shown in the diagram.

The prism spreads the colors of the light out in the vertical direction while the echelle grating spreads the colors of the light out in the horizontal direction. On the return path, the same optics, now acting as the camera, bring the spectrum into focus at the surface of the CCD.

The result is a spectral resolution ten times greater than that now possible with the MIRA spectrograph. This will provide MIRA astronomers the opportunity to make detailed studies of the atomic physics of the atmospheres of stars and nebulae. Of course, spreading the light out so much restricts us to the brightest half million stars in the sky, but most of those, including some of the most interesting stars in the Galaxy, are too bright for the world's largest telescopes. That should be enough to keep us busy for a while!



New Gifts for High Bay Buildout

Two local foundations, both longtime supporters of MIRA, have recently made contributions toward the construction of the new high bay at the Hamming Astronomy Center (see illustration, p. 5)

The Ralph Knox Foundation has given $15,000 for this purpose. Along with their support of the Ralph Knox Shops and other generous gifts, the Foundation has given MIRA invaluable support in developing the Marina campus.

Monterey Peninsula Volunteer Services has given $500 for the high bay project. These generous folks recently invited Dr. Arthur Babcock to one of their meetings, where he brought them up to date on MIRA's mission and activities. Monterey Peninsula Volunteer Services operates a thrift shop at 655 Broadway in Seaside. We invite our Friends to stop by and get acquainted with them.

Correction

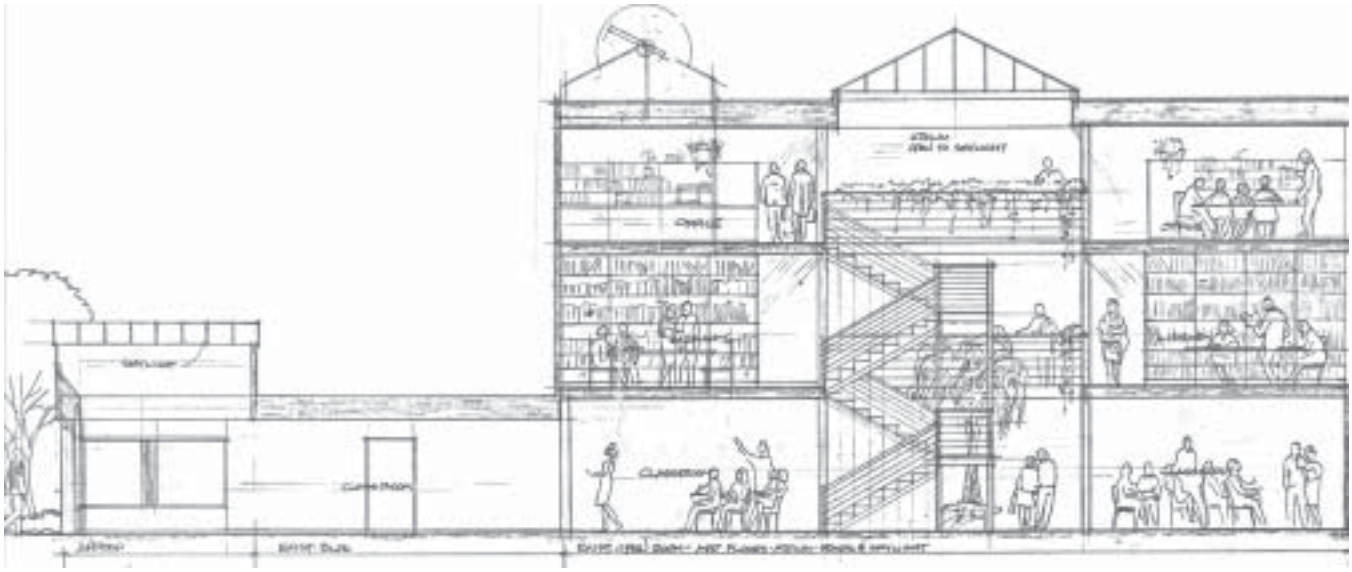
Due to an editorial error, our list of 2006 donors in the last issue omitted Dr. and Mrs. Whitney Shane from the Associates category. Our apologies to our good friends and colleagues, and our thanks for their generous support of MIRA.

The Editor

TABASGO Foundation Funds $50,000 Challenge Grant for Hamming Center High Bay Construction

by Dr. Wm. Bruce Weaver

With the recent $50,000 challenge grant from the TABASGO Foundation, the funding required to implement the badly-needed expansion of the MIRA facilities is nearing completion. The renovation will provide space for a unified library, classrooms, and work spaces for astronomers, volunteers, and students. The library is currently spread among three locations; astronomers, volunteers, and students share a single work space; and the classroom is poorly lit and difficult to use. Our plans to expand both our education and research programs are on hold until this renovation is complete. When this challenge is met, we'll be close enough to our funding goal to finalize the design and start construction. We hope you'll help; we'll save you a place at the ribbon-cutting.



Plans for the Buildout of the Richard W. Hamming Astronomy Center High Bay.

Friends of MIRA Invited to Perseid Meteor Shower Star Party at Oliver Observing Station

Many consider the Perseids the best meteor shower of the year. This year the peak of the shower falls on the August night of new moon. The predicted hour of the peak is 10 pm on Sunday, 12 August. The predicted maximum zenithal rate is 100 meteors per hour. How often will the peak of this shower fall both on the darkness of new moon and on a human-convenient weekend night? Roughly, about once every 60 years!

This year, the Friends of MIRA night on Chews Ridge will be 12 August. Since the main show of the night will be the fireworks of the Perseid meteor shower, we will be able to accommodate more current Friends than usual. Even so, the number of reservations will be limited.

Observing through the MIRA 36-inch telescope will also be available. Make your reservations with Holly at 883-1000.

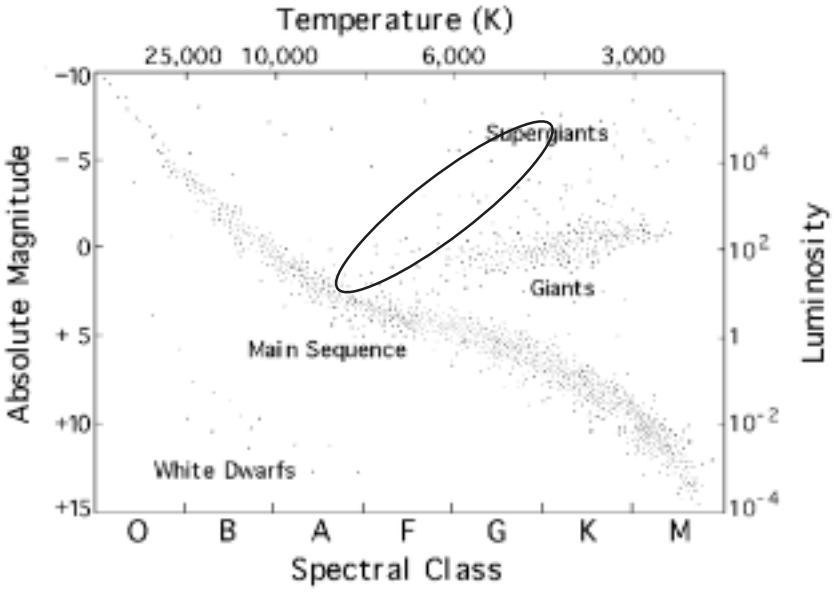
The Summer Sky

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

Fixed Stars

With the Milky Way once more coming into view, we are reminded of the many interesting objects to be found there. Among these, the Cepheid variables, which we have discussed earlier and are named for their prototype delta Cephei, are currently of particular importance. These are a large and diverse class of pulsating stars, and for almost a century they have been an important rung in the cosmic distance ladder, which leads us, by way of many steps, from the solar system to the outer reaches of the universe.

Already late in the nineteenth century it was recognized that, other things being equal (which they never are) the pulsation period of a star should be inversely proportional to the square root of its density. By itself this is not very helpful, but it becomes more interesting when we note that most stars are unable to pulsate because they lack the internal instability that provides the pulsation energy. If we think of the Hertzsprung-Russell (HR) diagram, where stars are plotted according to their absolute brightness and temperature, we find that most pulsating stars are located along a narrow band extending from faint hot stars to bright cool ones. We call this the instability strip. If a star is pulsating it probably lies on this strip. From the color we can determine the temperature (blue stars are hot, red stars are cool), and knowing this we can read off the brightness from the HR diagram. But we would like to do better than this, since the color is not easily measured in the presence of dust, and the conversion to temperature is complicated. We know that the density varies along the instability strip, the blue stars being more dense than the red ones. Since the period of the pulsation, which is easily determined, depends upon the density, this gives us a much better measure to the brightness than the color would. This is the basis of the very important period-luminosity relation for Cepheids.



The H-R diagram. The ellipse shows the approximate position of the instability strip.

The next step is to calibrate this relation, where the most difficult problem is determining the distances to the stars. We discussed this problem some years ago and concluded that, for stars within the Galaxy, the best methods were trigonometric parallaxes, as measured by the Hipparcos satellite, measurement of Cepheids in clusters at known distance, and the velocity and the light amplitude of the pulsation. This is still the case, and the three methods give quite consistent results, provided we confine ourselves to a single rather homogeneous group known as the classical Cepheids. The classical Cepheids are recently formed stars and are therefore relatively rich in heavy elements and are found close to the plane of the Milky Way. Other kinds of Cepheid variables, such as the RR Lyrae stars, also lie in the instability strip but are generally older and have somewhat different properties.

We can also calibrate the relation in the Magellanic Clouds, whose distances are now quite well determined and where large numbers of Cepheids are easily identified. To our horror we find that the period-luminosity relations here are quite different from what we found in the Galaxy. Not only are stars of the same period about a magnitude brighter in the Magellanic Clouds, but the shape of the relation is also different. There are even differences between the two clouds. The principal, but probably not the only, reason for the difference is the chemical composition of the stars. The Magellanic Clouds are less rich in heavy elements than the Galaxy, presumably because of a different evolutionary history. This results in a different internal structure of the stars which changes the pulsation properties.

That something of this sort was going on has been suspected for some time, but it has now been well studied and quantified. What is still lacking is an understanding of the physical details, and without this it is not possible to construct a theoretical period-luminosity relation for an arbitrary chemical composition. We must be able to do this if we are to use this method to determine distances to other galaxies. We must then determine the chemical composition of the stars in these galaxies, which is difficult but not impossible. Then we must know the periods and magnitudes of a sample of Cepheids in these galaxies. This had been done using the Hubble Space Telescope and will soon be possible with large ground-based telescopes using adaptive optics.

At present we have period-luminosity relations for two chemical compositions and we must interpolate between them in some way for whatever composition we think is appropriate for the galaxy we are studying. This is clearly an unsatisfactory state of affairs, and much work needs to be done before we can proceed up the distance ladder with any confidence. Happily we can now see what needs to be done, so we may expect that this will continue to be an active subject of research for some years to come.

Planets

Mercury will be visible in the morning sky during July reaching maximum elongation on July 20. Although quite bright, it will remain a difficult object due to twilight. It will reappear in the evening sky during September but will be unfavorably located for northern observers.

Venus will be very bright and high in the evening sky as the quarter begins. It will pass less than one degree south of Saturn on July 2. Later in July it will descend quickly into the evening twilight. It will reappear in the morning sky in the beginning of September.

Mars gradually climbs higher in the morning sky as the quarter progresses. It will rise before midnight by the end of September. It will spend most of the quarter in Taurus.

Jupiter is now past opposition and remains in the evening sky for the whole quarter. It is stationary on August 7. Because of its far southern declination it is poorly placed for observation.

Saturn will disappear into the evening twilight early in July and reappear in the morning sky in early September when it will pass close to Regulus. The series of lunar occultations continues, but they are now favoring the southern hemisphere.

Uranus spends this year in Aquarius and will be in opposition on September 9. Neptune spends the year in nearby Capricornus and is in opposition on August 13. Two more lunar occultations of Neptune are visible only from Antarctica.

Meteor Showers

No one need be reminded of Perseids, which this year will peak around midnight on the night of August 12. This falls only hours after new moon and is thus a perfect opportunity for observation. The outbursts of the 1990s, which coincided with perihelion passage of the parent comet 109P/Swift-Tuttle, are now behind us, but the experts still hold out faint hope for something spectacular this year. But even without that, it should still be a good show.

The Southern delta Aquarids peaking on July 28 and the second strongest shower of the summer, will be spoiled this year by the full moon. Among the minor showers, the kappa Cygnids on August 18 and the September Perseids on September 9 are both favored by the moon, but you are likely to have a long wait between detections.

Comets

The really good comets usually come unannounced, but the best predicted comet for the summer is C2006 VZ13 (LINEAR) which should reach a maximum brightness of ninth magnitude in July when it will be moving rather rapidly from Cepheus through Draco into Bootes and be visible all night. In August it will become an evening object and fade to tenth magnitude as it moves into Virgo as it disappears into the evening twilight.

Our second choice is C2007 E2 (Lovejoy), discovered by Terry Lovejoy in Australia, which will be almost stationary between Bootes and Ursa Minor. It is fading rapidly, but will still be thirteenth magnitude during July.

Eclipses

Eclipse season is again upon us, and we will be able to enjoy a total lunar eclipse during the early morning hours of August 28. The eclipse will begin at about 1 AM and last until nearly sunrise. Totality will last from about 3:00 to 4:30.

A partial solar eclipse on September 11 will be visible only from parts of South America and Antarctica, with the greatest eclipse covering most of Chile.

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_____

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Welcome to our new Friends

Clarissa Conn

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.

Visit our Web site and *Field Trips to the Stars:*
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