Former MIRA Intern Observes with the Keck Telescope!
(See story on Thomas Bohn, p. 5)
Recent Grants to MIRA

MIRA depends to a great extent on donations from local and national foundations as well as from the loyal Friends of MIRA.

Recently, we received some very welcome support for our educational programs from two local foundations: the Pebble Beach Company Foundation, which granted us $4,000, and the Yellow Brick Road Benefit Shop, which gave $1500.

The latter organization relies on volunteers to work in their three stores, and asks that we publicize their need, which we are happy to do. Potential volunteers can call 831-626-8480 or visit http://yellowbrickroadbenefitshop.org.

Calendar of Events

Sunday, 8 December, 4-8pm, Hamming Astronomy Center. The Annual MIRA Holiday Potluck. Limited to the Friends of MIRA.

Saturday, 11 January, 7:30pm, MPC Lecture Forum. The annual Bonestell Lecture: “Was There A Single Big Bang?” by Dr. Brian G. Keating, UC San Diego Center for Astrophysics and Space Sciences.

Date and time to be arranged: A lecture by Dr. Natalie Batalha of the Department of Astronomy and Astrophysics at UC Santa Cruz on planetary habitability and evidence of life beyond the solar system.

Welcome to our new Friends

Irma Gomez
Lisa Huntley
Sofia Jamieson
Ken & Joan McIntire
Jesse Reimer
James Yuen

Thanks!

MIRA Board of Directors

Gordon Jones, Chairman
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MIRA Newsletter in Color

The MIRA Newsletter is available in color on the MIRA website (www.mira.org)
Repairs and Other Work at the OOS

In order to take full advantage of our excellent atmospheric conditions, the Bernard M. Oliver Observing Station uses a roll-off roof, rather than the classic observatory dome, so as to permit the least disturbed air flow and avoid degradation of the atmospheric conditions through which we observe. Last year we discovered that two of the four motors that move this massive three-layer roof were no longer functional and both astronomer and student use was suspended until this situation could be remedied.

We made several attempts to repair the original motors and associated electrical and mechanical systems. But the gears, motor parts, shafts, etc., were no longer available, so we determined that only a full replacement of the roof-moving systems would provide a sensible solution with reasonable longevity. All the work was performed by our highly capable engineer, Jeff Larson.

Jeff Larson repairs rolling roof track while volunteers stand by below to extinguish any errant sparks.

Our 2019 interns at the telescope for a daytime work crew visit as night-time viewing was precluded by repairs to the rolling roof. Left to right: Aaron Chu, Elijah Wenn, Samuel Liao, and Lucia Zacek (missing: Samuel Fontaine).

A forlorn wind turbine: the blades from the OOS wind turbine were removed this summer when we discovered they had been seriously damaged in last winter’s storms and had become a safety hazard. This is an essential part of our off-grid power system and we hope to replace it before this winter.

The south stairwell at the Oliver Observing Station is frequented by visitors, so, following the suggestion by one of the Friends of MIRA, we installed safety tape to the treads.
Would you like to help solve one of the great mysteries of the Universe?

Toward the end of the last century Bruce Weaver showed me a picture of the prototype gravitational lens, the Einstein Cross. It had been sent to him by a colleague in Canada. He said “We can do better than this.” He argued that with our vastly superior observing conditions we could do better despite having a telescope only half as big. I agreed with him, and we set about proving that we were right. The illustration shows how well we succeeded.

It did not come easily. First we needed to build a first-class guider in order to improve the telescope tracking during long exposures. Then we had to buy a set of precision filters for the colors that we intended to use, and install a reliable filter wheel. Finally, we had to train ourselves in the art of precise imaging for photometry, for neither of us had done this seriously for many years and never with a state-of-the-art CCD camera.

An image like the Einstein Cross occurs when the light from a very distant source passes, on its way to the observer, a massive object like a black hole or a galaxy. As Einstein had predicted, the light path is bent by the gravitational field of the intervening object. In a perfectly symmetric case, the light would appear as a circle, but this is rarely the case. Ordinarily we see an asymmetric ring, broken into pieces by irregularities in the gravitational field.

There are many things to be learned from pictures of gravitational lenses. My own interest, as a specialist in the structure and dynamics of galaxies, was stimulated by the possibility of probing the gravitational field of the galaxy and thus the distribution of mass. Both optical and radio observations of galaxies have shown that the rotation speed is often too large to be accounted for by the visible material alone. The late Vera Rubin, personally known to some of us, was the initial leader in this kind of investigation. The most plausible explanation of this is that there is matter present which we do not see. We have no idea what this dark matter may be. Cosmologists have welcomed the thought of dark matter, as it allows them to resolve some difficulties in their models of the early evolution of the Universe. Observations of lenses also provide a direct measurement of the size and age of our Universe.

More information about the distribution of dark matter, which seems to be concentrated around galaxies or clusters of galaxies, is much needed, and, even with our modest instruments, our superb observing conditions should enable us to make a contribution. And so, has dark matter come to MIRA.

The project as we formulated it depended strongly upon stellar photometry, the measurement of the brightness of stars. As it so happened, Arthur Babcock was just then beginning an unrelated project which also required stellar photometry. Arthur had never done this and my own limited experience was from many years ago, so we decided to put our heads together and learn the trade. This took time, but after much study and experimentation...
and many false starts, we now like to think of ourselves as competent photometrists.

Using existing programs wherever possible, we have built up a process that carries us from the raw data from the telescope to well-calibrated brightnesses of stars on a standard system. We have documented the whole process, keeping it up to date as we develop new parts or improve old ones, so that now a new volunteer or a temporary summer student can, without much initial training, start working usefully on whatever part of the process that needs work. The only requirements are that he or she not be frightened of computers, be willing to work carefully and consistently, and above all, to remain alert for anything out of the ordinary. Who knows; he might discover something new. Recently we identified some previously unknown double stars. In the summer of 2018 a high school summer student, in her very first week, discovered a bolide (an exploding meteorite) on one of our images. These are not uncommon, but this was the first time that we had ever seen one on an image from our 36" telescope, which has a very small field of view on the sky.

But the important discoveries are those affecting the photometry, such as an error (everybody makes errors) in applying one of the programs, leading to bad results, or a distorted or disturbed stellar image, or an error in recording the data, or almost anything else. These must be traced down and corrected, if possible, or otherwise the data must be deleted or marked as unreliable. Arthur calls this "forensic astronomy." Many of us find this constant fight against errors to be the most exciting part of the whole process. Our motto is that bad data are worse than no data at all.

Then why the call for HELP in the title of this piece? We started this project by observing gravitational lenses. We had a list of 17, which we thought to be suitable candidates. Between 2001 and 2007 we did little but observe these objects, first more or less at random but later more systematically. We built up a huge collection of observations. When we finally saw what the photometry involved, we realized that we had a lot of work ahead of us.

We have made good progress, with one important series of observations almost ready for publication. But if we are to resume serious observing, as we hope to do very soon, we must put more work into analyzing the backlog observations. One or two enthusiastic part time volunteers could very well solve this problem. If you find the idea interesting, please contact us, and we can talk about it. Perhaps you can help us lift the Curse of the Unknown Dark Matter!

**Thomas Bohn**

Thomas Bohn, pictured on the cover in front of the 10-meter Keck 1 telescope on Mauna Kea, holds the record (so far!) for the greatest number of summers spent as an intern at MIRA: three. He first worked at MIRA in the summer of 2007, between his junior and senior years at the York School; he then returned during the summers of 2012 and 2013 while an undergraduate at Santa Clara University. During this time, a note appeared in the MIRA Newsletter about the intern who, after multiple internships at MIRA, was still interested in astronomy! Most of his internship time was spent working with Drs. Arthur Babcock and Whitney Shane on photometry of Young Stellar Objects and gravitational lenses.

We are happy to report that Thomas's interest has not only persisted, but deepened: he is now in the last stages of a Ph.D. in Astrophysics at the University of California, Riverside.

MIRA Administrator Joanna Sorci, who used to work at Lick Observatory, relates that she bumped into Thomas at Lick, where he had gone to observe with the main instrument, the 120-inch reflector. Now, the official name of the 120-inch reflector is the Shane Telescope, after C. Donald Shane, who was Director of Lick Observatory during the design and construction of the telescope. Donald Shane is also the father of MIRA astronomer Whitney Shane, and Joanna admires the sense of continuity that must be felt by a young astronomer who observes with a telescope named after the father of one of his mentors in his earliest work in astronomy.

During the summer of 2019, Thomas was a Keck Scholar at the Keck Observatory on Mauna Kea, pursuing his doctoral work on spectrographic observations in the near infrared of Active Galactic Nuclei (AGNs).

Part of the purpose of the Keck Scholarships according to their website is to give astronomers-in-training intensive experience in practical observational astronomy. We at MIRA like to think that many of our interns gain exactly that during their time with us. Indeed, Thomas related a couple of years ago that the second semester of graduate school at Riverside for students in astronomy is their introduction to IRAF. The Image Reduction and Analysis Facility (IRAF), an old and legendarily user-unfriendly software package, is still the standard tool for much astronomical analysis, and, after three summers at MIRA, Thomas had a considerable head start on his fellow students during that phase of their training.

We are still open for internships at MIRA. Would anyone care to try to beat Thomas’s record? Who knows, you could end up working on the Keck, or maybe even the Thirty-Meter Telescope, if they ever find a place to put it.
Dr. Albert Merville

I'm sad to report that Al Merville, one of MIRA's founders, died in August of this year at the age of 79.

I'm sad for many reasons: he, and his wife Ann Merville, subscribed whole-heartedly to the wacky idea of starting our own observatory; he started the Friends of MIRA, formed at the home of Ansel Adams; and he was with me when we met with Barney Oliver when we made the pitch for funding of the construction of what is now known as the Bernard M. Oliver Observing Station. On vacation from graduate school, he was the first to person-
ally explore our potential observatory site on Chews Ridge. He was an essential element in making this lifelong enterprise a success when it was young and vulnerable.

Al had had the most varied background of the founders, attending Vanderbilt University, Athens College, and the University of Alabama, with breaks to work for companies supporting the early days of NASA; before landing at the Warner and Swasey Observatory in 1967. There he obtained his Ph.D. in astronomy – formally from Case Western Reserve University – in 1972. As near as we can tell, the Merville and Weaver families entered different ends of the State of California for the next stage of our lives on the same day.

In order to make time for his MIRA activities, he worked as an instructor at the Monterey Peninsula and Hartnell Colleges, the latter where Ann still teaches today. At MIRA, he always had the longer view while being able to focus on the small details that are essential to successful projects.

Like several of the founders, as the obligations of family, including two daughters born in Monterey, became more substantial, he had to reduce the time he could spend raising the young MIRA as well. His “daylighting” job was as an analyst with the Scientific Support Laboratory of the Combat Developments Experimentation Command at Ft. Ord and Ft. Hunter Liggett.

But mostly I’m sad because Al was a solid friend; the sort you knew you could depend on for help you would be reluctant to ask others for. It was rare that you could broach a topic, no matter how arcane, to which he had not given serious and insightful thought. After retirement from the Military-Industrial Complex, he was seduced by travel; he and Ann roamed the southwest in their Tioga RV. I always looked forward to when our paths would cross; a conversation with Al invariably opened new horizons.
The Fall Sky
by Dr. Arthur Babcock

Planets

Mercury will be visible in the western evening sky from the start of the quarter through early November. It then becomes lost in the glare of the Sun, but take heart: on 11 November there will be a transit of Mercury, the first since 2016. On the Central Coast, we will miss the beginning of the transit, which begins before sunrise. The moment of greatest transit occurs at about 7:20am, and by 10:03, the transit will be over. Because the disc of the planet as seen from Earth is so small (much smaller than the disc of Venus during a transit), observing the transit of Mercury requires a telescope with a magnification of at least 50x. Since the telescope will be pointed squarely at the Sun, a proper solar filter is an absolute requirement. After the transit, the planet becomes visible in the morning sky from late November until the end of the period.

Venus at the start of the quarter is observable with difficulty in bright evening twilight in the western sky. It becomes easier to see in December, and passes within two degrees of Saturn on the 11th. Venus will have an excellent apparition in early 2020.

Mars is too close to the Sun to be observed in September. It is visible in the morning sky from mid-October through the end of the season. Mars is very distant from Earth during this period, and shows only a very small disc.

Jupiter will be visible throughout the quarter, albeit with some difficulty. At the start of the period, the planet does not set until about 11pm, so it may be observed in the evening. Throughout the period, it will be rather far south (around negative 22-23 degrees).

Saturn will also be visible throughout the quarter.

Uranus is well paced for observation throughout the period. It reaches opposition (when it is visible all night) on 28 October (see the discussion of the antisolar point toward the end of this article).

Neptune, too, is well positioned for evening viewing throughout the quarter.

Meteor Showers

Both of the good meteor showers of the Fall, the Leonids on 17 November and the Geminids on 14 December, will be washed out by the Moon.

Comets

Comet C/2018 W2 (Africano) is predicted to be at 8th magnitude (i.e., visible in binoculars) for the first part of the season. C/2017 T2 (PanSTARRS) may brighten to 9th magnitude in December and 8th magnitude in early 2020. Seiichi Yoshida's Home Page (www.aerith.net) is a good place to get finder charts and other information on comets.

Eclipses

No eclipses will be visible from the Central Coast during this quarter. There will be an annular solar eclipse on 26 December, but it won't be visible from these parts.

Interplanetary Dust

We are fast approaching the best time of the year to see the zodiacal light in the pre-dawn eastern sky (see the Summer issue for a fuller discussion).

The gegenschein (also discussed in the Summer issue) is found at the antisolar point, the point in the sky directly opposite the Sun. In the last issue I discussed a couple of methods for finding the antisolar point. Neither of those methods would work for finding the gegenschein, but I promised some better methods for the current issue. The first of these methods is akin to the Full Moon method (which is no good because the light of the Full Moon would overwhelm the gegenschein): find a planet at opposition, which by definition occurs when a planet is near the antisolar point. The gegenschein should be in the same general vicinity. This year, the only candidate is Uranus, which is at opposition on 28 October. The second method is simply to calculate the coordinates of the antisolar point from the coordinates of the Sun. The declination of the antisolar point will be the same number as the declination of the Sun, but of opposite sign. The right ascension of the antisolar point will be the Sun's right ascension plus 12 hours (or minus 12 hours, it makes no difference). For example, on 22 September the Sun's coordinates are declination +0 degrees, 11 minutes, 55 seconds, right ascension 11 hours, 58 minutes, 9 seconds. The antisolar point, then, is at -0d 11m 55s and 23h 58m 9s.

If anyone actually manages to spot the gegenschein using these instructions, I would appreciate hearing about it.
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

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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:
www.mira.org
E-mail us at mira@mira.org

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