

REFLECTIONS / REFRACTIONS

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University Lowbrow
Astronomers

August 2009

Volume 33 Issue 8

Midwest Astro Imaging Conference 2009

By Clay Kessler

The Midwest Astro Imaging Conference is sponsored by Al Degutis and Astrophoto Insight Magazine. I had the opportunity to attend the conference this year with Jeff Thrush. The event is held in Hoffman Estates Illinois – a northwest suburb of Chicago. The conference presentations are hosted at Northern Illinois University Hoffman Estates Meeting Center – a modern facility with classrooms, meeting facilities and a great kitchen.



(Image by Al Degutis)

An august group of presenters were on hand to learn from. They included (left to right):

Robert Reeves—Noted Author; Warren Keller—IP4AP; Chris Peterson—Research Associate, Denver Museum of Nature and Science; Craig Stark—Nebulosity, PHD Guide etc.; Kevin Nelson—VP Quantum Scientific Imaging; Hap Griffin—Hap Griffin Astro-Cables; Alan Erickson—Adobe.; Michael Kran—NASA Solar System Ambassador; Bob Denny—DC3 Dreams; Alan Friedman—Great Arrow Graphics

The conference started Friday morning and the first talk was given by Craig Stark. His subject was “Choosing a camera for Astrophotography”. This was a very in depth analysis of the pluses and minuses of DSLR’s and dedicated CCD cameras. Final conclusions were that if you want a dedicated astro system a CCD is the better way to go – but if you have a mixed use (terrestrial and astro photography) a DSLR has a lot to recommend it.

The second talk on Friday Morning was given by Alan Erickson from Adobe. Alan described Adobe’s family of products and demonstrated several photoshop features that can be very helpful for astrophotographers. He showed a very cool 3D effect that allowed you to zoom into an object and watch the foreground stars move to the side as if you were moving in space.

After lunch we continued with Hap Griffin's talk "Modifying DSLR's for Astronomical Photography". Hap took us through the "nuts and bolts" of removing the stock filter inside a DSLR and talked about the different considerations of no filter, clear glass or an IR cutoff filter like the Baader UV/IR replacement filter.



(typical session)

The final talk on Friday was Warren Keller "The 5 S's – Part 1". Warren is a very artistic astrophotographer who is very knowledgeable in the best use of Photoshop for astro image processing. Warren touched on many processing techniques revolving around "Stretching", "Sharpening" and "Saturating" the image.

Friday night was capped off with a dinner party at a local restaurant. After dinner – off for a good night's sleep..... but wait – it is clear in Michigan! No problem – Jeff fired up his observatory via the internet and took some images from Chicago!

Saturday morning was very nice and cool. We got to the conference center early to take advantage of the breakfast laid out for us and to peruse the vendor tables. I admit that I shamelessly took advantage of the Canon representatives. They brought several tabloid sized photo printers and offered to print our astrophotos free of charge. I got three tabloid sized prints that will grace my walls in the near future.

The first session that I attended on Saturday was Chris Peterson's "Advanced Guiding Tips and Tricks". This was a pretty technical discussion of autoguiding theory and practice. Chris talked about different electronic systems and cameras used to achieve "sub pixel" autoguiding. An interesting discussion that I took a lot away from.

Saturday's second session was Robert Reeves' "10+ ways to focus a DSLR for Astrophotography". Robert gave an enjoyable talk that discussed what critical focus is and detailed the 15 (and counting) ways to accomplish this with a DSLR. Not too technical – very good talk.

The next session was Alan Friedman's "Catching the Sun – High Resolution Astro-Imaging in the Daytime". Alan talked about how he takes high resolution lunar, solar and planetary photos from his urban back yard in Buffalo New York. All the photos – especially the solar shots – were very beautiful. I could very easily sit through this talk again!

After a fine lunch Kevin Nelson (from Quantum Scientific Imaging) gave his presentation "Bias and Darks and Flats, Oh My!" The how and why of image calibration. This was a technical discussion of image calibration and how to achieve the best results. Lots of info to absorb here and it was applicable to CCD and DSLR imaging.

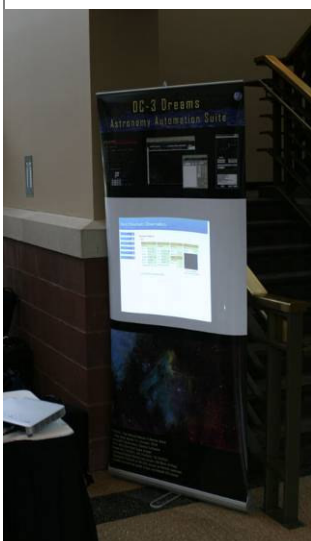
At this point I suffered from Information overload and sat out the last presentation. Instead I headed for the atrium and checked out some of the vendor displays. Canon had a great setup with the printers, all their DSLR cameras and enough high end glass to pay off my mortgage (almost!).



Quantum Scientific Instruments had a display and some cameras -



as did Fishcamp Engineering with their Starfish Cameras. Jeff Thrush was pretty interested in the AstroTrac setup – enough so one is shipping to him now! AstroTrac also had the new pier mounted version that can support up to a 4” refractor or an 8” SCT.



DC3 Dreams had a display table with information on their telescope/observatory automation software.

Finally – the last session – “Closing remarks and DOOR PRIZES!!!!”

This event had a great selection of door prizes including a Canon XSi camera kit. Two copies of Adobe Photoshop CS4+. Two Orion Starshoot imaging cameras and a Starshoot Autoguider. Lots of software and adapters. While I did not win anything Jeff Thrush got an Orion Starshoot Monochrome Imager!

The session ended at 5PM central time and we hopped on the tollway back to Michigan. It was a great weekend and I learned a lot. I am looking forward to attending next year!

The Intes-Alter M703, Experience with a Mak-Cass

By Charlie Nielsen

I still remember looking at the old Orion Telescope catalogs and being a bit more than just curious about their Maksutov/Cassegrain and Maksutov/Newtonian telescopes that they used to carry. Orion’s sales blurb was not the only testimony that I had heard or read regarding the high optical quality of these designs. Perhaps the most prominent design parameter is the use of spherical primary mirrors. This would normally be very bad since a parabolic mirror is required to reduce the inherent aberrations that come with a spherical mirror. But, a spherical mirror is much easier to figure accurately than a parabolic. Both designs use a corrector (lens) at the very front of the telescope which introduces the opposite errors that the spherical primary causes. Therefore one cancels out the other and this allows the primary to be figured to very high accuracy. Having a corrector and semi-sealed tube provides the advantage of keeping the primary and secondary clean, but also throws in the disadvantage of having a front surface that could dew up, or be touched by something other than air and photons. Both of these designs are capable of producing very high contrast, coma free images with spot sizes that are just short of refractor category. Small spot sizes translate into very tight, small, high resolution star images. This feature as well as both designs’ high contrast makes them excellent planetary scopes.

There are some differences between the two designs. The Mak-Newt uses the Newtonian optical path, and the Mak-Cass uses the Cassegrain path. Another difference is that the Mak-Cass will be a slower focal ratio. Typically they are F/10 to F/15, while the Mak-Newt is F/5 to F/8. The Mak-Cass typically uses a secondary that produces less central obstruction

than a typical Schmidt-Cass, while the Mak-Newt is smaller yet. Less central obstruction produces higher contrast. Given the same aperture, the Mak-Newt will be a longer optical tube and therefore heavier.

My reasons for selecting the Mak-Cass are that I wanted a slower focal ratio and it would require less mount than the Mak-Newt of equal aperture. My other scopes were all F/6 or faster, so I wanted something slower. A slower scope is more forgiving of eyepiece aberrations for one reason. But more significant to me was that given the same aperture a slower focal ratio will mean a longer focal length, and a longer focal length will produce higher magnification for a given eyepiece. This means that I could use my longer focal length eyepieces more, which usually have better eye relief. Being an eye-glass wearer with astigmatism this is of great benefit. Also, my dominant (right) eye is more astigmatic than my left, darn it. So I would now be able to produce higher magnifications easier and more comfortably. My final reason for going Mak-Cass is that it was shorter, lighter, and therefore easier to balance on a German Equatorial Mount than an equal aperture Mak-Newt. For mounting I went with the Orion Sirius EQ, which has a 30 lb. capacity. I will comment a little more about the mount later.

So, off I went looking at 6 inch Maksutov-Cassegrains. Orion's, which was imported from Intes-Micro of Russia, was no longer available, and their current 6 inch Mak-Cass, which is made in Asia, was not yet available. From reading reviews and comments in ads on Astromart, it appeared to me that Intes was probably the way I wanted to go. Intes seems to have changed names a few times in their history, and at one time some of their employees split off and formed another company. My telescope sports the Intes-Alter name tag, which I think was the premium division of the original Intes or Intes-Micro company. Eventually I called ITE of Jupiter, Florida. They have imported and worked with Intes for a number of years, and I heard some positive comments from fellow club members about that company. ITE showed 2 versions of the 6 inch Mak-Cass. One was F/10 and the other was F/15. F/15 was a little slower than what I wanted. Now to start the confusion, they have a 6.5 inch. Aperture fever starts to set in. But the 6.5 was a little longer, slower, and more expensive. Besides, now that I am looking at 6.5, is it that much of a leap to 7.1? Well, cost wise it was. So, having settled myself back down a bit, I called ITE. Mike Palermiti, owner of ITE, answered the phone. I found Mike to be a very friendly and knowledgeable guy who will talk your ear off if you let him. Besides being a business owner, Mike is also an avid observer and astro-photographer, with a bit of "Lowbrow" thrown in. He is a true pleasure to work with. Well, it turned out that Mike was freshly out-of stock on the Intes M603! So, I gritted my teeth and asked about the M703. I apparently caught him in a low inventory time because he only had one of those in stock. However, I worked out a very nice deal on that scope and ordered it. Mike knew I would get over the extra cost above the 6 inch, stating that there is a very noticeable light gathering advantage with that extra 1.1 inch of aperture. When I told him what I intended to mount it on he started getting excited too, being a fan of this mount himself. He thought the combination would be first class all the way.

About a week later, the glorious brown truck pulled up to my office at Scio Township Hall. The scope was reasonably well packed and showed no shipping damage. Looking through the visual back revealed a perfectly centered secondary mirror, leading me to believe there were no large collimation issues. However there was one issue. On the bottom of the aluminum optical tube are two brackets welded to the tube, to which is attached a Losmandy style plate. My mount uses a Vixen style. Yes, for about 3.5 seconds I considered duct tape. I called Mike at ITE and he felt badly about not thinking about this himself when I ordered. So he custom drilled a Vixen style dovetail that matched two 1/4-20 holes in the bottom of the Losmandy plate, free of charge, and sent it to me with an extra counter weight for my mount that I anticipated needing. I even got a good price on the counter weight. Meanwhile, I used the 1/4-20 holes to set the scope on a heavy duty photo tripod, and prayed. But, it held well enough for me to spot some terrestrial objects and provide a hint as to how good this telescope's resolution is.

Now that I was ready to really use the scope, you can guess what happened; clouds. Eventually, after sufficient punishment by the gods, I got a clear night. I had already used my mount with my Orion 80 ED refractor, so it was now just a matter of setting the M703 on top of it, and balancing everything out. When I talked to Mike about the dovetail he made, I asked for one as long as the optical tube. This provided me with plentiful balancing range, and an area toward the front of the tube where I could mount extra equipment to the area of the dovetail where there is a gap between it and the optical tube. One time I used this to rubber band a green laser to the dovetail. When someone asked me where I was pointing (which I was hoping they would), I just flipped on the laser and it pointed right at it.

Back to balancing; it was very easy and fast. The Orion Sirius mount handled the scope and the extra stuff mounted to it with ease. It passes the "bump test" beautifully. I like this mount and highly recommend it. It is a GoTo mount with Ce-

lestron style hand controller. The controller is Internet upgradeable and can even be operated while disconnected from the mount. This could be handy for entering your own user objects during the day, for example. The included, illuminated polar alignment scope works well and is easy to use. The first night out with this mount I achieved very good polar alignment, and had the GoTo placing every object near the center of the field of view; and it only took a few minutes to get to that point. Later I added a GPS unit, which plugs into the hand controller. Now, after doing the polar alignment I only need to tell the controller if I am still in this time zone, and still on DST. Then it acquires several GPS satellites. Next is selecting either 1, 2 or 3 alignment stars, doing the alignment, and we are good to go, or "go to". This mount also tracks very well. Once I have an object centered I can return hours later and it has not moved, even at high power.

Since this article is really about the telescope, I should return to it. I expected that I would need some amount of cool down time before I could really judge the optics. This is one of the common remarks about this design, that it has a long cool down time, mostly due to the rather thick corrector lens. Having now used the scope in all seasons, I have not had an issue with cool down. Even in winter it is pretty much less than an hour. I was already used to that time range or longer with my 8 inch DOB. The scope has a small cooling fan mounted on the back plate. It is filtered, as well as the ventilation holes at the front around the corrector. However, I have only used this fan a couple of times, and it was mostly just because it is there. The interior of the tube is painted a pretty effective flat black, and it features several baffles. The secondary mirror is also well baffled. The corrector shows no blemishes and displays very good looking multi-coatings. The primary mirror is spotless. When using the telescope, two things always impress; resolution, and contrast. Both of these characteristics are so strong, that the view often makes you have to remind yourself that this is not a refractor. On many objects it will outperform my 8 inch DOB, which has an outstanding primary. Occasionally, on globular star clusters, I am amazed at how close it approaches my 12 inch DOB. At comparable magnifications the 12 inch image will certainly be brighter, but the 7.1 inch will be very close on resolving the core. On planets and double stars, this scope is a monster. My first view of Saturn almost dropped me to the ground. Everything was razor sharp and colors were outstanding. I saw a cloud band on the disk that actually displayed a light brown against yellow background. Jupiter displays a similar high resolution, high contrast, and on good nights, colorful image. A couple of years or so ago I was set up for an open house at Peach Mountain, and happened to be right next to the Eastern Michigan University 14 inch Celestron Schmidt-Cass. That night Porima (a tough double star in Virgo) was well placed so I decided to try it. At that time I believe the separation was less than an arc second, and it was not ideal weather for double star splitting. But, the Intes split Porima easier and more consistently than the 14 inch, and also beat an Obsession 18 inch DOB a few steps away! Yes, I did say that, and I have witnesses. On another night up on the hill several of us decided to go for the despicable NGC 5053. For any reader that is not familiar with this dreaded globular, it is fairly large and has a very low surface brightness. That combination makes it very hard to pick it up against the sky background, even on good nights, which this one was. We did see it in a very high quality 12.5 inch and 14.5 inch DOB just before I wheeled over to it. I saw it immediately! I was dimmer than the already dim image we saw in the DOBs, but it was there with direct vision. We were all pretty blown away by that.

In conclusion, you may have the impression that I really like my Intes M703, and that is certainly true. I have since "tricked out" the scope by replacing the original finder with a very nice Stellarvue 9x50, correct image model. I rarely use it as a finder, but instead more often use it as a small wide field telescope since it is of very good optical quality. It also has the ability to change eyepieces and it will focus with most of my 1.25 inchers. I added a Rigel finder, which I use mostly during my initial GoTo alignment. I installed a William Optics SC type rotating Crayford focuser, followed by a William Optics dielectric diagonal. The stock focuser is now used just to set the focusing range for the Crayford. The telescope uses a moving primary to achieve focus. The focus motion is very smooth and I have not experienced any image shift or mirror flop at all. I added the Crayford because I wanted fine focus (it is a 2 speed) and to be able to rotate the focuser conveniently. Now when I move to a different part of the sky, and my eyepieces ends up upside-down, it is really easy to remedy. For dew prevention I added an Astrozap heated dew shield. This dew shield is long, very dark inside, and so effective I rarely need to use the heater part. I found that by attaching two small pieces of Velcro to my Rigel, a 1.25 inch eyepiece dew strap fits perfectly over the top of it and sticks in place via the Velcro already on the dew strap. This actually seems to work, but I have not tried it under very severe dew conditions yet. Since I now had 2 dew heaters I purchased a 4 port, 2 channel variable controller which Velcro's to a very convenient location on the mount. Me like Velcro! The whole system (mount, scope, and accessories) is optically excellent, very stable, easy to set up and operate, and user friendly. This combination makes it very fun and satisfying to use, and it has yet to disappoint me. Every time I use this setup I pack up for the night with a smile on my face.



The Seventh Annual
Great Lakes Star Gaze
September 17th – 20th, 2009
“A Star Party with Dark Skies”
Held at River Valley RV Park
Gladwin, MI

GENERAL INFORMATION:

Location and dark skies are the main attractions of this star party. Gladwin's central location provides excellent observing without traveling hours into Northern Michigan. Limiting magnitudes are estimated to be around 6.5 at zenith with some minor light domes from the cities of Mt. Pleasant and Midland, some 30 miles away. This is a star party for the astronomer who loves to observe and mingle with other astronomers. Some practical and interesting talks are scheduled to enhance your weekend experience.

GETTING TO RIVER VALLEY RV PARK:

2165 South Bailey Lake Ave., Gladwin, MI 48624

From US-10

Travel 11 Mi. N. from Loomis Exit.

From US-27

Travel 6-1/2 Mi. E. from Lake George Exit.

From M-61 travel 2-1/2 Mi. S. on Bailey Lake Ave.
 (Midway between Gladwin and Harrison).

WHAT IS INCLUDED WITH REGISTRATION?

- Camping on the observing hill, **tents only!**
- Participation in presentations and observing.
- Hot coffee/chocolate in welcome tent.
- One ticket for door prize raffle per registration
- Clean hot shower/restroom facilities.

TRAVEL TRAILER FEES:

- Water & electric sites for travel trailers are available, register with River Valley RV Park for a site in addition to our registration.
- Full hook-up sites run \$25 per night **plus** our star party registration fee.
- **River Valley RV Park, Phone: (989) 386-7844** Website: www.rivervalleyrv.com

FOOD VENDOR:

“Lisa’s Lunch Wagon” Lisa and her family will again be present to provide breakfast, lunch, and dinner on the hill.

EARLY REGISTRATION:

Registrations postmarked on or before August 21, 2009 will save \$15.00 off the cost of the regular registration fee.

www.greatlakesstargaze.com

SCHEDULE OF EVENTS

PHOTO CONTEST: (any format)

1st place \$25.00, 2nd place \$15.00, and 3rd place \$10.00. One print (no collages) per entry and must be registered attendee and present to win. Winners to be determined by star party participants. Bring hard copy print to swap meet at presentation tent on observing hill by 11:00 am on Saturday.

STAR PARTY HIGHLIGHTS:

Thursday, September 17th 5:00 pm Registration begins: Registration open from 5:00 pm to 10:00 pm.

The observing hill WILL NOT be open before this time! Your cooperation and understanding are appreciated! For stargazers who would like to arrive before Thursday or stay after Sunday, camping in RV Park is available at campground rates. Contact RV Park to make reservations.

Friday, September 18th: Registration open from 12:00 pm to 10:00 pm.

6:30 – 7:00

Opening Comments

7:00 – 8:00

Tom Trusock "To Be Announced"

8:00 – ???

Observing on the hill. Welcome Tent will be open all night !

Saturday, September 19th: Registration open from 10:00 am to 6:00 pm.

8:00 – 10:00 Kids Fishing Contest: Held at the pond in the main campground. Ages 13 and under, bring your own fishing pole, hook, and bobber, worms will be provided. Prizes for the first fish caught, biggest fish caught, and the most fish caught.

10:30 – 11:00 Rocket Launches: Norbert Vance, Eastern Michigan University

11:00 – 1:00 Swap Meet: Held in the tent on observing hill. Bring your old equipment and your wallet!

12:00 – 2:00 Children's Time: Guided fun activities for children.

2:00 – 5:30 Astronomy Presentations:

- **Ardis Harold** "Amateur Microwave Adventures in Astronomy"
- **Dr. Axel Mellinger, Central Michigan University**
"Wide-field Imaging in the Digital Age"
- **Tom Trusock** "To Be Announced"

5:30 – 7:00 Dinner Break:

7:00 – 8:00 Door Prize Drawings:

- Must be present to win.
- Closing comments.

8:00 - ??? Observing on the hill:

- Welcome Tent open all night with hot drinks.

Sunday, September 20th

- Departure by 1:00 p.m. unless you would like to stay for clean up.
- If planning to stay for more nights please make arrangements with the RV Park.

University Lowbrow Astronomers Schedule of Events

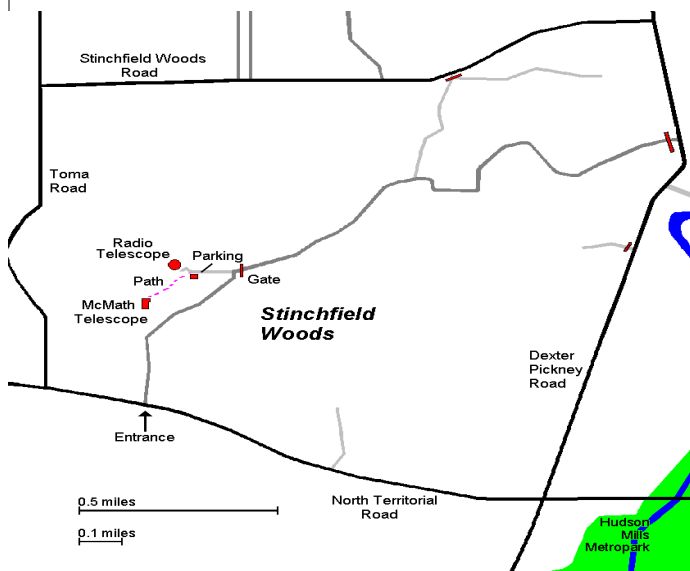
- **Saturday, August 15, 2009.** *May be cancelled if it's cloudy.* (Starting at Sunset). Open House at Peach Mountain.
- **Friday, August 21, 2009.** (7:30PM). Monthly Club Meeting.
- **Saturday, August 22, 2009.** *May be cancelled if it's cloudy.* (Starting at Sunset). Open House at Peach Mountain.
- **Friday, September 18, 2009.** (7:30PM). Monthly Club Meeting.
- **Saturday, September 19, 2009.** *Cancelled if it's cloudy.* (Starting at Sunset). Open House at Peach Mountain.
- **Friday, September 25, 2009.** (6:00 PM to Midnight). The 13th Annual "Astronomy at the Beach" at Kensington Metropark. Hosted by GLAAC (the Great Lakes Association of Astronomy Clubs).
- **Saturday, September 26, 2009.** (6:00 PM to Midnight). The 13th Annual "Astronomy at the Beach" at Kensington Metropark. Hosted by GLAAC (the Great Lakes Association of Astronomy Clubs).
- **Sunday, October 11, 2009.** Special Club Meeting with Brother Guy Consolmagno (Vatican Astronomer).
- **Friday, October 16, 2009.** (7:30PM). Monthly Club Meeting.
- **Saturday, October 17, 2009.** *May be cancelled if it's cloudy.* (Starting at Sunset). Open House at Peach Mountain.
- **Saturday, October 24, 2009.** *May be cancelled if it's cloudy.* (Starting at Sunset). Open House at Peach Mountain.
- **Saturday, November 14, 2009.** *May be cancelled if it's cloudy.* (Starting at Sunset). Open House at Peach Mountain.
- **Friday, November 20, 2009.** (7:30PM). Monthly Club Meeting.
- **Saturday, November 21, 2009.** *May be cancelled if it's cloudy.* (Starting at Sunset). Open House at Peach Mountain.
- **Saturday, December 12, 2009.** *May be cancelled if it's cloudy.* (Starting at Sunset). Open House at Peach Mountain.
- **Friday, December 18, 2009.** (7:30PM). Monthly Club Meeting.
- **Saturday, December 19, 2009.** *May be cancelled if it's cloudy.* (Starting at Sunset). Open House at Peach Mountain.



Places & Times

Dennison Hall, also known as The University of Michigan's Physics & Astronomy building, is the site of the monthly meeting of the University Lowbrow Astronomers. Dennison Hall can be found on Church Street about one block north of South University Avenue in Ann Arbor, MI. The meetings are usually held in room 130, and on the 3rd Friday of each month at 7:30 pm. During the summer months and when weather permits, a club observing session at the Peach Mountain Observatory will follow the meeting.

Peach Mountain Observatory is the home of the University of Michigan's 25 meter radio telescope as well as the University's McMath 24" telescope which is maintained and operated by the Lowbrows. The observatory is located northwest of Dexter, MI; the entrance is on North Territorial Rd. 1.1 miles west of Dexter-Pinckney Rd. A small maize & blue sign on the north side of the road marks the gate. Follow the gravel road to the top of the hill and a parking area near the radio telescopes, then walk along the path between the two fenced in areas (about 300 feet) to reach the McMath telescope building.



Public Open House / Star Parties

Public Open Houses / Star Parties are generally held on the Saturdays before and after the New Moon at the Peach Mountain observatory, but are usually cancelled if the sky is cloudy at sunset or the temperature is below 10 degrees F. For the most up to date info on the Open House / Star Party status call: (734)332-9132. Many members bring their telescope to share with the public and visitors are welcome to do the same. Peach Mountain is home to millions of hungry mosquitoes, so apply bug repellent, and it can get rather cold at night, please dress accordingly.

Membership

Membership dues in the University Lowbrow Astronomers are \$20 per year for individuals or families, \$12 per year for students and seniors (age 55+) and \$5 if you live outside of the Lower Peninsula of Michigan.

This entitles you to the access to our monthly Newsletters on-line at our website and use of the 24" McMath telescope (after some training).

A hard copy of the Newsletter can be obtained with an additional \$12 annual fee to cover printing and postage. Dues can be paid at the monthly meetings or by check made out to University Lowbrow Astronomers and mailed to:

**The University Lowbrow Astronomers
c/o Liz Calhoun
P.O. 4465
Ann Arbor, MI 48106**

Membership in the Lowbrows can also get you a discount on these magazine subscriptions:

Sky & Telescope - \$32.95 / year

Astronomy - \$34.00 / year or \$60.00 for 2 years

For more information contact the club Treasurer. Members renewing their subscriptions are reminded to provide the renewal notice along with your check to the club Treasurer. Please make your check out to: "University Lowbrow Astronomers"

Newsletter Contributions

Members and (non-members) are encouraged to write about any astronomy related topic of interest.

Call or Email the Newsletter Editor: **Mark S Deprest (734)223-0262 or msdeprest@comcast.net** to discuss length and format. Announcements, articles and images are due by the 1st day of the month as publication is the 7th.

Telephone Numbers

- | | | |
|-----------------------|------------------|----------------|
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Lowbrow's Home Page

<http://www.umich.edu/~lowbrows/>

Email at:

Lowbrow-members@umich.edu



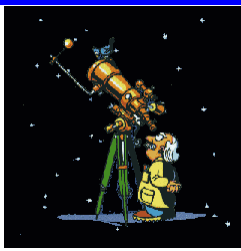
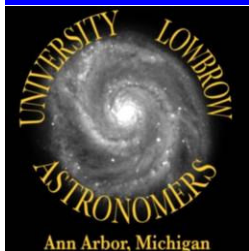


University Lowbrow Astronomers

University Lowbrow Astronomers
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Ann Arbor, MI 48106

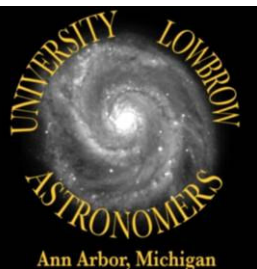
lizcal@umich.edu

Reflections & Refractions



Website

www.umich.edu/~lowbrows/



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THE UNIVERSE YOURS TO DISCOVER



INTERNATIONAL YEAR OF ASTRONOMY 2009

Check your membership expiration date on the mailing label