REFLECTIONS / REFRACTIONS

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University Lowbrow Astronomers
Ann Arbor, Michigan

May 2007
Volume 31 Issue 5

M81—By David Tucker

M81 is a beautiful rotating disk of about 250 Billion stars located near the big dipper, at an estimated distance of 12 million light years. The haze that seems to make up the galaxy is in reality billions and billions of individual stars. Some of the brighter star-like objects may be globular clusters, which are dense clumps of tens of thousands of stars, others are likely foreground stars in our own galaxy. Also note the two faint spiral arms extending out of the disk of the galaxy.

This is basically the m81 image I took last month, but I went out and got some additional frames through Red, Green and Blue filters, so I was able to build a color image, using the new "color" frames plus the original image (the original B&W image was used to supply the brightness or "luminance" data for the picture – this is referred to as LRGB imaging). This is one of the first images I have taken with my Starlight Express MX716, which is significantly less noisy then my older ATiK 2HS (specifically because of its Active Cooling system which freezes the imaging chip down to about 30 degrees Celsius below the ambient temperature – heat noise from Infrared photons emanating from warm surfaces with the camera itself were a significant problem when doing long exposures with the older camera) The image stacks taken through the red, green and blue filters (about 25 1 minute exposures each) were separately Stacked and Aligned using k3ccd, and then the separate completed Red, Green, Blue and White-Light images were finally aligned and combined using RegiStar (a very powerful program for image alignment, but also fairly expensive given that it doesn't do anything else). Final color tweaking (etc.) was done in JASC Paint Shop. It is extremely difficult to know how accurate the color really is, I just tweaked it in PaintShop until most of the stars turned white. Other software used includes AstroArt (which I use for camera control and initial image processing), and PixInsight, a ***Free*** Astro-Imaging program with some very powerful features for removing light pollution gradients (an increasing problem out here).

As usual, image was taken from my backyard near Howell, MI. Lessons learned include not allowing the dog to dig under the tripod legs while imaging.

Final Statistics:

110 * 60 seconds white light ("Luminance");

25 * 60 seconds each through R, G and B filters;

Total Sleep: about 5 hours

Televue Genesis 4" F5 Refractor with Starlight Express MX716 Camera, image is just under 1" across (main diagonal)

Important Club Info

- **Monday, May 7, 2007.** (7:00 PM, refreshments available before and after lecture). Public Lecture. (Hosted by the Michigan Center for Theoretical Physics). Gregory Laughlin (University of California, Santa Cruz). "Alien Solar Systems—Taking the Galactic Planetary Census."
- **Saturday, May 12, 2007.** *May be cancelled if it's cloudy.* (Starting at Sunset). Open House at Peach Mountain.
- **Friday, May 18, 2007.** (7:30PM). Monthly Club Meeting.
- **Saturday, May 19, 2007.** *May be cancelled if it's cloudy.* (Starting at Sunset). Open House at Peach Mountain.
- **Friday, June 15, 2007.** (7:30PM). Monthly Club Meeting.
- **Saturday, June 16, 2007.** *May be cancelled if it's cloudy.* (Starting at Sunset). Open House at Peach Mountain.
- **Saturday, June 23, 2007.** *May be cancelled if it's cloudy.* (Starting at Sunset). Open House at Peach Mountain.

Got Aberrations?

by Doug Scobel

I've been a Newtonian reflector user for going on forty years now (can it really be that long?). For much of that time I had thought that all you need is good telescope optics, good collimation, a solid mounting, good atmospheric steadiness, and that's all there is to it, right? Not so fast. I have come to realize that there's one more critical element that can make the difference between views that are just good and views that will make you and others cry out "Oh WOW!" The difference can be just as dramatic as the difference between watching television in standard and high definition.

And what is this critical element? It's the eyepiece. It's the sometimes forgotten part of the equation that can virtually make or break visual observing. In fact, Al Nagler, the design genius behind Tele Vue optics, calls the eyepiece fully half of the equation. The wrong choice can make a good telescope look bad, but the flip side is the right choice can bring out your telescope's best.

The eyepiece, sometimes called the ocular, is the element in the optical train that magnifies the image created by the objective. It has to be just as well corrected as the rest of the scope if you want to see everything that's there. But what do I mean by "corrected"? Correct what? Well, all eyepieces are prone to a number of aberrations, some due to their own design, and some due to the scope itself. What I thought I'd do here is describe these aberrations and how to identify them so that you can evaluate your own eyepieces.

So what got me started on this? It all started for me when I built my 13.1-inch f/4.5 Dobsonian reflector back in the early 1980s. Up until then I had done the bulk of my observing with my 6-inch reflector, which being relatively slow at f/8, let most any eyepiece work quite well. At that time I had a hodge-podge of old, hand-me-down Kellners, symmetricals, and orthoscopics that got the job done in that scope. When I built the 13-inch, I bought a set of three University Optics "Wide-Field" Plossls, with focal lengths of 26, 17, and 10 millimeters. They called them "Wide Field" because they boasted a fifty degree apparent field of view, which isn't very impressive now but was quite good at that time. They were the first eyepieces I bought new, and my first multi-coated ones to boot. They worked quite well, certainly better than my old ones. But after a time, new eyepieces appeared on the market, which were more suited to the fast focal ratio Dobsonians that were then exploding on the amateur astronomy scene. A couple notables were the University Optics Pretoria, the first eyepiece to correct the coma inherent in fast Newtonians, and the Tele Vue Nagler, with its jaw-dropping ultra wide eighty-two degree apparent field of view. Some years ago, at a Lowbrow open house, I remember trying a Nagler (it may have belonged to John Causland?) in my Dob, and I couldn't believe my eyes. The field of view was *huge*, and stars were sharp right to the edge of the field! By comparison, only the middle third or so of the noticeably narrower field was sharp in the Plossls. Up until then I didn't know what I was missing – but after just that one glimpse I just *had* to get me some of those. So one by one, as cash became available (it took a couple years), I replaced the old Plossls with a 28mm Pretoria, and 13mm, 7mm, and 4.8mm Naglers. They served me well after that, and while I no longer own the Naglers (as they now belong to various Lowbrows), I still use the Pretoria.

It's the same telescope, so why the big difference in the quality of the view? The reason is the telescope's focal ratio. Almost all eyepieces will be sharp and color-free on-axis, that is, in the middle of the field of view, regardless of the focal ratio. With a slow focal ratio of let's say f/8, the light cone from the objective has a gentle taper, and relatively simple three and four element eyepiece designs will work quite well, even up to the edges of the field. But fast focal ratios, especially f/5 and faster, are another story. Here the light cone converges at a steep angle, and most simple and even some more complex eyepiece designs simply cannot handle it cleanly. Most of the time there are a number of aberrations happening all at once, and while a particular eyepiece design may correct some aberrations well, it falls down with others. It is rare indeed that an eyepiece does a good job on all of them at once, especially in scopes with fast focal ratios. Those that do usually come with a correspondingly high price tag.

In the following discussion, most of my descriptions are admittedly biased towards Newtonian reflectors. The simple reason for that is because that's all I own! But my descriptions of aberrations attributable to the eyepiece are valid regardless of the type of telescope being used. Also, before you try checking for these aberrations in your own scope, make sure it is collimated well, and in otherwise good working order.

One more caveat. It is seldom that you have a single eyepiece aberration present and no others. So while the illustrations below show each aberration in isolation, it is seldom that way when actually looking through a real eyepiece. There can be several aberrations present at once, and while one or more may dominate, it can make it difficult to determine exactly what you're looking at.

Okay, enough of the fine print. Let's cut to the chase and see what these aberrations are, and how to look for them.

Coma

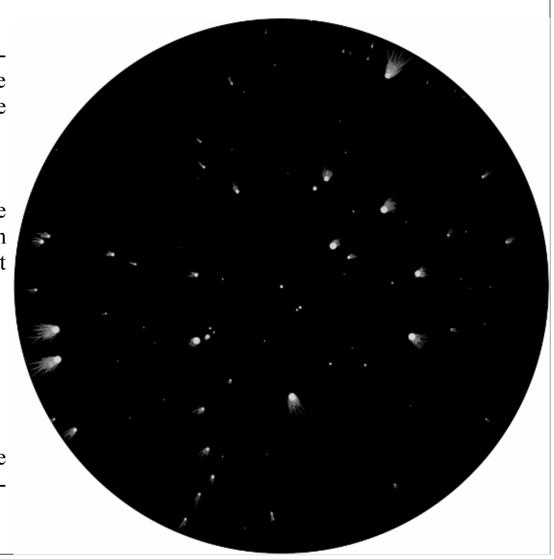
What it is

Coma is rarely due to the eyepiece. Coma is an aberration primarily of the Newtonian's paraboloidal primary mirror, which cannot bring off-axis light rays to a single point. I mention it here because it will usually be visible to one degree or another in a Newtonian, particularly if you are using one with a fast focal ratio. It can sometimes be mistaken for a problem with the eyepiece.

What to look for

Coma causes stars away from the center of the field of view to look like little comets, hence the name. The farther the star is away from the center, the worse the effect, as also is the case with most all other eyepiece aberrations. And the faster the scope, the more pronounced it will be. It may not be noticeable at all at f/8, but will usually be obvious at f/5 or faster.

Fig. 1 - Coma in a Newtonain reflector



Astigmatism

What it is

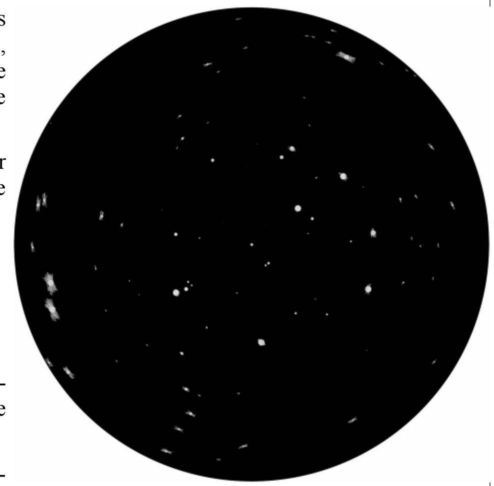
This can be a problem with the telescope or with the eyepiece, or even your own eye. It can be induced by poorly figured optics, pinched and/or poorly supported optics, or even poor collimation. In the eyepiece, it is induced by off-axis light rays.

What to look for

Astigmatism can be difficult to nail down, because it looks different in every eyepiece. It can cause stars close to the edge of the field to appear as crosses, lines, squares, or any number of other odd shapes, such as a the outline of a cartoon sea gull. It can even masquerade as coma. It will be always worse the farther away the star is from the center. It is usually more noticeable in less expensive and/or wide-angle eyepieces, and in scopes with faster focal ratios.

If the aberration is distributed radially about the center of the field of view, and gets worse the farther away from center you look, then it is in the eyepiece. If it is aligned in the same direction throughout the field of view, then it is in the telescope, or it may even be in your own eye.

Fig. 2 - Astigmatism



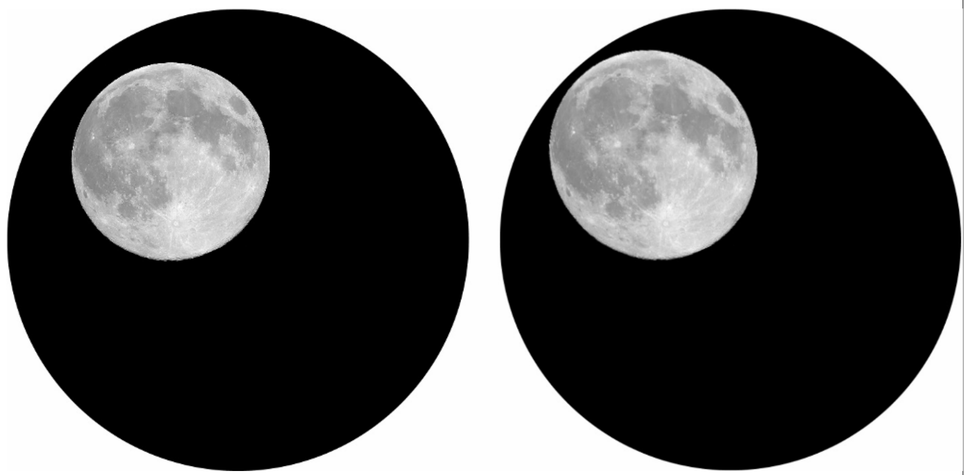
Distortion

What it is

Distortion is an unequal magnification across the entire field. It is sometimes called pincushion. Usually, the outer regions of the field of view have a higher magnification than at the center. As a result, the outer portions of the field appear to stretch out towards the edge.

An eyepiece that is absent of distortion is said to be orthoscopic. Don't confuse this with the Abbe Orthoscopic eyepiece design, which has a plano-convex eye lens, and a triplet field lens. There are other eyepiece designs that are also orthoscopic.

Fig. 3 – Distortion: (left) no distortion i.e., orthoscopic; (right) distortion present



What to look for

The easiest way to look for distortion is during the day. Focus on a distant, straight line, such as the edge of a building or a telephone pole. Move the object towards the edge of the field. If there is distortion present, then the line will appear to bend, getting worse the closer you get to the edge. To test for it at night, look at a round object, like a planet at high power, or the moon at low power. Move the body towards the edge of the field. If it elongates, and becomes oblong, then there is distortion present. If the distortion is severe, you may even notice it while panning through rich star fields.

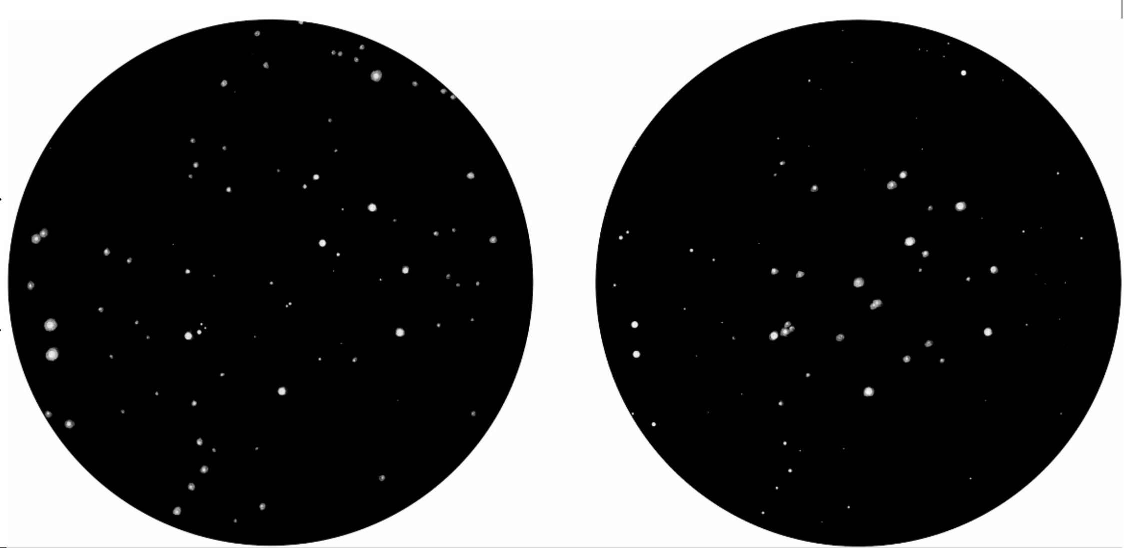
Field curvature

What it is

This is the inability of the image in the eyepiece to be in focus at the center and edges of the field simultaneously. Rarely this is strictly in the eyepiece. Most all telescopes, in particular those with fast focal ratios, have focal "planes" that are actually curved. So the field curvature you see in the eyepiece is the net effect of the combination of telescope and eyepiece.

What to look for

Fig. 4 – Field curvature: (left) center in focus; (right) edge in focus



Look at a rich star field, and bring the center of the field to best focus. Now look at the edge of the field. If the stars there are not focused well, then try adjusting the focus. If you can get a better focus at the edge, and now the center of the field is out of focus, then there is field curvature present. Note that if there is significant astigmatism then it may make it difficult to determine best focus near the edge of the field. Mild field curvature is sometimes not noticed by younger folks because their own eyes' accommodation can automatically adjust for it, while older folks may have more trouble with it.

Lateral Color

What it is

Most all modern eyepieces are very well corrected for color at the center of the field. But off axis (towards the edge of the field) some color fringing may be seen.

What to look for

Look at a bright star or planet that is well up in the sky, say at least forty-five degrees up. If the object is too low then atmospheric dispersion can cause color fringing that could interfere with the test. Look for blue/violet and/or yellow/orange fringing on either side of the object, getting worse as you get away from the center of the field. Usually the brighter the object the more noticeable it will be. Sometimes an eyepiece that exhibits lateral color in daytime viewing shows little or none under the stars.

Also beware of the scope you are using. Reflectors are all achromatic, but not all refractors are. Except for so-called apochromatic refractors, there will typically be at least some amount of residual color, regardless of the eyepiece being used. Generally this will be more or less constant across the entire field of view, which may make it easier to distinguish from lateral color in the eyepiece, which will be more apparent around the edges of the field. Of course, if you use a high-end apochromatic refractor, then you can probably safely conclude that any color seen is caused by the eyepiece.

Fig. 5 – Lateral color

Other Eyepiece Considerations

Other aberrations, such as spherical aberration, which causes poor focus at the center of the field, and chromatic aberration, which causes color fringing at the center of the field, are all but absent in modern, multi-element eyepieces. But there are also other things that while technically are not aberrations, can still adversely affect the view through the eyepiece.

Color

This is the overall color cast when looking through the eyepiece. It can be caused by the type of glass used, and the type and quality of lens coatings. Generally the differences between eyepieces are subtle, but can be noticeable when doing side-by-side comparisons.

Contrast

This is the contrast between the bright and dark areas of the field. It is affected by the clarity, number, and thickness of the glass elements in the eyepiece, and the quality of the lens coatings. It affects the darkness of the sky background, and the faintest objects you can see in the eyepiece. When comparing two eyepieces for contrast, be sure to use the same telescope and the same magnification. The lower the magnification the brighter the sky background will be, and this may be mistaken for lower contrast when compared against an eyepiece operating at a higher magnification.

Internal Reflections

These are caused by lower quality lens coatings, whereby light reflecting off the lens and internal surfaces becomes visible. Sometimes there can be reflections off the ground edges of the lenses, or even from poorly blackened internal surfaces of the eyepiece barrel. Fully multi-coated eyepieces, where every air-to-glass surface is multi-coated, will minimize such reflections, as will those with blackened lens edges, and good internal baffling and blackening.

Eye Relief

This is the distance between the eye lens and where you need to place the pupil of your eye for optimal viewing. In low-power, long focal length eyepieces, eye relief is usually ample. But at short eyepiece focal lengths, eye relief can be very short, forcing the observer to put their eye almost right on the glass. And if you have to wear eyeglasses, too little eye relief may make an eyepiece unusable. Some newer eyepiece designs are now available that have a constant, long eye relief, even at very short focal lengths.

Apparent Field of View

This is the angular diameter of the field of view as it appears to your eye. Older eyepiece designs, like older Abbe Orthoscopics, might have an angular field of view of maybe forty or forty-five degrees, while newer, complex eyepiece designs might sport eighty degrees, or even more. The thing to keep in mind is that the wider the apparent field of view, the more difficult it is for the eyepiece designer to keep all the aberrations within acceptable limits across the entire field.

Kidney Bean

Many modern eyepiece designs, while being very well corrected optically, require very accurate positioning of your eye on the exit pupil. If your eye is not exactly centered, and at the right distance from the eye lens, then portions of the field may "black out". Often this blacked out portion of the field is shaped like a kidney bean, hence the name. Such eyepieces are often designed with a positional eyecup, making it easier to hold your eye in the correct position.

The Good News – and the Bad

Unfortunately, on this side of heaven there is no such thing as perfection. Everything is a compromise. Eyepieces are no exception. The designer must balance correction of one aberration against correction of another. And then trying to make it work with a wide field of view, and work with fast focal ratios, and with adequate eye relief, and make it affordable, well, you can see that it can't be easy. The good news is that there are some eyepieces out there that do a very good job of correcting most everything at once. The bad news is that they almost invariably come with hefty price tags. But the alternative is to pay less and put up with more. Sorry, no free lunch. Like I said, everything is a compromise.

So now I'm at it again, another round of revamping my eyepiece collection. Now that I have two f/4.5 reflectors, I've been doing some reevaluating of what I own, and evaluating some I don't own, at least not yet. I'll let you know the end result – but that will have to wait for another time.

Messier Marathon 2007

Bob Gruszczynski

Photos by John Kirchhoff

After several years of frustratingly fickle Michigan weather, this year was looking like it would yield at least a partial Messier Marathon. After one year of finding approximately 66 objects in a three-night stretch playing hide-and-seek with the clouds, and several years just plain clouded out, I really had the bug to get out and try it. A weather watch by several members concluded that the weather would be good enough for at least a partial try, with perhaps a partly cloudy start.

I wrestled with the desire to be successful and taking the 8" Infinity with its Sky Commander object locator, and the challenge of going it raw with more aperture and the 12.5" PortaBall. The group was also split between Peach Mountain and Lake Hudson. I finally loaded up the 'Ball and headed for Lake Hudson, thinking that the lower horizons and larger aperture would give me more chance for success.

The word was that the activity would be at the beach at Lake Hudson, to provide the lowest horizons available. When I arrived, the clouds were still firmly in place, and the wind was pretty strong. There was a gentleman named Don from the Jackson Club who had already set up a fairly large Celestron SCT. He had also strung some painters' tarps between several parking signs to act as a windbreak. This would end up making the night much more bearable. The temperature dropped below 30 degrees and the wind never died down below 10 or so mph, making for some pretty cold wind chills.

As people started trickling in and setting up, the clouds began to dissipate. Doug Scobel showed up with the big dob, looking to do some more serious Herschel hunting, rather than Marathoning. He also brought out Nate Murphy's 10" PortaBall, and Nate came out a short time later to set up and have a go. Doug Nelle showed up to make the "good Doug – evil Doug" team complete. More Jackson Club members came out, and near dark, John Kirchhoff arrived with his newest RV. John had all of the amenities to really make the night comfortable. He brought plenty of coffee and even prepared hot dogs later for energy in the middle of the night. A Huge Thanks John!!!

I used a plethora of resources to try to make as many objects as possible. With all of the tools, I thought that I would have a reasonable chance of viewing all 110 objects. Here is a list of all of the resources that I utilized in my quest:

- The messier list from www.messiermarathon.com (this is an awesome resource!)
- March 2007 Astronomy Magazine pullout
- Brent Watson's "Finder Charts of the Messier Objects"
- Mark Deprest's suggested tour of the Virgo Cluster

The clouds parted just at sunset allowing for great viewing of the first items – M77 and M74. They turned out to be more visible than I had expected. I was sure glad that I settled on the PortaBall. Some of the Jackson guys came over to verify the starfields to make sure that they were looking in the right place. I know that I can't remember the last time that I viewed these objects myself. The temperature stayed fairly constant and it got pretty quiet as we all went to work. Doug Scobel also borrowed my 35 mm Panoptic as part of his low-power eyepiece experiment. We did some quick testing with Saturn and some easy items. Nate was sharing some of his views with some folks who did not bring telescopes.

Using the lists from the above-mentioned website, I went straight after the "Early Evening Group" and the "Big Dipper and Leo Area". This was a fairly easy ride with the 'Ball and pretty much went through viewing and logging. I came at this time to understand the true nature of the "marathon". I took just enough time to view, verify, and log each item. No time to enjoy the view, just to catalog. I wonder what Charles Messier was thinking about as he was logging these items. During the Big Dipper Group, I logged NGC 5866, The Spindle Galaxy in Draco as M102. Both Astronomy Magazine and the web list recommended this.

At this time, I took a coffee break in John's RV, and chatted with a few of the other folks who had also made it that far and were "caffeining up". This is exactly what I thought a Messier Marathon would be like. Good views, good talks, and good coffee. I walked around and found out how far others had gotten. John was cruising along with his search and would soon be taking a break. During his break, he put in some hot dogs that would be ready for the next break. It was time to start on the Virgo Cluster.

Obviously this is one of the most difficult portions of the search. I used all of the tools available. I used the Watson Chart, page 3 of Volume 2, which shows a close-up of the Virgo Cluster. Then I supplemented that with Mark's suggested tour of the area. Ultimately, I used the photos in the Astronomy Magazine pullout to verify the galaxies that I was unsure of. The stars shown in the photos around the galaxies in question helped me to make sure that I had the correct galaxy. This made everything go very smoothly, and I was finished in less than 2 hours. This allowed me to also knock off the "After Midnight Group" in short order. Many of the observers started leaving during this period of time. Nathan finally packed up around this time, and we helped the gentleman from the Jackson Club take down his tarps. I was then able to take an extended break in John's RV.

The hot dogs that John cooked while he was taking his earlier break were a perfect snack. The coffee was hot and the RV was warm. I napped for an hour and was totally revitalized. I went out to see who was left. It was pretty much down to three of us. John was still struggling through the Virgo Cluster, so I gave him some moral support and went back to the 'Ball. The other person left was Ken Anderson, also from Jackson. He had some questions and we did some co-verification. By now, it was around 5AM and time for the stretch run. "The Scorpius and Sagittarius Regions" were also difficult. Everything was pretty far south and this was the worst direction for horizon viewing. There were trees along with a small light dome from Morenci and Toledo. As I rolled down to the lower end of Sagittarius It was a battle with the trees, and then, the Sun. When I finally gave up, I was at a count of 104 items. I missed out on M55, M75, M2, M72, M73, and M30. John had also missed M74 and was at 103 objects.

As we packed up to leave, the three of us took a moment to reflect on the nights' activities. We had survived the weather and the fatigue to claim a fair victory in the world of the Messier Marathon. Admittedly, we did not see all 110 objects, but certainly not for lack of trying. We were diligent in our observation and verification of the objects that we did observe, and we did it on our own. We left with a great sense of satisfaction. It was 7:45 AM on Sunday morning, and I was headed off into the sunrise. I was very content with the whole experience, it was better that I had imagined. The weather cooperated for the whole night, a sky full of wonders to behold, and some really great observing partners. It was, however, not all fun and games. I did not take much time on any given object. I never trained my telescope on Jupiter, which was riding high in the sky at the end. The only exception was M104, which was spectacular. I enjoyed sharing it with several of the folks who were around at the time. I'm ready to try it again.

A Mini-Analemma

By Mark S Deprest

Have you ever wanted to create an Analemma? You know that cool looking 'figure-8' pattern that the Sun makes as its apparent position in the sky at a particular time of day shifts day by day over a period of a full year. You've probably seen those beautiful photos of the sun's 'figure-8' path over ancient Greek Temples that have been featured in various astronomy publications.

I know you don't have the sophisticated equipment or the financial reserves that it would take to fly to Greece every 10 or 14 days snap a picture in the same spot at the same time of day to create your own masterpiece. However, that doesn't mean you can never have an Analemma of you own creation. At least on a smaller more personal scale, and here's how:

Create a Mini-Analemma on "Foam Core Board" and it will be just as amazing and just as accurate as those very cool pictures. The best part about this project is that you don't need all sorts of fancy, expensive equipment to create it. You need a 20"x 30" piece of Foam-Core board, a ruler or 12" long dowel (about ½" diameter), a level, a compass, a 3"x 5" index card, a squaring tool, a marker, some tape, clear sky at noon every 10 to 14 days and patience for 1 full year.

1. Make ¼" hole in the center of the 3"x 5" index card.
2. Attach the index card to one end of the ruler or dowel, so that most of the card extends beyond (above) the ruler or dowel.
3. Attach the other end of the ruler or dowel to the middle of the 20" edge of the Foam-Care board, so that laying the Foam-Core board flat on a table will have the ruler or dowel standing straight up at a right angle to the plane of the board. Use the squaring tool to make sure. (You may want to support the ruler with a "right triangle" of Foam-Core board attached to both the ruler and Foam-Core base)
4. Mark a "north – south" line in one corner of your Foam-Core base that runs about 5" long and is parallel to the 30" edge and about 2" from edge of the Foam-Core base. Mark south at the ruler end of the line.
5. At noon on the first sunny day, take your Mini-Analemma board, your level and your compass outside. Find a clear spot that will always be clear for a full year and place your Mini-Analemma so that it is level and north – south aligned. You should have a shadow of the ruler and index card cast on your board with a small bright circle in the center of the shadow. Mark that spot and note the time and date next to it. Repeat this process at the same time of day every 10 to 14 days. In one full year you will have your Analemma.
6. Caveats: Make sure you are in the exact same place each time you set up and the same time of day is equally important. (Don't forget to compensate for Daylight Savings Time). Also, check your alignment and levelness each time.

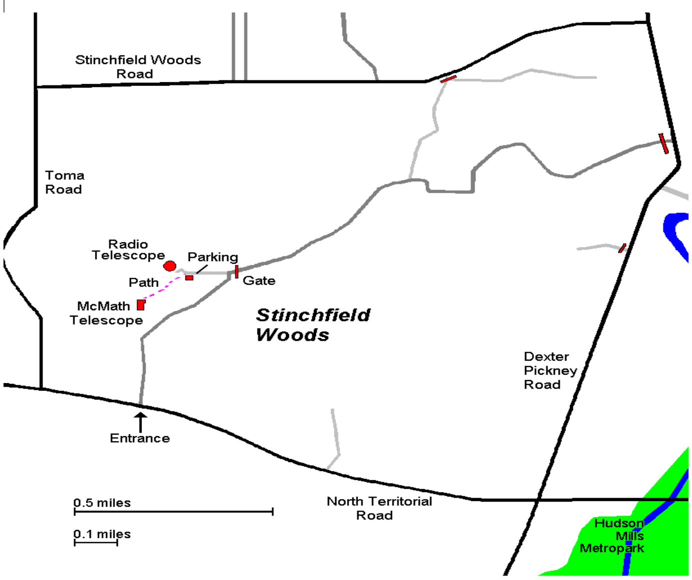
Good Luck and Clear Skies … let me know how yours comes out.

(You might want to note your location on the board i.e. longitude and latitude)

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 Astronomer c/o Yasuharu Inugi

1515 Natalie Lane #205
Ann Arbor, MI 48105

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.

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Reflections & Refractions

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Comet Lovejoy—C/2007 E2

By Clayton Kessler

The image data is: 3X300 seconds exposure @ISO 400
William Optics ZenithStar 66SD refractor with field flattener
Modified Canon 10D DSLR / G11 mount - ST4 autoguider

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