REFLECTIONS / REFRACTIONS

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University Lowbrow Astronomers

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NGC4565 by David Tucker

A few months back I snapped a monochrome image of the Edge-On spiral galaxy NGC 4656 ("Snapped", in this case, meaning taking 120 1-minute exposures, stacking and aligning them, then spending a couple hours using paintshop to try to bring out the faint spiral arms while removing the not-so-faint light dome from the City of Brighton. If any of you happen to live in Brighton, please consider using more efficient outdoor lighting fixtures).

At any rate, last Friday night I "Colorized" the image by taking about 15 1 minute exposures (each) through Red, Green and Blue filters, then again "Aligning and Stacking" the data with K3CCD, then finally using Paintshop to merge my new (low-resolution) color image with the original higher-res Black and White image. The resulting color could best be described as pure guesswork. Initially all of the fainter details of the image came out red, reflecting the relatively higher sensitivity of my CCD camera to red light. I then adjusted the color so that the stars where basically white, then adjusted it some more when that resulted in a blue galaxy (which seems pretty unlikely).

I only got color data for the area right around the galaxy (this is basically the color frames did not overlap very well with the B&W, but fortunately the galaxy itself was in all the images). I took the original B&W image at the full resolution of the camera (750 by 580). I took the color frames at half this resolution using a process called 2X2 binning, in which 2 by 2 groups of adjacent pixels are treated as individual pixels. This reduces the effective resolution to about 375x290, but each of the resulting "virtual" pixels is four times larger then a standard pixel, and hence catches 4 times as much light (just like telescope aperture, right?). This process of building a separate high-resolution monochrome image and a lower resolution color image and then merging them is called "LRGB" imaging, and is standard practice in photographing Deep-Space objects because images taken through color filters will generally be even fainter and fuzzier then monochrome images of these objects. So the idea is to get the color from the RGB image, but the detail from the monochrome.

I regret missing Brian Ottum's talk on "Lazy Astrophotography" last month (family commitments). If there's an easier way to do this, I'd sure like to know what it is – in the meantime, better get the coffee started, looks like it's gonna be a clear night…..

PS: Does this mean I now have your permission, if not cash, to buy a 31mm Nagler?

(Yes David, go and buy that Nagler, you have my permission! Editor)

Equipment Review: William Optics Megrez 90 APO Telescope

By Clayton Kessler

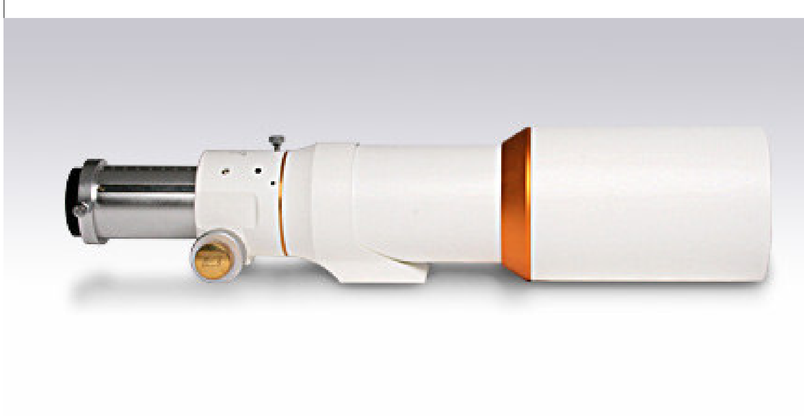
Well, it's official – APO refractors are like Crack – you can't get enough! I liked the William Optics ZenithStar 66SD refractor so much I started saving my pennies for a larger APO scope for astrophotography. There are lots of choices out there and I looked around for a while (do you have any idea just how **MANY** pennies are needed to buy an APO refractor?).

I quickly realized that I needed to sit down and determine what characteristics I was looking for in a new refractor. A serious look at my proposed use was in order to make sure I spend my hard saved pennies wisely. Those that know me will realize that my major use of the scope will be for astrophotography with a very secondary use for visual observing. Really, the little 66 will probably see more visual observing. It is so small it is easy to throw on a photo tripod and take on a short trip. On the other hand – good visual color correction and sharp high contrast views are what APO scopes are all about. The scope should have some serious aperture – larger than 80mm at least. It should be small enough to cluster on my mount with other telescopes (Hmmm…. A hint at future projects…..). Focal ratio should be between f5 and f7 to keep exposures on extended objects reasonably short and still maintain good color correction. Focal length….. hmmmm… The focal length of the 66 is about 320mm with the Field Flattener in use. A reasonable focal length would be about double that to properly frame objects that are just too small for the 66's field of view.

So far I determined that I wanted a scope that was at least 90mm in aperture, and no more than about f7 in focal ratio. This still left a bunch of choices out there. Several of the StellarView telescopes are in this range and they have an extremely good reputation. There are also the AstroTech scopes – some new ones coming up are very interesting. TeleVue has a number of contenders – the TV85 and NP101 both fit my criteria. TMB Signature Series has a 92mm that looks interesting – but it is not available yet. William Optics had a 90mm Megrez model and a new 110 Megrez model that were both intriguing.

Getting down to choices – the TeleVue models are very well made and very well corrected. They are also very expensive in comparison to the others that I was looking at. Stellarview has a great reputation but I have never seen one in the flesh so to speak. AstroTech also enjoys a good reputation but the 90mm scope is just out (I don't know if there have been any delivered yet) and the 100mm is "coming". AstroTech and Stellarview do not have local dealers so I could not actually see one of these anywhere around here. William Optics….. I already own one WO scope, the 66mm SD, and I am impressed with the build and optical quality as well as the "value" (bang for buck). I saw two of the 90mm Megrez scopes at the FAAC swap meet in the winter so they have been around for a while. Riders Hobbies in Livonia is a William Optics dealer so I can have a local connection for the scope – an important consideration IMHO.

Between the two WO scopes – which one should I buy? The introductory price for the Megrez 110 puts the cost only about 200.00 higher than the Megrez 90. That seems to be a bargain for an additional 20mm of aperture. I suspect that I would be happy with either one and "The Enabler" at Riders was tempting me with both models. The Megrez 90 is an f6.9 APO doublet using an FLP53 glass element. The Megrez 110 is an f5.9 APO doublet using an FLP51 glass element. The slightly longer focal length and the FLP53 glass would seem to give the 90 a slight edge in color correction for visual use. A call to William Optics (by the enabler) confirmed that the 110 was really intended for astrophotography use as opposed to visual use.



So now you are thinking – Clay does astrophotography – of course he bought the 110! Well ….. I bought the 90. My thinking was that either scope will work for astrophotography but for those times that I will be looking through it I want the best color correction that I can get. The 90 has been around for a couple of years without any systemic problems that I could find on the internet – and I did find some excellent reviews of the scope.

About the scope:

(info and picture from manufacturers web site)

Aperture	90mm
Focal Ratio	F/6.9
Focal Length	621mm
Objective Type	Doublet FPL-53 Air Spaced
Resolving Power	1.35"
Limiting Magnitude	11.5
Lens Shade	Retractable
Focuser	360° Rotating Camera-angle Adjuster
	1:10 Dual Speed Fine Focus
1.25" Adapter	Included
1.25" Adapter	Brass Compression Rings
Tube Diameter	90mm
Tube Length	430mm (Fully Retracted)
Tube Weight	7.1lbs. (3.2kg)
Case	High Quality Aluminum Case
Case Dimensions	(WxHxD)
	23.2" x 8.3" x 7.1"
	(59cm x 21cm x 18cm)
Case Weight	3.8kg

It is a very nice looking telescope with a white pebble finish powder coat paint and gold colored accent rings. The end cap is also gold and sports the WO swan logo prominently on the front. The supplied rings are a nice black finish and are made very nicely. The crayford focuser is a typical William Optics masterpiece being butter smooth and the rotate is very nice for photo composition. The scope features a "foot" mount like some of the smaller WO models including the 66mm. In my opinion this scope is too heavy for practical use of the foot mount. I personally would eliminate it. It would have been more convenient for mounting if the bottom of the foot was at the same level as the bottom of the rings. This is a minor quibble and I will take care of this in the adapters that I use when I build a permanent mounting to my G11. Until then, the 90 mounts well on my G11 with the little 66 riding on top.

Optically this scope performs! To say that it "snaps" into focus would be an understatement. The dual speed focuser is overkill on this scope – there is no question where the focus point is located. The first time I used it I was looking at Saturn. I stepped up through my eyepieces until I was looking through my 4.8mm Nagler at a totally sharp and high contrast Saturn surrounded by a seeming cloud of faint moons. I actually had to go and dig out my seldom used 3mm Radian just to see how the scope handled it. No problem! 206X was a breeze and Saturn looked great!

How does it work as an astrograph?

I started out using the WO66 as a guide scope and immediately noticed some flexure (the astrophotographer's evil foe!) in the mounting. I worked on this for a couple of nights and then I said to myself "Hey – I bet my Taurus Tracker will fit on the 90!" Defeating flexure is the reason that I bought the Taurus Tracker. Problem solved! Springtime is the "time of the galaxies" not the best of targets for a 620mm focal length scope and a DSLR. I did, however, manage to get a shot that I have wanted to take for a while. Markarian's Chain in Virgo.

Not to worry – the Milky Way is rising earlier every day. I really like the Milky Way, there are so many targets suited to the focal length of this telescope. I have managed to take some shots over the last few weeks.

One of my favorite targets – the Lagoon Nebula. The Megrez shows excellent color correction around the bright stars. Globular cluster NGC6544 looks good and NGC6559 shows both red and blue nebulosity. You can even see a very small planetary nebula PLN 6-2.1. I am sure the processing could be better but this is my best shot of this object to date.

The next two shots are segments of the veil nebula. I have attempted to shoot these at various times with my achromatic refractor but with no where near this success.

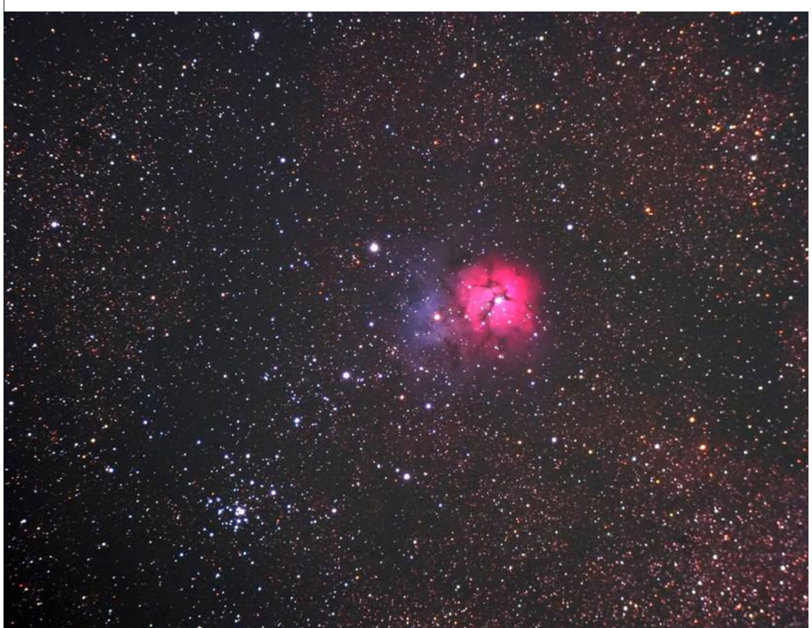
NGC 6960:

And NGC 6992:

Both are very faint objects with a large H-alpha and O III component. They are also surrounded by a large number of stars. The 90mm APO gave me great color correction so I avoided the dreaded blue halos and it also allowed me to reproduce the various star colors quite nicely. My latest shots include M13:

This is a highly cropped portion of the total frame. The size of M13 in a 600mm focal length instrument is very small. The Megrez 90/10D combination is sharp enough to allow for quite a bit of enlargement.

And M20:



I really like the star colors that I am getting with this telescope. Much better than blue halos!

Like most doublets it really should have a field flattener to give it's best results. William Optics says that one is in the works and will be released later this year. Until then I will crop my frames to remove the majority of the field curvature. Even with the field curvature this is the nicest astrograph that I have ever had.

A small quibble:

Beyond the foot mount height I found that the focuser did not seem to lock down very tightly. In looking at the arrangement the lock screw is bearing on a plastic ball that acts as a brake on the focus drawtube. A call to William Optics got me instructions on adjusting the focus tension. The tension is set pretty loose as the scope comes from the factory. It is good for visual use but much too light for imaging. Once I adjusted the focus tension it was much easier to lock the focus down securely. This also "tightens up" the focus action – not a bad thing for me but a purely visual astronomer might want to leave the focus tension looser. The nice thing is that the adjustment is there! I only wish the manual covered the adjustment better (or at all!).

Conclusion:

My $1200.00 was very well spent! I am quite happy with this refractor and I am looking forward to using it to shoot many of the summer Milky Way objects in the coming months. It was great to be able to get this locally – having local dealer support is a good feeling when you are plunking down cash for a purchase like this. John at Riders was a peach to deal with as always. I should mention that John currently has one of these in stock if you should want to take a look at one. All I can say is "Come On New Moon Weekends" !!!!!

The Allen Telescope Array - A Wide Angle Panchromatic Camera for SETI And Radio Astronomy

By Dave Snyder

Last November I went to a talk on the Allen Telescope Array (ATA). I had written the first draft of an article some time ago, but I hadn't managed to finish it until now. The ATA is a radio telescope currently under construction in Northern California. Before I discuss the ATA, I want to talk about radio telescopes in general. The first radio telescope was built in the early 1930's. Over time, more radio telescopes were built. The early telescopes all had a single antenna and produced blurry images. Astronomers wanted sharper images. They realized building bigger antennas would improve the resolution but this was expensive. In the early 1950's, Martin Ryle and Antony Hewish took four antennas and combined the output with electronics to produce one signal. This became known as an "array." Arrays were a cost effective way to increase resolution (Ryle and Hewish won the 1974 Nobel Prize in Physics "for their pioneering research in radio astrophysics: Ryle for his observations and inventions, in particular of the aperture synthesis technique, and Hewish for his decisive role in the discovery of pulsars.")

Other arrays have been constructed, the most well known is the VLA, located in New Mexico (shown in the photograph left). It is an array of 27 antennas arranged in a "Y" shape. Suppose we want to build a new array, how do we decide the number of antennas to use? Typically the array will be built so it can produce images with a specific resolution or better (call this resolution R). This resolution is picked to support specific research goals. Now suppose our array has N antennas (N is an unknown, we don't know its value yet). Given N, we can calculate the diameter of each antenna (call this D) that would result in the given R. We pick N to minimize the total cost of the project. The cost is the sum of two items. The cost of the antennas is proportional to the volume of material. That is a function of both N and D, but as N increases the cost goes down (that's because D decreases faster than N increases). The cost of the electronics. That's a function of N. As N goes up the cost of the electronics goes up. To reduce the overall cost, you have to balance these two items. This means there is an optimal value of N for a specified resolution. N should not be too big nor too small. When the VLA was designed in the early 1970's, the decision was made to built the array with N=27 and D=25 meters, which were reasonable choices at the time. Since the 70's, electronics have steadily become less and less expensive. So the optimal solution today would involve an array with more than 27 antennas, each of which is smaller than 25 meters.

So let's return to the Allen Telescope Array. It is currently under construction in Northern California and operated by the University of California Berkley. When completed, it will consist of 350 antennas each of which is 6.1 meters in diameter. At the end of 2006, 42 antennas were operational. Over time additional antennas will be added until all 350 have been completed. Each antenna is relatively inexpensive and approximately 3 antennas can be constructed each week. (The photograph above shows one of these antennas with a person for scale).

Unlike the VLA, which has 27 antennas arranged in a "Y" shape, the ALA antennas are arranged in a seemingly random manner. However it only looks random, they are carefully arranged so that there is a well defined region of the sky where the telescope is sensitive. The telescope is able to reject signals outside this region much better than traditional telescopes. And as a side effect, it is possible to add antennas one at a time. Even with 42 antennas, the array can be used for research and as more antennas are added, the resolution gradually increases.

One expense in traditional radio telescopes are refrigerators. Refrigerators are used to keep the electronics cool which reduces noise. The ATA uses sterling-cycle refrigerators which were obtained at low cost. Each antenna produces an RF (radio frequency) signal which is converted to a digital signal that in turn is processed by digital IF processors. The signals from the various antennas are combined by a phase array back end. This arrangement provides a great deal of flexibility. It is possible to have four different experiments operational simultaneously. And the ATA electronics can do some simple calculations itself that support different types of experiments. For example, it is possible to configure what is known as a selective null. This is used to remove sources such as GPS satellites that otherwise might add unwanted noise to the signal. This and other operations can be configured in a flexible way in real time (unlike more traditional radio telescopes, where these kinds of operations require time consuming post processing).

The arrangement also allows different parts of the sky to be examined simultaneously. The ATA can be used to take "snapshots" (traditional radio telescopes need to point at a target for long periods to form an image, the ATA can do the same thing much faster). It is possible to use the ATA to do some simple analysis directly without producing an image (though more complex analysis will require post processing). And the ATA is able to process a wide range of frequencies simultaneously. Some of the applications of the ATA include:

Galaxy surveys (a single image from the ATA covers 2.5 degrees of the sky and consists of 18000 pixels and 1024 "colors." Since the human eye can't see radio waves, these are not real colors, but represent different frequencies of radio waves).

Study of masers (both methanol and hydroxyl).

Study of star forming regions.

Study of dark galaxies. These are recently discovered objects that may led to new insights into galaxy formation. The study of dark galaxies with existing telescopes requires several days at best, similar studies with the ATA will require only 5 minutes.

Search for large organic molecules in space.

FiGSS: This is a survey of the sky at 5 GHz that will complement existing surveys and should add to our knowledge of galaxies and other radio sources.

Study of millisecond pulsars.

Detection of gravitational waves.

The search for extra-solar planets.

Study of "Weird Stars." These are poorly understood stars with unusual spectra.

This was the first part of the talk. Before I go on to the second part, I should tell you about the presenter. The talk was given by Dr. Jill Tarter, the Director of the Center for SETI Research at the SETI Institute located in Mountain View, California. However Dr. Tarter is best known because of the motion picture "Contact." In the movie, Jodie Foster plays an astronomer searching for extra-terrestrial radio transmissions. Jodie Foster's character was based on Dr. Tarter. Dr Tarter spent the rest of the talk discussing SETI. SETI is a program to look for evidence of intelligent life and developed from ideas that are at least one hundred years old. In the 19th century, many scientists believed if there is life on the earth, it must exist on other planets. At the time, Mars and Venus were assumed to be inhabited. Other scientists argued that life was created on the earth, and that is the only place it exists. However no one really knew. While our knowledge has grown over the past hundred years, we still don't know if there is life elsewhere in the universe. If there is life elsewhere in the galaxy and if that life has built a civilization, we might be able to detect evidence of that civilization. One way to do that was to search for radio signals (which can be detected by a radio telescope). The late Phil Morrison (physicist and team member of the Manhattan Project) said that if we detect a signal from a civilization it tells us about their past (since the signal takes time to reach us) and our future (presumably the civilization will be more advanced than us). The SETI program was originally funded by NASA; however NASA dropped its funding in 1993. Dr. Tarter had the responsibility of looking for new funding. Soon, through the generosity of Microsoft co-founder Paul Allen, funding arrived. That funding allowed the ATA to be built. The ATA will be used partly for radio astronomy applications (as mentioned above) and partly for SETI. We don't know what frequencies an extra-terrestrial civilization might use (if they exist at all), nor do we know where they might be located. So any search involves looking at a wide range of frequencies and looking at every point in the sky. This is very time consuming process. The ATA promises to make the process faster. However, even with the ATA there are no guarantees of success. While in the early days SETI was limited to radio signals, more recently researchers realized that an advanced civilization might communicate using lasers. A narrow beam could be sent in a specific direction in the form of a short bright pulse of light. Up until recently searching for such pulses was not practical. However recent improvements in devices known as photodiodes have made searching for these signals a possibility. However this cannot be done with the ATA and would require additional equipment. Whether there are extraterrestrial civilizations or not, the search is likely to continue for many years.

References:
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http://nobelprize.org/nobel_prizes/physics/laureates/1974/ "Physics 1974" (Extracted June 1, 2007) [The 1974 Nobel Prize in Physics].
http://www.vla.nrao.edu/ "NRAO Very Large Array." (Extracted June 1, 2007)
http://www.seti.org/ "SETI Institute." (Extracted June 1, 2007) [Information about SETI and the Allen Telescope Array]
http://ata.cam.seti.org/ "ATA Web Cam - Panorama." (Extracted June 1, 2007) [Shows pictures from the ATA construction site and is updated daily]

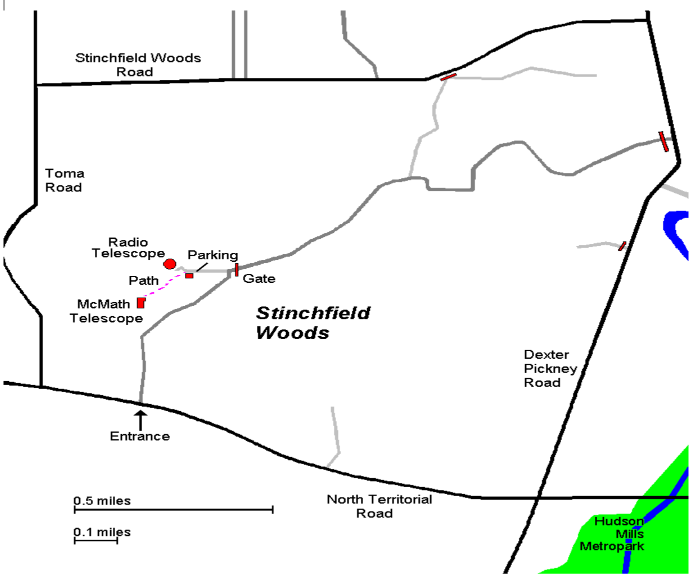
Date	RA	declination	Dist.-Sun (AU)	Dist.-Obs (AU)	mag. (m-1)	Elong / Sun	Altitude	Azimuth	Speed "/hr	PA	Con
30-Jun-07	21h08.71999m	+65 30.862'	1.2332	0.7623	9.5	86.5	48.69	34.07	319.67	303.0	Cep
1-Jul-07	20h50.20521m	+66 37.673'	1.2240	0.7392	9.4	86.9	50.85	32.03	339.97	298.5	Cep
2-Jul-07	20h28.70503m	+67 38.376'	1.2150	0.7172	9.3	87.2	53.05	29.56	361.22	293.3	Dra
3-Jul-07	20h03.94680m	+68 29.621'	1.2061	0.6962	9.2	87.4	55.24	26.57	383.27	287.4	Dra
4-Jul-07	19h35.88003m	+69 07.341'	1.1974	0.6765	9.1	87.6	57.41	22.93	405.88	280.6	Dra
5-Jul-07	19h04.83497m	+69 27.021'	1.1888	0.6582	9.0	87.7	59.49	18.51	428.75	273.2	Dra
6-Jul-07	18h31.63820m	+69 24.268'	1.1803	0.6413	8.9	87.7	61.41	13.18	451.48	265.2	Dra
7-Jul-07	17h57.57423m	+68 55.622'	1.1720	0.6261	8.8	87.7	63.09	6.80	473.57	257.1	Dra
8-Jul-07	17h24.13587m	+67 59.296'	1.1639	0.6127	8.8	87.5	64.41	359.33	494.47	249.1	Dra
9-Jul-07	16h52.66061m	+66 35.510'	1.1559	0.6011	8.7	87.2	65.25	350.88	513.52	241.7	Dra
10-Jul-07	16h24.05298m	+64 46.265'	1.1481	0.5915	8.6	86.9	65.49	341.75	530.08	235.0	Dra
11-Jul-07	15h58.71427m	+62 34.773'	1.1405	0.5840	8.5	86.4	65.06	332.44	543.50	229.2	Dra
12-Jul-07	15h36.64185m	+60 04.841'	1.1330	0.5787	8.5	85.9	63.95	323.51	553.21	224.2	Dra
13-Jul-07	15h17.58730m	+57 20.414'	1.1258	0.5757	8.4	85.2	62.23	315.41	558.79	220.0	Dra
14-Jul-07	15h01.19269m	+54 25.303'	1.1187	0.5749	8.4	84.5	59.99	308.34	559.97	216.5	Boo
15-Jul-07	14h47.07875m	+51 23.035'	1.1118	0.5765	8.4	83.6	57.35	302.37	556.71	213.6	Boo
16-Jul-07	14h34.89114m	+48 16.788'	1.1051	0.5803	8.4	82.8	54.41	297.39	549.15	211.2	Boo
17-Jul-07	14h24.31922m	+45 09.348'	1.0986	0.5863	8.4	81.8	51.29	293.27	537.66	209.1	Boo
18-Jul-07	14h15.09980m	+42 03.095'	1.0923	0.5944	8.3	80.8	48.04	289.88	522.75	207.5	Boo
19-Jul-07	14h07.01401m	+38 59.996'	1.0862	0.6046	8.4	79.8	44.76	287.09	505.03	206.1	CVn
20-Jul-07	13h59.88140m	+36 01.620'	1.0804	0.6167	8.4	78.7	41.47	284.78	485.15	204.9	CVn
21-Jul-07	13h53.55373m	+33 09.158'	1.0747	0.6306	8.4	77.6	38.21	282.87	463.76	203.9	CVn
22-Jul-07	13h47.90915m	+30 23.463'	1.0693	0.6462	8.4	76.5	35.03	281.28	441.48	203.1	CVn
23-Jul-07	13h42.84726m	+27 45.088'	1.0642	0.6633	8.4	75.4	31.92	279.97	418.82	202.4	Boo
24-Jul-07	13h38.28508m	+25 14.339'	1.0592	0.6818	8.5	74.3	28.91	278.88	396.24	201.8	Boo
25-Jul-07	13h34.15365m	+22 51.317'	1.0545	0.7015	8.5	73.2	26.01	277.98	374.08	201.3	Com
26-Jul-07	13h30.39543m	+20 35.966'	1.0501	0.7224	8.6	72.1	23.21	277.23	352.62	200.9	Com
27-Jul-07	13h26.96234m	+18 28.112'	1.0459	0.7444	8.6	71.0	20.52	276.62	332.05	200.6	Com
28-Jul-07	13h23.81323m	+16 27.487'	1.0420	0.7672	8.6	70.0	17.94	276.13	312.48	200.3	Com
29-Jul-07	13h20.91394m	+14 33.776'	1.0383	0.7908	8.7	68.9	15.45	275.73	293.99	200.1	Com
30-Jul-07	13h18.23511m	+12 46.624'	1.0349	0.8152	8.7	67.8	13.07	275.43	276.61	199.9	Vir

The Spreadsheet above is an Ephemeris for the ***Comet C/2006 VZ13 (LINEAR).*** *This was pulled for 00:00:00 EDT The columns are pretty self-explanatory:* **mag. (m-1)** *refers to overall magnitude of the comet,* **Elong / Sun** *refers to the comets elongation from the Sun,* **Speed "/hr** *refers to speed of apparent motion in arc seconds per hour,* **PA** *refers to the apparent direction of that motion.*

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.

Telephone Numbers

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Lowbrow's Home Page

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

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University Lowbrow Astronomers

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Reflections & Refractions

UNIVERSITY LOWBROW ASTRONOMERS
Ann Arbor, Michigan

Website
www.umich.edu/~lowbrows/

- **Saturday, July 7, 2007.** *May be cancelled if it's cloudy.* (Starting at Sunset). Open House at Peach Mountain.
- **Saturday, July 14, 2007.** *May be cancelled if it's cloudy.* (Starting at Sunset). Open House at Peach Mountain.
- **Friday, July 20, 2007.** (7:30PM). Monthly Club Meeting.
- **Saturday, August 11, 2007.** *May be cancelled if it's cloudy.* (Starting at Sunset). Open House at Peach Mountain.
- **Friday, August 17, 2007.** (7:30PM). Monthly Club Meeting.
- **Saturday, August 18, 2007.** *May be cancelled if it's cloudy.* (Starting at Sunset). Open House at Peach Mountain.
- **Saturday, September 8, 2007.** *May be cancelled if it's cloudy.* (Starting at Sunset). Open House at Peach Mountain.
- **Saturday, September 15, 2007.** *May be cancelled if it's cloudy.* (Starting at Sunset). Open House at Peach Mountain.
- **Friday, September 21, 2007.** (7:30PM). Monthly Club Meeting. *[It is likely the date of this meeting will change to either September 14th or September 28th].*

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Ann Arbor, Michigan

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Check your membership expiration date on the mailing label