REFLECTIONS / REFRACTIONS

University Lowbrow Astronomers

April 2009

Volume 33 Issue 4

Canon Hackin'

by Doug Scobel

If you've been watching the Lowbrows' email space lately then you've no doubt seen some of the wide-field astrophotos I've been posting recently. And you've probably also noticed that I've taken most of them with a point-and-shoot camera. If you've been wondering how I'm doing it with such an unsophisticated camera, then here's your chance to learn my secrets. And if you own a late model Canon point-and-shoot digital camera, then chances are you can get in on the action as well.

Truth be told, the "secret" isn't a secret at all. It's actually a free, public web site that someone (whose name escapes me) pointed me to. This web site tells you how to turn your ordinary Canon point-and-shoot camera into a super-camera. The URL is *http://lifehacker.com/387380/turn-your-point+and+shoot-into-a-super+camera*. The main gist of this web site is that, at least in Canon's case, the camera's hardware is capable of far more than what its menus and controls let you do. The "hack", called the Canon Hacker's Development Kit, or CHDK, consists of new firmware you can upload onto your camera to let you unlock capabilities that you most likely didn't even know were there.

Here's an example. The most important capability in my opinion when taking astrophotos is the ability to take long exposures. My camera, a PowerShot A630, only allows up to fifteen second exposures. That's not very long. But with the CHDK firmware upgrade, it can now go up to 64 seconds. In photography terms that's slightly more than two stops worth of additional exposure. Here's a side-by side comparison. The image on the left is a 15 second exposure, and the image on the right is 64 seconds. The insets show how many more stars are captured with the longer exposure - even the Orion nebula begins to show up.

Left, 15 seconds; Right, 64 seconds. Both exposures are f/2.8 at ISO 200, no digital post-processing. All images by the author.

How does this CHDK firmware upgrade actually work, you might ask. You can get all the details from the web site, but in a nutshell you first determine if your camera is supported, and if it is, you download the firmware update to your com-

puter, and then write it to your camera's memory card. When you turn your camera on, it will behave just as it always has. But with a simple menu sequence, you activate the upgrade. You then have a bunch of additional menu options, everything from RAW mode settings to shutter speed and ISO and aperture overrides to more informative battery life indicators. You can also download scripts, for instance to have your camera take a series of pictures at set time intervals, or even to play games – on your camera! I've not yet done anything with scripts, but I'm definitely planning to try out some available so-called "intervalometer" scripts, to see if I can make some time-lapse animations of the night sky. Another bonus of CHDK is that it's useful even if you never use your camera to photograph the stars – it's equally applicable to daytime photography. For example, I've found that with CHDK I can stop my camera's lens down to f/11 or even f/16, up to two stops slower than the f/8 that the standard menus limit it to.

Just a mild-mannered point-and-shoot digital camera…

but with the CHDK update applied (this is just one of many menu screens it adds) it becomes Super-Camera!

Besides longer exposures, another feature of interest when shooting astrophotos is the ability to obtain images in RAW mode. RAW format is the encoding of the image file as taken by the camera's sensor, before the camera does any post processing. With most digital cameras, after the image is taken, the camera performs electronic processing on this "raw" image and saves it in a compressed form on the memory card, typically in JPEG format. For general photography this results in a decent looking picture, and one that doesn't take a lot of room on the memory card, but it has some drawbacks. The first is that the JPEG compression performed by the camera, even at the camera's highest resolution setting, adds artificial artifacts to the image. Also, image contrast can suffer, where shadow details can become lost or bright highlights can become burned out. Most digital single lens reflex (SLR) cameras let you save RAW images, but it's unusual in point-and-shoots. The Canon Hack firmware upgrade lets you save the RAW image along with the JPEGs.

Keep in mind that RAW images cannot be used directly. You must first convert it to a usable format, massage it using photo processing software, and then save it to a viewable format, again typically JPEG. So why bother if you're going to end up with basically the same thing? The answer is that the camera only has its built-in program to do the processing. This "one size fits all" approach, particularly with point-and-shoot cameras, can only do so much on individual images, especially on astrophotos. Yes, they build some amazing circuitry into modern cameras, but still it can't do nearly as good a job on astronomical images as a human can working on a computer with image processing software. The bottom line is that RAW is the format of choice for astro-imagers.

Unfortunately, as of this writing I haven't done much with RAW format. I just haven't spent the effort to climb the learning curve yet. But rest assured, one of these days I'll be working with them and I'll be sharing my results. So in the meantime, everything I've shared up to now has been done with JPEG images.

Here are some pictures I took with my Canon "super camera" from Peach Mountain on March 13, 2009. You may notice that the Flame Nebula is faintly visible to the ENE of Zeta Orionis, and the Merope Nebula is making a bit of an appearance in the Pleiades. These images won't win any awards, nor will you find them in the gallery pages of Sky and Telescope magazine, but keep in mind *they were taken with a point-and-shoot camera!*

Left to right: Orion's belt and sword, the Pleiades, the Double Cluster. All three images are stacks of ten 64 second exposures at f/3.5, ISO 200, at full zoom with a 1.7x teleconverter. Stacking was done with RegiStax 4, and digital processing was done in Paint Shop Pro 8.

The only other thing you'll probably need if you want to take longer exposures at night and get tight star images is a tracking mount. An equatorial mount is preferred, but I think with an alt-azimuth mount a 64 second exposure won't produce a noticeable amount of field rotation (though if you stack multiple images it could). Any driven mount will do - it doesn't have to be a beefy mount at all. Point and shoot cameras are very light, certainly much lighter than any telescope, so weight won't be a factor. You could even use a homemade barn door drive with good results. And if you don't have a driven mount, even at 64 seconds you won't get a whole lot of star trailing. Just setting the camera on a tripod will do, particularly when shooting at wide angles.

One more accessory that I recommend is a ball head for mounting the camera. It lets you swivel the camera to almost any orientation, making it much easier to frame your target regardless of where it is in the sky. I use a Bogen/Monfrotto 486 head, which is a little large, and probably overkill for a point-and-shoot camera, but I also use it with my SLR camera which is bigger and heavier. A smaller one will do. I mounted it on a dovetail to make it easy to attach to my mount. Here's a picture of my rig:

So do you have a late model Canon point-and-shoot camera? If so then you might want to give CHDK a try. Will your pictures make you famous? Maybe not. But will you have a lot of fun? I guarantee it!

My "sophisticated" astrophotography rig. So easy even a caveman can do it.

[To see larger versions of these and other images I've taken with my "new" super-camera check out my gallery at http://picasaweb.google.com/djscobel/CanonHackin?feat=directlink - Doug]

Grinding to Size

By Tom Ryan

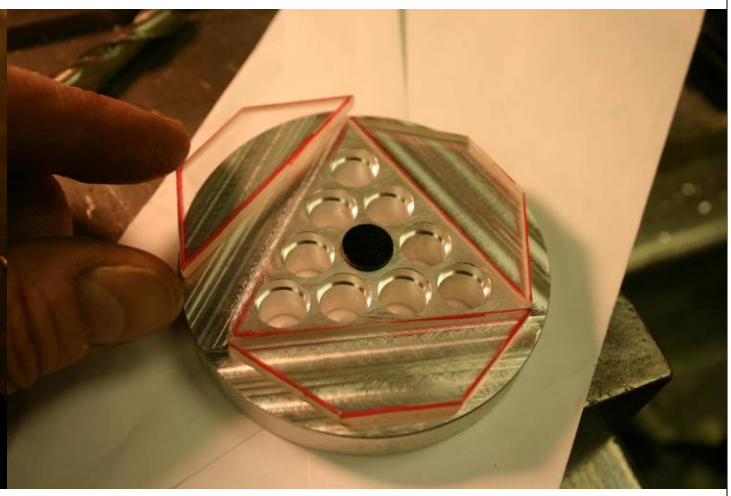
I've always shied away from making refractor lenses, because the thickness requirements scared me. For a lens, the optical designer would always specify the thickness of the lens, in addition to its radius of curvature, surface finish, surface accuracy, wedge, etc. Mirrors seemed to me to be a lot easier to make.

Since I've been designing optics, I've come to understand that lens thickness is the most error-tolerant of all of the things specified, but I've still been reluctant to make lenses. However, all things come to those who wait.

I was recently asked to grind and polish some filters for a local medical company. Their existing filters had the wrong extinction values, and grinding them thinner was the cheapest way to get the desired values. Unfortunately, the filters were composites made of three cemented glass layers, and I had to grind down and polish one of the glass layers to the thickness of a piece of paper (0.003"), without breaking through the optical cement to the dielectric coating, or chipping or breaking that thin layer of glass.

Here is how I did it.

I first machined an aluminum block to hold the filters in place and at a common height, since in optics, success or failure often hinges on good tooling. The filters rested on accurately machined ledges at equal depths. They have through holes under them, so their individual thicknesses can be monitored during grinding, and so wedge can be controlled. The thickness tolerance on the filters was +/- 0.0004".



I then cut some glass blockers on a diamond saw, and used optician's cement to glue them to the machined aluminum puck. The glass blockers keep the edges of the filters from turning down. In the above picture, a filter appears in the middle of the puck.

Next, the filters were glued in and were ground against a piece of scrap float glass, which is quite flat from the manufacturer.

The critical thing to know when grinding off 0.122" glass to a tolerance of +/-.0004" is how much glass is ground off by each grade of abrasive. The answer to that question involves working backwards from our desired thickness.

The idea of starting with a coarse abrasive is to be able to grind fast enough to do the job economically and in a reasonable length of time. But coarse grinding creates chips and fractures that propagate into the glass, which have to be removed by finer abrasives, which in turn leave chips and fractures of their own. This continues right up to polishing. Ideally, you'd like to grind as much glass as possible with coarse abrasive, then switch to polishing. However, you can't polish out craters from #80 abrasive in a reasonable length of time. Therefore, I used a grinding sequence of #120, #320 (nine micron), five micron, and then polished with Zirconium Oxide.

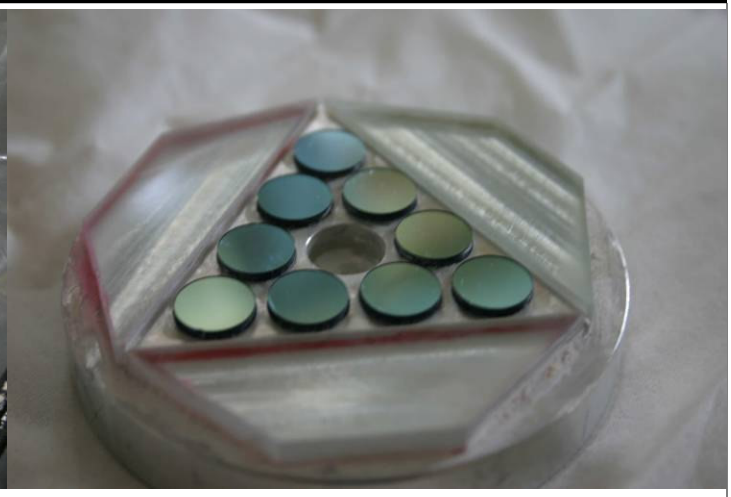
The trick is to leave enough glass at each stage to allow the next stage to remove the fractures which grinding drives into glass, and that means knowing how deep the fractures are from each abrasive. It turns out that the fractures from each stage are about as deep as the diameter of the abrasive. Polishing compounds are composed of one micron diameter particles, and they remove a few microns of glass. Five micron abrasive leaves fractures about five microns deep, nine micron leaves nine micron fractures, and so on. I was conservative, and left more than twice as much glass on the filters at each stage as was required to clean up the fractures. At 25.4 microns per 0.001", I left 0.0005" for polishing, 0.001" for five micron, 0.002" for nine microns, and ground the rest with #120. It seemed to work.

I poured a pitch lap on an aluminum disk, cut the facets with a couple of new razor blades (they dull and start to chip the pitch after cutting about eight channels, and so need to be changed), and pressed the lap flat with an old fused silica optical flat.

Ideally, when machine polishing with the optics on top, the lap should be 6/5 the diameter of the optic. In this case, I didn't have a ready-made tool of the correct size, and the lap I had was considerably bigger than optimum. When this happens, you have to start polishing with a lap that is already in the desired shape. In hand polishing, the lap is often the same size as the optic, and working them together causes the lap to take on the correct shape. However, when the sizes are very different, you have to rely on some other method for forming the lap. Hence the optical flat.

Pitch is soft, and on a microscopic (optical) level, it very much resembles the seat cushions on a couch. If your optic doesn't bridge the entire couch, it will locally sink into the cushions, and the edges of the glass will get rounded off as the optic moves across the pitch. That is the reason for having a glass blocker surround the filters, and for flattening the pitch by frequently pressing the optical flat onto it during polishing.

The machine polished out the filters in about twenty minutes. If I'd known they were this fast, I'd have bought a machine just to polish my first 12.5" mirror.



When the polished filters came off the machine, I checked them on a Zygo interferometer. They were flat all the way across to about 1/10 wave. However, they were still 0.0005" too thick (I had overestimated how much material polishing removed. It was, after all, the first time I tried this), so I placed a couple weights on the polishing arm, cranked the speed up, and let it go for another 40 minutes.

At the end of that time, they were at the correct thickness, but their overall surface flatness had dropped to ¼ wave. (High pressure plowing had rounded the edges.) This is a good argument for keeping good records, or for letting someone else do the job first. However, since ¼ wave was about four times better than the specifications required, the customer was quite happy with the results.

Officer nominations so far are:

Pres.: Charlie Nielsen

VP: Jim Forrester, Belinda Lee, Mike Kurylo, Ken Cook, Bobby Gryszinski

Treasurer: Yasu Inugi

Newsletter Editor: Mark Deprest

OD: Mike Kurylo, Mike Radwick

Webmaster: Dave Snyder

Lowbrow Meeting Minutes

2009-02-20

It is with deep regret that we announce the death of long-time member, supporter, and friend to all, Lorna Simmons. She passed away peacefully in her sleep on 2009-01-10. In her honor we will be attaching plaques on the telescopes she donated to the Lowbrows, the Questar, and the 8" Meade reflector. A memorial observing session is planned for the evening of 2009-03-14.

Attendees: ~20

Presentation: Rehearsal for the UM theme semester presentation at Saturday Morning Physics on 2009-03-14 by Charlie, Yasu, Dave, and Jack. Appropriate treats will be available such as Starbursts, Milky Way & Mars bars at SMP. Outstanding work guys!

Proposed presentation schedule for 2009:

March 20 – Pat Sitzer, space debris

April 17 – Elections and swap meet

May 15 – Belinda Lee, Night Sky Network

June 19 – OPEN

July 17 – John Kirchhoff, Rider's Hobby annual demo at Eastern Michigan University.

August 21 – Jack Lousma, form NASA astronaut

September 18 – OPEN

October 16 – Mark Deprest & Friends, Okie-Tex Star Party report

November 20 – John Kirchhoff, Astrophotography

December 18 – OPEN

There will be a special presentation on Sunday October 11 by the author of "Turn Left at Orion" and Vatican astronomer, Brother Guy Consolmagno. His topic will be "Are Asteroids Fluffy?"

Proposed Open House Dates:

March – 14, 21, 28

April – 18, 25

May – 16, 23

June – 20, 27

Officer Reports:

Dave Snyder met with UM's Doug Richstone to discuss the future of Peach Mountain. The topics covered the possible retirement in the next five years of Doug Richstone, Hugh Aller (both involved with the radio scope), and George Latimer, as well as the availability of the McMath telescope for Lowbrow and open house use. Charlie will continue these discussions with Doug on Thursday, February 26 at 3pm.

Dave Snyder taped a 30 minute video about seeing in the dark.

There are several astronomy related events taking place currently on campus at the Exhibit Museum and the Hatcher Graduate Library on the 7th floor.

D.C. Moons recently discussed some observatory related items with George Latimer and is awaiting permission within the next two weeks to proceed with the masonry repairs of the SE corner of the building. This will include, but is not limited to, replacing damaged blocks and mortar, and adding exterior outlets on the South wall. We may add a timer on the outlet to prevent accidental misuse of the outlets from unapproved personnel. A drain spout will also be added to the SE corner re-

pairs as well as addressing the grading of the ground in that area. A ramp is under consideration to increase the accessibility of the observatory. Funding for these projects will be coming from the Lowbrows.

At the end of March or early April we intend on removing the McMath mirrors for recoating at Flabeg in Pittsburg, PA. George will be verifying the UM policy of requiring that a UM employee accompany the mirror. We need to be prepared with a "volunteer" for the trip. Prior to the mirror removal we need to send some updated photos of the mirrors condition to Flabeg and request current prices for the two coating options.

D.C. Moons also informed the Lowbrows that he will not be seeking re-election as observatory director in April.

Former Lowbrow President Mark Vincent is now working at UCal-Davis as a research assistant. Congratulations Mark!

As a reminder, the Ford club's annual swap meet in Livonia is on March 7th.

As a membership incentive during the Year of Astronomy it was proposed that we reduce or eliminate dues for new members during 2009, and earn a dues reduction for each new member a current member recruits. A more enticing alternative may be to earn bonus points for a year end raffle of a highly desired piece of astronomy equipment. A call to Rider's Hobby for participation may be in order.

Doug Nelle has nearly finished the test stand for the refiguring work we are doing on the 17.5" Coulter rebuild. As luck may have it, fellow Lowbrow member Doug Scobel is simultaneously working on a sister scope.

Yasu reported 100 Lowbrow members with just over $8000 in the account.

Paul reminded us that the GLACC event will be the weekend of Sept. 25 & 26.

Jim brought up the precipitous drop in Lowbrow participation at our open houses. Only once did we have 10 or more members come out and assist with our public outreach events. As the gray hairs increase it becomes more important to reinvigorate the members and add new ones to assist in our endeavors. One suggestion was to reduce the number of open houses we host to lower the burden on the regular participants. At one point only 2 Lowbrows were in attendance, and as a consequence the McMath was not available for viewing. At a minimum, 4 or 5 members are required to adequately staff an open house event. We need members to commit to several dates a year to make this work!

There will be campus observing sessions on March 7th and April 4th by the League near the Bell Tower.

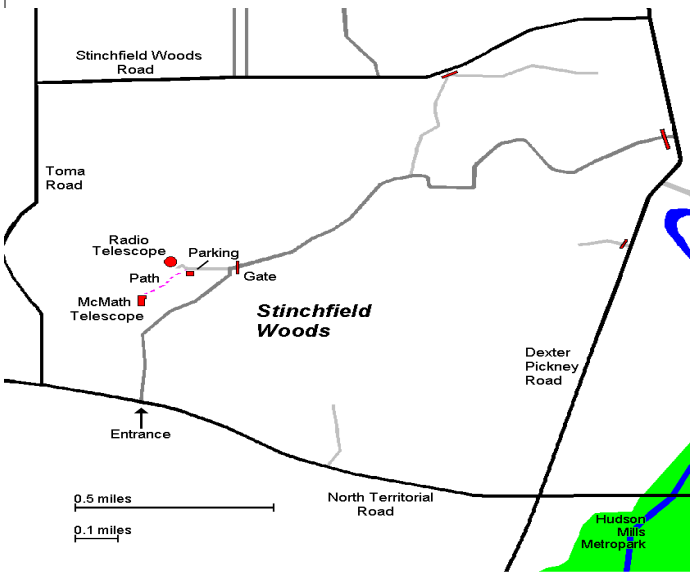
University Lowbrow Astronomers 2008 Balance Sheet (3/26/2008 - 3/30/2009)

Expenses		**Income**		
Telephone bills	-$143.40	Dues @ $20	$1,040.00	(52)
GLAAC AATB Donation (2008&2009)	-$600.00	Dues (senor) @ $12	$408.00	(34)
International Dark Sky Association	-$100.00	Dues (student) @ $12	$48.00	(4)
Talk Fee	-$200.00	Dues @ $5	$20.00	(4)
Events	-$149.50	Advanced Dues	$55.00	
Supplies	-$50.46	Donations	$246.05	
RASC - Calendars & OH	-$781.80	Printed Newsletters	$60.00	(5)
Astronomy 2009 Calendars	-$97.13	RASC - Calendars & OH	$863.00	
		Astronomy 2009 Calendars	$126.00	
Total Expenses	-$2,122.29	**Total Income**	$2,866.05	
		Previous Balance (3/26/2008)	$7,300.80	
		Current Balance (3/26/2009)	$8,044.56	

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

2918 W Clark Rd #203
Ypsilanti, MI 48197

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

President:	Charlie Nielsen	(734) 747-6585
Vice Presidents:	Jim Forrester	(734) 663-1638
	Ken Cook	(734)769-7468
	Mike Kurylo	(517)223-7585
	Belinda Leeb	(313)600-9210
Treasurer:	Yasuharu Inugi	(734)434-9544
Observatory Director:	D. C. Moons	(586) 254-9439
Newsletter Editor:	Mark S Deprest	(734) 223-0262
Key-holders:	Jim Forrester	(734) 663-1638
	Fred Schebor	(734) 426-2363
	Charlie Nielsen	(734) 747-6585
Webmaster	Dave Snyder	(734) 747-6537

Lowbrow's Home Page

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

Email at:

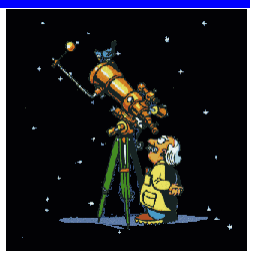
Lowbrow-members@umich.edu

University Lowbrow Astronomers

Yasuharu Inugi
2918 W Clark Rd #203
Ypsilanti, MI 48197

Phone: 734-434-9544
E-mail: yinugi@hotmail.com

Reflections & Refractions



Website
www.umich.edu/~lowbrows/

This is an urgent request for Lowbrow help. My wife encouraged me to do something crazy – invite the city of Saline to my house for a star party! Notices have appeared in our paper and at the library.

So now I'm worried that I may get 100+ if the weather is nice.

I've scheduled four nights of star parties – Thurs April 30 through Sun May 3. So at least one night should be clear.

If you can bring a telescope, it would be much appreciated. However, I do need a couple operators of my telescopes (I'll probably stay in the dome).

I'm at 398 Green Hills Drive in Saline. That's 1.5mile east of the intersection of 12 and State.

Arrive at 7:30pm to set up your telescope, park in driveway near house/garage

People will start arriving at about 9pm (could be over 100)

Show them the MOON, SATURN, DOUBLE STAR (Mizar/Alcor or Castor), STAR CLUSTER (M3 or M44Beehive). (the moon will make galaxies unimpressive)

If lines get long, direct folks to other scopes that may have shorter lines

Refreshments will be provided

I need all the Lowbrow helpers I can get!

Feel free to call me or reply with any questions or offers.

Thanks so much.

Brian Ottum

(734) 429-3559

University Lowbrow Astronomers
2918 W Clark Rd #203
Ypsilanti, MI 48197

Check your membership expiration date on the mailing label