

Review of the iOptron SmartStar A “Cube” Mount

February, 2012

Brian D. Ottum, Ph.D. Michigan

This is a review of the iOptron SmartStar A mount. I purchased the mount for \$422 (including delivery) from Amazon in January of 2012. The purpose of the purchase was to get a lightweight “grab-n-go” mount that has a motor drive. Not having a motor drive became a real problem when I was showing hundreds of people solar prominences last summer (while I volunteered at Bryce Canyon National Park). I’d have to take the time to nudge the scope between visitors, often butting heads with the overly eager. The need for a drive will be critical this spring when I return to Bryce to help serve the crowds of visitors viewing the May 20 annular solar eclipse and the June 5 transit of Venus. In nearly 40 years of serious observing, I’ve owned many scopes. Pertinent to this review, I have a GO TO Starmaster 14.5” and a GO TO Gemini drive system.

Before purchasing, I did extensive Google searches and read many reviews and experiences with the various iOptron “Cube” products and their derivatives. Being a Sky & Telescope “Product of the Year,” the Cube has generated a lot of interest and sales. It offers a lot of technology for a low price.

However, the reviews are decidedly mixed. Folks complain about shaky tripods, poor documentation, buggy software and poor pointing accuracy. To be fair, many folks deal with the negatives, modify the mount and become enthusiastic supporters.

Out of the many iOptron mount options, I picked the SmartStar A because it is the lightest, and also has the unique ability to tilt up and emulate an equatorial mount. It could possibly replace the AstroTrac 320 lightweight drive that I have and use for widefield astrophotography. Also, it could be used for both my hydrogen alpha Lunt scope and my 4” APO refractor, replacing the Astro-Tech Voyager alt-az mount (which has a stripped azimuth gear and a totally unresponsive manufacturer – another story for another time).

I was advised that the SmartStar A has a recommended 12lb maximum payload. My 4” refractor is just under this. The larger iOptrons can carry more. But I decided to get the SmartStar A anyway, since this is to be a lightweight travel mount.

OUT OF THE BOX

The mount arrived less than a week after ordering. The first thing that struck me was the shortness of the tripod. Yes, I had been warned in the online reviews. This tripod is inappropriate for viewing while standing. However, I am fine with a sitting-only mount. That’s the only way newcomers get a comfortable and satisfying view.

The second thing that struck me is how tiny the mount is. It’s a small cube, with pink accents. Yes, I know I will get ribbing for a pink telescope mount. But I went with the pink over the other colors because it is a more welcoming look to attract visitors in front of the national park visitor center.

The third thing that struck me is the total lack of an owner’s manual. There’s just a quick start guide that only hits the high points (and is fraught with misspellings and poor grammar). Luckily, I had already searched and downloaded the .pdf manual from ioptron.com (which also suffered from poor writing).

SETTING IT UP

It just takes a minute to put it all together. After setting up the tripod I saw what others had been complaining about. There is nothing from stopping the tripod legs from “splaying” outward as you tighten the eyepiece tray/spreader plate. What a poor design! So I immediately went to ACE hardware and bought \$14 worth of chain and rings. I have to thank David Rogers for sending me pictures of his modification. This really helped tighten up the legs and increase tripod stability.

The manual advises to do initial setup and “playing” with the mount inside during the daytime. This is good advice, given that this computerized mount is highly complex and not intuitive. But since I’ve got experience with a couple other computerized mounts, I was able to get up to speed on this one.

I mounted my 4” APO refractor using a Vixen-style dovetail plate and immediately saw that it was going to tax this little cube. The altitude tightening



knob really needs to be cranked to secure the scope. This is another issue cited in online reviews. The clutch is insufficient and tends to slip.



FIRST NIGHT OUT

Unlike most times after buying a new piece of equipment, it was clear the night after arrival. (I'm in Michigan, so a clear and comfortable January night is highly unusual.) So I carried the scope and mount onto the deck, and plugged in the mount using the included A/C adapter. The mount powered up quickly, and the internal GPS automatically acquired satellites within a minute, requiring no button pushing. In addition to lat/long, the GPS feeds the correct time to the mount. All I had to do was a "1 star align." The mount tracked Venus & Jupiter @ 130X for over half an hour! I was very pleased. The sound of the tracking motors inside seemed a bit loud, but comforting. On the other hand, the slewing motors are like a coffee grinder (but no different than what you hear from other mass-produced mounts).

A NIGHT OF THOROUGH TESTING

About a week later I decided to do a really critical evaluation. So I carried the scope+mount outside, set it in place on the patio and plugged it into an outlet using an extension cord (7:23pm). The first step is to point the mount's "South" arrow to the south. This is an imprecise exercise because the arrow is short and the mount lacks long lines for sighting. The second step in aligning is ensuring the iOptron is leveled, so I fiddled with the leg heights until the bubble level was centered. The manual suggests using an additional "torpedo" level, but this is difficult because there are no large flat surfaces on the iOptron. So you gotta trust the bubble. A torpedo level on the top surface shows that the bubble is pretty accurate (but is the top surface exactly parallel to the azimuth axis?). The last step of setting up is to aim the telescope as perfectly vertical as possible. The small torpedo level was used to level the mounting ring (which I hope is 90 degrees from the scope's optical axis). "Southing" and leveling and "verticaling" took until 7:28pm. I turned on the mount switch and watched the hand controller display until "GPS OK" appeared. Wow, it took only about a minute to acquire the satellites (where my car GPS often takes a couple minutes). I pressed "2 Star Alignment," the best possible in alt-az mode. The first star it suggested was Aldebaran, so I pressed "enter" and it quickly slewed to the star. I was using a 30mm eyepiece, yielding nearly a 3 degree field. Aldebaran appeared near the center of the field of view. Yay! I changed slewing speeds to something slower, and carefully centered Aldebaran in the center of the field and hit enter again. The display suggested the second star was Alpheratz, so I hit enter and it slewed to this star in Andromeda, on the other side



of the meridian. (The computer offers you a list of bright stars, but does not factor in the first one, so you only see stars that are up and located a good distance away from the first one. This means you may select a second star that is right next to the first one, then the computer tells you that it's too close for a good alignment.) I was miffed to NOT see Alpheratz in the eyepiece. Even an eyepiece with a whopping 3 degree field! So I sighted along the refractor tube to slew slightly to the right – I was about 3 degrees off of the star. Then saw the star in the scope and centered it precisely, hit enter. Two star alignment is done at 7:32pm. So now it was time to test the accuracy of the alignment and the computer pointing. The computer contains an impressive list of objects, including all Solar System, Messier, NGC, IC, major stars, SAO double stars, variables, etc. I selected M31 and slewed. Andromeda galaxy was smack-dab in the middle! Yee hah (7:35). Then on to Venus, located about half a degree from the center, still very good (7:37). Then a very difficult object to find – a first quarter moon ;-). It was located about a degree above the center of the field of view but still well within the 3 degree field (7:38). Then nearby Jupiter, also offset about a degree up (actually north, 7:39pm). M45, the Pleiades were positioned about a degree up from the center of the field of view, and perfectly acceptable to me. The wide field view was great (7:42). Why not try a star? So I selected "stars" and was presented with a numbered list. The numberings went up with the alphabetical list of hundreds of the brighter named stars. Of course, these numbers mean nothing. You have to repeatedly press the down arrow to go down the list to find the star you want. This is very tedious. Gloved hands do NOT make this easy. The numbers mean NOTHING, so why are they there? Later, I discovered that I could enter a high number (like 050) to jump down the list. But not intuitive or easy. Star 061 is Betelgeuse so I slewed there. It appeared near the top right edge of the field of view, nearly 1.5 degrees from the center. Acceptable but concerning (7:43). Then I decided to do a rapid fire tour of the bright clusters in Auriga – M36, M37 and M38. All appeared at the upper right edge of the field of view (ending at 7:49). The double star Castor was also positioned in the eyepiece, albeit at the edge. This was a difficult test because Castor was rising low in the East, opposite Alpheratz, the second alignment star. I decided to "nudge" the scope in the vertical so that Castor appeared in the



center. Then selecting M35, the mount placed it perfectly in the center. Then back to the moon, which appeared also close to the center. Jupiter perfectly centered at 7:55.

So my initial experience is that this tiny cube works quite well to position objects in a wide field eyepiece, after a careful initial alignment.

After this experience, I carefully manipulated the scope while “locked.” I could feel that the altitude was quite locked down and tight. However, there is about a 1 degree “play/slop/backlash” in the altitude gear. This is the source of the pointing inaccuracy that I observed. This is also the reason it was hard to keep objects centered when trying to change eyepieces or focus.

TRACKING TEST

I put the scope on Jupiter at 130X and watched it carefully for half an hour. The drive kept it in the 0.6 degree field of view easily during that time. But I could see tiny drift down and to the right (which is undoubtedly due to my imprecise “Southing,” leveling and “verticaling” the scope at the beginning). No surprise.

MODIFICATIONS TO ELIMINATE THE ALTITUDE “PLAY”

Another owner, “Paul C.,” advised me to carefully remove the mount’s cover and take a look at the altitude gears. I saw that once the mount was locked in altitude, any pushing of the telescope caused the entire altitude gear housing (plastic) to twist and flex. This is undoubtedly the cause of the 1° vertical play. So I cut a wood pencil to the proper length and pressed it between the plastic gear housing and the inside of the metal case. A pencil happened to be the perfect width to stop the flex. Now the “play” nearly gone, which should result in better pointing accuracy and easier focusing.

One other modification recommended by David Rogers was to replace the nylon altitude clutch washer with a larger one. I did that and the scope is much easier to lock tight.

RE-TESTING AFTER MODIFICATIONS

I placed my Lunt hydrogen alpha scope on the mount and took it out into the [rare] clear winter day. After “southing,” leveling, and “verticaling” I powered up the mount and it acquired the GPS satellites in about a minute. I selected the sun and the mount gave me a loud warning “beep!” with a stern warning on the hand controller. But once selected, the mount slewed to the sun, centering it PERFECTLY in the 40X eyepiece. Conveniently, the mount automatically switches to the solar tracking rate when you slew to the sun. The altitude/vertical “slop” is now completely gone. Changing eyepieces and focusing is a breeze, as the object stays in the field of view. (Also, using a 12V battery supply worked just fine with the mount.)

DETAILED ASTROPHOTOGRAPHY TESTING

The third purpose for this mount, other than solar viewing during the day and refractor viewing at night, is wide field astrophotography. The goal is to have a highly portable drive that is accurate enough to take 2 minute exposures with my Canon 20Da and 200mm lens (plus the wider angle lenses which require a LOT less tracking accuracy). So one night I set up the mount in “equatorial” mode by simply tilting the mount and locking it in place. Polar alignment is not quick, but quite effective. You roughly point the mount to Polaris, point the camera toward Polaris, align on one bright star, align on another bright star in another part of the sky, then press “enter.” The display tells you how far off of the true north celestial pole both in altitude and azimuth (albeit using confusing terms like “Altitude: 82mins higher” – does that mean too high or that I need to go higher?). Adjusting altitude is easy, just a few turns of the tilt screws. Azimuth changes are tough, as you have to carefully pick up the tripod and rotate either easterly or westerly by a tiny bit. This iterative operation became easier for me once I found out that my 200mm lens gives a 4° altitude x 6° azimuth view of Polaris. So after the 3rd iteration, when the mount told me I was a degree too high and two degrees too west, I could look through the camera to monitor my adjustments. It might have been funny watching me crane my neck to peer through the viewfinder as I hunched over the tripod, attempting to carefully rotate it. I stopped the process once I was aligned within a degree of the pole. The polar alignment took a half hour. I took a variety of 30 second exposures with the camera, and the results were pretty good. Most shots had very good tracking, with pinpoint stars (see Betelgeuse below). However, when the camera was pointed near the zenith (the Pleiades), there was a large tracking error in the R.A. I conclude that this is simply a counterbalance error – the drive is slipping. So I have ordered the optional iOptron counterweight which should fix the problem.

So I conclude that this mount can be used for good 200mm astrophotography (if the counterweight fixes the slippage), and perfect for anything of shorter focal length.



NOT A MOUNT FOR BEGINNERS

This is a mount that is priced and marketed for beginners. However, it is a poor choice for beginners because it is such a complex and non-intuitive product. I've seen online evidence of folks making mistakes with the mount and getting frustrated. As a result, there are an unusually high number of newer "cubes" and "towers" for sale on Astromart. Here are the key drawbacks that will stump beginners:

- No manual included – have to search, download and print your own.
- Manual is poorly written
- Hand controller display is jammed with numbers (and they even boast about it) Have to precisely balance the telescope, not described in manual
- Alignment requires knowing the names and positions in the sky of obscure stars (this is a huge problem – how many beginners know where Alpheratz is?)
- Tripod is unstable and susceptible to dangerous falls (unless you install stability like I did) The "play" in the altitude gears will prevent folks from finding objects, prevent easy eyepiece changes, and prevent easy focusing (unless one takes the mount apart and makes the modifications)
- The power cord wraps around the cube as it slews to new objects, eventually causing damage (unless you monitor the situation)
- Updating the firmware is a 30-step process, with the very real chance of wiping out the mount's brain

This mount is analogous to a first generation piece of software. New and powerful, but full of bugs and rough edges. The opposite of what Apple would do (however, an "iMount" would cost \$1,200).

MY OVERALL ASSESSMENT

This mount seems like it will meet my needs well. It is inexpensive, considering all the things it can do. It is small and extremely portable. It quickly finds and keeps objects within the field of view. It can accommodate my solar scope during the day, and my 4" refractor at night. I can fix or accommodate its shortcomings.

Ann Arbor Public Library events:

Friday, April 27, 8:00 p.m:

Launch of the Ann Arbor District Library telescope collection at the Leslie Science Center. This will include a brief presentation by the Lowbrows followed by viewing with Library scopes outside. The inside portion of this event will happen regardless of the weather, though it'll obviously end early if there's no outside viewing.

Thursday, May 24, 7:00 p.m:

Talk by Terence Dickinson; author of "Night Watch: A Practical Guide to Observing the Universe" at the Downtown Library.

Wednesday, June 27, 8:00 p.m:

Viewing session with Lowbrows at Leslie Science Center, (This is just a regular viewing opportunity, like the ones the Lowbrows usually have when invited to the Science Center by other groups. It's more about encouraging stargazing in general because it'll be part of the Library's Summer Game. We won't be doing any indoor demo of Library scopes, though we can provide a couple tables outside in case people happen to bring them. And we'll cancel this one if the weather doesn't cooperate.)

Amy Cantu

George Ferrier & the Junior Lowbrows update

It has been a while since I have done anything due to several reasons:



1. The Weather
2. Loss of members, we are down to 5 who observe more the 80% of the time



3. Fighting Depression & PTSD

We started doing some observing this month although only the moon. We are just getting used to the features and getting our orientation set. We were looking at the major Craters like Ptavius, Tyco. We especially liked the dark ring around Tyco. We also looked at Copernicus, Kepler and Aristarchus. We observed that Aristarchus features would change from the Last Quarter till a Full Moon. Their favorite view is looking at the Mare Fecunditatis and the Craters Messier and Messier A and also Mare Tranquillitatis. I also enjoy looking at Prinz. We also spent a lot of time to see if we can locate the APOLLO Landing sites.

We also did some observing on Nov. 6th from 6PM until Midnight. We found the moon and then we tried to locate Uranus, which we initially did discover and were able to see the Greenish Glow. Then we just looked around just taking in the beauty if it all. Nov 21st & 23rd from 11:00PM - 12:27AM we were observing Taurus, Gemini and Orion. We compared the colors of Betelgeuse and Rigel, Looked at Orion's Nebula, Caster, Pollux and Aldebaran and just taking in the colors and beauty. While looking at Taurus naked eye we observed a Meteor pass above Aldebaran passing east to west at a magnitude of approximate 3.2 (compared to Pi3 Orioni) and lasting over 1 second.

We also observed the moons of Jupiter on October 16th & 17th, November 21st & 23rd

Conducting Lowbrow Open Houses requires some planning, but not a lot.

By Jim Forrester

The main thing is to get Lowbrows and their scopes out on the hill. The magic number is 5 or 6 scopes plus operators for the McMath. Begin button holing people with the meeting before the month you are to do the open houses and keep after people until you have some rough commitments. It's difficult for many of the members to commit very far in advance but they should know you have them in your sights.

McMath operators are not plentiful. Charlie Nielsen and Dave Snyder have shouldered much of that duty the past couple of years and may be willing again, but try for other members as well. Mike Radwick knows as much as anyone about the McMath and it never hurts to ask him. DC Moons loves the scope but is hardly ever available. Dipankur and Rachel (I don't have their last names) have been trained as has been John Manney. They would probably have to team with some of the above to gain more experience before soloing. Yasu Inugi can also operate the scope but has been very busy of late, but it can't hurt to ask. Tom Ryan can also run the scope but rarely attends open houses. These people probably know of some folks I haven't thought of. Whoever you get, find someone to partner with them, even if they have little experience with the scope as it can get very lonely at the observatory.

Weather predictions more than three days out are usually crap. Begin tracking the meteorology web sites about Wednesday and if the forecast looks good, start sending emails to the club firing them up to come out. I use the US Weather Service, Clear Sky Clock (or Chart as it is officially known), Weather Underground and Accuweather. Intellicast and Unisys Weather are also helpful.

We've adopted a rule of making a decision on the open house by 4:00 PM so the phone message can be changed in a timely way. More than once, however, the decision to cancel has been made only to see the skies clear at sunset. Sometimes you'll want to open even if the forecast is iffy. That's ok, we only have so many opportunities to observe on the weekend, but keep in mind you don't want to burn people out. If any possibility of rain exists, DO NOT open the observatory. If a storm comes, it is impossible to get the building secured before a great deal of damage is done.

The email announcing the open house needs to be sent out as early in the day Saturday as possible. Sometimes the forecast is firm enough to send out the email on Friday. The sooner it can be sent, the more members you'll likely see on the hill. The message should include what time you will open, where you plan to park the public, what conditions on the hill will be like (hot, cold, mud, bugs, etc.) and an admonition to drive safely. Including the times of sunset and the end of astronomical twilight helps both you and the members plan the evening.

You'll need to decide if you are willing/able to keep the hill open all night. If you need to leave before you think most other Lowbrows would want, you need to recruit someone to close. You may find yourself at your limit at 2:00 AM or 3:00 AM among Lowbrows who wish to continue observing. One of them must step up and volunteer to lock the gate, if not, you are within your rights to shoo them off the hill.

You'll need to arrive about 15 minutes before you announce the gate opening to set out the cones on the road if you plan to park people on the grass shoulder. It's always helpful to have a member park on the shoulder to give arriving guests the correct idea. I have also been placing signs on the shoulder of North Territorial at ground level pointing out the entrance. I'm not sure how helpful they are, but you can't always know what works.

We usually park the public on the grass shoulder below the crest of the hill on the way up to the radio telescope. However, early spring open houses sometimes find that shoulder too soft for cars and guests will have to be parked in the two lots at the top of the hill. If we have spring snow storms, the result will be the same.

Speaking of snow, most any storm will make the road up the hill impassable if it has not been plowed. The road also can be icy and difficult for some vehicles to navigate safely. The only way to know these conditions is for someone to drive out to the hill and check them out. Since you will have the key, that someone is likely to be you.

If the grass shoulder is not usable for parking that night, it is good for the members to know that ahead of time, as it means we will be parking people in the two lots by the radio telescope. And if the shoulder can't handle traffic, vehicles might tear up the field by the radio telescope as well. This means the members will have to carry their equipment onto the field. Members should park in the upper of the two lots under these conditions

The road down to the observatory and the ground around the building also needs to be checked. The two-track has a couple of soft spots that can ensnare an unlucky driver and the incline behind the observatory can be unclimbable due to ice or mud over still frozen ground. This only happens in late winter or early spring. If there is any possibility these conditions could exist, someone will have to walk the road to determine its' condition. This you can do after arriving. If the road is impassable, use the cones to block it off.

Guests should be greeted as they arrive. Sometimes members are willing to set up near the southeast corner of the field and be on duty the entire evening. Usually, though it will be up to you to either do it yourself or share greeting guests with all the Lowbrows at hand. Headlights coming around that last corner become visible to all up top and someone should begin walking that way.

Greeting the guests includes telling them they have indeed found Peach Mt. and are talking to a Lowbrow. Follow that with a short rundown of do's and don'ts. Star party etiquette is outlined on the Lowbrow web site. If the Observatory is open, offer to walk them down the path, or at least to it if they (and you) think they can walk the hundred or so yards safely.

Closing: Be sure everyone has left or is leaving. Collect the cones and signs and put them back in the observatory. The McMath operator will have buttoned down the scope and closed the building.

We have not yet determined a procedure for passing along the gate key. When I have had to be out of town for a open house, I've either transferred it at the previous meeting or the person has come by my house to pick it up. To keep ourselves square with the University, I believe the key should officially be in the "official" possession of a particular individual. As long as I'm responsible for recruiting open house coordinators, I would like that person to be me.

While cell phone use is banned on the hill, it is probably a good idea for one of the attendant members to have one. I can't remember any real emergencies, but you never know and a cell phone would be very useful.

Speaking of emergencies, we aren't set up in any way to deal with them. I don't recall much in the way of a first aid kit in the observatory and a first aid course has not been part of the requirement for those hosting the open houses. It is most likely a coordinator will have to call for help.

I likely have left something out, or some of what is here may be unnecessary, so feel free to make comments/deletions both large and small. The goal of this document is to give the person volunteering to conduct open houses enough information to be successful. Success will be elusive, though, if said person does not have strong support from the club. Thanks, Jim Forrester

University Lowbrow Astronomers' April 2012 Outreach Events

Strap on your seat belt for a busy April and May. I am just going to list the April events in this email, but will send a similar one toward the end of this month regarding May. Also, please keep in mind that I post these on the NSN calendar, mostly for your reference...so please use it. So here we go:

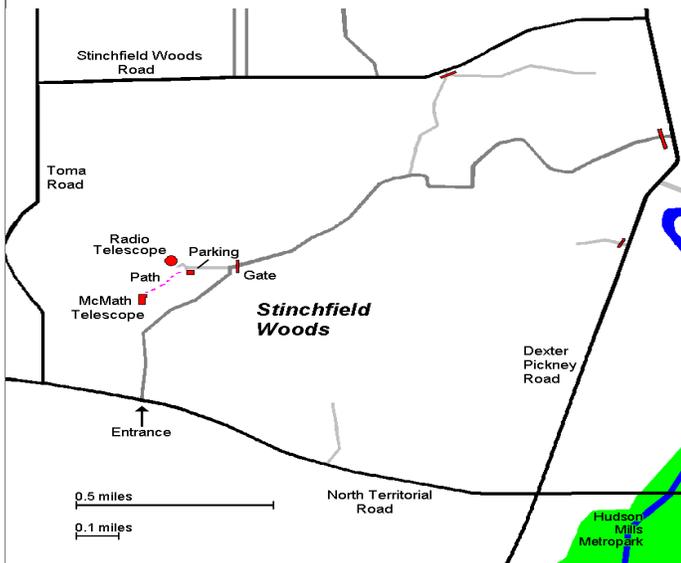
- 1.) Thursday, April 5, 6:30 PM, 130 Dennison--Jack Brisbin and I will be rehearsing our Chelsea ALI presentation. (just in case you are curious).
- 2.) Saturday, April 14, Sunset, Peach Mt.--Open House if the weather lets us.
- 3.) Tuesday, April 17, 1:00 PM, Lakewood School--the Lowbrow team doing our 5th grade presentation. (STILL LOOKING FOR TEAM MEMBERS)
- 4.) Wednesday, April 18, Noon, Peach Mt.--Astronomy Department radio telescope celebration. (not a Lowbrow event, but close enough)
- 5.) Friday, April 20, 7:30 PM, 130 Dennison--Monthly Lowbrow Meeting. (Elections and Swap Meet)
- 6.) Saturday, April 21, Sunset, Peach Mt.--Open House if the weather allows it.
- 7.) Sunday, April 22, 9:00 PM, Emerson School--another observing session at this site for students and parents. (PLEASE VOLUNTEER)
- 8.) Thursday, April 26, 7:00 PM, Triplet Building (809 W. Middle St., Chelsea)--Lowbrows presentation for Chelsea Adult Learners Institute. This is our second appearance for them. Jack Brisbin and I are doing the lecture, but we need Lowbrows to come out and bring scopes for observing after the indoor session, starting around 8:30 to 9:00 PM. Please let me know if you can help.
- 9.) Friday, April 27, 7:30 PM, Leslie Science and Nature Center--The AA District Library kicks off their telescope loaner program. I will do a short presentation about the program in the building and we will then move the scopes outside (weather permitting) to show people how to use them. I am looking for help for this event as well.

We also have AA School events on May 1 and May 22, but more on that later. Please let me know if you can participate in any of these events. Brian Ottum is helping with the Emerson School event and he will be sending a reminder later in the month. This one could get rescheduled, but we will let you know immediately if we change the date. Thanks everyone! Clear skies, Charlie

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.

(See the website

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

for more information on joining the club).

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.

Newsletter Contributions

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



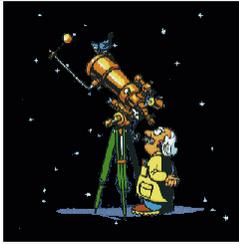
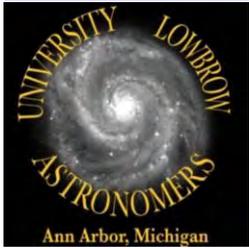
Lowbrow's Home Page

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



University Lowbrow Astronomers

Reflections & Refractions



Website

www.umich.edu/~lowbrows/

