The Observer

The Official Publication of the Lehigh Valley Amateur Astronomical Society

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ad astra

Jake Ginsberg from one of our neighbor societies, the Delaware Valley Amateur Astronomers, gave us a great talk for our June meeting on how to do some astroimaging without spending a lot of money. I found myself taking in his presentation from two different points of view at the same time. On the one hand, even though I have never done any serious imaging of my own, I have been hanging around with LVAAS' more-advanced astroimagers for too long to really "get into" the bargain-basement approach that Jake was talking about; but on the other, the results he showed were much better than anything I ever obtained when I dabbled with that aspect of the hobby; and his "barn-door" equatorial mount, constructed from "found" pine boards, certainly reminded me of some of my projects from my early days in astronomy.

For our July meeting/Members' Night/summer picnic, we will be hearing from Jon Bartz, a graduate student whom I met at Lehigh University, about his research on Be stars. (Don't forget, the July meeting is scheduled for Saturday, July 8, with Sunday July 9 reserved as a rain date. And we are starting at 5:00 p.m. with our picnic! Bring a dish to share; LVAAS will bring burgers, dogs, and beverages.)

Chuck and Donna Heading West

This month, long-time LVAAS members, great friends and tireless contributors Chuck and Donna Bradbury are moving to live under the drier (and probably less cloudy) skies of St. George, Utah. Most recently Chuck was our Member Services Director, running the Red Shift and getting us ready for our picnics and parties, often with help from Donna. My favorite memories of Donna are of her behind the buffet counter at the Holiday Party, getting all of those tasty dishes arranged for the crowd.

My favorite memories of Chuck, however, are up on the mountain, on the occasions he came up to help us assemble the 18" Cassegrain telescope in the Schlegel-McHugh Observatory. My recollection is a little fuzzy, but I actually think Chuck got stuck helping to hold up both the counterweight and the mirror cell, while somebody else threaded in the attachment bolts, on two separate occasions. Each of these is somewhere in the low-3-digit range in terms of weight in pounds, and my impression of Chuck's demeanor while he held up his end (I think Ron Kunkel was on the other end) was a careful balancing act: while he did not want to let us see him sweat, he also did not want to encourage whoever was getting the bolts started to lollygag.

I will miss seeing the Bradburys at LVAAS events, and I think everyone else will, as well. Thank you so much, Chuck and Donna, for being such a big part of LVAAS, and best of luck and happiness in your new home!

Megameet, Agility, and Superstition

At this point we are on Plan C with respect to Megameet. We have postponed it twice, due to poor weather forecasts, and are currently hoping for better luck for the weekend of July 21-23. We have not picked a new rain date yet, but you can be sure that it will not be in August, which instead is reserved for Solar Eclipse adventures.

We decided to schedule Megameet for early this year to give us plenty of chances to try to make it happen, after getting rained out last year. Now, it may be my imagination, but I think I am starting to feel some rain-date and postponement fatigue, at least in the emails on our Board of Governors mailing list. Hang in there, folks, the plan is working! We may have been rained-out or clouded-out twice already, but we still have 2 or 3 more chances to have a great event. So, even accounting for our bad luck so far, we are in much better shape than we were last year.

This is a hobby that requires agility, or flexibility, or whatever you want to call it, because the ultimate practice of astronomy — observing objects in the sky, outside Earth's atmosphere — requires said atmosphere to get more-or-less out of the way, and we never know when it is going to do that. So, when we plan an observing event for a specific time, we need to be prepared to reschedule or cancel. And, to get the most out of the observing opportunities that come up, we need to be prepared to get out there under the sky when those unexpected, unscheduled "perfect nights" show up.

In Pennsylvania, those can be few and far between, prompting astronomers, with "tongue in cheek" to entertain various magical ideas about how to make them happen more often. During this round of rescheduling Megameet, the BOG mailing list carried suggestions such as renaming it "Hopefullmeet" or "Rain meet" (or just relocating it to Nevada.) I seem to recall someone suggesting a rain dance, or "anti-rain" dance.

All of this gave me the idea that perhaps astronomers are more likely to be superstitious than scientists in any other subfield, since we depend so much on good fortune weather-wise to get anything done. This was sternly denied by one of our astroimaging veterans, who in the same breath proposed a pre-Megameet ban on buying equipment, to defeat the fancy-new-hardware jinx. At least somebody gets my jokes.

Keep the faith. We have had great Megameets in the past few years, and soon we shall again. Until then, take advantage of those great nights when they happen. Ad Astra!

— *Rich Hogg*

General Meeting Minutes of June 11, 2017 held at South Mountain, Allentown

Director Rich Hogg brought the meeting into session at 7:08 p.m. after a bit of delay due to technical difficulties because the wireless mouse was missing. He then noted that shortly Sandy Mesics would be introducing the speaker and that after the speaker there would be a short break, to be followed by the usual information session to include the introduction of new members, a brief treasurer's report, and other possible items of interest.

Sandy then introduced Jake Ginsburg, the speaker for the evening. Jake is the Publicity Chair for a sister club, the DVAA. Jake spoke on "Astrophotography Doesn't Need to be Expensive." Jake gave an entertaining talk about his 'no expense' foray into astroimaging. He demonstrated his barn door tracker that he built out of scraps of plywood and with erasers for vibration isolation pads. Members wishing to contact Jake can reach him at JakeGinsburg@gmail.com.

The presentation ended at 7:47 p.m., a break followed, and at 8:00 p.m. Rich brought the meeting back to session. Scott Fowler conducted membership readings. Second readings were conducted for Paul Zvarik and Kathlene Conn. First readings were conducted for Wendy Jamison, Sean Jamison, Charlie Wirth, Grant Pinsley, Warren Landis, Steve Merioine, Aaron Dotson, and Evan Putnam.

Rich then recognized some long-term contributors for their service to LVAAS. Jim Rittenburg. who is moving to northwest Montana, has been organizing speakers for our public star parties for a number of years. Chuck Bradbury is moving to Utah. Chuck and his wife, Donna, ran the Red Shift Store for a number of years.

Rich also mentioned that free replacement drive keys were available. Also mentioned was the fact that MegaMeet, scheduled for this coming weekend, would likely be canceled, and if so the new rain-date would be July 21-23. The final decision will be posted to the LVAAS website by Thursday afternoon.

Lastly he mentioned that the July Membership Meeting and picnic will be held here at South Mountain on July 8th starting at 5:00 p.m. The rain-date is July 9th, same time.

Rich then called on Treasurer Gwyn Fowler for a report. Gwyn reported income for the month of $390.81 and expenses for the month of $214.08. Additional expenses from the 40" Fund totaled $2948.48, essentially for coring the mirror. Frank Lyter reported that the 40" mirror has now been cored and it was next going to be rechecked to ensure that the figure had not been affected by the coring. Once this is verified, the next step is to send the mirror to Iowa for coating.

The meeting adjourned at 8:35 p.m.

Minutes were prepared and submitted by Secretary, Ron Kunkel.

July General Meeting, Members' Night & Annual Picnic

Saturday, July 8 (rain date Sunday, July 9), 5:00 p.m

Please check the website for weather-related updates

LVAAS South Mountain Headquarters
620B East Rock Rd., Allentown PA 18103

"The Latest on 'Be' Stars"

Jon Bartz, Lehigh University

So-called "Be stars" are massive, rapidly rotating, pulsating stars that occasionally eject mass from their surface, which then forms a disk. I will present recent results that describe the behavior of hundreds of these systems on timescales from hours to years.

Jonathan Labadie-Bartz is a 5th year graduate student at Lehigh University, whose research interests include massive stars and discovering "Hot Jupiter" exoplanets with the KELT collaboration. His dissertation work involves studying large numbers of "Be stars", which are massive and highly variable.

The LVAAS July General Meeting is a "pot-luck" picnic, with burgers, hot dogs, and beverages supplied by LVAAS. Please plan to bring a covered dish, dessert, or side dish to share. The event is scheduled for Saturday, but may be rescheduled for Sunday in the event of bad weather. If this occurs, an email will be sent to members in addition to an announcement on the website.

Swap Meet

Do you have items of interest to astronomers that you would like to sell or trade? You are invited to show them at the picnic (please bring your own display table.)

Megameet is currently scheduled for July 21-23. A new rain-date will be announced.

LVAAS Library Announcement

by David Raker, LVAAS Librarian

The following **videos** are new to the library collection:

Dr. Bonnie Buratti: The Rosetta Mission: Landing On A Comet

Gary Becker & Pete Detterline: August 2017 Solar Eclipse

The following videos were donated by **Pete Detterline (Thanks, Pete!):**

A. Einstein: How I See The World	IMAX: Cosmic Voyage
NOVA: Saturn's Titan	The Apollo Moon Landing
Inside the Space Station	If We Had No Moon
Genesis	Cosmic Collisions

The following **books** are new to the library:

Black Hole	Voyage to Mars
Beyond Earth	The Night Sky Month By Month
Deep Space	The Hubble Cosmos
Clyde Tombaugh: Discoverer of Planet Pluto	

The following books were donated by **Pete Deterline (Thanks, Pete!):**

Telescope Power	Leslie Peltier's Guide to the Stars
The Hole In the Universe	The Aliens Are Coming!
The Search For Life On Mars	What If the Moon Didn't Exist?
Before the Big Bang	Nearest Star (The Sun)
Star Hunters	

The library will close on July 31 until mid-August for the annual inventory of our library collection. Please return all books, videos and CD's by that time. Thanks.

For Sale – Like NEW

Meade 10” f/10 LX200GPS Schmidt-Cassegrain Telescope and Accessories

The telescope has the Ritchey-Chretien (advanced coma free) optics, Meade Autostar II controller, AC power supply, heavy duty tripod, Astrozap dewshield, and a Telegizmos scope cover.

Additional accessories include a Meade electronic focuser, an Orion 2” dielectric diagonal, a Meade 1¼” diagonal prism, and a very complete set of Meade 5000 Series eyepieces of focal lengths 8.8mm, 14mm, 18mm, 24mm, 26mm, and 34mm.

There is also a Meade Deep Sky Imager Pro II monochrome CCD camera and numerous filters, 2” 13% moon filter, 2” 1A Skylight filter, a set of four 1¼” CCD color filters, and assorted adapters.

The system also comes with Starry Night Pro Plus version 6 software and the required RS232 cable to interface to the telescope.

The system was purchased in January 2007 but used less than a handful of times. The total purchase price of the system approaches $5000 and is being sold as one complete unit, no parting out of the accessories.

Virtually all of the items come in their original boxes, some of them appear to have never been opened.

Asking price is $3000. If interested and you have questions, please contact the LVAAS Secretary, Ron Kunkel. You can get his email address from the LVAAS website’s Contact Us webpage.

Note, the system is not the property of Ron, he is simply facilitating the sale for a friend.

Hello,

We are reaching out to share with you information about the **Maine Astronomy Retreat** at Medomak Retreat Center in Washington, Maine - a vacation for you and your telescope!

Washington, Maine has some of the darkest skies in the Northeast, with a limiting visual magnitude of 6.3 (SQM value: 21.3 MPSAS). This summer, **July 23-29**, we are hosting our fourth annual Maine Astronomy Retreat. For six nights you will be able to revel under our expansive dark skies - we will have telescopes on hand and encourage you to bring yours, too. During the day, in addition to engaging lectures and programs by our expert facilitators, you can enjoy the use of our facilities, including a waterfront with canoes, kayaks and sailboats, tennis and basketball courts.

The retreat is led by **J. Kelly Beatty**, Sky & Telescope's senior editor, and **Bruce Berger**, director of Amateur Telescope Makers of Boston Research and Imaging Observatory; Our special guests will be **Rick Binzel**, Professor of Planetary Sciences at M.I.T. and co-investigator on the New Horizons mission, **Babak Tafreshi,** founder of The World at Night and nightscape photographer for the National Geographic image collection.

For this star party there's no need to bring a tent, sleep in a sleeping bag, or eat uninspired food. Medomak has comfortable, private cabins with real beds, hot showers, and electricity, as well as delicious, locally-sourced meals prepared on the premises. And it's all included in your tuition.

Please see our website, http://www.astronomyretreat.com, for more details, and to register.
If you have any questions, please feel free to give us a call at 1-866-MEDOMAK.

Thank you so much for your time and consideration.
Best regards,

David Brunner

Director

Medomak

Summer Camp for Families & Retreat Center for Adults

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Winter *September-May*	**Summer** *June-August*
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Clarksville, MD 21029	Washington, ME 04574
(301) 854-9100	(207) 845-6001

Schlegel Observatory Report

by Rich Hogg

July, 2017

This month I am going to run down the various options that have been considered for the radial support system for the main mirror, that is, the means of supporting the glass from the edge, when the telescope is pointed anywhere but straight up. This is an element of the design that was never finalized, so we need to choose a plan and get to the point where we can begin building it. I am going to go through all of the ideas that I know about, because although I have an idea that I think will work, I still think there might be a better one out there. If you are mechanically-minded and inventive, please think about our problem and send me any new ideas that you have.

Our mirror is a "full thickness" piece of glass, 40" in diameter and about 5" thick, and weighing perhaps 550 pounds. These days, most mirrors are less substantial, made from a "cellular" blank with hexagonal pockets in the back side, or just thinner glass. Our full-thickness glass is very stiff but also very heavy.

Supporting a large telescope mirror is a challenge because it must be allowed to deform, under its own weight, only very slightly. We want to maintain the shape of the optical surface to significantly less than a wavelength of the light we will be observing; perhaps, in the worst case, 100 nanometers, or 1 10-millionth the diameter (approximately 1 meter) of the mirror.

Ideally, we would like the mirror to be floating in space, so that gravity would not act to distort it at all. Our concerns here were not the concerns of the designers of the Hubble Space Telescope, who had to make a structure that would survive launch and keep the mirror properly aligned. In their support design they had to be careful not to distort it, but they did not need to fight gravity when doing so.

Most amateur telescopes with large mirrors are Dobsonians, with alt-az mounts. In these the tube only tilts in one direction relative to the mirror cell. For many of these, a sling of webbing around the edge of the mirror works well enough; the mirror "hangs" in the U-shaped sling and maintains its shape satisfactorily. Our system uses an equatorial mount and can tilt in any direction, so the sling will not work.

Let's take a detour for a couple of paragraphs and talk about the axial support system - that is, how the mirror is supported from the back side when pointed straight up, and how the fraction of the weight that must be supported axially is supported by the telescope. (This is the total weight times the sine of the azimuth angle; the total times the cosine is the radial support component.) The most common system for this is what is called a "whiffle tree" - a hierarchy of triangular, 2-dimensional see-saws that distribute one third of the mirrors weight to each of three points where the system attaches to the mirror cell. As long as the system is properly balanced and all of the joints can move freely enough, this system will work very well.

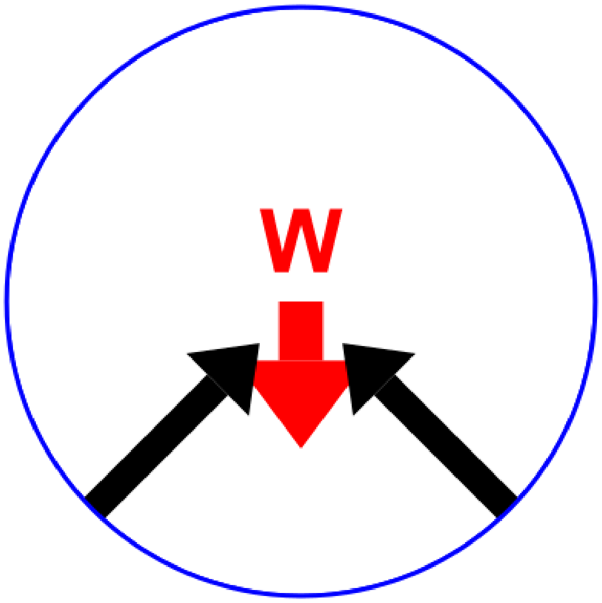
Our system is an airbag. The bottom of the mirror cell is a flat plate, with three hard supports (that are adjustable to allow collimating the system) equally spaced around the mirror. In between, there is a flat bag of rubber, perforated for the hard supports and protected by a layer of fabric, that can be inflated with air to lift the mirror; sufficient pressure (anything more than the weight, in pounds, of 5 cubic inches of Schott Duran 50 glass, or 0.4 PSI - not a lot) would lift the mirror entirely off the 3 hard supports. But, there is a system to regulate the pressure to only just take most of the weight off the hard points, leaving a little to keep the mirror in contact and pointed accurately, but supporting the rest evenly enough to keep the distortion within acceptable limits. The system in place is mechanical, but we will replace it with a more-reliable electronic system, that can be easily monitored.

This should work well, and it has the characteristics that we need for it to work well, that we also require for the edge support. First, it maintains the mirror in contact with the hard supports so that we can control its position. Except when we are collimating the system, we don't want it to move within the mirror cell at all - not a millimeter, ideally, not a nanometer. Second, the airbag supports most of the mirror's weight very evenly, leaving a small fraction of the weight to be supported at the hard points.

So what do we have right now? Well, we have a concrete disk instead of a mirror; the mirror is still at our optician's, and the concrete stand-in is there to keep the telescope balanced. It sits within an imperfect steel ring, through which are threaded a series of steel bolts that are screwed pointy-end into the concrete. Obviously this will not do for our very expensive glass.

In this photo, the "concrete mirror" is visible along with two of the hex-head bolts that are holding it in position in the radial direction.

Naively, one might think we could true up that steel ring, and replace those bolts with something that had a little bit of padding - furniture legs with plastic pads or something similar. That would not be good enough. Even if you could make everything perfectly, it could

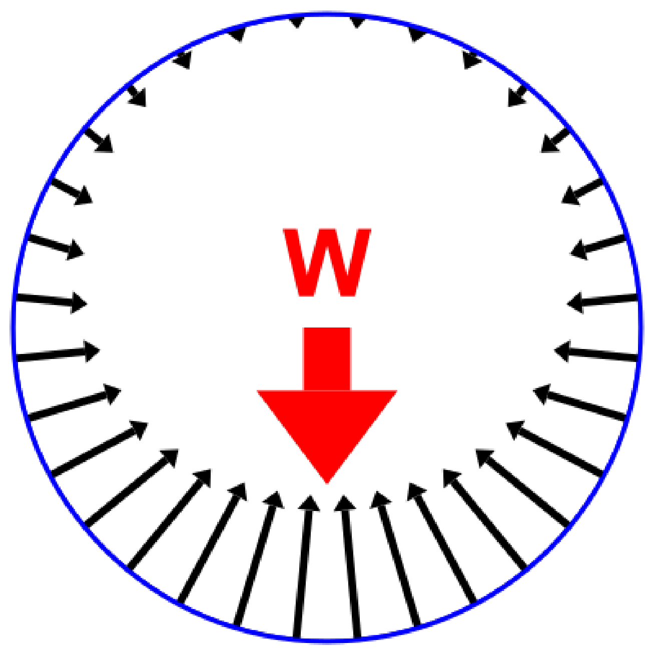


If we were to use hard supports - such as screws with plastic pads, like furniture legs - to support the rim of the mirror, in practice, the weight would normally be born by only two of them at a time, resulting in excessive distortion of the reflecting surface.

only be perfect at one temperature - different materials expand at different rates, and in fact our glass has a very low coefficient of expansion, but the materials that form the structure of the mirror cell (primarily, steel) will not. At low temperatures. the steel ring would contract and squeeze the mirror, slightly changing its focal length and distorting its figure, no matter which way it was pointed. At high temperatures the ring would loosen up and the mirror could move a little; also, depending on which way it was pointed, its weight would be borne by two hard points, causing its shape to distort.

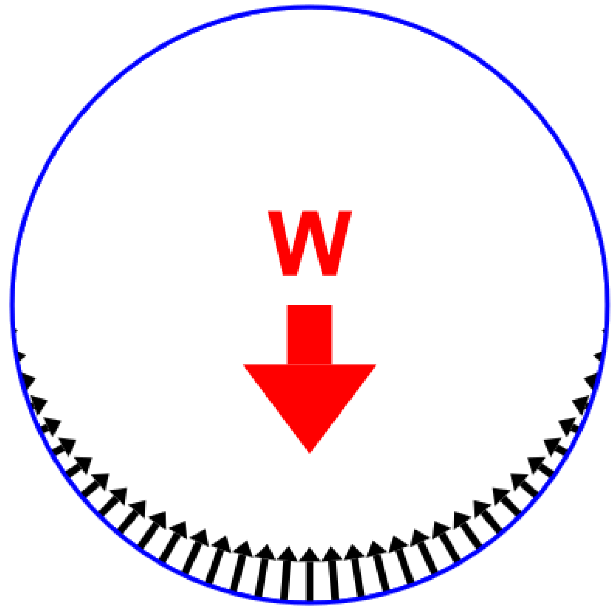
We actually want two hard points - exactly two hard points - to be in contact with the mirror at all times; this is how we will position the mirror, similar to the three hard points supporting the back of the glass. What we need is a suspension that takes most of the weight, but not all, off of the hard points, no matter which way the telescope is tilted.

How about two hard pads, and the rest of the circumference populated with regularly-spaced springy pads? First of all, if the mirror is surrounded by springs, it is getting squeezed, or "pinched," and we don't want that. Second, we want the springs on the bottom side of the mirror, depending on which way it is pointed, to apply more force to the mirror than the ones on the top, in order for the spring force to counteract gravity. But for the force applied by a spring to increase, it must be compressed, which would require the mirror to move. We don't want that either.



Springy pads around the edge of the mirror would "pinch" it, and they would also allow the mirror to move.

***The Mercury Tube* -** one idea that was considered by the some LVAAS members who previously worked on the design of the telescope, is a tube filled with mercury. I think this could work really well as long as it was accompanied by two hard pads, plus two opposing springy pads to lightly bias the mirror to press against the hard pads. The tube would be flat, like a deflated bicycle inner tube, and contain enough mercury to remain full up to about the halfway point of the mirror's circumference, no matter which way it is tilted. Mercury is about 6.1 times as dense as the glass, so if the width of the tube was about 1/3 of the thickness of the glass - about 1.6 inches - it should bear on the edge of the glass with the right amount of force to support it, as if the mirror was floating in a sea of liquid, displacing its weight with half its volume. This would give a nice, even support, as long as everything stayed where it was supposed to.

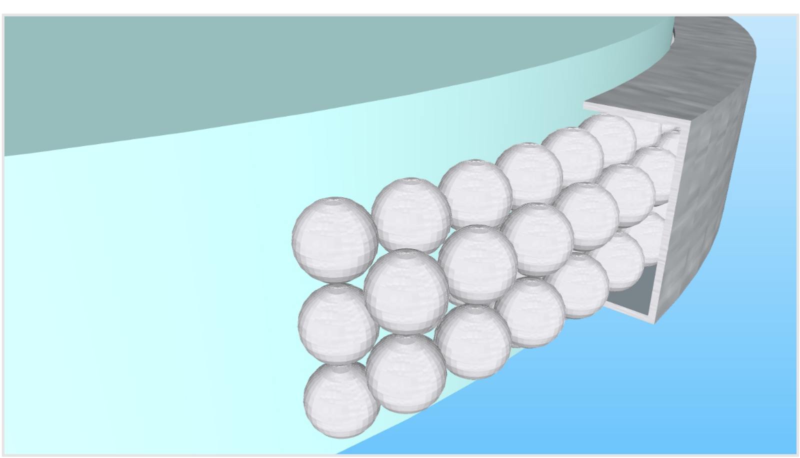


A properly-configured Mercury Tube would provide the mirror with nice, even support, resulting in minimal distortion and good optical performance.

Unfortunately, mercury is a health hazard, and containers, especially flexible tubes, eventually leak. Sooner or later, our observatory would become contaminated with poisonous metal vapor, and we would need to abandon it, and probably go bankrupt paying to clean it up.

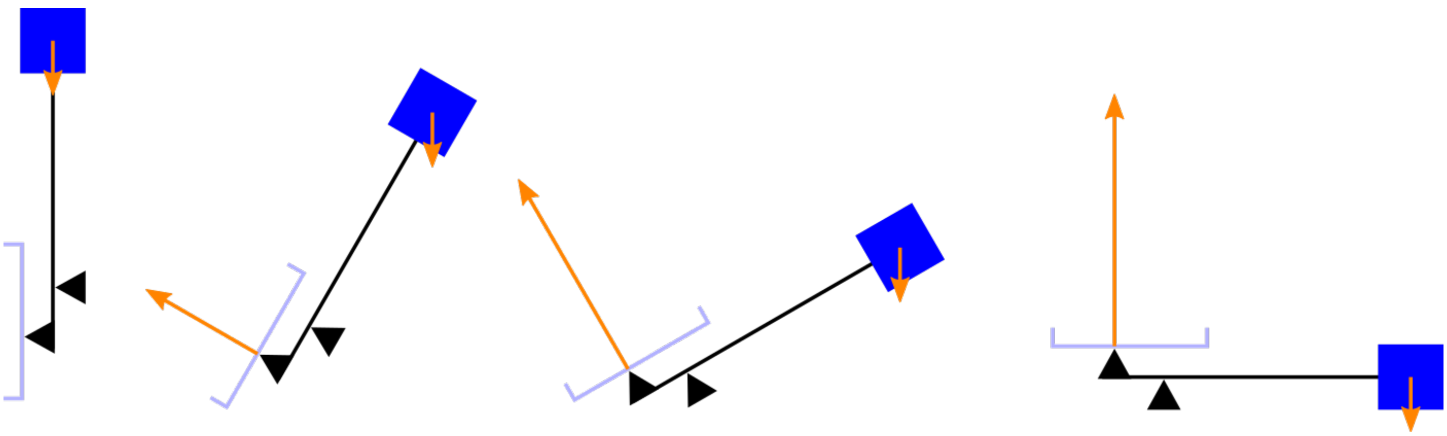
The only reasonable alternative to mercury that I have come across is gallium, or an alloy of gallium such as Galinstan. This is about half as dense, so the tube would need to be twice as wide. Gallium is safe for humans, but it is fatal to aluminum, so in the event of the inevitable leak, the cleanup would be less expensive; but our telescope would likely be destroyed.

I also considered an idea to mimic the action of a free-flowing liquid with some ensemble of solid objects. A precision-machined U-shaped channel, half-filled with a loosely-stacked, free-rolling array of steel (or tungsten?) balls, might be made to do the job, at least until the stink-bugs crawled in there and gummed everything up. (I think this is a really bad idea, but I included it anyway on the chance that it might inspire a good idea.)



Maybe a system of stainless-steel (or maybe tungsten) balls rolling around in a U-shaped channel could mimic the effect of a mercury tube in applying pressure to the mirror. The channel would need to go all the way around the mirror, and the balls (like the mercury) would only fill it half-way, requiring some sort of lightweight "bearing cage" to keep them stacked properly. I think we are going to put this idea on the shelf for the time being.

Astatic Levers - another "passive mechanical" design, i.e. one that applies the correct force to the mirror just by virtue of how its mechanical configuration responds to the positioning and tilting of the assembly, is a proven system for mirror support known as "astatic levers." For radial supports, the level is parallel with the tube, and when the tube is vertical, the weight on the lever is born entirely by the lever's fulcrum support of the lever (and, the weight of the mirror is born by the axial airbag support.) As the tube starts to tilt from vertical, the gravitational moment of the weight on the lever exactly counterbalances the radial load of the mirror.



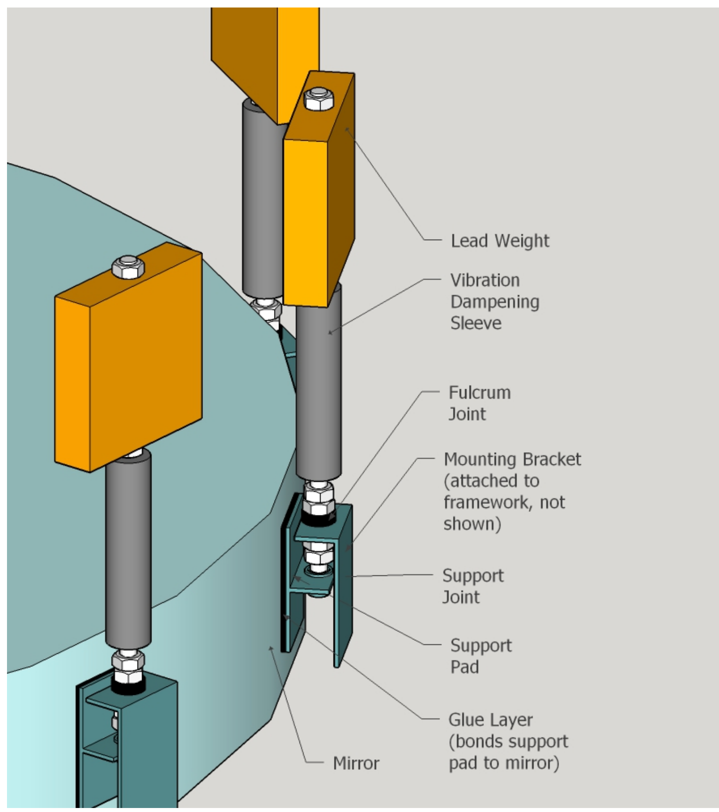
Each astatic lever contributes the proper force to bear its share of the mirror's radial support load automatically, as the mirror is tilted in any direction.

This needs a weight at the end of the lever, and the total weight on the levers needs to equal the total weight to be supported, divided by the ratio of the arm lengths. If we surrounded our mirror with astatic radial support levers, we could arrange them so that they were pointing towards the front of the tube, and arrange for the weights to end up close to the DEC axis, so they would not affect the balance of the telescope too much.

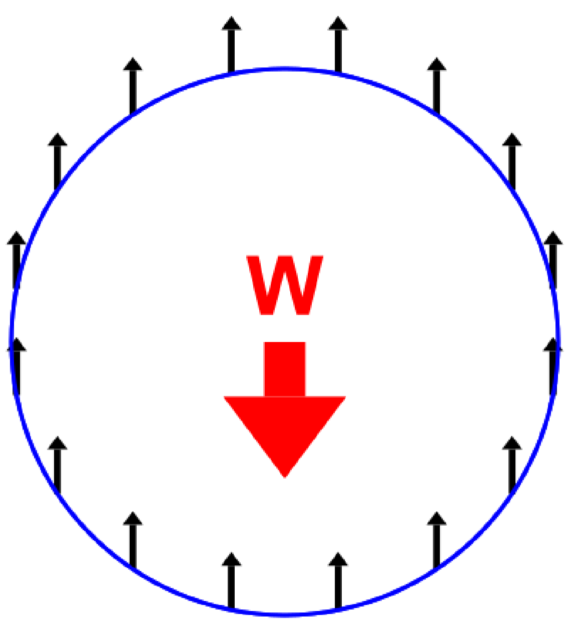
The next design consideration for this system is related to controlling the amount of added weight, and supporting the mirror more evenly. Most of these support options involve some kind of surface that touches the mirror, and can only press against it - in other words, apply a normal force inwards towards the center of the mirror. That means, when the mirror is tilted in a certain direction, most of the weight is borne by about 25% of the support fixtures that are on the "bottom" in that tilt direction. If this were the case with the astatic levers, then we would need enough levers to bear 4 times the weight of the mirror, since effectively only one quarter of them would be providing support at any time. The required weight of the counterweights would be the mirror weight, times 4, divided by the leverage ratio. This seems to me like it would be too much weight.

So I considered another design, where the lever is able to support the mirror not only by pushing on it, put also by pulling on it or applying force in a sideways directions - in other words, applying a combination of compression, tension, and shear forces, rather than just the compression force of a typical pad support. We could do this by creating a bonded support, in other words, by gluing the ends of the fixtures to the glass, rather than just having them press against the glass. Bonding a support fixture to a mirror is not uncommon in telescope design, and in fact a former LVAAS member who designs mirror supports for space telescopes gave me the identity of the product that NASA would use for this purpose. I priced it at about $1,000 per gallon! However, one of its attributes for space applications, very low outgassing in a vacuum, is not a requirement for us, and we could probably use something much cheaper.

So, I worked up a preliminary design for an astatic lever system consisting of 16 levers, equally spaced around the mirror. But then, I set this design aside. It just seemed to difficult, expensive, and risky (I had nightmares about what could happen while installing heavy lead weights on lever arms just inches above our mirror surface.) It looks like it could be fitted into our mirror cell, but it would be tight, creating a cluttered space in a critical and sensitive part of the instrument. I really think of it as a pretty good idea, but we can do better. So, I decided to put this idea on the back burner and look for something else.



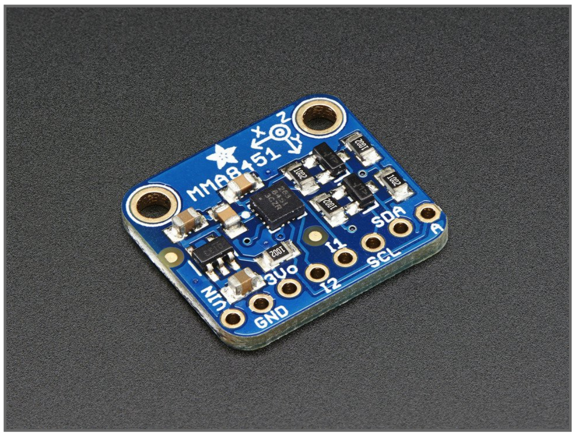
A design for a system of 16 astatic levers arrayed around the rim of our mirror, each bonded to the glass so it can provide support in tension or shear as well as compression. The amount of clutter this creates in the mirror cell, as well as the hazard of installing large blocks of lead inches above our precision optical surface, convinced me to look for alternatives.



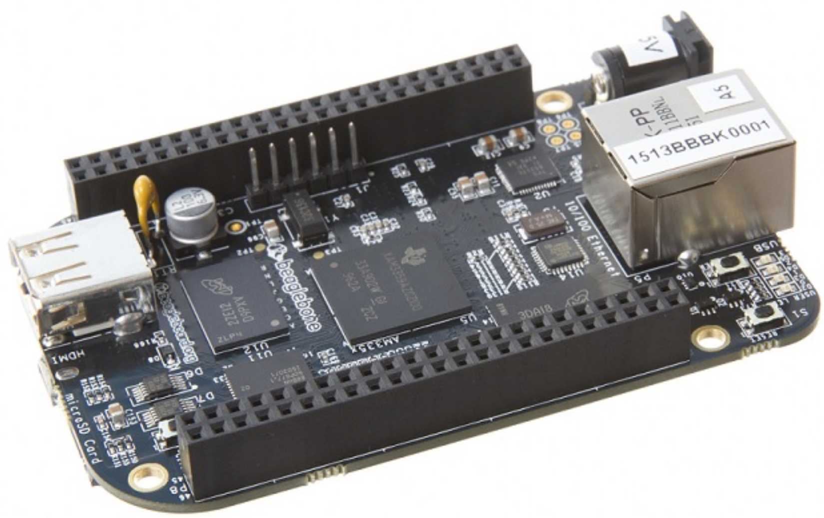
By being bonded to the glass, the astatic levers could apply force in tension and shear as well as compression, and so would support the mirror from all sides.

Floating on Air - the next scheme I decided to look at is to take the airbag system we have for axial support, and extend it to fulfill the radial support requirement. And (spoiler alert) this has become my new "Plan A." I am still interested in hearing any new ideas that you, readers of this article, may come up with, but I have been thinking about the airbag notion for a while and I still like it.

What would be needed to make this work? The idea is to have a bunch of small airbags around the edge of the mirror, and a control system that would keep just the right amount of air in the various bags to support the mirror, and gently press it against two hard supports. Here are the components we need to do this (just for fun, sort of in backwards order):

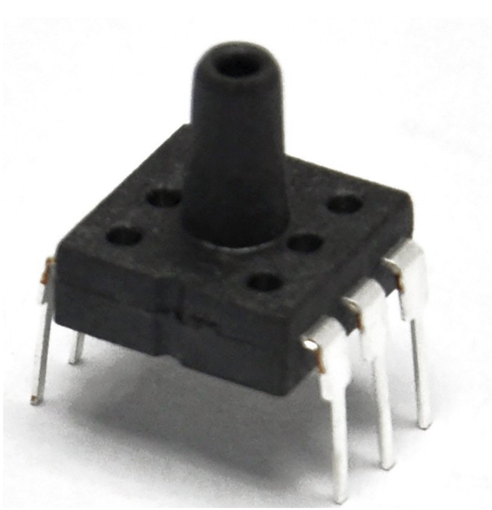


A tilt sensor, in order to know how much the telescope is tilted and in what direction. We could use the RA and DEC axis encoders to figure this out, but electronic tilt sensors (accelerometers) are so inexpensive these days that it makes sense to have an independent system.



A control computer. For the price of a decent restaurant meal you can now buy a small computer that is more powerful than the biggest supercomputer in the world was, at the time this project was started, so the control computer is not a big deal.

Air pressure sensors to monitor the pressure in each airbag. Again, this is something that is very inexpensive.

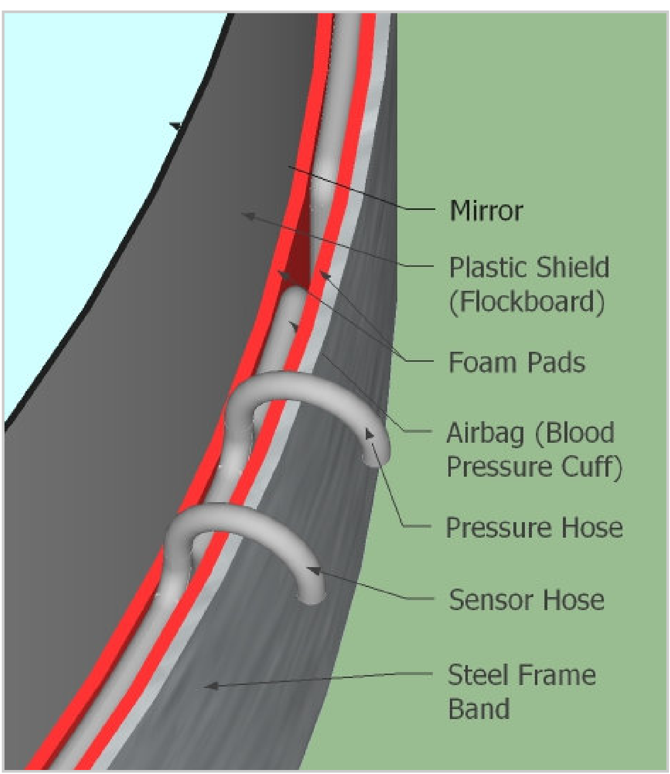


Solenoid valves to allow adding and releasing air from each airbag, under control of the computer, using feedback from the pressure sensors. This might be the most expensive part of the system, but I have not done much shopping yet.

What I have found so far is very inexpensive, but I'm a little worried that it might not be reliable enough for our purposes.

We will need a bunch of plastic tubing and fittings for the "air wiring" (and, of course, copper wire for the "electron wiring.")

Finally, airbags. Here is the part of this idea that tickles me, and why I saved it for last: there just happens to be a product that is readily available and reasonably priced, that is almost exactly what we need. I have one in front of me that I bought for about $7.00. The air-containing portion of it is 5 inches wide (exactly the same as our glass) and 9 inches long, so we can fit 12 around the circumference with some space in between. Each has two rubber hoses connected to it for supplying and monitoring the pressure, and a nice, protective, comfortable fabric covering, with a little patch on it that has an arrow and the word "ARTERY." It is an old-style manual blood-pressure cuff, and I am seriously proposing to incorporate a dozen of them into the design of our mirror support.

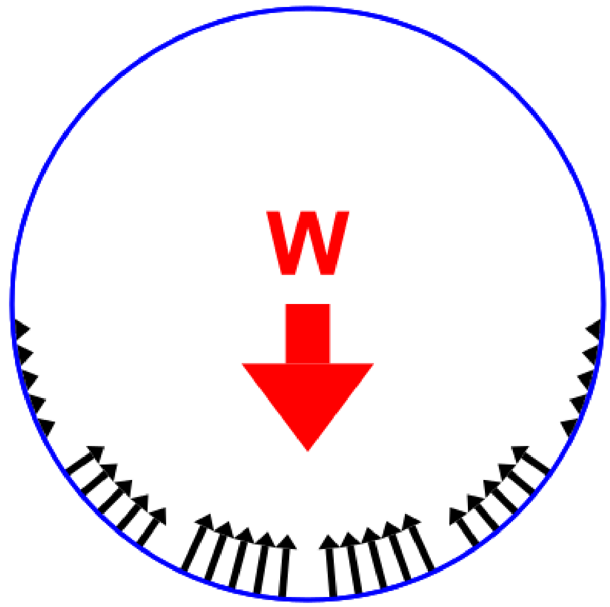


A rough design for the radial support system using airbags. In this design the airbag is shown with the outer fabric cover removed, and the rubber bag protected by layers of foam or rubber padding, which also serves to provide clearance for the rubber hoses that are connected to the edge of the bag.

A layer of [Protostar Flockboard] is shown separating the mirror from the support system, extending above the mirror surface by a few inches. It serves several purposes: it helps to prevent the air hoses from getting into the optical path; it provides some protection of the mirror surface from incidental damage when work is being done on the support system and other components in the mirror cell; and it absorbs stray light.

Airbags would provide support similar to a mercury tube, though not as smoothly distributed, and with some gaps. The pressure in each bag would be controlled by the electronics to apply just the right amount of force from each individual bag. The illustrations show a system using 12 9-inch bags with small gaps between them; we could increase the number of bags by finding smaller ones, or even by overlapping the bags in the system.

In practice, the system will need at least 4 gaps between the bags, just as the axial support airbag has 3 holes in it. The mirror must be in contact with 2 "hard supports" that will fix its position for correct optical performance. The hard supports will support the mirror when the telescope is powered down, and the system will control the pressure to keep the mirror lightly in contact with them during operation. The other 2 gaps are needed for "safety supports" which would ordinarily not touch the mirror, but would support it if the tube were pointed in a direction that takes the weight off the primary pads, while the air system was not in operation.



Magnets - I mentioned the airbag concept to a couple of members at a recent star party, and they suggested an alternative: electromagnets. So, I spend some time researching the idea. So far, it does not seem to me to work as well as the airbags.

There seem to be two primary types of electromagnets commonly available that we could use. One is called a "lifting magnet," and is intended to be used for picking up objects made of iron or steel. They are strong and relatively inexpensive, but they are designed to operate in contact with the load, which does not give us any way to control the force being applied. We would need to introduce a small gap, so that we would know the force as a function of the electrical current supplied to the magnet and the size of the gap; without the gap, we would only know the maximum force that it could be applying. Also, since these magnets are designed to pull on their load, instead of push, we would need some kind of U-shaped bracket to wrap around the magnet and push against the mirror. The problem with them is I don't know how we could control the size of that gap adequately. The lifting magnet would act like a spring with a very high spring constant, in other words, the force is highly dependent on the distance, such that we would not be able to rely on just the static mechanical construction of the system to maintain the right spacing over all temperatures - we would need some additional sensing or control in order to regulate the applied force adequately, making the system very complicated and expensive.

The other type of magnet that is readily available is a solenoid - a common component in electronic doors, vending machines, factory automation, etc. We would need a solenoid designed for continuous operation on direct current, rather than intermittent duty using AC, which is much more common. I have found a few products that might meet our needs, but the dollar cost, the amount of electrical power required, and even the weight add up pretty quick. So far, I do not think the idea is preferable to the airbag concept, but I may do some further research on it and keep it in reserve as a backup.

A suitable solenoid for use as an active mirror support instead of airbags? It can apply about 1.5 pounds of force, draw about 5 watts of electrical power, and cost over $35.00. We would need almost 1,300 of them, assuming we only allow the instrument to be used down to 30 degrees altitude above the horizon, where 87% of the mirror's weight is supported radially - since only 1/4 of the solenoids would be effective at any one time, depending on which way the telescope is tilted.

Summary - we have gone through quite a variety of possible solutions for the radial support of our 40" mirror.

- The sling used in many large Dobsonians is not suitable for an equatorial mount that can tilt in any direction.
- The current, rigid support system, even if improved with pads on the ends of the bolts, will not support the mirror well enough to avoid distortion, especially when different rates of thermal expansion are considered.
- A system that surrounds the mirror with springs or cushions would pinch it, as well as allowing it to move slightly.
- A mercury tube would be a health hazard. Gallium as an alternative would be hazardous to the mirror and elements of the structure. Simulating the effect of mercury with steel balls would probably be very difficult to get working and would be vulnerable to insect infestation.
- Astatic Levers would be difficult and somewhat risky to implement, but would probably work, and are a plan that is being kept in reserve.
- An active support system using electromagnets looks like it would probably not be practical, but may be worthy of further research.
- An active support system using airbags made from blood-pressure cuffs seems like the best option at this time.

If you have another idea that you think might be better than the airbags, or even if you have a crazy idea that might be entertaining to share and might inspire something new, please send me an email.

Current Status and Activities: For the record, the new RA motor driver circuit for the 18-inch has been installed and is working well. I observed a couple of unrelated minor anomalies in how the drive system is performing that will need further investigation, but I will come back to them at a future date.

The forty-inch mirror has been approved by Lockwood Optics to be released for coating. They will be using the same coater for a couple of other projects, so they are planning to ship them all together, which will hopefully save us a few dollars.

We have made some progress in the observatory building: Ron has applied a coat of polyurethane paint to the existing plywood floor to increase its water-resistance, before we cover it with the additional layer of sub-flooring. Additional progress on the floor has been delayed by all the rain, and progress on the electrical work has been delayed by the desire to keep the building in service for Megameet.

Ron's Ramblings

Ron's Ramblings is a monthly series of articles describing some recent or otherwise important event in astronomy. The ramblings will attempt to describe both the astronomical event and its significance. Obviously, the description will be that of a rambling amateur astronomer.

Stolen Stars in the Milky Way

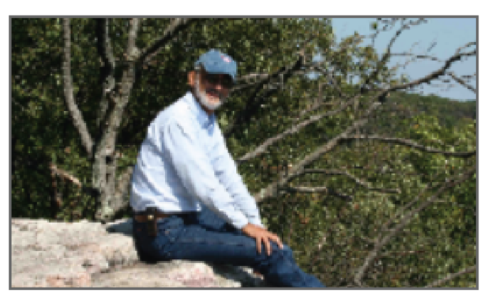
The diameter of the disk of the Milky Way is about 120,000 light years. This disk is however imbedded in a spherical halo of old stars and dark matter that extends out to at least 300,000 light years from the center of the galaxy. Researchers have now identified that at least 5 of the 11 most distant stars known to reside in this halo have likely been stolen from the Sagittarius Dwarf galaxy.

Astronomers from the Harvard Smithsonian Center for Astrophysics built a computer model to simulate the orbit of the Sagittarius Dwarf galaxy around the Milky Way for the past 8 billion years. The model is based on astronomical observations and is designed to replicate the proposed dwarf galaxy's velocity and approach angle to the Milky Way. These parameters determine the orbit of the dwarf galaxy around the Milky Way. The model predicts that the dwarf galaxy would, over the course of 8 billion years, lose at least a third of its stars and 90% of its dark matter to the spherical halo of the Milky Way. The model actually predicts three streams of stars stretching from the Sagittarius Dwarf around the Milky Way. Using the Sloan Digital Sky Survey, the astronomers identified five distant stars that are believed to be a small part of the stream of stars stolen from the Sagittarius Dwarf.

The Sagittarius Dwarf is just one of dozens of dwarf galaxies orbiting the Milky Way. Each passage of these dwarf galaxies allows the strong gravitational pull of the Milky Way to steal stars from the smaller galaxy. The astronomers believe that many more stolen stars are just waiting to be identified and that these discoveries will eventually uncover the larger structure of the star steams predicted by their model.

References:

Farthest Stars in Milky Way Might Be Ripped from Another Galaxy. (2017, January 11). Retrieved from https://www.cfa.harvard.edu/news/2017-02



The end of my ramblings until next month-
Ron Kunkel

StarWatch

by Gary A. Becker

Filtered Solar Eclipse Viewing

Previously I wrote about safe and inexpensive solar projection techniques for viewing the August 21 total solar eclipse. If you are not positioned along the narrow path of totality that stretches across the continental US from Oregon to South Carolina, then all aspects of the eclipse will be partial, and at no time will it be safe to view the sun unless the image of Sol is safely projected or filtered.

The eye acts like a lens, focusing light onto the fovea and retinal net. "The mechanism by which retinal tissue damage occurs in solar retinopathy (retinal 'disorder' burn) is photomechanical [and chemical] in nature (Ross Bronson Chod, MD), due to the sun's brightness." This situation may be thermally enhanced if the retina is heated by infrared radiation from the sun, but it should be noted that staring into any bright light source is bad for the eyes. In addition, the retinal net has no pain sensors, making it difficult at the time of observation to realize that any damage is occurring. In most cases, patients with solar retinopathy make partial to full recoveries after about 18 months, but you'd be plain **stupid** to take any chances. In addition, the overwhelming brightness of the sun hides the moon in a total solar eclipse until about 10-15 seconds before totality. Filtering the sun's light is an inexpensive alternative that produces a much sharper image than the simple projection techniques discussed last week, but the solar intensity must be reduced by about 99.999 percent before safe solar viewing can occur.

Here are some suggestions. Go to any welding supply store and purchase a **No.14** welder's filter. They come in two different varieties. A less expensive version produces a green representation of the sun, and for a few dollars more, a filter that is "gold" coated, which will give the observer a more natural view of Sol. You can also buy goggles, usually red in color, with a filter holder in front to watch the eclipse.

My recommendation, however, is to purchase a pair of black, Mylar eclipse glasses which can be worn just so or over regular glasses. **None of these filtering techniques are meant to be used at the eyepiece end of a telescope or binoculars.** The focused light from the sun will melt the Mylar or crack the welder's filter. Contact Rainbow Symphony for Mylar eclipse glasses at https://www.rainbowsymphony.com/eclipse-glasses/ or stop into the Collier Hall of Science office at Moravian College where Lou Ann Vlahovic (610-861-1425) will sell you as many as you would like for just a buck each. Do it now before the big rush in a few weeks.

Moravian College Astronomy - astronomy.org

From the LVAAS Archives:

LVAAS Officially Acquires Pulpit Rock, and a History of LVAAS Eclipse Expeditions

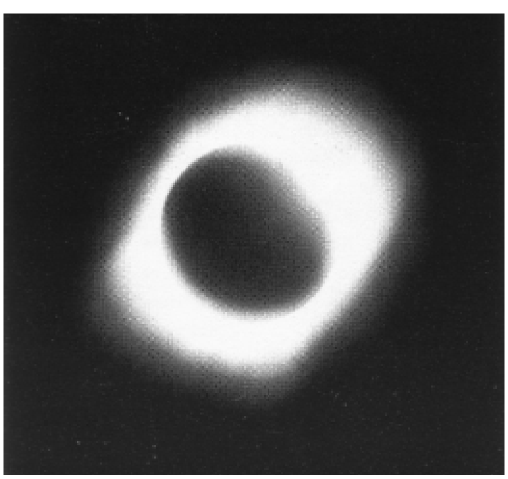
by Sandy Mesics

On Friday, April 14, 1967, the contract for ownership by the LVAAS of 4.35 acres of land atop Pulpit Rock was recorded in the Berks County Court House by LVAAS attorney Robert van Hoove and Director Ernie Robson. On the same date, the final draft of the agreement for an easement to build a road via the Hamburg Reservoir to the site was written and concluded by attorney Van Hoove and attorney Weidener of the Hamburg Borough. LVAAS officers would appear at Hamburg Council meeting on April 17, 1967 to receive the township's signatures. The actual agreement to deed the land to LVAAS didn't come about until March 27, 1967, and the deed was executed on July 25, 1967.

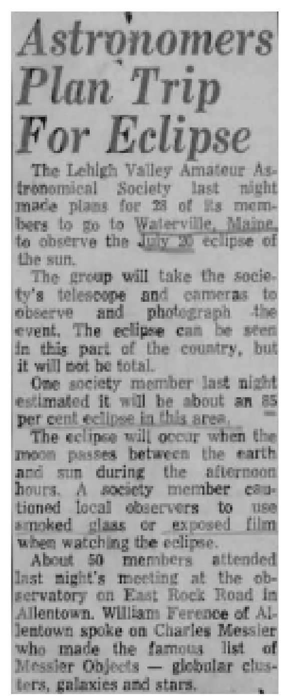
1. Left to Right: Henry Kawecki, Secretary Paul Shenkle, Director Ernie Robson, and attorney Van Hoove.

The Total Solar Eclipse of July, 1963

LVAAS has a rich tradition of observing solar eclipses in the United States. On July 20, 1963, a total eclipse occurred in New England. Twenty-three LVAAS members made the trip to Maine to see the eclipse, and enjoy only 59 seconds of totality. Unfortunately, there was no report of the eclipse in the meeting minutes or the Observer: the event was "eclipsed" by the dedication of the South Mountain headquarters, which took place in September 1963. LVAAS sold slide sets of the eclipse taken by members. A set of 5 was offered for sale through Sky and Telescope for $2.50. By December, 1963 twelve sets were sold through Sky and Telescope.



2. Photo taken at Great Indian Lake, ME. July 20, 1963 by Bill Ference.



Astronomers Plan Trip For Eclipse

The Lehigh Valley Amateur Astronomical Society last night made plans for 28 of its members to go to Waterville, Maine, to observe the July 20 eclipse of the sun.

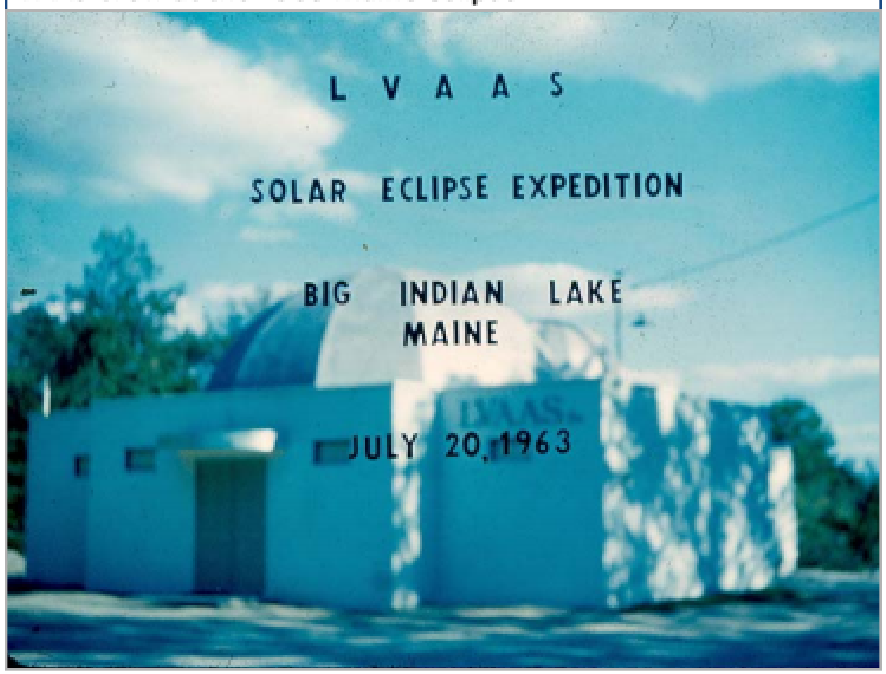
The group will take the society's telescope and cameras to observe and photograph the event. The eclipse can be seen in this part of the country, but it will not be total.

One society member last night estimated it will be about an 85 per cent eclipse in this area.

The eclipse will occur when the moon passes between the earth and sun during the afternoon hours. A society member cautioned local observers to use smoked glass or exposed film when watching the eclipse.

About 50 members attended last night's meeting at the observatory on East Rock Road in Allentown. William Ference of Allentown spoke on Charles Messier who made the famous list of Messier Objects — globular clusters, galaxies and stars.


LVAAS Crew at the 1963 Maine eclipse



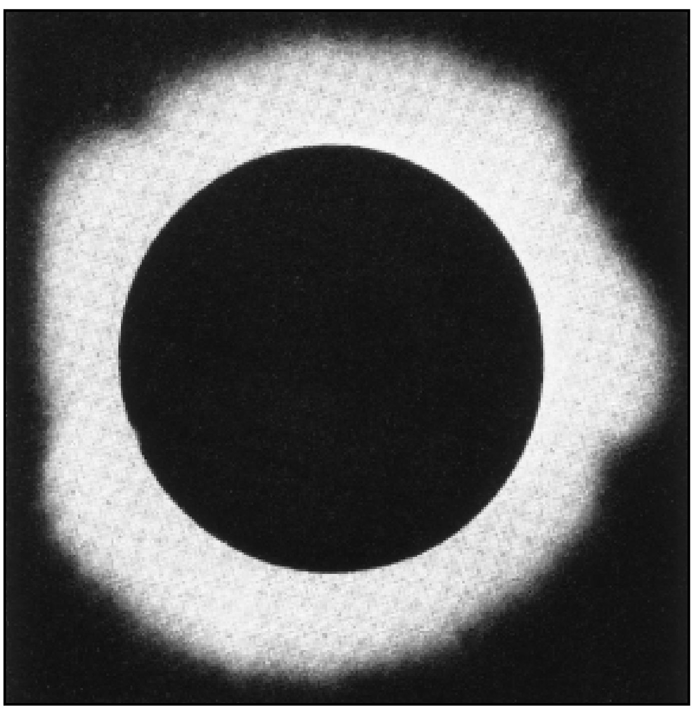
The Total Solar Eclipse of March 7, 1970

This eclipse offered three minutes of totality, and an LVAAS expedition of 36 members rendezvoused at the Redwood Motor Lodge on Interstate 95, just north of Lumberton, North Carolina. First contact was at 12:10, totaliting at 1:28 p.m. and ending at 1:31 p.m. Last contact was at 2:46 p.m. LVAAS observing projects were ambitious, and included shadow-band photography, comet search, coronal studies and photography, and environmental changes.

George Maurer gave an elegant account of the event in the April 1970 Observer. The society observed the eclipse from Jones Lake, in Bladen Lakes State Park, near Elizabethtown, NC. There were 36 persons in the expedition, 22 of [whom] utilized telescopes, cameras and auxiliary equipment. Some early morning fog lifted by 10 a.m., and the temperature rose to 65 degrees by first contact. The temperature continued to drop during the eclipse, hitting a low of 55 degrees about 9 minutes after totality.

The LVAAS eclipse expedition in North Carolina, March 7, 1970

"The main event of totality approached quite dramatically. ... The appearance of Bailey's Beads followed by the diamond ring, stirred the emotions of everyone present, a crowd of several hundred by this time. A chorus of sighs followed by spontaneous applause rang through the air and, as if to reply, Venus seemingly blazed into view as the ring quickly faded into totality. The darkness of totality comes on abruptly, as if controlled by a switch. ... The darkness of totality was not the deep blackness of night, but more like the dusk of evening after most all of the color has faded from the sky. Along the Southern horizon, a reddish glow appeared; a false sunset."



North Carolina 1970. Photo Paul G. Shenkle

Two sets of slides depicting the eclipse were shown at the end of the May, 1970 general meeting, and were apparently well-received.

For the upcoming August 21, 2017 eclipse, Frank Lyter of the Board of Governors formulated a plan for an LVAAS eclipse expedition, but there was not enough interest to pursue this as a Society project. Members are mostly making their own plans to observe the event, some from Oregon, others from Wyoming, to Tennessee. Everyone has their own logic: the odds of favorable weather, the length of totality, or simply the cost.

We can be sure that come August 21, either none, some, or all of our members will be successful with their individual expeditions. We can also be sure that no matter how successful, we will miss the camaraderie of an LVAAS group during those moments of totality.

Sources:

The Observer, May 1967, March 1970, April 1970

Cherry Springs Star Party 2017

Frank Lyter

Here are some unadulterated photos from this weekend at the Star Party. Josh, Tom Duff's grandson, was the big winner at at the raffle, winning two meteorite samples! We had some nice hours of viewing Saturday night till around 1 am when clouds, then the showers rolled in. Club member attendees included Mike Morgan (another double winner at the raffle), Tom Duff (another double winner at the raffle), Bill Dahlenburg, John LaShell, Eric Loch and Frank Lyter.

I was showing some folks views of Jupiter in the darkness, and a couple recognized my voice - turns out they are my neighbors from the Kempton area, who have a cabin in the area and were visiting the event for the first time (small world.) It was remarkable that the light from the Milky Way provided enough illumination to permit walking from telescope to telescope. Folks that were willing to allow the public to view through the scopes hung red glow sticks at the telescopes. I was next to a group of Dobsonian telescope builders from Ontario, Canada with great conversations and liberal use of the catchy phrase 'eh'.

There are rules limiting use of white lights to save your night vision, which are strictly enforced on the field. Wouldn't you know it, some unnamed LVAAS member from the Kempton area determined that if you bumped your pocket containing your car remote twice, your car would remotely start and the dashboard and headlights come on. Fortunately the headlights were covered with a tarp, but there was some razzing from unnamed astronomers, eh :)

Regards,

Frank

Cherry Springs Star Party 2017: Clockwise from top (L): Southern view of Milky Way; Northwestern view MW; large Dobsonian; Tom's Camp; Observer preparations; Bill's camp. Photos by Frank Lyter.

*This article is provided by **NASA Space Place.** With articles, activities, crafts, games, and lesson plans, NASA Space Place encourages everyone to get excited about science and technology. Visit spaceplace.nasa.gov to explore space and Earth science!*

The Shape of the Solar System

By Marcus Woo

When Stamatios (Tom) Krimigis was selected for the Voyager mission in 1971, he became the team's youngest principal investigator of an instrument, responsible for the Low Energy Charged Particles (LECP) instrument. It would measure the ions coursing around and between the planets, as well as those beyond. Little did he know, though, that more than 40 years later, both Voyager 1 and 2 still would be speeding through space, continuing to literally reshape our view of the solar system.

The solar system is enclosed in a vast bubble, carved out by the solar wind blowing against the gas of the interstellar medium. For more than half a century, scientists thought that as the sun moved through the galaxy, the interstellar medium would push back on the heliosphere, elongating the bubble and giving it a pointy, comet-like tail similar to the magnetospheres—bubbles formed by magnetic fields—surrounding Earth and most of the other planets

"We in the heliophysics community have lived with this picture for 55 years," said Krimigis, of The Johns Hopkins University Applied Physics Laboratory in Laurel, Maryland. "And we did that because we didn't have any data. It was all theory." But now, he and his colleagues have the data. New measurements from Voyager and the Cassini spacecraft suggest that the bubble isn't pointy after all. It's spherical.

Their analysis relies on measuring high-speed particles from the heliosphere boundary. There, the heated ions from the solar wind can strike neutral atoms coming from the interstellar medium and snatch away an electron. Those ions become neutral atoms, and ricochet back toward the sun and the planets, uninhibited by the interplanetary magnetic field.

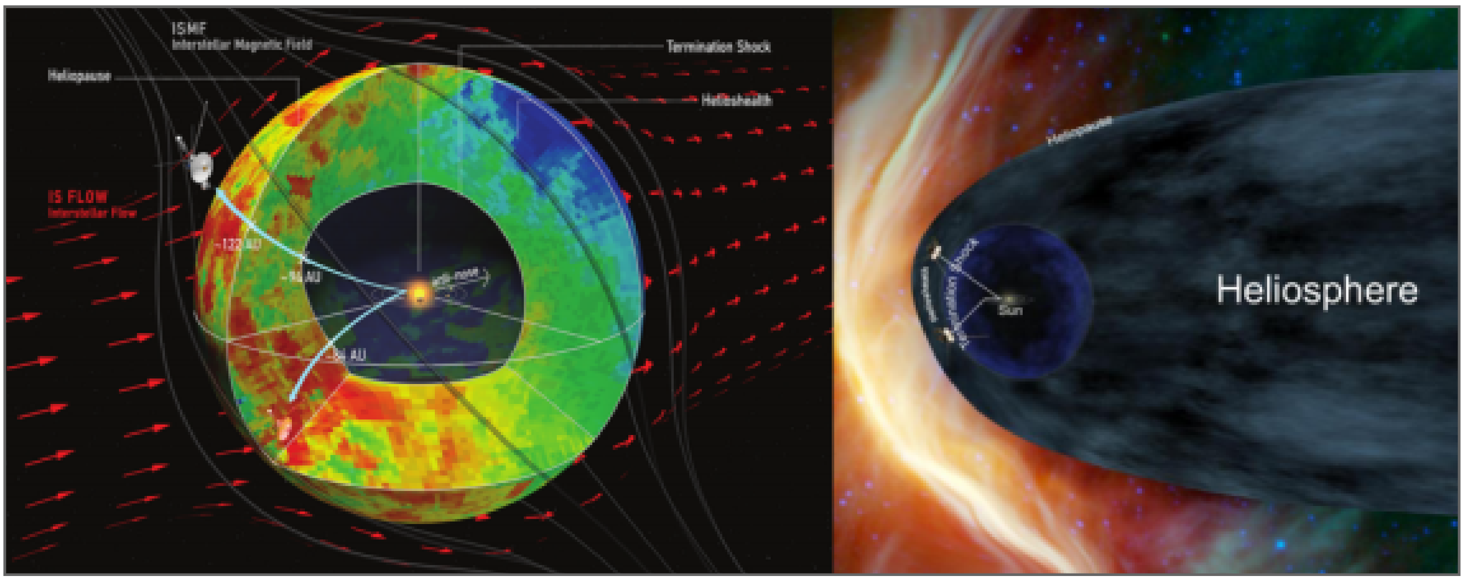
Voyager is now at the edge of the heliosphere, where its LECP instrument can detect those solar-wind ions. The researchers found that the number of measured ions rise and fall with increased and decreased solar activity, matching the 11-year solar cycle, showing that the particles are indeed originating from the sun.

Meanwhile, Cassini, which launched 20 years after Voyager in 1997, has been measuring those neutral atoms bouncing back, using another instrument led by Krimigis, the Magnetosphere Imaging Instrument (MIMI). Between 2003 and 2014, the number of measured atoms soared and dropped in the same way as the ions, revealing that the latter begat the former. The neutral atoms must therefore come from the edge of the heliosphere.

If the heliosphere were comet-shaped, atoms from the tail would take longer to arrive at MIMI than those from the head. But the measurements from MIMI, which can detect incoming atoms from all directions, were the same everywhere. This suggests the distance to the heliosphere is the same every which way. The heliosphere, then, must be round, upending most scientists' prior assumptions.

It's a discovery more than four decades in the making. As Cassini ends its mission this year, the Voyager spacecraft will continue blazing through interstellar space, their remarkable longevity having been essential for revealing the heliosphere's shape. "Without them," Krimigis says, "we wouldn't be able to do any of this."

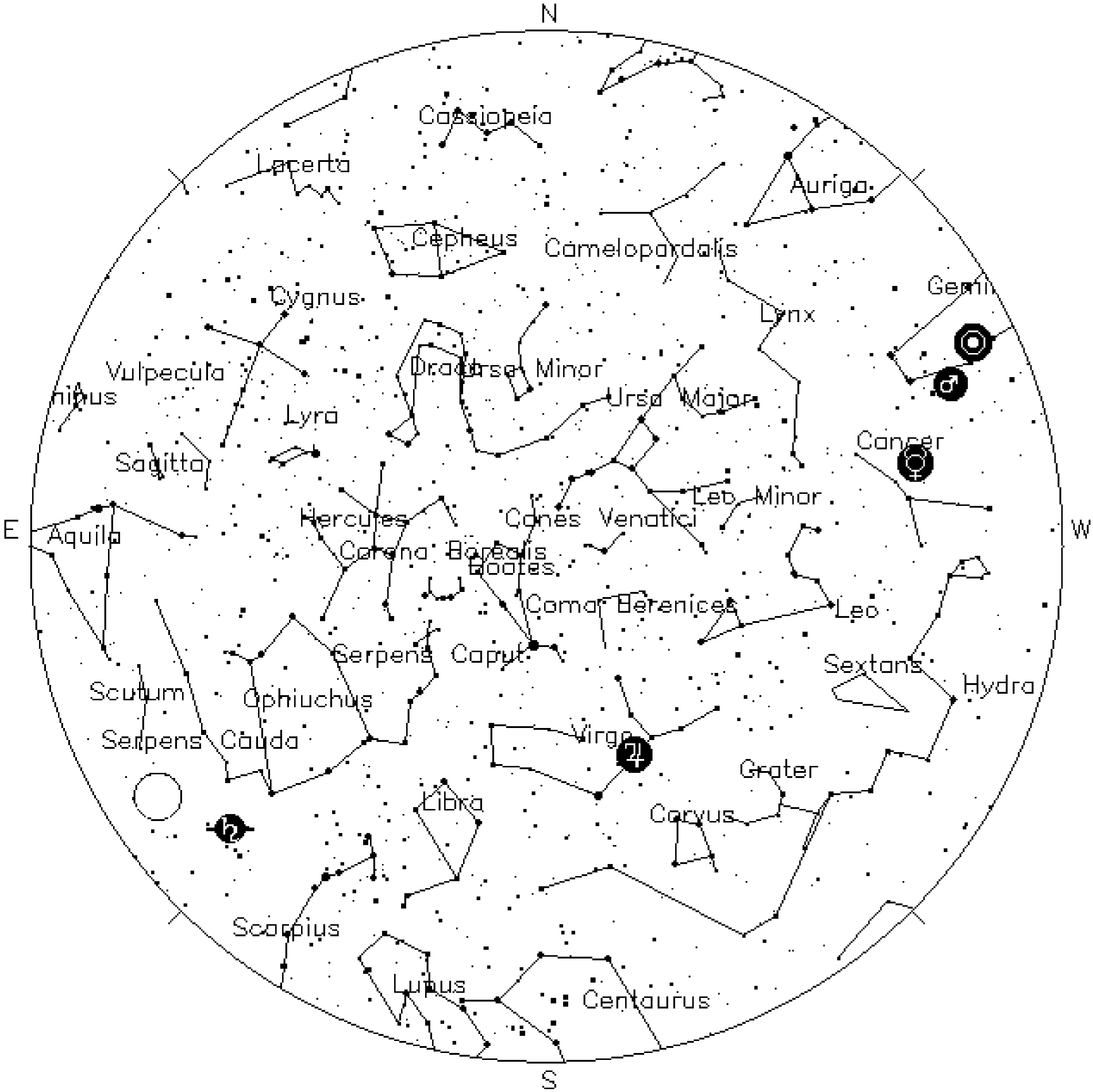
To teach kids about the Voyager mission, visit the NASA Space Place: https://spaceplace.nasa.gov/voyager-to-planets



New data from NASA's Cassini and Voyager show that the heliosphere — the bubble of the sun's magnetic influence that surrounds the solar system — may be much more compact and rounded than previously thought. The image on the left shows a compact model of the heliosphere, supported by this latest data, while the image on the right shows an alternate model with an extended tail. The main difference is the new model's lack of a trailing, comet-like tail on one side of the heliosphere. This tail is shown in the old model in light blue.

Image credits: Dialynas, et al. (left); NASA (right)

Sky above 40°33'58"N 75°26'5"W at Sat 2017 July 8 0:00 UTC



Your Sky was implemented by John Walker in January and February of 1998. The calculation and display software was adapted from Home Planet for Windows.

The GIF output file generation is based upon the ppmtogif module of Jef Poskanzer's pbmplus toolkit, of which many other components were used in creating the images you see here.

ppmtogif.c - read a portable pixmap and produce a GIF file

Based on GIFENCOD by David Rowley [mgardi@watdscu.waterloo.edu].

Lempel-Zim compression based on "compress"

Modified by Marcel Wijkstra [wijkstra@fwi.uva.nl]

*Check out additional features of **Your Sky** at* : http://www.fourmilab.ch/yoursky/

Please visit lvaas.org for up-to-the-minute calendar information

JULY 2017

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
						01
02	03	04	05	06	07	08 General Meeting/Picnic - 5:00 PM South Mountain
09 Full Moon General Meeting/Picnic - (rain Date)	10	11	12	13	14	15
16 Last Quarter Moon	17	18	19	20	21 MegaMeet	22 MegaMeet
23 MegaMeet Deadline for submissions to the Observer New Moon	24	25	26	27	28	29 Star Party
30 First Quarter Moon LVAAS Board of Governors Meeting	31					

AUGUST 2017

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
		01	02	03	04	05
06	07 Full Moon	08	09	10	11	12 General Meeting 7:00 PM Pulpit Rock
13 General Meeting Pulpit Rock (rain date)	14 Last Quarter Moon	15	16	17	18	19
20 Deadline for submissions to the Observer	21 New Moon	22	23	24	25	26 Star Party
27 LVAAS Board of Governors Meeting	28	29 First Quarter Moon	30	31		

2017 LVAAS Event Calendar

*** Lunatics and Stargazers has been discontinued until further notice**

2017 LVAAS Event Calendar												
	Sundays			Thursday	Friday	Saturday	Mondays	Multi-Day Weekends	Moon Phase			
	General Meeting time	location	Board meeting	Astro-Imaging	Lunatics and Stargazers	Star Parties	Scouts at S. Mountain	Scouts at Pulpit R.	New	First	Full	Last
January	2:00 PM 8	Muhlenberg	29	12	no mtg	no mtg		no camping	27	5	12	19
February	2:00 PM 12	Muhlenberg	26	9	no mtg	no mtg		no camping	26	3	10	18
March	2:00 PM 12	Muhlenberg	26	9	3 & 31	4		no camping	27	5	12	20
April	9	S.M.	30	13	no mtg	1		7 – 9	26	3	11	19
May	7	S.M.	21	11	5	6		19 – 21	25	2	10	18
June	11	S.M.	25	no mtg	2	3		9 – 11	23	1 30	9	17
July	05:00 PM 8	S.M.	30	no mtg	28	29		14 – 16	23	30	9	16
August	12	Pulpit	27	no mtg	25	26		4 – 6	21	29	7	14
September	10	S.M.	24	7	29	30		8 – 10	20	27	6	13
October	8	S.M.	29	5	27	28		6 – 8	19	27	5	12
November	2:00 PM 12	S.M.	26	2	no mtg	25		3 – 5	18	26	4	10
December	2:00 PM 9	Grace Community	17	7	no mtg	no mtg		no camping	18	26	3	10

Megameet is currently scheduled for July 21-23. A new rain date will be announced.

July, Aug & Dec are Saturday meetings with rain date on Sunday
Jan., Feb., and March meetings are at Muhlenberg College
August meeting is at Pulpit Rock
December meeting / Holiday Party is at at Grace Community Church
All meetings 7 P.M. unless otherwise noted

Contributed by Bill Dahlenburg

Publishing images is a balancing act!

When preparing your images for publication in The Observer, please consider the following guidelines:

Put the quality in:

- Considering the "print" size of the image, make sure you have at least 150 pixels/inch.
- Use a reasonably good quality for the JPEG compression ratio.

But watch the "waistline"!

- Don't go too much above 200 pixels/inch max.
- Use the lowest JPEG quality that still looks good!
- Shoot for <300KB for a 1/2 page image or <600KB for a full page.

Tip: If you're not Photoshop-savvy, you can re-size and compress undemanding images ("human interest", not astroimages), with an online tool such as http://www.ivertech.com/freeOnlineImageResizer/freeOnlineImageResizer.aspx. It will also tell you the pixel size and file size of your original, even if you don't download the processed copy.

The Observer is the official monthly publication of the Lehigh Valley Amateur Astronomical Society (LVAAS) Inc., 620-B East Rock Road, Allentown, PA, 18103 and as of June 2016, is available for public viewing. Frances A. Kopy, editorlvaas@gmail.com.

Members please use above email address for submissions.

Society members who would like to submit articles or images for publication should kindly do so by the Sunday before the monthly meeting of the BOG (please see calendar on website) for the article to appear in the upcoming month's issue. PDF format is preferred. Early submissions are greatly appreciated. Articles may be edited for publication. Your comments and suggestions are welcome.

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For existing members to update LVAAS information, or to make member contact changes or corrections, please email the membership director membership@lvaas.org.