The Spectrogram

Newsletter for the Society of Telescopy, Astronomy, and Radio

February 2003

Inside this Issue

S*T*A*R
P.O. Box 863
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On the web at:

http://www.starastronomy.org

February's Meeting

The next meeting of S*T*A*R will be Thursday, February 6th.

The meeting will begin promptly at 8:00 PM at the King of Kings Lutheran Church, 250 Harmony Street, Middletown.

Our featured speaker will be Bob Sal of the Astronomical Society of the Toms River Area (ASTRA), who will give a presentation entitled "Binoculars and Binocular Astronomy".

Binoculars are an excellent astronomical instrument for beginners as well as more experienced observers. Please join us for an informative and enjoyable presentation by a fellow amateur astronomer.

Calendar

September 5, 2002
Ernie Rossie

October 3, 2002
David Segelstein & Gordon Waite

November 7, 2002
Dr. Haimin Wang

December 5, 2002
Canceled due to poor weather

January 2, 2003
Dr. Eddie Guerra

February 6, 2003
Bob Sal

March 6, 2003
Dr. Dale Gary

April 3, 2003
Tentative – Dr. Jerry Sellwood

May 1, 2003
Freeman Dyson

June 5, 2003
Annual Business Meeting

Spectrogram's New Look

By Greg Cantrell

Noticed anything different? I'm trying a new look for the *Spectrogram*! After reviewing newsletters for several other astronomy clubs, it really seemed time for a make-over. Hopefully, you'll find this design interesting and the articles useful and informative! Please feel free to provide suggestions or comments to cantrell@optonline.net.

Once again….Thank you to this month's contributors. The *Spectrogram* is your newsletter and appreciates your support. Club members are encouraged to submit articles or announcements to me at the monthly meetings or electronically at cantrell@optonline.net.

President's Corner

By Greg Cantrell

February's meeting will feature another presentation by an amateur astronomer, though this time from outside the club. Bob Sal of the Astronomical Society of the Toms River Area (ASTRA) will enlighten and entertain us with his presentation "Binoculars and Binocular Astronomy".

A number of other issues will be discussed during the February Meeting. Several club members have developed recommendations for updating the club bylaws. Electronic and written copies will be distributed prior to the meeting, and a brief introduction and explanation of each of the proposed amendments will be offered after the speaker presentation. Club members will be given a month to consider the amendments, with a discussion and vote planned for the March meeting.

A Board meeting was held on January 7th, with several items discussed. These included planning for events for new members, including an observing session at a convenient location. Identifying this location has proven challenging, and I would ask any club member that knows of a space the club could use to please contact me, either at the meeting or at home (732-308-3488).

The Board considered several ways to increase observing incentives and opportunities among the members. After discussion, the Board voted to recommend that S*T*A*R become a member of the Astronomical League. For a very modest fee, club members would become eligible for observing certificates, book discounts, and will receive the League's quarterly newsletter, the Reflector. The club benefits by increased visibility through association with a national organization and discounted liability insurance. This will also be discussed during the February meeting.

Did you receive a new scope during the holiday season and are having a difficult time figuring out how to use it? Why not bring your scope to the February meeting and seek guidance of some of our more experienced members? If this sounds interesting to you, please contact me at cantrell@optonline.net, or give me a call at 732-308-3488 so that we can discuss your plans.

Hope to see everyone at the February meeting! Clear Skies!

January Meeting Minutes

By Dennis O'Leary

Meeting was called to order by President Greg Cantrell who discussed upcoming schedule of meeting speakers.

Announcements:

Greg discussed having field trip to the Hayden Planetarium on a Saturday in March. He would look into a bus and group rate for admission if the club was interested. Approximate cost was thought to be about $35.00 per person. A show of hands indicated that the members were interested and Greg was authorized to put down a deposit of $100.00 to secure the bus. If additional people are needed to fill the bus, the trip will be opened to guests and other clubs.

Andy Zangle said the pastor asked us to watch for anyone who might cause vandalism at the meeting place. Apparently some damage was done on our last meeting date.

The club scope is currently in Taffy Notarcola's care. She plans to bring it to the next meeting if anyone would like to use it.

Mike Lindner reminded us that Saturn is in opposition and occulting the Crab Nebula next week it's a good time to go out and observe.

Ernie Rossi discussed having a Planetary Shootout at his house on January 10, 2003 at 8:00 PM. Bring your scopes and eyepieces. He will post a notice on the discussion board.

Larry Campbell announced a Star Party at Union Hill School in Holmdel on February 5, 2003. He expects 300 students and their families to attend and needs the help of whoever can be there. He will post a notice on the discussion board.

Presentation:

Dr. Eddie Guerra of Rowan University gave a presentation entitled "Radio Astronomy: A Probe of the Universe"

He discussed what Radio Astronomy is and how it gives us a glimpse of the most distant (and thus oldest) known objects and structures in the universe. He explained the basic use and design of the Very Large Array (VLA) telescope in New Mexico. His research with the (VLA) applied the technique of aperture synthesis (interferometry), to examine the detailed structure of active galactic nuclei (AGN). Many radio-loud AGN are among the most distant objects observed, and the light we observe from these objects originated billions of years ago (when the universe was significantly younger). He also mentioned many advances in cosmology, the study of the universe as a whole and single system, which have come from precise measurements of the cosmic microwave background at radio wavelengths, and that more insight will be gained in the next decade with such measurements.

Saturn’s Moons

By Ernie Rossi

How many Saturnian moons are visible depends on many factors: opening of Saturn's rings, sky conditions, location of Saturn, location of the moons around Saturn, and size of your telescope. Saturn is roughly 800,000,000 miles from us even at its closest distance so its moons are much more difficult to see than Jupiter's bright moons. At last count Saturn has 30 moons, second to mighty Jupiter with a count now of 40.

The first moon discovered was Titan, Saturn's largest moon in 1655 by Christopher Huygens with a telescope aperture of around 2”. Titan has a diameter of about 3200-3300 miles, which makes it the second largest moon in the solar system after Jupiter’s moon Ganymede. Titan also has a dense atmosphere comprised mostly of nitrogen. The spacecraft Cassini is headed for Saturn and should arrive in 2004. It's carrying a probe called Huygens that will be parachuted down to the surface of Titan in January of 2005 to further explore its atmosphere and surface.

Saturn at its closest to us shows a disc of 20”, and with the rings opened at the maximum, the diameter increases to 50”, about the visible size of Jupiter, which makes viewing some of its closer moons like Mimas and Enceladus difficult. When Titan is at its furthest elongation from Saturn, it lies at around 5 diameters in distance from the rings, and takes approximately 16 days for 1 orbit around the planet. At magnitude of 8.4, a 50-60 MM scope at 50× should be able to see it.

The next brightest moon is Rhea, which was discovered by G. Cassini in 1672 with a telescope of around 2.5 to 3 inches. Rhea is Saturn's next largest moon, around 1100 miles in diameter, and the second brightest, with a magnitude of 9.7. It takes 4.3 days to make a revolution around Saturn and should be visible in a 60 MM or larger scope when it lies at it's farthest elongation from the planet which is 1' 25”, or about 1 1/2 times past the rings. The brightness of the rings when open makes it more difficult to see. Since the rings are now opened, you may need a 4” scope to see this satellite. The brightness level Rhea leads us to believe that it is covered with a dirty ice. Rhea revolves around Saturn in about 4 1/2 days.

The next moon in order of brightness and ease of seeing is Dione, which was discovered by Cassini in 1684. Dione has a diameter of 900 miles and it shines at 10.4 magnitude. Dione is also covered with a dirty ice and lies very close to Saturn’s ring since its farthest elongation is 1’, or 60”. Telescope of 4-6” is needed to see this moon because of its proximity to Saturn's ring. Dione revolves around Saturn in about 2 3/4 days.

Tethys is another very bright moon rivaling Dione even though it only has a diameter of 750 miles due to a very high reflective surface of ice. This moon was discovered by Cassini in 1684, and has a magnitude of 10.3. When the rings are edge on a 3” telescope can see it, but since the rings are now open and Tethys is 48” from Saturn a telescope of 4” to 6” is probably needed. Tethys revolves around Saturn is in just a little under 2 days.

Iapetus is a very strange moon. When it lies on the western side of Saturn its magnitude is around 10, and can be seen with a 3” telescope, but when it lies on the eastern side, it shines at only 12th magnitude, more than five times dimmer, and a telescope of 6-8”of aperture is needed. Cassini discovered this moon in 1671. Iapetus takes 79 days to orbit Saturn, and has a diameter of 892 miles and lies 9’30” from Saturn at greatest elongation.

Enceladus was discovered by William Herschel in 1789, and has a diameter of 450 miles. This moon was discovered on the 2nd night using his new 48” reflector, and has a magnitude of 11.8. This moon is very difficult to see in any telescope smaller than 10” because it lies so close to Saturn and its rings, but under ideal conditions when the rings are edge on, it can be seen with a 6” scope. At greatest elongation the separation is only 38” from Saturn, and the surface seems to be ice covered.

William Herschel also discovered Mimas in 1789, 3 weeks after Enceladus, using the same 48” telescope. Mimas is even more difficult to see since it is smaller, 350 miles in diameter, and lies closer to Saturn - about 30” away at greatest elongation. Mimas has a magnitude of 12.1, but ideal conditions and a 10” telescope are needed to see it.

Hyperion the eighth moon of Saturn was discovered by William Cranch Bond and his son George who founded the Harvard College Observatory with a 15” Clark refractor the largest of its time in 1848. Hyperion orbit is just beyond Titans, but it's a small moon about 200 miles in diameter made up of mostly dirty ice and debris at around magnitude 14. Since it lies more than 4 ring diameters at greatest elongation from Saturn, the glare is a lot less. Hyperion takes 21 days to orbit Saturn and a telescope of 10-18” is needed to detect it.

Two freeware computer programs that display the orbit configurations of Saturn's satellites are SATSAT2 and Meridian. SATSAT2, by Dan Burton, is a DOS program and is available at www.physics.sfasu.edu/astro/dansofeware.html. Meridian, by Claude Duplesis, is a windows program and is available at page.infinit.net/merid/index.html.

My own experience after observing Saturn for approximately 50 years using all size telescopes is as follows: With a 3” refractor, 3, possibly 4 moons are visible when Iapetus is at its western elongation; 5 moons with a 4” refractor, 6 moons with 6” and 8” scopes, 7 moons with a 10”, and 8 moons with 12.5” and larger telescopes.

What's Mike Been Up To?

By Michael Lindner

ATM project progress is improving, thanks to my continued joblessness. I guess unemployment does have some small benefits.

The first order of business is to report on progress on the Lurie Anastigmat. I had a small setback when my newly rebuilt spherometer was turned loose on the corrector element. It seems that one of the sides was ground too concave. I had to go back to 320 grit, then 500, then 12 micron.

The good news is that's all fixed. The bad news was that during the process, I managed to put a scratch in the polished side that I had to go back to 5 micron to remove. I am now re-polishing the concave side.
I have decided to hold off polishing the convex side until I foucault test the concave side. That's because when I had both sides polished (briefly), I discovered that reflections from the convex side were very annoying when looking for reflections from the concave side.

The other thing I did was some mirror cell experimentation. I am designing/building two prototype mirror cells; one with a sling and one with the mirror siliconed to support pads. They will both be six point flotation cells.

While I was thinking "mirror cells", I got a call from our fearless leader, Greg. He bought a very beat up looking used Coulter 13.1" and wanted some advice, since I bought and rebuilt the exact same model several years ago. I wound up building him a duplicate of the cell I built for my 13", with a few improvements, and I think it's interesting enough for a newsletter article (hope you do too)!

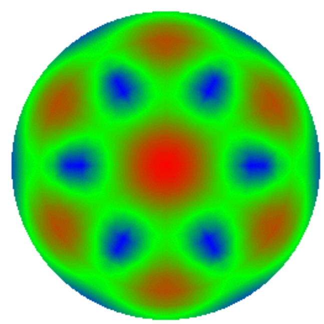
As mentioned, the scope I bought was a used 13.1" Coulter Odyssey II. These scopes are relatively inexpensive, and make the most out of inexpensive materials. In my mind, this makes them ideal. You get a scope for very little money, and use it while you are rebuilding it. Since I was going to replace everything anyway, why pay for stuff I'm not going to use.

One of the little marvels of economy is the mirror cell, shown here. The back of the scope is a circle of oriented strand board (OSB, the stuff they use for house sheathing) 16" in diameter, painted black, with rubber feet on it. On top of that is another circle of OSB that fits inside the tube, to hold it in place (three drywall screws through the tube hold it in, originally, but Greg's had been modified with dozens of hefty 10 foot long machine screws!).

On top of that is the mirror cell proper, which consists of a circle of particleboard. Three push screws and three pull screws serve to tilt the particleboard circle, which has three rubber pads stapled to it. The mirror sits on the three pads, and is held in place laterally by duct tape. The duct tape is secured to the mirror with a large hose clamp, and to the particleboard by staples (and in Greg's case the duct tape had been reinforced by adding several more layers, and each layer attached not only with adhesive, but with thumbtacks!). I assume the staples, thumb tacks, and clamp are so that the mirror doesn't fall out if the duct tape glue gets soft from heat.

The problems with this cell are that it is difficult for the mirror to cool down, because air can't circulate around it, and dqueezing the mirror in a hose clamp is generally frowned upon. In addition, 3 pads don't adequately support such a large thin mirror (the mirror is 1" thick, 13.1" in diameter).

Out of this need, the "T" cell was born. I call it the "T" cell, because the mirror supports form a "T" shape. I have so far made four of these cells, and have found them to be lightweight and to work well. My first "T" cell was a 3 point cell for my 6" Newtonian, but since then I have made 6 point flotation cells, and have no reason to believe they wouldn't scale to 9 points, I just haven't had the need for one.



Six points, according to "Plop", David Lewis' mirror cell optimization program, can adequately support even my 17.5" x 1.3" thick mirror. Plop stands for "Plate Optimizer, and is a software tool for designing mirror cell supports. I'd be happy to expound on the subject if someone expresses an interest. I have used Plop to design each of my "T" cells, and have had no complaints about astigmatism due to improper support.

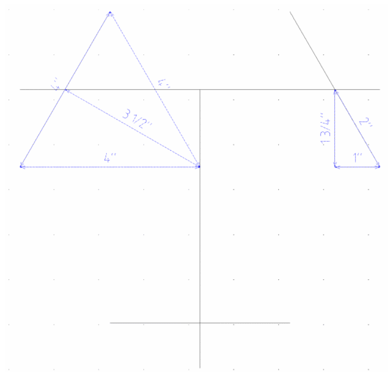
Traditional "tailgate" cells (ala Kriege) have collimation bolts that are directly under the pads that support the mirror. This simplifies the construction somewhat, but means that the collimation bolts are rather closely spaced, so that small adjustments make a large difference in collimation. One of the nice features of the ``T'' cell is that the collimation bolts can be spaced much farther out than the mirror supports, so that fine tuning collimation is easier.

Another advantage is that this cell can be built from readily available parts (from a home improvement store) rather than requiring welding or machining like many other designs. In addition, it can be completely made of aluminum, stainless steel and plastic, so the mirror can be cleaned without removing it from the cell (a plus, since the mirror is siliconed onto the cell, so it is not easy to remove it).

The parts list for a six point flotation cell for a 13" mirror cell is as follows:

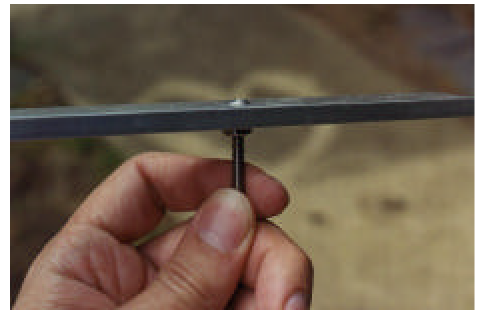
1" x 1/16" square aluminum tubing
2" x 1/16" aluminum angle
¾" x 1/8" aluminum angle
1" x ¼" aluminum bar
2' x 4' x ¾" plywood
1 x 2 clear maple or other hardwood
3 ¼-20 "tee" nuts
3 ¼-20 x 2.5" thumb screws (or threaded rod with a hand knob attached)
6 ¼" x 1" fender washers
3 springs (stiff enough to support mirror) with about 1" usable travel.
3 8-32 x 2" flat head machine screws
9 8-32 hex nuts
4 ¼-20 x 1" furniture screws (or truss head screws)
2" drywall screws
Wood glue (I use Gorilla urethane glue)
GE Silicone II clear adhesive
Aluminum pop rivets
JB Weld metal epoxy
Clear polyurethane
Flat black paint
"Feet" (optional, I used drawer pulls)
End caps for tubing (optional)

Plop suggested three pads 3.92" from the center, and three more pads 3.96" from the center and 60 degrees between each pad. In practice, six evenly spaced pads, 4" from the center work as well, and the math and measurements are easier. Because the sides of a hexagon are the same as the distance from the center to each vertex, all the measurements are 4".

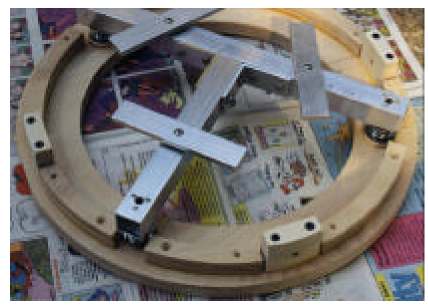


The next step is to figure out how long to cut the upright and top of the "T". Using a little trigonometry, the center of the top should be 3" above the center of the cell, or about 1.75". The lengths of the two pieces should be as long as possible and still fit inside the tube. Remember to allow for the width of the bars when determining where to cut. The small number of cuts to be made can easily be done with a hacksaw, using a file to clean up any rough edges produced. The factory cut end of the tubing was used as the top of the upright, as it already had an accurately made right angle cut.

After cutting the two "T" bars to length, they are attached at right angles by gluing (with JB Weld) and riveting to short sections of 2x2" angle, which reinforce the joint (note that the picture shows screws – that wasn't what I used in the final design). The center of the cell is marked, and the support positions marked using a compass (they are all 3.5" from center). The support holes were drilled slightly undersized, and the screws themselves were used to tap the holes in the soft aluminum. This was to ensure a non-wobbly fit.



The "see-saw" bars that hold the six pads are cut from 1x1/4" bar. Remember to add 1" to the 4" length to allow for the pads to be of finite size for gluing the mirror to the cell. I drilled the center of each bar to an exact fit for the support screw, and countersunk for the heads with a 100 degree countersink (you can probably use a standard drill bit – the idea is that the countersink must not match the 82 degree screw head, so it can wobble in the hole).

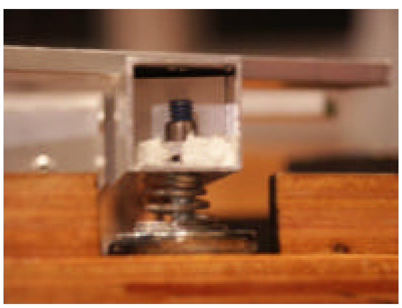


Your tube dimensions may vary, but for my Coulter, I cut 2 squares of 3/4" birch plywood, and routed them into rings. One is 16" outer diameter, and 11" inner. This replaces the bottom of the mirror cell. The second is 15 1/8" outer diameter, 13 1/2" inner. It merely serves as a guide to center the cell on the back of the tube. I cut 3 sections out of the smaller ring, to allow clearance for the ``T''. I then cut 4 sections out, which were replaced by 2" x 1 1/2" x 3/4" blocks of maple, which are how the cell is attached to the tube. The maples blocks are screwed (with 2" drywall screws) and glued to the cell, and have holes in them to accept 1/4"-20 furniture screws.

The furniture screws have a tapered end, and a large flat head. The holes in the maple were drilled tight (drill size ``A''), and the screws were turned in the holes to thread them. After the wooden parts of the cell were done, they were fitted in the tube and a small drill was used from the inside to make holes in the tube to mark where the screws should go. I then drilled slightly oversized holes in the tube from the outside.

Once the wooden and aluminum parts are cut and glued, the collimation bolts can be added. Clamp the aluminum "T" to the wooden frame, and drill through both pieces using the "A" drill bit. The wooden holes will be drilled out to snugly fit the ¼" collimation bolts. They should slide through the holes, but there should be no play side to side. The holes in the bottom of the "T" get drilled out to loosely pass the collimation bolts.

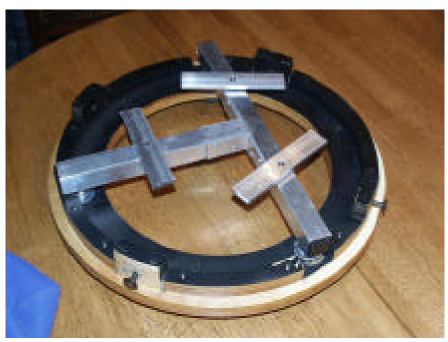
The tee nuts pull the mirror cell down against the springs, and as such, need to be compliant so that as the cell tilts, the tee nut stays square to the collimation bolt. On the other hand, the tee nut must be constrained from rotating, or the cell will not hold collimation, and will be subject to backlash.



I solved this problem by cutting three 7/8" long pieces of ¾" aluminum angle. The pieces are a sliding fit (cut them oversized and file until the fit is right) in the aluminum tube. They have a hole cut to pass the barrel of the tee nut, centered side to side, but close enough to one edge so that one prong of the tee nut can be bent over to keep the tee nut from rotating (the other three prongs are cut off or bent out of the way). This assembly is inserted into the tube, and the collimation bolts are screwed into the tee nuts. Finally, some silicone is squirted in to hold the tee nut assembly in place, but allow enough give to allow for collimation tilt (in the photo above I used white silicone).

Next comes final assembly. All the places where metal hits plywood (the springs on top and the collimation knobs on the bottom) have washers between the wood and metal, to keep the hardware from compressing the wood, which might throw off the collimation, as well as to reduce wear.

I added 3 nice looking wooden drawer pulls to the back of the cell, to act as feet. I thought about using the rubber ones from the old cell, but decided I liked the look of the wood, even if it gets scratched up right away. The entire ``wooden part'' was covered with 4 coats of satin spar urethane, and the parts that would show inside the scope were painted flat black. The aluminum was left bare. On my first "T" cell, I painted the aluminum black, but discovered it washed off with the acetone I used to prevent water spots when cleaning my mirror. If it bothers you, you can paint your aluminum black, or add a small baffle in front of the cell. In practice, I have not suffered from reflections off of the aluminum of the cell



The last part is attaching the mirror to the cell. To do that, lay your mirror face down. Make sure the back is clean! Mark the center of the back, and mark where the support pads should be placed. Take the wooden frame off of the cell, and place it on top of the mirror to make sure the layout is correct. Make sure the cell is clean! I cleaned my mirror beck and cell with acetone, and made sure there were no fingerprints on anything. Wear gloves!

Place 1/8" spacers to hold the see-saw supports off of the glass (a nickel and a penny stacked together work well). Place a dab of silicone where each pad is to be glued, and lay the cell back down on the silicone. Make sure you use enough silicone to touch both the aluminum and glass, but not enough to make a mess.
After the silicone has set overnight, remove the spacers and if necessary, fill in the silicone pads to make them 1" square and neat looking (OK, neat is optional). Let the fresh silicone cure another 24 hours before lifting.

So far, my cell has stood up to four years of observing and several washings. The only time I removed the mirror was to have it recoated. I used a dial indicator to measure flex, and determined that from horizon to zenith my mirror shifts 0.0015" laterally, and does not otherwise shift or tilt detectably. All in all I consider that a successful ATM project!

The STAR field trip to Hayden Planetarium will be held on Saturday, March 22nd. We'll depart from Middletown (location to be determined) promptly at 9AM. Our day will consist of admission to the museum and the Rose Center, an 11AM planetarium show, followed by a 1:30PM admission to the Einstein exhibit. We'll depart the museum at 4PM; arriving back in Middletown at about 5PM. Lunch will be on your own.

Ticket prices are $45 for adults, $30 for children ages 2 - 12. Please sign up as quickly as possible, as registrations will be accepted on a first come, first served basis. Space on the bus is limited to 49 people, so contact Greg Cantrell as soon as possible if you sure that you'll be attending.

Messier Objects - February

by Greg Cantrell

The continued cold, cloudy weather makes February challenging for even the most ardent observer. According, this month's Messier list is relatively short and could be accomplished during short observing sessions.

M 44 (NGC 2632) – The Beehive Cluster is a 3.1 magnitude open cluster found the Cancer the Crab. Easily visible with the naked eye, this is also a wonderful binocular object.

M 46 (NGC 2437) – A 6.1 magnitude open clusters in Puppis that is visible to the naked eye from a dark location. Binoculars reveal a large fuzzy patch, while the cluster fills the eyepiece at low power telescope views. While observing M 46, look for a blue-green planetary nebula, NGC 2438, in the foreground.

M 47 (NGC 2422) – Found near M 46, this 4.4 magnitude open cluster in Puppis is easily visible to the naked eye as a fuzzy patch of light. Best viewed through binoculars or telescopes under low powers.

M 67 (NGC 2682) – This 6.9 magnitude open cluster Cancer appears as a large hazy patch in binoculars, similar to M 46. Use low power telescope views to resolve this rich cluster.

M 93 (NGC 2447) – A small 6.2 magnitude open cluster in Puppis is a difficult binocular object, due to the richness of the field around it. Appears wedge shaped when viewed at low powers telescopically.

M 102 (NGC 5866) – Controversy surrounds M 102, as many believe that Messier simply mis-identified M 101 and reclassified it as M 102. However, some believe that NGC 5866 in Draco is the true M 102, and I list it here as well. This 9.9 magnitude lenticular galaxy is seen almost exactly edge on, and is a wonderful telescope object.

Upcoming Events

Star parties and other astronomy-related events are an important part of the amateur astronomy experience. Listed below are several events offering dark skies and astronomical fellowship.

January 29 – February 2 The **Orange Blossom Special Star Party** will be hosted by the St. Petersburg Astronomy Club. Visit http://home1.gte.net/hoffmanc/index.html.

February 3 – 8 The **Winter Star Party** will be hosted by the Southern Cross Astronomical Society. For more information, visit http://www.scas.org/wsp.html.

February 23 – March 1 The **Cedar Key Star Party** will be hosted by the Cedar Key State Museum. For more information, visit http://members.aol.com/bemusabord/cedarkey.html.

February 27 – March 2 The **Mid-Florida Stargaze** will be hosted by Astronomical Society of the Palm Beaches. For more information, visit http://www.palmbeachastro.org.

February 28 – March 2 The 3rd annual Mid-Atlantic Mirror Grinding Seminar hosted by the Delmarva Stargazers. For more information, visit http://www.delmarvastargazers.org/.

April 18 The **Astronomical Society of Greater Hartford** holds its annual **Starconn**. Visit http://www.asgh.org for more information.

April 27 – May 4 The 25th annual **Texas Star Party** will be hosted by the Southwestern Region of the Astronomical League. Visit http://www.texasstarparty.org/.

May 17 – 18 The **Northeast Astronomy Forum and Telescope Show**. More information at http://www.rocklandastronomy.com/neaf.htm

Feb 1 Feb 9 Feb 16 Feb 23

Are You a STAR Member

S*T*A*R is a member of United Astronomy Clubs of New Jersey (UACNJ) and the International Dark Sky Association (IDA). Meetings are the first Thursday of each month, except July and August, at 8:00 PM at the King of Kings Lutheran Church, 250 Harmony Rd. in Middletown (intersection of Harmony and Cherry Tree Farm Rd.). Meeting generally consist of lectures and discussion by members or guest speakers on a variety of interesting astronomical topics.

Memberships: ( )Individual....$25
( ) Family...$35 ( ) Institutional $25

Name______________________________
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Make checks payable to: STAR Astronomy Society, Inc and mail to P.O. Box 863, Red Bank, NJ 07701

Magazines are also available to STAR members at discounted rates, including Sky and Telescope and Astronomy. See STAR Treasurer Paul Nadolny for more information.