

Astrofiles

Auburn Astronomical Society E-Newsletter November, 2013

Archived editions at: <http://www.auburnastro.org/> & click on "**Astrofiles**"
Use **Ctrl-Click** to follow links in the MS WORD and RTF files

In this Issue

[Events
Calendar](#)

[Public
Stargazes](#)

[Web
Links](#)

[Member
News](#)

Events Calendar

We'll resume our regular monthly meetings following a 2-month hiatus because of the Auburn home football games, on **Friday November 1**, in [room 215 of Davis Hall, the Aerospace Engineering Building](#), on the [main campus of Auburn University](#). The program this month will be a presentation by **Maggie Murphy**, a senior in mechanical engineering at Auburn, on her telescope project. In response to our invitation to speak, Maggie wrote:

I would love to present the telescope project at the November meeting! I can bring in the stand, mirror blanks, grit, etc and hopefully I will have finished the Foucault testing device and made a pitch lap, in case anyone wants to try polishing the mirror! Maybe we could look at shadowgrams and everyone would be more than welcome to have a go at re-figuring the paraboloid? I have some pictures I'd love to share [from] the Stellafane convention over my break at home...it was such a riotous blast!! The weekend convention was such a wonderful time and a great learning experience! I brought the mirrors and got a chance to talk to some of Springfield's Amateur Telescope Makers' members after a mirror making presentation they did. They were so kind and helpful, and reassured me that the mirrors are in a fine condition to continue forth with the grinding process!

We anticipate a very good crowd because we have had to cancel the past two meetings and especially due to the excellent subject matter of the presentation.

Our **dark-sky star party** will be on the Saturday following our meeting, Nov 02, either at the [Conecuh National Forest](#) or at [Cliff Hill's farm](#) — clouds permitting, of course. We'll discuss these options at Friday's meeting.

Public Stargazes

October Scout Troop Stargaze Report

On October 5, **Frank Ward's** son's scout troop had their stargaze in [Lowndes County](#). Frank had arrived earlier so the scouts could view the sun with the AAS PST solar scope. I arrived at sunset to find Frank's 12-inch Lightbridge Dobsonian already set up. I was greeted by some curious cattle checking out their strange visitors. The cows had made us some pies to make us feel welcome. We almost

didn't step in them. The scout's prepared a steak supper for us. By the time the boys arrived at the observing site from their camp site, we had 50% - 75% cloud cover, but we managed to have the boys view an assortment of deep-sky objects and binary stars that were required for their astronomy badges. Frank wrapped up the viewing suggesting to the boys that they concentrate their studies in the fields of math and science. Clouds notwithstanding, the sky is quite dark at this site with the exception of one cell tower strobe about a mile away. Frank has received permission to use this site from the property owner.

Tuskegee Airmen National Historic Site Stargaze

This event now holds the record for most cancellations beginning in May of 2012. This time, the government shut-down was to blame. **Ranger Christine Biggers** wrote:

I'm so sorry that we could not host the stargaze planned for October 12th. This time it was Congress' fault for shutting us down. I hope nobody came out. I had no way of contacting you because we had to turn in our keys, laptops, etc. We will have to regroup and see what management wants to do. I'll be in touch.

It's good to have you back. I know you had no choice in this matter and no need for the apology. We hated it too. We had let all of our folks know why the event had to be cancelled. Let us know when you want to try again.

Forest Preserve

Jennifer Lolley has asked that we postpone her group's stargaze until January or February. Jennifer writes:

I would love to host one with the club to try it out on December 7th (without crowds). I do have permission to use Kiesel-. I went out and it is so nice and dark. We have bathrooms, parking, the gazebo to show the movies and have snacks. Would like to do this in January or February if possible with crowds- have student help then for set-up. I also am trying to bring in a Starlab planetarium to try out- best for in January. If this won't work for January I will try to recruit help for December.

We'll schedule our December dark-sky star party for this dry run before Jennifer invites her Forest Preserve members.

Web Links

From **Brian Combs**: Jupiter - October 16, 2013
http://www.bcastropics.com/img/gallery/3/2013-10-16-0945_4-BGCombs-RGB4_full.jpg

From **Larry Owsley**: Take a look at the website below & check out the great coursework that is available (for free). <https://www.coursera.org/>

From **Rodger Morrison**: Thought you might like to see what someone did with just a camera on a tripod. Wow! <http://www.flickr.com/photos/latent0image/6866355961/>. And, I think you'll like this: <http://www.xkcd.com/1276/>

Member News

Discount Magazine Subscriptions/Renewals

AAS treasurer, **John Zachry**, will be collecting for club subscriptions to Astronomy and Sky & Telescope magazines at the November meeting. The cost is the same as last year: **Astronomy** (Regular \$42.95), Club rate **\$34.00**. No minimum number of subscriptions required. **Sky & Telescope** (Regular \$42.95), Club rate **\$32.95**. We must have 5 subscriptions/renewals to qualify. If you can't attend the November meeting, [e-mail John](#) and can pay him later.

Send checks made out to Auburn Astronomical Society, to:

Mr. John Zachry, Secretary/Treasurer
501 Summerfield Road
West Point GA 31833

Phil Hosey's Halloween astro-imaging: <http://www.astrobin.com/full/59859/>

Phil also posted on the [AAS facebook page](#):

Haven't been getting much sleep with all the clear nights we've been having this past week. Here's a little something from last night. IC1805 / Melotte 15. It's a combination of RGB and a luminance layer created with a blend of H-alpha data and the red channel, about 4 hours integration. Be sure to look at the full resolution version. I have plans to shoot this again in November with the 8" RC so I can get in closer to the structure in the center of the Melotte 15 cluster. <http://www.astrobin.com/full/61874/>

From: **Scott Carnahan**

I would really like to get everything set up to enable to club to meet at Trinity in the future so we can avoid the football parking problems for everyone. In the future, I believe meetings would run smoothly at Trinity Lutheran Church on Gay Street and I talked with Pastor Hudspith and the church would be happy for us to meet there. There is always parking on Friday nights and towing does not happen Friday nights. I have a key as well. We would have large meeting room and access to a video player and even a large flatscreen TV and/or projector, whichever we want.

I'll be graduating after this year, but if the same problem comes up next year, I am sure the church would still be happy to host AAS.

Thanks! I think we're good for the rest of this year, but it's a really good chance we'll be taking you up on this offer next year. Thanks for your help.

On a related topic, **Rodger Morrison** writes:

I propose we change our club meetings to be always two Fridays after our new moon stargaze.

It seems we tried this early in the club's history. We can discuss this at the meeting.

From: Melanie Folds

I am trying to help Camryn find resources for her science fair project. Camryn has hypothesized that the differences between light pollution in cities compared to that of rural areas is not just the result of a higher concentration of artificial light. She wants to focus on other things in the atmosphere that effect the concentration of light and give special focus to how those things effect the color appearance of the light pollution.

Camryn changed schools last week and was placed in an advanced science class that requires her to complete this project as a large part of her test grade. She told the teacher that she would have no problem meeting the deadlines already given to her class and immediately gave the teacher the hypothesis. You have to love her ambition. She must turn in a research plan by October 15th.

I have sent a message to Rodger Morrison, and I was hoping you may know others that might be able to help guide her in the right direction. Thanks so much!

**Putting it all Together:
Modifications to the Orion 10" f/4.7 OTA and related equipment.
Rodger Morrison**

Well, Saturday October 12th was a productive evening at Cliff Hill's farm. I have been laid up from knee surgery and spent a couple of weeks making modifications to the 10" Orion f/4.7 that I purchased last Christmas. The weather through the summer months, along with some work related issues that killed my free time, kept me from getting finished with the upgrades and taking the scope out at all. I have done quite a bit, and think I really have a versatile and functional setup now, so I thought I would take some time and summarize everything for the club. Maybe someone can get some good ideas from what I have done and improve on them. I started this project earlier this year with Orion's 10" f/4.7 OTA. This is a plain scope with very little in terms of extras. No baffles, no finder, no primary fan, heat, etc. In short, I got the mirrors mounted in a steel tube with a focuser and little else. I also bought a pair of tube rings, which worked well, and already had a Celestron bar to mount with. I already had a 9x50 finder and a hypertuned CG-5 mount. This summer, Russell passed a note from someone in Florida that was selling a new CGEM mount for half price, which I pounced on to replace the CG-5. I already had a laptop and an assortment of other stuff, but really did not have a good solution for autoguiding, so I purchased Orion's Magnificent Mini Deluxe Autoguiding package (the one with the helical focuser), which came with their StarShoot Autoguider (SSAG). This is really just a 9x50 finder, but with a helical focuser for a 1.25" eyepiece, where they added the SSAG. Swap out the guiding camera with an eyepiece and you have a finder, which is nice though I don't need to use it that way. The only problem with this setup is that it is really not good for any focal lengths over about 1700mm, and the Orion 10" comes in at 1200mm. This means that I am okay using the SSAG to guide at prime focus, but not if I use a 2x Barlow. I was also able to acquire an Orion ShortTube-80 (ST-80) for more wide-field work, which Orion also sells as an optical tube for guiding with the SSAG. I added another Celestron bar I had in my junk box, along with a pair of tube rings, and this little scope fits nicely on topside of the OTA's rings. It has a finder block for the SSAG to mount also, so I can image through the ST-80 as well. I added a pair of threaded brass screws pointed out from the tube rings on the 10", which fit into holes I drilled

on the ST-80 bar to mount the two together. So, I can image through the 10" at prime focus using just the SSAG, or I can mount the SSAG camera on the ST-80 and then mount that to the 10" for imaging at longer focal lengths. Cool.

One thing that bothered me when I did get the big 10" hanging on the little CG-5 mount was the weight. I was right at the CG-5's weight limit of @32lbs, and the slightest little bump or breeze really moved the scope quite a bit. I like to describe it as akin to a kite in a hurricane, and it really felt like it, but the entire assembly mounts quite nicely and very sturdily on the new CGEM without issue. I haven't modified the CGEM, except for the addition of a couple of extra weights and a custom machined counterweight bar. I also added a PTFE bushing between the machined face where the mount sits on the top of the tripod. This weekend's testing session revealed that the two faces do not move easily when drift aligning, so this was a must-do to smooth things up. Other than that, no modifications to the CGEM were made, other than moving the polar scope over from the CG-5, and setting the entire thing up on a trio of Celestron's vibration isolation pads (which now sit on small pieces of heavy plywood).

One issue that we all hate is that of dew. I HATE losing an evening to dew on my secondary. As most of you know, dew is typically not much of an issue in a Newtonian because the primary is at the bottom end of the tube. However, it seemed to be worse on this OTA than on my earlier 6", but I also did not have a dew shield or any kind of anti-dew controls. I enjoy fabricating things from scratch and experimenting with different designs, so I thought I might try to make some resistive heaters. I could have bought some Nichrome wire, but decided to use a pile of 1/2 watt power resistors I have had on my workbench for a while. These are REALLY easy to make, and you almost can't screw it up if you follow basic soldering principles. First, I decided how much wattage I wanted on everything (primary, secondary, focuser, ST-80 objective, ST-80 eyepiece, finder objective, finder eyepiece, Telrad, SSAG objective, etc.) These values are easy to find on the Internet, and you only need to be approximate. I also decided to keep everything on a 12v system because I had a few extra automotive batteries collecting dust, which included a 104 amp-hour deep cycle marine battery. The amount of resistance (in Ohms) required to obtain a given wattage of heat is easy to calculate. Just square the voltage and divide by the wattage you want, which results in the number of ohms required. For example, if you want 5 watts at 12v, then you simply divide 5 into 144 (12 squared) to get 28.8 ohms. So, you only need to solder enough resistors in series (end-to-end) to make about 30 ohms. You must be careful using 1/2 watt resistors though. To get 5 watts using 1/2 watt resistors means that you must use at least 10 (15 would be better) equal-sized resistors or you'll burn them up. Another way is to wire them in parallel so that a common hot wire (+12v) runs down all of one end, and a common ground wire (the negative side) runs down the other. Then, to get 5 watts, one only needs to figure out how many resistors you want to use and then calculate the heat produced by each one. I wanted to keep each resistor to less than a third of a watt (as a safety margin), so to get 5 watts, I simply divided 5 by 1/3 to get 15 resistors. A single resistor of about 432 ohms produces about 1/3 of a watt at about 12v, so that was easy to do. Be careful, though. A fully-charged lead-acid battery actually puts out 12.75v, so your wattage will be about 13% higher and you don't want to burn up the resistors by driving them right to 1/2 watt each. Once you get the resistors soldered together, just sandwich the assembly between two layers of electrical tape, making sure your wires are not so close that they might touch and short the whole thing out. Then sandwich the taped strips between two layers of hobby foam (I used 3mm black foam, but any close-cell foam will work - Hobby Lobby sells in many colors). Solder however much slightly heavier wire you need to the hot and ground side, then solder the male side of an

RCA connector set to the other end of that, and DONE. One resistive heater. Use an ohmmeter to check the resistance, then double check your calculations just to be sure. Make one heater strip for each thing you want to warm up and you are finished. If you want to wrap the heater strip around something, you can attach Velcro strips or whatever you want to use (I used some old Velcro wire ties). Be careful not to put too much heat around anything plastic, as it will obviously melt. Controlling the heaters' output is a different story. Simply wiring them to a switch is a problem because you are either heating up your optics more than is needed, or you are not heating them at all. This will then require constant attention (with an infrared thermometer) and switching to get the right amount of heat. If you heat up your optics too much, especially the primary and secondary glass, the excess heat WILL change their optical shape. This is especially true for astrophotography applications, which is my passion, so I needed something to control 12v that was cheap, durable, and easy to use. I found a solution on eBay that is both affordable and perfectly suited to the task, but which will also allow me to control three separate channels. The solution is a 12v PWM LED strip-lighting controller (see eBay item number 170858664352). PWM stands for Pulse Width Modulation and basically means that there is a microcircuit that opens and closes a solid state switch very rapidly. The switch controls the application of 12v to whatever is on the output side of the circuit. Think of it like this. Imagine that you wanted 6v applied to your heaters because 12v was too much and 0v was too little. 6v is 50% of 12v, right? In a given period of time (1 second for example), the PWM circuit would simply turn on the 12v 50% of the time, and turn it off for 50% of the time. The average voltage is 12v, which is perfect for things such as resistance heaters, DC electric motors, and even color LED dimming. If you want only 9v, then the circuit would be energized for 75% of the time, and off for the other 25%. Perfect!!! About \$12 and a few days later, I had one 3-channel controller (36 watts total output per channel – a TON of heat!!). I divided up the heaters I made into 3 groups that made sense at the time, and connected them each group to one channel of the controller. I also needed to add a few 12v switches to control power to a few things, so I decided to mount everything in an old aluminum hard drive enclosure that I had in my junk box.

Another thing that I wanted to do, which all astrophotographers should think about, was to get the battery out of my Canon DSLR. Some of the internal heat within the camera comes from the battery itself (especially during long exposures at high ISO settings), so why not relocate the battery out of the camera completely? I found a 110v power adapter for the camera on eBay (similar to #270979950899), then cut off the 110v-to-7.5v transformer. I then bought a 12v-7.5v buck transformer (small – eBay #360736667420), connected it to the part that inserts into the battery slot in the camera, then wired the other end to an RCA connector. Perfect, now no battery in the camera and it will run on 12v, just like everything else. I did the same thing to the 3v (2 AA battery) power source in my Telrad (the 12v-to-3v transformer weighs less than the batteries – see eBay #121134160042), and then routed all cables to lighted switches in the new power box I made. I then added a 12v PC cooling fan (40CFM) to the primary mirror cell (the factory mount was a perfect fit), then wired that up as well. I thought it prudent to add a fuse to the input side of the power box and will add an output fuse bank later. I added 12v input wires, with battery clips, put the whole thing together, and then bundled the wires together with lightweight polystyrene cable wrap. I also wrapped in a couple of USB cables for the camera and the DSLR. I hung the new wiring harness to the OTA with Velcro cable ties. I used female RCA adapters for quick disconnects, with the center pin positive. Always use female RCA to reduce the chance of accidental short circuits, and make the center pin positive so that you don't accidentally reverse

the polarity on any 12v accessories you might later add. The entire harness adds very little added weight to the mount and keeps the cables from moving around much during astrophotography sessions. I can control the heat levels on everything, switch all non-heater accessories on/off at will, and everything runs a LONG time on a single 12v battery. I did discover that the deep cycle marine battery I had been using was actually a factory defect, so AutoZone replaced it at no charge. I think the bad battery was what blew up my 500W inverter in September, which I also replaced with a new 800W unit by Black and Decker. Now, I have 12v straight to the power box, the CGEM, and the inverter, which supplies 110v to my Dell laptop and a powered USB hub.

The Dell laptop is a dual-processor Windows 7 box, but is nothing fancy. I did load a few pieces of software though. I connected the CGEM mount keypad to the laptop through a USB serial adapter, which allows me to slew the mount using Stellarium. Everything connects to the laptop via USB, which includes the mouse, CGEM mount, SSAG, Canon DSLR, and a new TEMPerHUM device that records temperature and humidity. There were not enough USB ports, so I added a powered USB 2.0 hub that I had in my junk box and moved everything to that except for the Canon and the autoguider. This means my mouse, the mount's serial input, and the TEMPerHUM all share a single USB port on the laptop and the two camera sensors don't have to compete for USB bandwidth. I installed copies of copy of AstroPhotographyTool (APT) that I wanted to try out, but also wanted to try BackYardEOS (BYE), which Wes and Phil introduced me to a month ago. I had loaded a trial copy of BYE on the laptop, along with Stellarium, PHD (which came with the SSAG), and a couple of other things. I use Stellarium to identify which targets I want to image and then to slew to them without having to touch the mount. I then use Bye to control the imaging session, which includes dithering the mount during guiding and such. I must admit though that APT has a much better drift alignment tool than the simple reticle assist provided in BYE. I used APT to drift align, which is something that normally takes me an hour or so to do properly without software assistance. Using APT however, I can do it in about 10 minutes or so and can even do it as soon as I can see a few stars. Nice, cheap, and easy to set up. Simply set up the mount, do a quick polar align with the polar scope, then do a two-star align (no calibration stars). Once that is done, slew to a star near the equator and meridian and run the polar align routine in the CGEM software (takes about a minute). Then, while still pointed at the same star, use APT's align routine to adjust azimuth, slew along the equator to a star on either the east or west horizon, and run APT's align routine to adjust altitude. Once that is done, slew back to the meridian and run them both again. That's it. Drift alignment is completed. I then slew back to the home position (OTA pointed almost at Polaris), cycle the mount's power, and then go through a two-star align with a few calibration stars. Done, aligned, and ready to accept input. Of course, I also focus using a Bahtinov mask that I had cut by a guy in Great Britain, and as soon as I can, I align the finder, Telrad, and whatever else I have mounted to the OTA while it is pointed at a bright star. One can also align the accessories in the daytime using anything in the distance, and there is a nice distant light several miles to the east, straight down Cliff Hill's runway, which is perfect for aligning just as it is getting dark.

I discovered that the contrast with this OTA was not that good from the factory, and a quick inspection soon revealed why. The interior of the scope was not black at all, but was a very dull flat green color. It was also not baffled, which led to internal reflections that also hurt the contrast. Baffles are merely rings that are affixed to the inside of the OTA that are used to block internal reflections by shadowing the primary and the focusing tube. The interior of the focusing tube was nice, clean, shiny aluminum. Darn. It should have been jet black and flat. This

would be a simple fix, but as I told my wife, it is like digging a ditch. Not really a complicated process, but it really takes a lot of effort. First, I used the online tool "Newt for the Web" (<http://stellafane.org/tm/newt-web/newt-web.html>) to calculate the baffle sizes and locations for the OTA. To use this tool, one will need a micrometer that measures in fractions of an inch, and a good precision ruler. Simply enter the values in the online tool as you measure them, press calculate, and then switch to the "Dimensions" tab. Here, you will find a very precise measurement of the inner diameter of each baffle, along with where in the OTA it should be fixed. Easy. Just remember to measure twice and verify everything over and over until you are sure your measurements are correct. Cutting the baffles, however, is not so easy. As it turned out, cutting a perfect circle is a real pain in the fanny, unless one is cutting thin paper (useless for this purpose). I found a plasticized paper often used for matting artwork, and had a local framing shop cut the baffle rings with their computerized mat cutter. Total cost to have the baffles cut (including the material) was less than \$30. To affix them to the inside of the OTA required a complete disassembly, then using the precision ruler to place one side of a baffle where it needed to be. I then dabbed a small bit of hot glue to hold it, then set the other side of that baffle, and repeated at +/- 90 degrees. After each baffle was set, I ran a bead of hot glue around both sides to permanently fix it in place and then moved to the next baffle. The three narrowest baffles, however, are at the focuser end of the OTA and were too thin to do this way. Rather, I used black foam rubber adhesive door-sealing tape, which just happened to be the right thickness. A dab of super glue here and there makes sure the adhesive doesn't come loose. After everything was in place, I used an entire can of flat black Krylon on the inside of the tube to REALLY darken it. Krylon has a waterproofing effect and should also seal the baffles against any moisture that might land on them. Finally, I bought a sheet of black velvet from Hobby Lobby and cut a few lengths to line the inside wall of the OTA opposite the focuser. This stuff is as black as can be had for less than a buck (technically, \$1.09 with tax). I used the remnant pieces to line the inside of the focuser tube and a couple of other things. While I was painting, I also removed and painted the focuser tube inside and out. The inside of the OTA is so dark now that one must use a flashlight to see much, even in a well-lit room. This was a cheap and HUGE improvement!!!

I noted during this process that the focuser centerline was only 7.5" from the tube opening. Ideally, it should be 1-1.5 times the diameter of the OTA, which is just over 12". Hmmm. Most folks don't use a dew shield with a Newtonian, but it seemed as an easy solution to reduce dew, so I made one from a 12" Sonotube. Sonotubes are the yellow cardboard tubes (like a paper towel tube, only bigger) and are used as concrete forms for setting foundation piers. I found a damaged one at Lowes (crushed on one end) and was able to secure it from them for about half what they normally cost (I think I paid about \$5 or so). I cut a piece to length, then painted the inner and outer face with Krylon to seal it up some against moisture and turn it very black. After the paint was dry, I lined the inside face with 2mm black hobby foam so that it would friction fit against the aluminum ring on the open end of the OTA. I needed a way to keep it aligned with the OTA, so I replaced the short 1/4" screws that held the end ring to the OTA with 1" screws of the same thread size. The replacement screws are pointed outward, so they stick out a bit. I then put nuts on the end, just for safety to keep them from working loose and falling down the tube onto the primary, and cut equal-depth slots on the dew shield. The entire thing fits on the end of the OTA and the screws seat into the slots the same way all around to keep the shield lined up and in place. Works great and is reasonably light weight. I am not really happy with this however, and might break down and buy a

plastic dew shield made for this OTA from Orion, which weighs about a third as much.

I had quite a bit of left over 2mm and 3mm foam sheeting, so I made a few dew shields for the smaller tubes on the finder and SSAG. I also used the leftovers to insulate outer facing sides of the heaters so they would not lose as much heat to the air. I also added a neat Telrad dew shield, from a design I found online. One thing I noted was that the primary end of the OTA was totally open and one could simply light up the inside of the OTA (including the focuser at the other end) with a flashlight. Hmm. I found this to be interesting, and studied on it for a while. I ended up cutting a sheet of black foam-core sandwich board (similar to CoroPlast, but not corrugated), and set it in place in the back end of the tube. I cut a square hole in it for the fan blades to rotate in, then mounted it over the fan with the fan's mount screws holding it in place. I then hot glued a strip of 3mm foam around the perimeter to help isolate any fan vibrations. To remove it, I merely remove the fan mount screws and the entire thing comes off in my hand. One added benefit is that it acts as a shroud to direct the air entering the fan up and around the primary itself, rather than simply bouncing air against the primary and back out to the atmosphere. This should improve the efficiency of the entire fan assembly considerably. As I said before, I use an unmodified Canon T2i DSLR for imaging, but I did load Magic Lantern on it. This allows me to take very long exposures repeatedly and automatically without having to touch the camera (the Canon is limited to 10ea x30sec exposure runs from the factory). Using BYE negates the need for Magic Lantern, but it does have some cool functions to use if one is not using a laptop to control the camera, so I mention it here.

Finally, I had only to put it all together and line everything up before heading to the field on Saturday. To keep the center of the OTA's mass as close as possible to the axis of rotation, I mounted the OTA in it's rings such that the focuser drawtube is pointed directly back at the axis. I then mount the camera such that the hot shoe is pointed at the open end of the OTA. This does three things. First, it orients north in the same position in the image every time I set it up in the field, which means I can image over multiple nights and not have as many alignment problems during post-processing. Second, it makes the X and the Y coordinates of the image correspond to the DEC and RA axes during APT's drift alignment process and makes that much easier as well. Third, it moves the center of mass of the camera inwards so less counterweight is required. Orienting the SSAG sensor in a similar manner makes autoguiding more efficient, because RA and DEC move along one of the two sensor axes and the algorithms don't have to work as hard (mathematically) to determine how much to adjust during guiding.

With all of these mods done, I was ready to go out and give it a try to see how it was going to work. Our October 12th stargaze at the Tuskegee Airmen National Historic Site was postponed due to the government shutdown, so I headed over to Cliff Hill's place where we usually meet for our new moon stargaze. I arrived about sunset and it did not take me long to set everything up and balanced. Everything worked almost as I had hoped, with only a couple of minor exceptions. I did note one bad connector, which supplied voltage to the secondary heater (which I had wrapped around the secondary's aluminum support post). I fixed that a few days later. I also noted that I forgot to align the mount for the finder scope with the OTA during reassembly, which I corrected on the spot. I tried out AstroPhotographyTool (APT) for the first time, and used it to focus and drift-align. I will continue to use APT rather than BYE for aligning, because it simply works better and is more automated. This was also the first time I tried to use my new TEMPerHUM device, which interfaced automatically with both BYE and APT (both add the data to the pic files!). This device (paid about \$20 new on eBay) revealed that the temperature stayed only

a few degrees above the dew point. I ran a couple of short imaging sequences with BYE, which worked flawlessly. My new heaters worked well everywhere except for on the Telrad, which I had inadvertently unplugged. After plugging it back in, the dew was gone very quickly. The dew was not really all that bad, as observing sessions go, because of the cloud cover, so it will take a few more observing sessions before I am confident that this will work as I want it to. I checked the focus using the FWHM function of BYE, with the tube fan both on and off. There was no difference, which means that I might not use any primary heat at all and may simply leave the fan on 100% of the time, which is less likely to change the optical characteristics of the mirror's shape. Autoguiding worked great, though I had to tinker around with the PHD settings until I found what worked, but the real problem seemed to be that I needed to let it recalibrate each time I slewed very far across the sky before autoguiding. All new hardware and modifications seemed to work well, though I have a few very minor modifications to make to a couple of things before next new moon stargaze (mostly just tweaks to mounting and such, nothing substantial). The skies were VERY cloudy with only broken patches to look through before midnight (and nothing from then until 1am), so there was not chance for any serious astrophotography, though I did get a few shots at M42, M33, M1, and a few other things. All-in-all, a very successful testing and tuning evening.

During post-processing of the images, I noted something in some test images I made of Deneb. The diffraction spikes from the secondary's spider looked normal, but there was a weird fan pattern between them and additional, but less pronounced, set of spikes at 45 degrees from the spider's spikes. It turns out that the primary's retention clips are very large and invade much more of the primary mirror's surface than is necessary. I did a little research and talked to a few people more experienced than I, and discovered that the 10" mirror's edge right at the bevel is likely slightly mis-formed. I came across many others that have had the same problem and corrected it with an additional baffle right at the mirror's edge, but cut in such a way as to cover the outer 5mm of mirror surface. This "mask" baffle, along with a modification to the mirror's clips to bring them out some, results in NO clips being visible to the secondary. I also noted that the mirror clips are steel, but sit on rubber L-clamps that were clamping down on the mirror face. The underside of the mirror sits on four cork buttons right near the middle 1/3 of the mirror. I believe that the downward pressure of the clips on the edge, coupled with the upward pressure from the underside cork, as well as a probable turned down few mm or so at the edge of the mirror face, was deforming the mirror considerably and causing the strange diffraction pattern. The modifications should have taken the stress off the mirror but has reduced my aperture from 254mm to 244mm (which increases my focal ratio from f/4.7 to f/4.92). I would rather have 244mm of well-shaped surface than 254mm of surface that includes a turned-down edge. The increase to the focal ratio should also help reduce a slight bit of coma that my GSO coma corrector is not adjusting for. I also found out during this process that the GSO coma corrector requires 75mm between the last lens face and the sensor's imaging face, but I only had 61mm, so I added a 13mm extension tube at the end of the T-ring. I'll try another test on Deneb soon, but suspect that things are MUCH better. Thanks again to all those that provided input and advice. Hopefully, these details can help someone else.

Dark Skies!!!

Hope to see everyone at the meeting,
Russell