AG OPTICAL SYSTEMS
18-INCH NEWTONIAN ASTROGRAPH

By Mark Manner

When I received a call a few months ago from Dave Tandy, the founder of AG Optical Systems, asking if I might be willing to take a few images to test a new telescope, I was immediately interested. Although I am happy with the telescopes I currently use for imaging, like most amateur astronomers, I enjoy working with new equipment and thought that it would be interesting to image with a different instrument.

It wasn't until after I met with Dave that I found that I would be testing his company's first 18-inch f/3.54 Newtonian Astrograph, manufactured using in-house designed and fabricated carbon-fiber components. Given that my task was to report on the telescope's imaging performance, for most of the technical aspects of its design and fabrication I refer the reader to AGO's very helpful and informative website, www.agoptical.com.

Since my prior experience has primarily been with telescopes in the f/7-to-f/20 range, I was very excited about the prospect of working with a large, fast telescope. I was also interested in seeing how AGO handled the structural precision demanded by a very fast optical system.

The telescope was delivered in early October and set up on a Paramount ME on a temporary pier in the middle of my roll-off roof observatory. Since I have two piers in my observatory, fitting a third in the middle required some experimentation with the park position of my other instruments (**see Image 1**).

Image 1 - The AGO Newtonian astrograph positioned on a portable third pier in the center of the author's observatory.

My initial impression was that the telescope was huge! Given its size, the optical tube assembly's relatively light 90-pound weight was impressive, and a testament to its carbon fiber construction. As described on its website, AGO uses a carbon-fiber "sandwich" in the walls of the tube, resulting in an extremely light yet rigid structure. Even with the very-narrow critical-focus zone inherent in an f/3.54 system, I found the focus to remain stable while imaging for several hours with a temperature change of more than 20-degrees Fahrenheit.

The telescope arrived with three adjustable cooling fans behind the primary mirror, a well-flocked black tube interior, the new Finger Lakes Instruments (FLI) Atlas focuser, and a 3-inch Wynne corrector. I attached my SBIG STL6303E camera with AstroDon LRGBHa filters to the corrector, and began the process of getting set up for imaging. I controlled the Paramount with *TheSky6*, used *CCDSoft* for camera control, and *FocusMax* to automate focusing with the FLI Atlas. After the usual challenges with software and hardware unrelated to the OTA, I was

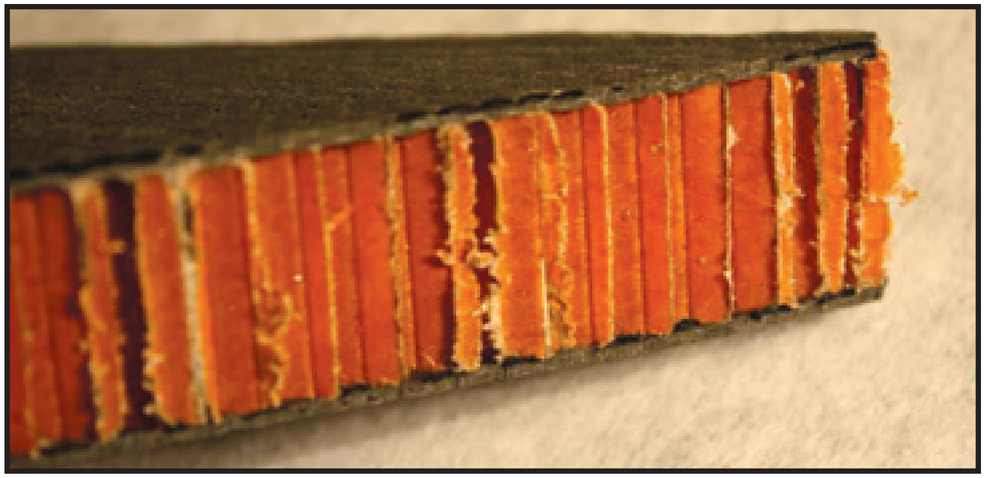


Image 2 - Cross section of AGO's custom carbon-fiber/Nomex-honeycomb composite tube wall.

Image 3 - The FLI Atlas focuser carrying the author's SBIG STL6303E camera.

able to begin imaging. Image calibration and initial processing was done with CCDWare's *CCDStack2*, and final processing steps were accomplished in *Photoshop CS5*.

Initially, the tight tolerances of this fast optical system created a few problems with field flatness and star shape. After adjusting the tilt-tip plate that the focuser was mounted on, I relatively quickly achieved a fairly-flat field. This process was greatly aided by use of CCDWare's *CCDInspector2*. I expect that further fine-tuning of the collimation and tilt-tip of the focuser base would result in even better performance. This would be the first step once this telescope was permanently set up in the owner's observatory, and should only be a one-time exercise, as I was able to confirm that there was no appreciable change in flatness or focus when slewing around from one side of the meridian to the other. Pointing was also excellent all-sky, even given the temporary nature of the mounting and relatively small T-Point model I used. This confirms that the OTA's mounting dovetail, mirror attachments and tube structure are robust and rigid.

Since I was using a non-anti-blooming gate camera, I experienced significant blooming in most images. The STL11K or other anti-blooming gate camera would of course be a better match for this system. All of my imaging was done without binning the camera, yielding an image scale of 1.15 arcseconds per pixel. To minimize the blooming issue, I initially imaged M27, the Dumbbell Nebula, using an Ha filter (**see Image 4**). This test resulted in a very nice narrow-band image with only 40 minutes total exposure time using one-minute subexposures.

I next tried an LRGB image, taking 310 minutes total exposure time on M33 (**see Image 5**). The results were very good, with nice color depth.

My final two images were NGC 281, the PacMan Nebula (**Image 6**), 340 minutes Ha, and M27 LRGB (**Image 7**), 148 minutes total exposure time. Both images


Image 4


Image5


Image 6

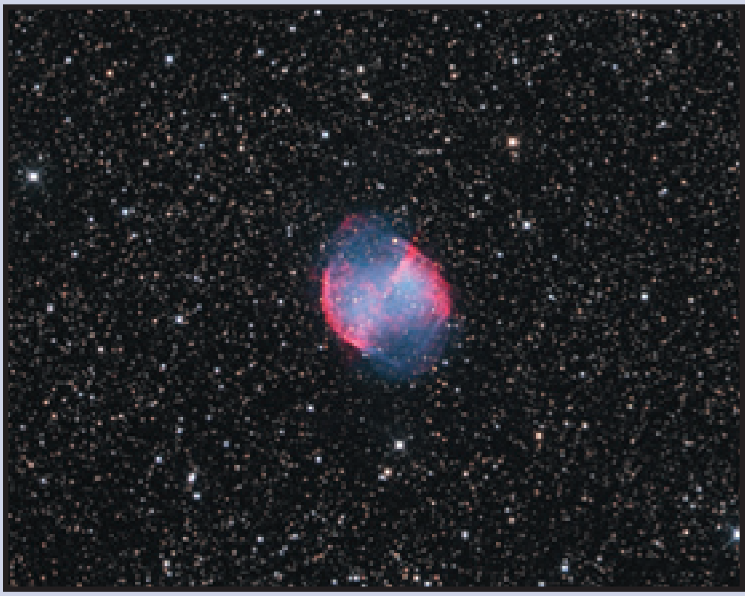
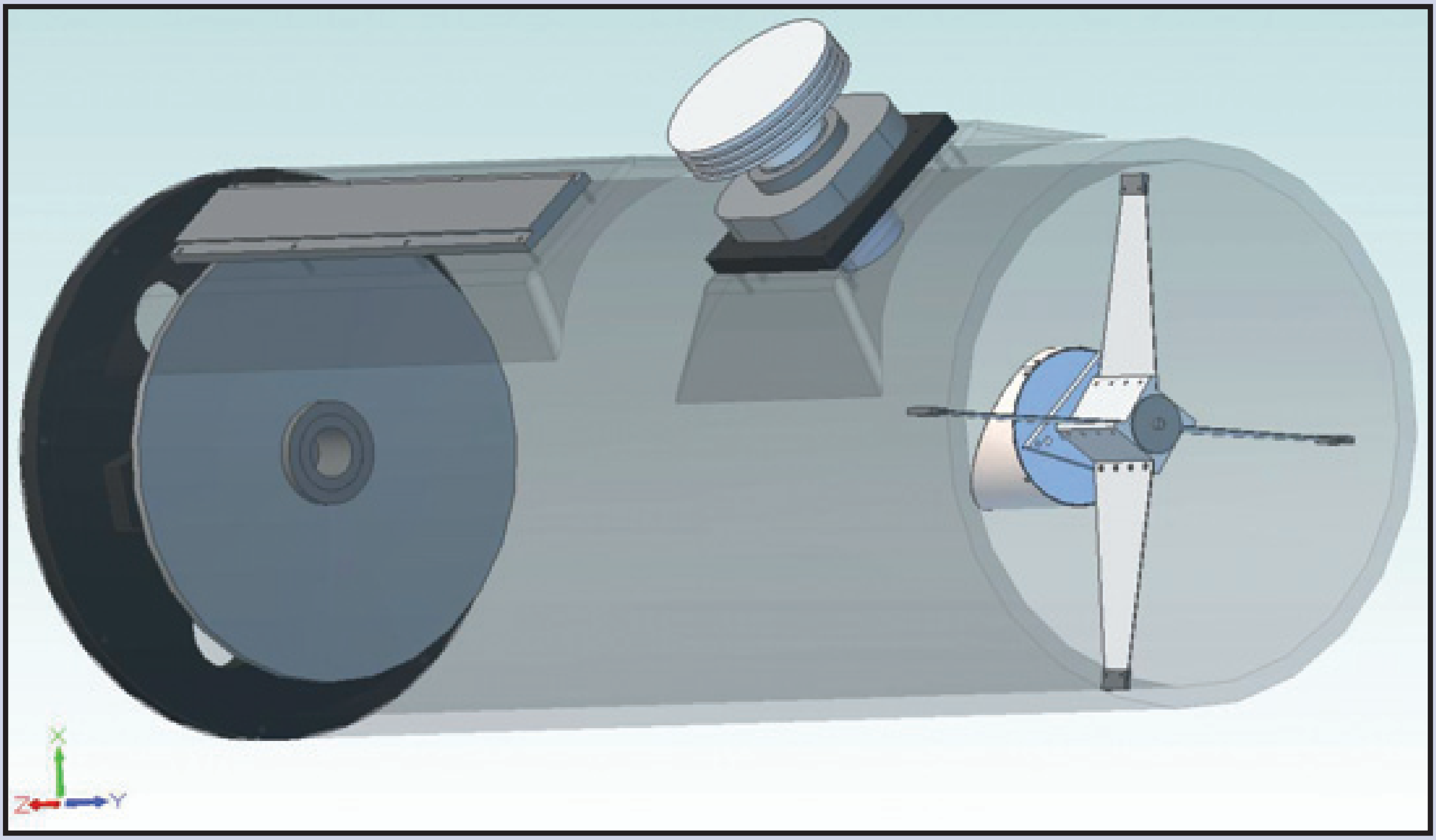


Image 7

continued to showcase the benefits of a well-put-together fast optical system.

Large fast astrographs are becoming very popular with amateurs using large-chip cameras, and after testing AGO's Newtonian Astrograph I can see why. AGO has entered this market with a range of very competitive astrographs, and I was sorry to see the telescope leave my observatory. Based on my experience with their first product, I look forward to seeing more from the company, including their line of f/6.7 "Imaging Dall Kirkham" telescopes. ATT

AGO Newtonian Astrographs Features



AGO Newtonian astrographs combine large aperture, fast focal ratio, and corrected optics with a lightweight, very stiff, thermally-stable carbon-fiber tube. The f/3.6 interferometrically-tested optics incorporate oversize secondaries to assure full illumination of a wide field of view. The primary and secondary mirrors feature enhanced-aluminum coatings for maximum light throughput and contrast.

AGO Newtonian astrographs use Supremax 33 (a Schott Borosilicate glass) primary mirrors that have a conical shape. Conical mirrors are lighter than typical flat mirrors and the conical shape facilitates simple yet rigid mounting that maintains the integrity of the wavefront produced by the primary mirror surface.

Off-axis abberations are corrected through the use of a 3-inch Wynne corrector providing pinpoint stars over a 50-mm diameter field. The Wynne corrector privides 57 mm of backfocus to accommodate most CCD camera-plus-filter-wheel combinations.

The short focal lengths of AGO Newtonian astrographs are capable of producing fields of view that are significantly larger than those of standard Ritchey-Chretien and Dall-Kirkham telescopes of comparable aperture. For example, the AGO 16-inch f/3.6 Newtonian produces a image field measuring 64 minutes by 43 minutes when mated with the SBIG STL11000 – a combination that perfectly frames such extended objects as the Orion Nebula (M42) or the M81-M82 galaxy pair and that is well-suited for research activities such as near-earth-object searches and photometry.

The tube of the AGO Newtonian astrograph consists of a 0.75-inch carbon-fiber composite that sandwiches a core of honeycomb Nomex between carbon fiber skins to yield a tube that is very stiff and yet much lighter than aluminum tubes of comparable strength. The chief benefit of this carbon-fiber composite structure is the focus stability that results from its very-low coefficient of thermal expansion.

The interior of the tube is coated with a premium-quality flocking material to mitigate internal reflection for maximum contrast at the focal plane. All aluminum components of the tube assembly are precision machined from 6061 aluminum and black anodized to produce a dark, wear-resistant finish. To prevent corrosion, all fasteners used in the assembly are stainless steel. Each AGO Newtonian astrograph is shipped with a set of lightweight, stiff, precision-machined aluminum mounting rings together with a dovetail plate.

AGO's standard package includes cooling fans and a manual speed controller, but it also offers an optional Thermal Control System based upon the Kendrick Premier Digital Controller, which system allows control fans and anti-dew heaters via a hand controller or a PC-based software application.

AGO selected the Starlight Instruments 3.5-inch digital focuser as standard equipment for a smooth, robust platform that allows automatic focusing.