The Orion 190-mm Maksutov-Newtonian

A Fast, Flat-Field, Large-Aperture, and Yet Affordable Astrograph

View down the tube of the Orion 190-mm Maksutov-Newtonian Astrograph showing the corrector plate, baffles and primary mirror.

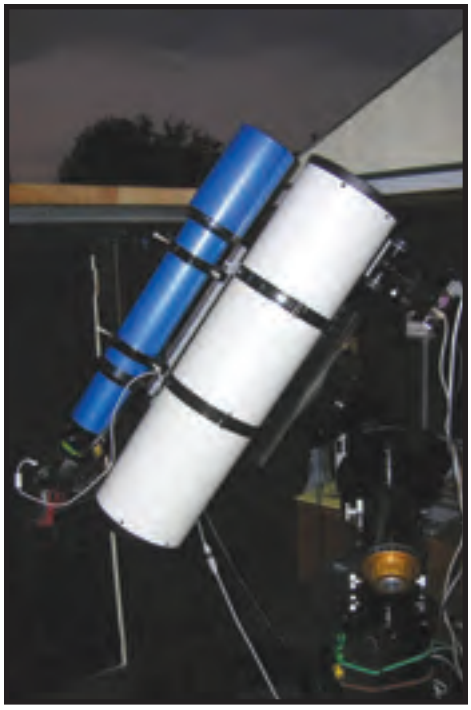
By James R. Dire, Ph.D.

The past few years I have used an 8-inch f/7 Newtonian and a Stellarvue 4-inch f/7.9 apochromatic refractor for observing and digital photography. The large focal ratio of the Newtonian minimizes coma throughout most of the field of view incident on the CCD in my Santa Barbara Instruments Group (SBIG) Model ST-2000 XCM camera. Similarly, the large focal ratio refractor has a fairly flat field throughout most of its field of view and provides excellent results with the CCD camera. Today, most DSLR and large-format CCD cameras have imaging chips that are four times larger than that of the ST-2000 CCD camera and the normal optical aberrations in these two instruments become apparent near the edges of images taken with large-format digital cameras.

As much as I loved the visual views in both of these telescopes, I decided to shop around for an instrument with a flatter field of view. Three telescope designs that offer very flat fields are Ritchey-Crètien (RC) reflectors, Petzval design refractors, and Maksutov-Newtonian reflectors. Reflectors always provide more aperture per dollar – since I was looking for an instrument with around an 8-inch aperture and didn't want another mortgage on my house, that eliminated a refractor.

Ritchey-Crètiens have been very popular in the last decade and most large, modern professional telescopes use this design. In recent years, RC telescopes as small as 8-10 inches have appeared on the market and some are surprisingly affordable. But these scopes typically come in focal ratios around 9 to 10 – quite slow for photographic use.

Although generally of high quality and capability, Maksutov-Newtonian reflectors are not as well known as other optical designs. But that may change rather quickly with Orion Telescopes & Binocular's introduction of a 190-mm (7.5 inch) Maksutov-Newtonian (Mak-Newt) astrograph. I decided to order one of these telescopes and give it a thorough workout in my backyard observatory (www.wildwoodpines.org). The Orion astrograph only has half the focal length of an 8-inch f/10 instrument, but its f/5.3 focal ratio is



The Orion 190-mm Maksutov-Newtonian Astrograph in the author's observatory on a Parallax HD150 German equatorial mount with a 4-inch apochromatic refractor guide scope.

exceedingly fast for a scope of such generous aperture, resulting in much shorter exposure times for deep space objects!

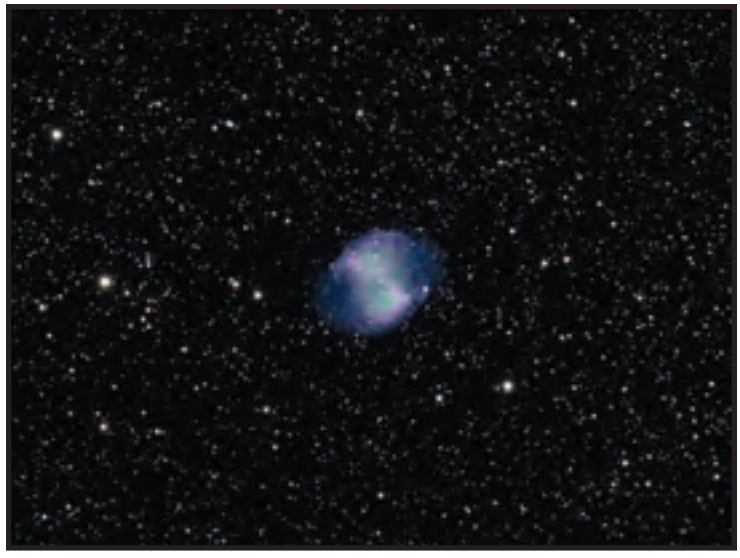
I ordered the 190-mm astrograph on a Monday – right after Orion's website showed they were in stock. Orion estimated five business days for shipping and my scope arrived on the Federal Express truck the following Saturday. In addition to the optical tube assembly, I ordered a set of 9.25-inch Orion tube rings, a dew controller and heating strip for the front corrector. All catadioptric telescope corrector plates tend to dew over when the night temperature drops below the dew point, so the heating strip is a must for long imaging sessions.

The astrograph came nicely packed with a double cardboard box and foam protection. After unpacking, I carefully inspected the nicely polished white tube assembly for damage and found none. The corrector plate and mirrors were clean and free of defects except that the primary mirror had some blemishes in the coatings from the manufacturing process. Although these did not appear to affect the telescope's performance, I elected to request a replacement and Orion cheerfully obliged, even paying the shipping charges for returning the first scope.

After unpacking the scope and components, I first attached the tube rings onto my Parallax HD150 German equatorial mount. The rings are not as thick and heavy as Parallax rings, but they are rugged and sturdy. One nice thing about this ring design is that when fully-clamped the bolts can be backed off a few turns to allow the tube to rotate without unclamping the rings. I attached a second set of adjustable rings to the Orion rings so my 4-inch apo could ride piggyback to the 190-mm astrograph.

The astrograph's manual stated the telescope was factory collimated and may not need adjustment. Ha, like I really believed that! A small Phillips screwdriver is needed to adjust both mirrors. Additionally a 2.5-mm Allen wrench is required to

5-Dminute exposure of globular cluster M13 located in the constellation Hercules.



Combination of three 10-minutes exposures of the planetary nebula M27 taken with an SBIG ST-2000XCM CCD camera.

collimate the primary mirror. Orion includes these tools with the telescope.

I visually checked the alignment of the secondary by sighting down the tube and through the open focuser. The orientation of the focuser and secondary mirror looked good. Then I inserted a laser collimation tool. A plastic cover must be manually removed to expose the secondary mirror collimation screws and this had to be done without touching the corrector plate to avoid hand smudges on the plate. The primary mirror has a 0.25-inch black hole reinforcement sticker marking its center. After a few small turns of secondary collimation screws, the secondary was aligned. Both tools were required to adjust the tilt of the primary mirror in a push-pull fashion for each of the three points of adjustment behind the mirror, but I found this to be simple and straightforward. The entire collimation process took about five minutes.

The telescope is designed for use as an astrograph. This means the optical path from the primary mirror to the focuser is shorter than that of a normal telescope of the same focal length to allow images to come to focus on a camera's sensor. The focuser only has an inch of adjustment to prevent its barrel from obstructing the light path inside of the optical tube assembly (OTA). Orion includes a 2-inch long, 2-inch inner diameter focus extender so the telescope can be used visually.

I choose the star Vega for first light to allow me to star test the collimation. I placed identical 26-mm Plossl eyepieces in the 1000-mm focal-length Mak-Newt and 800-mm focal-length apochromatic refractor to compare them under identical environmental conditions. In the 190-mm astrograph, the diffraction rings were perfectly symmetric, showing the collimation was perfect. After adjusting the three-point screws on the apo's rings to make both scopes parallel, I moved them over to Epsilon Lyrae, the Double-Double. Despite the astrograph's central obstruction and average seeing conditions, the Mak-Newt easily resolved all four stars of the Double-Double at 38x. There was no indication that the OTA had not reached thermal equilibrium after only one hour under dark skies.

For the next few hours I explored star clusters, galaxies and nebulae, going back

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and forth between the two telescopes. The views through the Mak-Newt were splendid. The field was flat from edge to edge and noticeably better near the edges than in the refractor.

The next night I attached my Canon 30D camera to the astrograph for prime-focus digital imaging and installed my SBIG ST-2000XCM camera on the apo as an autoguider. I attached a T-ring with a 2-inch nosepiece to the camera and inserted it into the focuser. The large setscrew on the focuser's compression ring held the camera firmly in place. The Orion 190-mm Mak-Newt comes with a Crayford focuser with two large handles, but a two-speed focuser would have been useful to speed up the otherwise tedious manual focusing process. Once focused, the test images contained pinpoint stars across the entire field of view. Since the Canon 30D has no internal cooling, I usually only use it for imaging below 55° F, and because the temperature was in the 70s, I decided to switch to the thermal-electric cooled SBIG CCD camera.

Although heavier than the Canon 30D, the compression ring held it firmly in place. Unfortunately, I was unable to achieve focus with the Crayford focuser's one inch of travel – it would not extend out far enough to achieve focus. I attached the two-inch focus extender, but then the focuser would not go in far enough to achieve focus. So, I ordered a one-inch focus extender and when it arrived I was able to focus the CCD camera.

Images with the CCD camera were as impressive as with the Canon 30D. My first target was M13, the finest globular cluster in the northern sky, which after five minutes was rendered perfectly on the CCD. Then I went for M27, one of the easiest planetary nebulas to photograph. Combining three 10-minute exposures yielded more detail in the nebula than I'd ever before obtained. My third object was the Western Veil Nebula, adjacent to the star 52 Cygni. Six stacked 10-minute exposures yielded crisp wispy red and blue gas filaments with pin-point stars at all edges of the image. For deep-space objects, the Mak-Newt's fast focal ratio provided excellent results with a fraction of the exposure times it would take with an f/9 optical system. Plus, the large field of view made finding a guide star on the SBIG camera's tracking chip a simple matter.

In conclusion, the scope is everything it is advertised to be. It is nicely crafted, fast and has an incredibly flat field. Orion doesn't advertise the specs on the primary mirror, but they must be close to diffraction-limited. With no primary mirror specifications and given the fact that the astrograph does not come with a two-speed focuser, I question calling it a "premium" instrument. However, for digital imaging and visual use, the telescope is a great value compared to alternate optical designs of similar aperture. ATT