IAN MORISON explains aspects of instruments and observing

Newtonians and their derivatives part 3: Maksutov–Newtonians

Newtonian reflecting telescopes are good all-round performers at an affordable price, as the first two articles in this series have shown. But, as explained in the March–April 2020 issue, that is not say that they are perfect telescopes. As many astrophotographers have discovered, star images at some distance from the optical axis suffer from coma, which makes them all appear like tiny comets, and the spider assembly that carries the diagonal mirror creates spikes on star images. Maksutov–Newtonians largely overcome these defects, though at a price.

Figure 1 shows the optical design of the Maksutov–Newtonian. This will be the same length as an equivalent aperture and focal length Newtonian but, instead of using a parabolic primary mirror, it has a spherical mirror allied to a thick, curved, meniscus lens at the front of the optical tube. This corrects for the spherical aberration of the primary mirror but also significantly reduces the coma that would be seen towards the edge of the field of view of a low power eyepiece and provides a flatter image plane which is better for astroimaging. The fact that the secondary mirror is not supported by a spider eliminates the diffraction spikes that would be seen in a Newtonian and helps to increase the "micro-contrast" of the image. Due to the increasing weight of the corrector plate, large-aperture Maksutov–Newtonians are not too practical and these designs are limited to about 300 mm aperture.

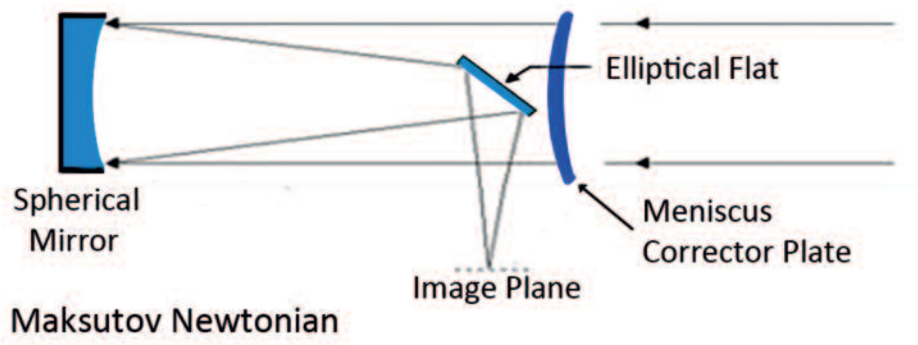
For around £850 and as seen in figure 2, Rother Valley Optics can provide the Explore Scientific "David H Levy Comet Hunter 152 mm Carbon-Fibre Maksutov–Newtonian". With an f/4.8 design, this instrument can provide fields of view up to two degrees across. It is constructed using thermally inert and extremely robust – yet very light – carbon fibre. The whole telescope weighs around 8 kg and puts very little strain on mounts compared to other instruments of similar aperture. The tube is heavily baffled and internally blackened to improve its overall contrast and has a 2-inch graduated 10:1 Crayford focuser and an 8 × 50 illuminated finder.

Maksutov–Newtonians of 190 mm aperture are sold by Sky-Watcher, with the 190MN DS Pro, as seen in figure 3, and by Orion Telescopes (USA) with the "premium" MN 190/1000. Both have an f/5.3 focal ratio and I suspect that they are virtually identical and are made by Synta in China. They claim, I think rightly, that they provide image quality comparable to a top class apochromat refractor at a considerably lower price. In fact, in one respect they will be better as they provide a flatter image field than a refractor without the addition of a field flattener. Both claim to be astrographs in providing an aberration-free flat field for use with DSLRs, mirrorless or CCD cooled cameras. One downside of the design for this use is that the camera will be mounted to one side of the tube assembly so may need balancing if a weighty camera and filter wheel are used. An ideal lightweight mirrorless APSC-sized sensor camera is the Sony A5000, available secondhand for under £150. The 190MN DS Pro is equipped with a 50 mm diameter secondary while the Orion Optics (USA) telescope uses a larger 64 mm diameter secondary which will better illuminate this size of camera sensor. This would, however, make it less suitable for planetary imaging where a smaller secondary is preferable.

These two telescopes are quite heavy, due to the weight of the corrector plate and the fact that they have oversized tubes so that they can contain baffles down their interior to improves their overall contrast. They will have a high moment of inertia, with much of their weight at the ends of the optical tube. Together this means that quite a substantial equatorial mount would be needed but, though not usually done, they could be mounted on a Dobsonian mount and Orion Optics (UK) can provide a suitable mount for about £220.

The Russian company Intes Micro made (at some cost) a very wide range of premium Maksutov–Newtonian telescopes, and although they have stopped manufacturing them, they are still available from UK suppliers. They range in aperture from 127 mm through 152, 178, and 254 mm up to 305 mm. The smaller aperture telescopes can be obtained with a focal ratio of either f/6 (as is my 152 mm MN66 and seen in figure 4) or f/8 which, having a smaller secondary, are better for planetary observing. The larger telescopes are either f/5.5 or f/6. The telescope tubes are of a larger diameter than one might expect as they contain numerous baffles down the tube interior as well as a set of baffles immediately opposite the focuser (visible in figure 4). These will help give the maximum possible overall contrast. The mirrors are specified to be equal or better than $\lambda/6$ peak to peak. A closed tube such as a Maksutov–Newtonian will take longer to cool down than an open-tube Newtonian, but to reduce this to a minimum, a plate can be removed from behind the primary mirror and the periphery of the corrector plate has openings to let ambient air circulate within the tube and so reduce the cool-down time. The focuser is somewhat novel, being a short-travel very low-profile model (if a bit fiddly). This is good as it reduces the distance between the eyepiece and secondary mirror to a minimum and thus allows a smaller mirror to be used, reducing its diffraction effects and so increasing the micro-contrast of the telescope making it better for observing the planets. The images in figures 5 and 6, taken through my Intes Micro MN66, attest to their superb optical performance.

I think that it is fair to say that a well-designed Maksutov–Newtonian is as near perfect an optical instrument as it is possible to create.



▲ Figure 1: The optical design of a Maksutov–Newtonian. Credit: Ian Morison.

◄ Figure 2: The David H Levy Comet Hunter 152 mm aperture carbon-fibre Maksutov–Newtonian. Credit: www.bresser.de.

► Figure 3: Sky-Watcher 190MN DS Pro Maksutov–Newtonian, widely available in the UK. Credit: Optical Vision Limited.

► Figure 4: The Intes Micro MN66 152 mm f/6 Maksutov–Newtonian. Note the numerous baffles inside the tube. Credit: Intes Micro.

▼ Figure 5: The eight-day Moon imaged with my own MN66 Maksutov–Newtonian. Credit: Ian Morison.

▼ Figure 6: The Southern Highlands with the Tycho and Clavius craters. Credit: Ian Morison.