Text and photography by TONY PUERZER

AUTO-GUIDING FOR DUMMIES

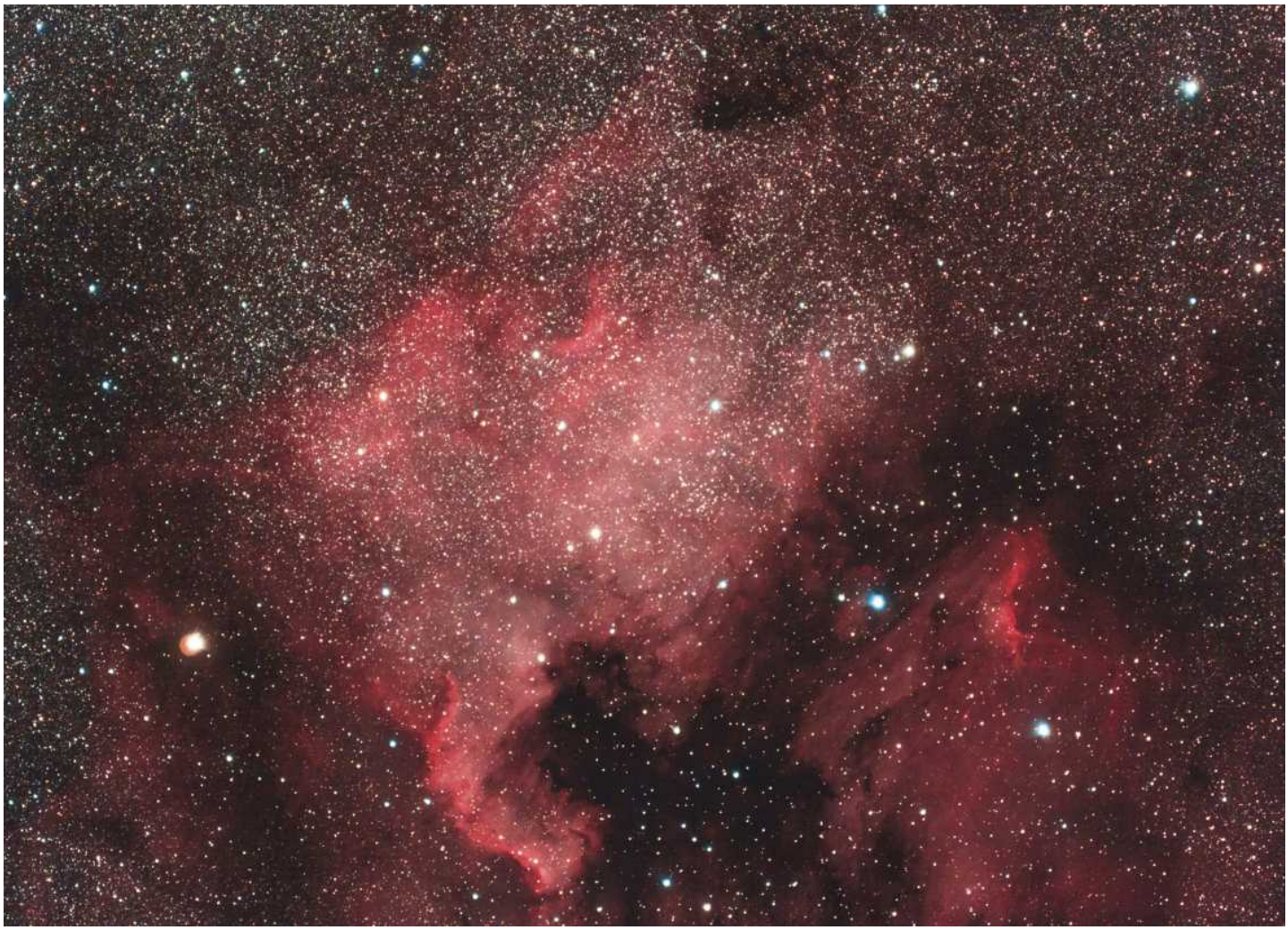
A little effort (and some extra gear) helps yield sharp astrophotos

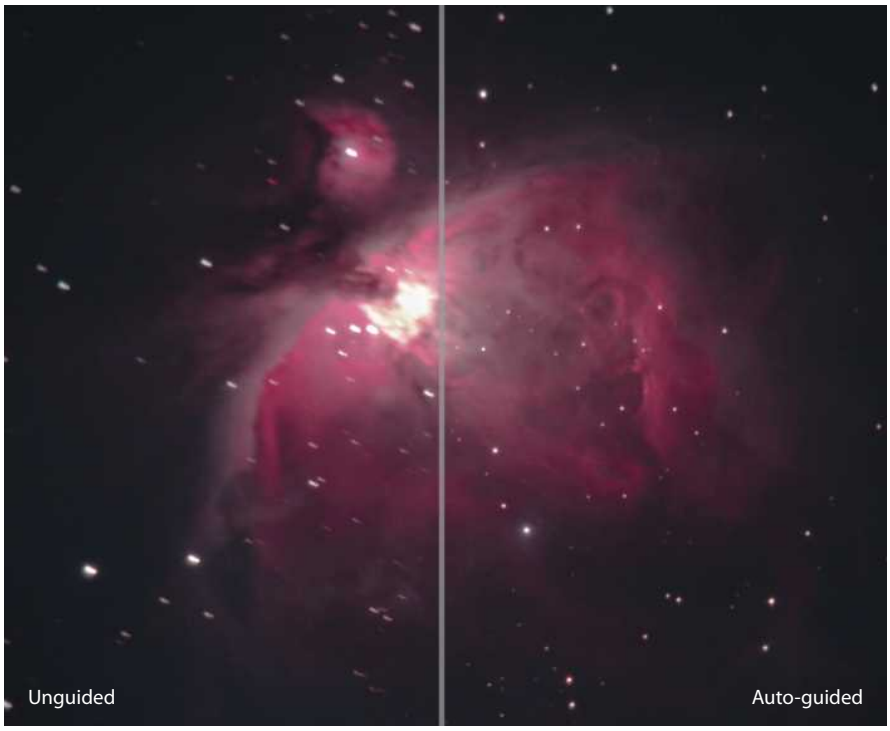
EVEN THE BEST motorized equatorial mounts don't track perfectly. This is a nonissue for visual observers, but for those wanting to capture long-exposure photographs, it's a problem. If you've carefully polar-aligned your mount and still find the stars in your images are wiggly lines rather than perfect points, poor tracking is likely the culprit. An auto-guider could be the answer.

A typical auto-guider setup employs an auxiliary camera and special software to monitor the position of a selected guide star. If the software detects any drift in the guide star, it sends tiny tracking adjustments to the mount to compensate for this motion and keep it on track.

I bought my first auto-guider several years ago. It wasn't cheap. I remarked to the salesperson that for the same money, I could go on a nice tropical vacation. "Yes," he agreed, then added without missing a beat, "but while your trip would be over in a week, this auto-guider will torment you for years to come." He was partially right about the torment (just a few bumps in the road, really), but that purchase helped unlock the full potential of my mount. Whether an auto-guider is the right solution for you comes down to the type of imaging you plan to do.

A CONTINENT OF NEBULOSITY The author used an astro-modified Canon EOS 60D DSLR camera (working at ISO 1600), a Canon EF 300mm f/4L IS USM lens and an iOptron iEQ30 Pro mount for this 6-minute exposure of the North America Nebula, in Cygnus. The mount was auto-guided with PHD2 software running on a laptop computer and an Orion Mini 50mm guidescope fitted with a ZWO ASI120MM-S guide camera.





TO GUIDE OR NOT TO GUIDE This pair of 4-minute exposures of the Orion Nebula shows the perils of letting your equatorial mount track unassisted (left side) versus the benefits of auto-guiding (right side). Note that the stars are little squiggles in the left half of the frame and sharp points on the right.

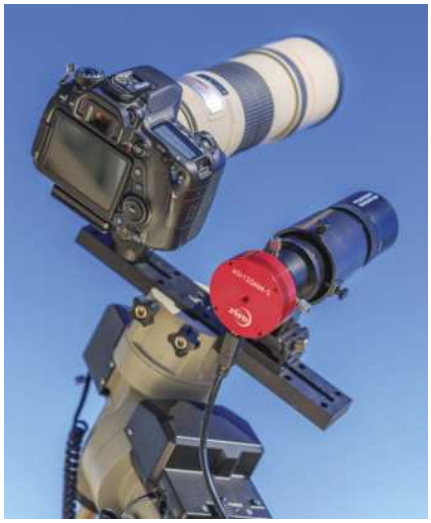
Auto-guiding is generally necessary only if you want to do long-exposure imaging with a telephoto lens or a telescope having a focal length that exceeds 300mm. At the image scale produced by such optics, even small tracking imperfections become apparent in a multiminute exposure. However, if you generally opt for shorter exposures or wide-angle lenses, chances are you can live without the extra expense and complexity that auto-guiding entails.

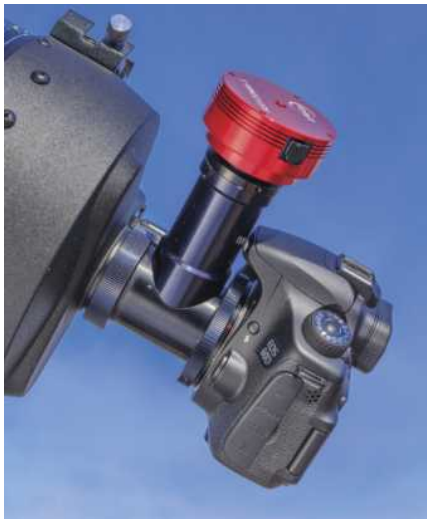
If you decide that an auto-guider is the cure for what ails your images, keep in mind it's not magic—you'll still need a sturdy, motor-driven equatorial mount that's accurately polar-aligned. And to avoid the potential torment that comes with the extra complexity auto-guiding introduces, you should already be able to centre your target and get it perfectly focused. If you're struggling with these basics, you're probably not ready to add auto-guiding to your astrophotography mix just yet.

PICK YOUR POISON

There are two kinds of auto-guiding setups: *off-axis* and *coaxial* (also called parallel). The former uses an accessory off-axis guider, which includes a small prism to pick off a tiny bit of starlight from the edge of the imaging circle—slightly outside the field of view of your main camera—and direct it to a guide camera. In the coaxial configuration, the guide camera is attached to a dedicated guidescope (usually a small refractor) mounted on the main imaging telescope. Both arrangements can work well, though off-axis is especially suited to astrophotography with Schmidt-Cassegrain optical systems, which often exhibit a small amount of image shift (due to "mirror flop") as the scope's orientation changes while the mount tracks the sky.

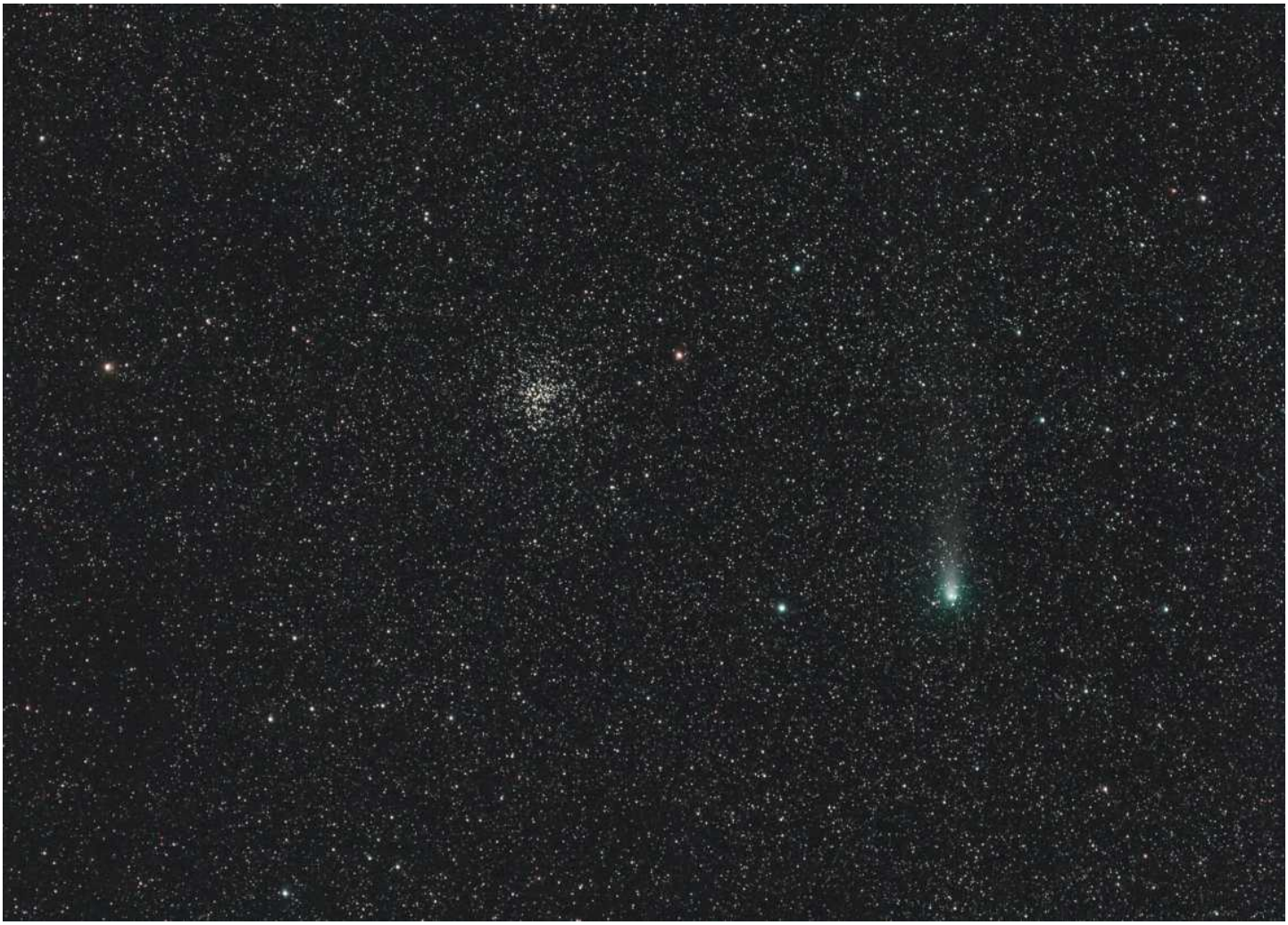
The coaxial option is the more popular of the two for a couple of reasons. First, the wide field of view offered by a guidescope presents a large number of potential guide stars. (Off-axis guiders have a very limited choice of stars around the periphery of the field.) Second, going coaxial gives you the ability to guide on the same object you're trying to image. This capability comes in handy when you're attempting to capture fast-moving targets, such as comets or asteroids. An off-axis guider won't work in these instances because the pickup prism gets in the way of the imaging camera.





SCOPING THE OPTIONS Left: An Orion Mini 50mm guidescope and a ZWO ASI120MM-S guide camera are mounted in parallel on a dovetail bar with the imaging instrument, a Canon EF 300mm f/4L IS USM lens and an astro-modified Canon EOS 60D DSLR camera. Right: Both the guide camera and the imaging camera are attached to the telescope via an accessory off-axis guider. The device utilizes a small prism to direct part of the focal plane to the guiding camera.

The guidescope you select for your system should have a focal length at least one-tenth that of the main imaging telescope. For example, the Orion Mini 50mm guidescope I use has a focal length of 162mm, which means it's fine for telescopes with focal lengths up to about 1600mm. When it comes to choosing a guide camera, a monochrome unit with small pixels and high sensitivity is the best option. Popular examples include the Orion StarShoot



COMET ON THE RUN As it drifted through Auriga last September, Comet 21P/Giacobini-Zinner passed by open cluster M37. The author captured the encounter in a 2-minute exposure made with an auto-guided iOptron iEQ30 Pro mount and an astro-modified Canon EOS 60D DSLR camera. By using a coaxial auto-guiding configuration, it was possible to track the comet rather than a background star.

AutoGuider Pro Mono and the ZWO ASI120MM Mini. It's often less expensive to buy a camera as part of a bundle that includes a guidescope and mounting rings.

PUSH HERE, DUMMY

The final piece of the auto-guiding puzzle is the software needed to control everything. The most popular software is PHD2—a free open-source application. (PHD stands for "Push Here, Dummy.") It's what I chose.

To use PHD2, connect the guide camera to your computer and your computer to your mount. (How your camera, computer and mount get wired together depends on the specifics of your equipment.) Click the green USB button on the software to set up a profile for your equipment. There's a good chance the software will auto-detect the pixel size and resolution of your guide camera, but you'll have to manually enter the focal length of your guidescope.

Next, cap the front of the guidescope and instruct PHD2 to build a dark-frame library to minimize noise in the guide-camera images. This helps prevent the software from trying to guide on a "hot pixel" instead of an actual star.

Engaging the Loop feature in PHD2 starts a live video feed on your computer, allowing you to fine-tune the guidescope's focus and pick a guide star. Dimmer stars work best, since the bloated size of a bright star tends to mask tiny tracking deviations. Select an exposure time of 2 to 4 seconds to avoid having the auto-guider respond to a star's "twinkling" motion.

The first time you press the green Guide button, PHD2 will perform a calibration routine to discover the exact orientation of your guide camera and the properties of the right ascension and declination axes of your mount. To obtain the very best calibration, select a star close to the celestial equator and near the meridian. If you use the same equipment each imaging session, you can reuse this calibration.

If you've done everything correctly, PHD2 will simply start guiding after the initial calibration is completed. If not, you might start to wish you'd opted for that tropical vacation instead. But don't despair. There's plenty of helpful information available, both in the software documentation and on-line at the Open PHD2 Guiding website (openphdguiding.org).

Welcome to the wonderful world of auto-guiding. ✦

Tony Puerzer is a full-time professional photographer and part-time amateur astronomer living in Nanaimo, British Columbia.