



Creating Sharp Astrophotos

Taking well-focused images of the night sky is easy if you follow these simple tips.

A poorly focused lens can ruin an otherwise perfect astrophoto. Stars become bloated blobs (often surrounded by unsightly color fringes) and fine details are lost. Imprecise focus also means longer exposures are required to record faint objects. And none of these problems can be easily fixed during post-processing — that's why it's important to get everything right under the night sky.

Your camera's autofocus system works well in bright daylight but will struggle to lock in focus in dim conditions. In fact, some excellent lenses are fully manual and lack autofocus capabilities. For best results, you need to manually focus with the aid of a feature called Live View. It's included in most every digital camera sold these days. This option allows you to zoom in and examine a highly magnified image of a bright star or planet on your camera's rear display. This technique is

the only way to guarantee consistent results at night.

To Infinity . . . and Beyond

To begin, try to get close to infinity focus by rotating your lens's focus ring to its most distant setting. If it features a printed scale, you can use the infinity symbol (∞) as a handy reference; however, autofocus models go slightly past this point. If you have such a lens, turn the focus ring back a little bit from its maximum-distance setting — often there's an index mark to align with the infinity symbol. This preliminary step ensures the stars are sharp enough to show up when you engage Live View.

Now, set your camera to Manual mode with an exposure time of 30 seconds and set the lens aperture wide open (the lowest f/stop number). Increase the ISO setting to 1600 or more, and turn up the brightness of your camera's viewscreen. While this

▲ **SHARP LAGOON** Your time under a clear, dark sky is always limited, but it's important to take as long as you need to accurately focus your camera's lens. This crisply focused, 6-minute exposure of the Lagoon and Trifid Nebulae (M8 and M20) in Sagittarius was captured from Mount Kobau, British Columbia, with an astro-modified Canon 60D DSLR camera set to ISO 1600, and a 300-mm f/4 lens.

last step will ruin your night vision, it'll make seeing dim objects much easier.

To use Live View, center a bright star or planet in the field of view. Gently nudge the focus ring back and forth, stopping when the blur circle is smallest. Recenter your target and increase the magnification to 5× or 10×. Tweak the focus ring again slightly until the object appears as small as possible. You may notice faint stars suddenly appearing, just visible through the haze of sensor noise. This is a good indication that focus is nearly perfect.

And here's your pro tip for this

article: Be careful not to breathe on your camera's lens while making any adjustments. The warm, moist air you exhale might condense as dew on the front element of the lens, spoiling your images. (That's the voice of experience speaking here.)

Long-focal-length lenses often display mild *chromatic aberration* (color fringing) around bright stars. These halos will change from magenta to teal as you pass through the point of best focus. Ultimately, your goal is to minimize the size of the star and any associated color fringing. Sometimes the best setting is a compromise between a tiny star and one that's completely free of chromatic aberration.

Turbulence in the atmosphere can cause stars to appear to "twinkle," making it more difficult to evaluate your progress. In such conditions, avoid aiming near the horizon, where the twinkling effect is most extreme, and instead aim at a star near the zenith.

Open Wide

If you're working with the "kit" zoom lens your camera came with, consider upgrading to a fast *prime* (fixed-focal-length) lens with a wide aperture. Such

lenses usually produce brighter images, which are easier to evaluate for sharpness. Keep in mind that each decrease in *f/stop* doubles the amount of light reaching the camera's sensor. For example, an *f/1.4* lens gathers 16 times more light than one operating at *f/5.6*. (Turn to page 54 of the October 2022 issue for recommendations on upgrading your lens.)

Fast primes aren't cheap, but they often feature better optics and mechanics that enable more precise focusing. Inexpensive lenses may exhibit a slight amount of image-shift as you rotate the focus ring back and forth, which turns makes the entire process more challenging. The *focus throw* (the amount you have to turn the focus ring to go from closest focus to infinity) will determine how precisely you can adjust the lens. High-quality models with longer focus throws are generally easier to focus. Of course, it's not impossible to achieve good results with a kit zoom — you just need to work a little bit harder.

Going Remote

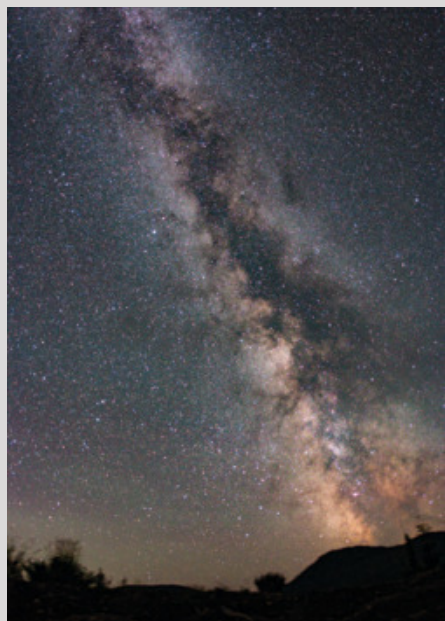
Even with a high-quality lens, the relatively small size of your camera's rear display will limit your ability to judge focus. Worse yet, if your camera lacks



▲ **BIG-SCREEN VIEW** The screen of an iPad tablet dwarfs the display of this Canon camera. Using Live View on a larger display makes obtaining perfect focus a snap, and since the connection is wireless the display can be positioned at a comfortable angle and away from the camera.

an articulated screen, you'll probably end up having to contort yourself into some weird and uncomfortable positions just to view it. This is especially true when shooting objects high overhead near the zenith.

Luckily, many cameras are capable of wireless control, allowing you to take advantage of the larger screen on your mobile phone or tablet. For example, Canon's *Camera Connect* app allows Live View and focus with iOS and Android



▲ **MILKY SIGHTS** *Left:* This twilight view of the Milky Way was recorded in a 2-minute exposure made with a Canon 70D DSLR camera set to ISO 1600 and a 15-mm fisheye lens at *f/2.8*. Wide-angle optics such as this are perfect for beginning astrophotographers because such lenses are more forgiving of slight focus errors than longer focal lengths are. *Right:* Poor focus can be masked by low-quality optics, unsteady seeing conditions, or even passing clouds. That was the situation when this 2-minute exposure of the North America Nebula was made using an 85-mm lens.

devices. Some third-party applications, such as *Cascable* (iOS only) support multiple camera brands. Check your manual to see whether your camera is equipped with Wi-Fi and can take advantage of this handy feature.

Most digital cameras can connect to a laptop computer using a USB cable (also known as *tethering*). This allows you to use your computer's generous screen for focusing. Many manufacturers offer software specifically for this task. For example, Canon supplies a free application called *EOS Utility*, which allows you to display the camera's Live View feed on your computer screen. The software also lets you adjust autofocus lenses remotely, eliminating the need to touch your camera and introduce vibration.

The Bat Signal

Judging precise focus is much easier with a simple accessory called a *Bahtinov mask*, which attaches to the front of your lens. The mask is a thin, plastic disk that has a series of slots cut into it designed to produce a specific pattern of diffraction spikes around bright stars. By observing the position of the overlapping spikes, it's easy to determine the point of perfect focus.

The mask works extremely well with telephoto lenses but isn't very effective



▲ **SUMMER SWAN** Taking the time to properly focus the lens yielded pinpoint stars in this 2-minute, tracked exposure at ISO 3200 showing the Milky Way around the constellations Cygnus and Lyra. The author used his Canon 70D DSLR with a 22-mm lens at f/4.5.

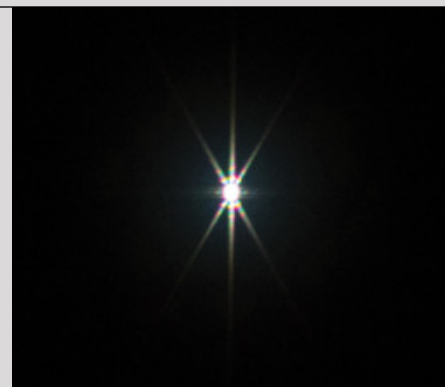
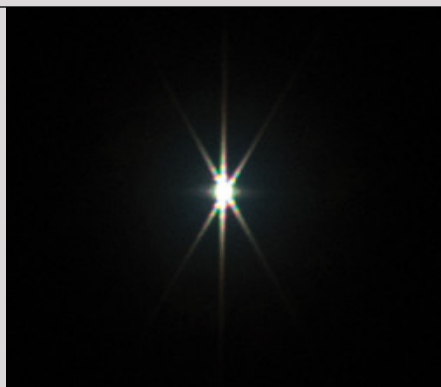
with wide-angle models owing to the tiny size of the resulting diffraction patterns. Bahtinov masks are available in various sizes from commercial sources, and you can even make your own if you're so inclined. They can be 3D-printed or simply cut from a sheet of black plastic. If you search online for "Bahtinov mask template" you'll find several options.

Finally, achieving sharp focus is one thing, but maintaining it throughout an entire imaging session is another. As your lens cools during the night, thermal contraction may cause the focus point to shift slightly. Also, some inexpensive lenses exhibit *focus creep* arising from mechanical components shifting slightly when the camera is pointed

skyward. Even aiming at a different part of the sky runs the risk of introducing focus creep. That's why it's important to recheck focus occasionally throughout an imaging session.

As with so many aspects of night-sky photography, producing attractive images with pinpoint stars requires attention to detail. Don't be discouraged if you initially find yourself spending a lot of time focusing and less time shooting. The process will become faster and easier over time. And the reward is an image you'll be proud to call your own.

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▲ **MASKING FOR FOCUS** *Left:* The author uses this Bahtinov mask from Farpoint Astro with his 300-mm telephoto lens. The mask installs much like a standard lens filter and allows for precise focusing. *Right:* This pair of images illustrates how to focus a lens fitted with a Bahtinov mask. When the central diffraction spike is positioned exactly halfway between the two diagonal spikes (far right image), the lens is perfectly focused.