

# The Spike-a Focusing Mask

## A Masterfully Executed Bahtinov Mask

By Craig Stark

Astrophotographers can be a picky bunch: We expect to be able to hold a position in the sky counteracting the earth's rotation to within an arcsecond, or even a small fraction of an arcsecond. To give you a better idea of what that means, an arcsecond isn't even as big as the angle that's formed when you put two meter sticks atop each other and put a piece of paper between them at one end. In fact, that's about 25 arcseconds.

We also expect to hit focus dead-on. While visual observers have eyes that can focus and accommodate for imperfect focus, CCD cameras don't have this luxury. Run at  $f/4$  and if you can't get the focus set to within 0.035 mm, you're inducing more

that  $1/4$  wave of error. That nice high-Strehl telescope means nothing if your focus isn't spot-on. To give you an idea of that degree of precision, the thickness of a piece of paper is 0.097 mm. The focus tolerance then is under half the thickness of a piece of paper (at  $f/7$  the tolerance is about the thickness of that paper). As I said, we're a picky bunch.

There are a lot of tools available that try to help us achieve this precision and hit solid focus, but none has taken the community by storm as much as the Bahtinov mask. The Bahtinov mask is related to the Hartmann mask that has been around for some time. Both are devices that you place over the front of your telescope. These

masks cause a diffraction pattern that can be used to fine-tune focus. But, the Hartmann, while not quite a Model T by comparison, is not in the same league as the Bahtinov.

Pavel Bahtinov, an amateur astrophotographer, developed the idea and math behind the mask and this idea was taken up by the community at large first with a vigorous discussion on the popular astronomy forum, Cloudy Nights ([www.cloudynights.com](http://www.cloudynights.com)). It was fun to watch the community work together to truly build the proverbial better mousetrap and after a number of masks were made using whatever folks had on hand (cardboard, clear plexiglass with tape making the diffraction

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**Image 1: Mask mounted on a Celestron CPC 1100 XLT scope. Note the clean machining, anodized finish, and nice non-marring screws used to securely anchor the mask to the scope.**

pattern, etc.), several had the bright idea that it sure would be nice if someone made them commercially. Enter Jerry Hailey and John Wunderlin of Spike-a ([www.spike-a.com](http://www.spike-a.com)).

Now, I've tried a lot of focusing tools and I've even written computer software to help you reach focus. I can say without reservation that the Bahtinov mask is one of the easiest (if not the easiest!) methods, to focus your scope. I've also made a number of Bahtinov masks myself and I've seen a few commercial offerings. I can also say

without reservation that the Spike-a mask is the best-made version I've seen. While about \$80 for an 8-inch mask is a lot more expensive than a piece of cardboard and a razor blade, the Spike-a version is a lot more sturdy and a heck of a lot classier than my home made attempts. If you're using a dedicated CCD to image with (and are therefore using image capture software that probably has a focus routine), think long and hard about using a mask, as it may make your life a good bit easier. If you're using a DSLR and trying to focus with its

viewfinder or LCD screen, stop reading now and order a mask. You'll thank me.

### The Spike-A Mask

The Spike-A mask is made out of nicely machined and anodized aluminum (**Image 1**). The main portion of the mask has a series of slits cut into it that produce the diffraction pattern used during focusing. This is considerably stronger than say, the thin cardboard box that used to hold a pack of manilla folders (ahem!).

One of the issues facing the home-builder after the mask has been, say cut out of said cardboard, is how you attach this to the front of the scope. Sure, there are homebrew solutions and a number of people out there have done wonderful jobs. I tend towards the quick-and-dirty approach and the "spring" I made out of folds of said cardboard worked...mostly. In the Spike-a version, three tabs of the aluminum are bent over and nylon screws are inserted through threaded holes. This way, it can securely attach to the front of the scope (foam pads protect your scope). Did I mention this looked more professional and was a lot sturdier?

### Using the Mask

The mask is easy to use. Simply aim your scope at a fairly bright star and put the mask over the front of the scope. What you'll see with the mask in place is the star with Vs coming off of two sides and a line that's either on one side of the V or in the middle of the V (see **Image 2**). As you turn

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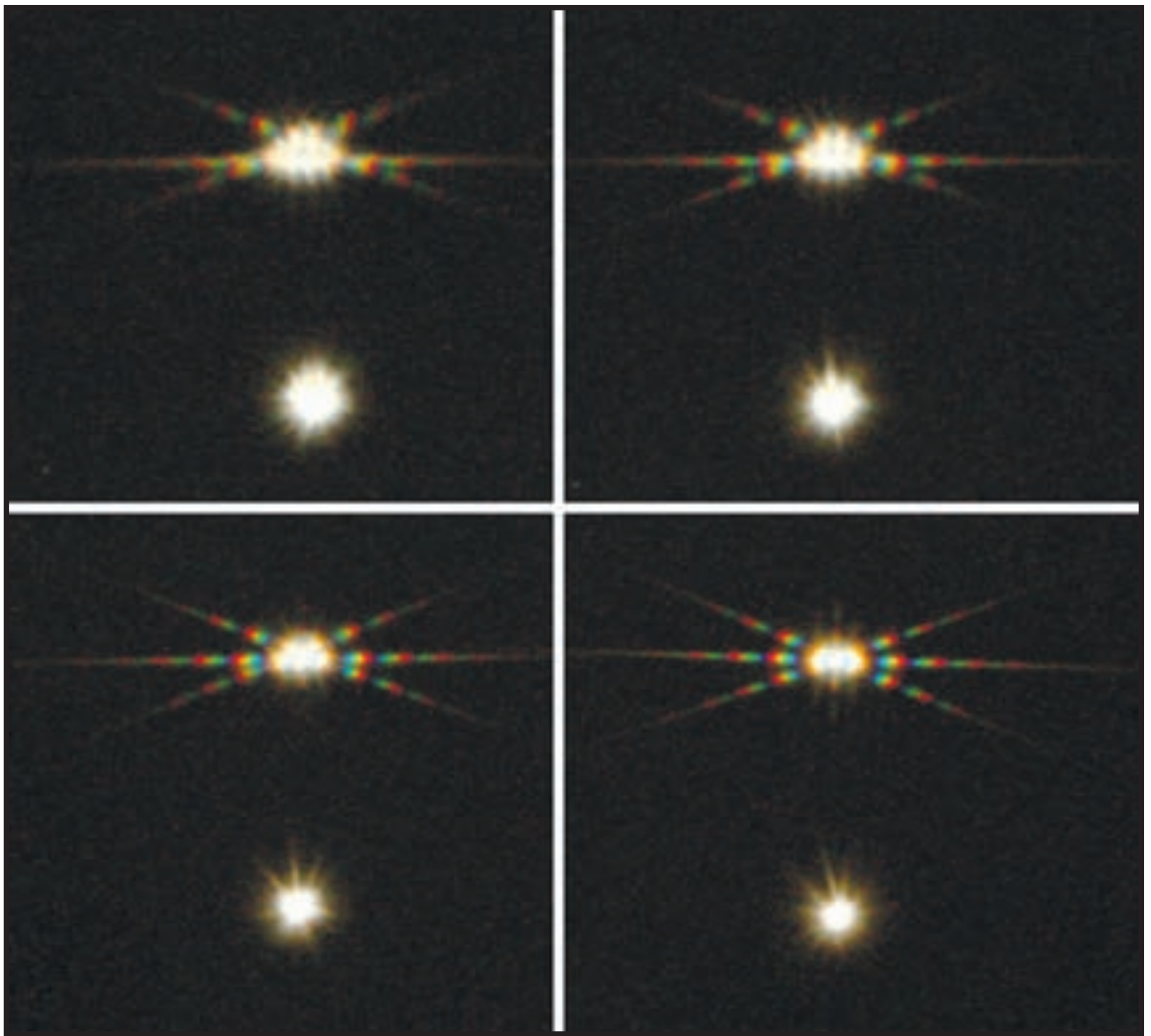
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the focus knob, the line will either move towards the center of the V or away from it. Get the line centered and you're in perfect focus. That's it.

Image 2 shows a demonstration of this. In each panel, I'm showing the star as viewed with (top) and without (bottom) the mask in place. Visually, it'd be tough to know exactly where focus was if all one had were the star's raw image (images taken with a Canon Rebel XSi and a Celestron CPC 1100 XLT). Is the first one in focus or not? With the mask in place, it's easy to see that we're out of focus. As we move in a bit more (upper-right) and then more (lower-left), the line gets closer to the middle of the V. Looking just at the star in the lower-left, you might think you're in focus. You'd be wrong though as the mask shows the line is near the middle of the V, but not quite there. Touch the focus knob a bit more and you're spot-on and in focus. Done.



**Image 2 - Figure 2: Each panel shows the image of a star both with (top) and without (bottom) the mask attached. Position of the focuser moves from frame to frame. Away from focus, the horizontal diffraction line is not centered on the V-shaped diffraction lines on either side of the star. In focus (lower-right), the line is perfectly centered on the V. Which side of the V the line is on tells you which side of focus you're on.**

Can you focus without it? Sure. In particular, if you've got a focus tool that's monitoring the star's FWHM (Full Width Half Maximum) or HFR (Half Flux Radius), you can often hit focus without much hassle. I've not clocked myself, but I'd not be at all surprised if the mask isn't a bit faster and it's certainly easier to know when you're there as you have an absolute reading (the line being in the middle of the V) and aren't relying on it being better or worse than other focus positions (what's my best possible FWHM tonight?). There's also nothing stopping you from using the mask while your software loops images of the stars. I've

done this myself and have an entry in my blog showing how this is done (<http://www.stark-labs.com/blog/files/Neb-Bahtinov.php>). This can be particularly helpful if you're trying to focus with a narrow-band filter in place. You can often hone in on focus with fewer iterations with the mask.

The Spike-a mask works very well in these situations. But where it truly shines and becomes not just a great tool, but indispensable, is when you're trying to focus and only using your DSLR's LCD screen. Even with Canon's Live View streaming images, it's still often tough to know whether you're really there or whether

you're just close. With the mask, there's no room for doubt. While I rarely actually use my DSLR for astrophotography, focusing it with the Spike-a mask and Live View was easier than any other focusing setup I've used. By the time I was done with this setup, I'd barely have gotten started with my normal setup (which I already consider simple and efficient).

### Summary

In summary, the Spike-A mask does exactly what it's designed to do and does it very well. Put it on the front of your scope and you'll be able to find focus quickly and accurately. It's easy enough that my five

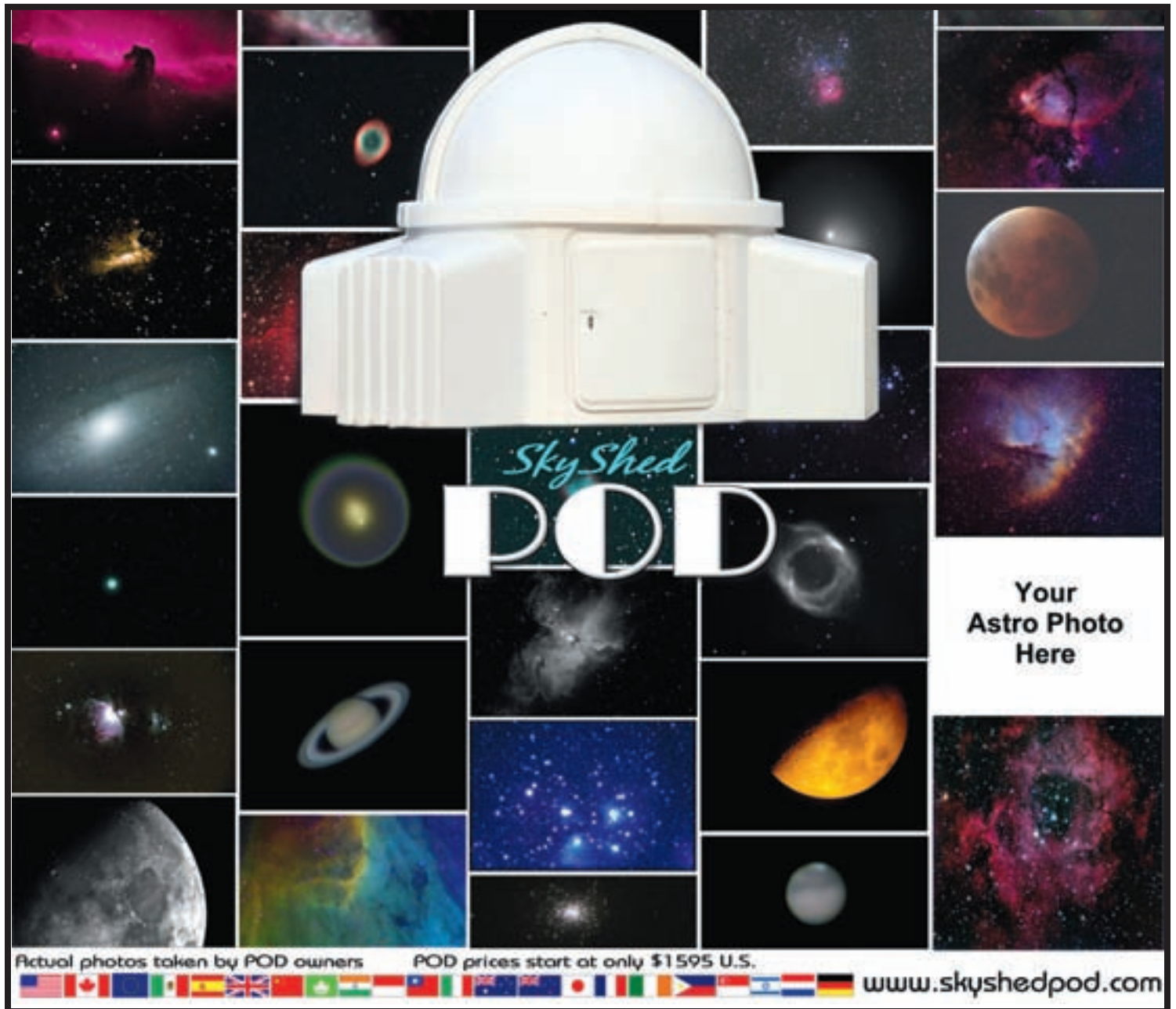
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year-old could do it. Heck, my three year-old probably could too. When the Spike-a masks first came out, I didn't know how well they'd work and Spike-a's prices were a good bit higher than they are now. So, I went the cardboard and razor approach. This worked well until the mask got mangled in transport. Now, having to do it over again (I don't image much with the CPC 1100 XLT these days), I'm faced with the choice of not using the mask, making another one out of cardboard, or picking up one from Spike-a or one of the other ven-

dors selling masks. As I'm in this hobby longer and longer and as my free time seems to always get shorter and shorter, I find myself gravitating towards (or just hanging onto) gear that just plain works. Heaven knows, my old Takahashi EM-10 mount isn't fancy (it's go-to system requires an attached computer, is based on a one-star alignment, and has slews that are honestly quite pokey) and its size limits my OTA load considerably. But, each time I set it up, it just plain works. Polar alignment is a snap and its error small and easily removed with

guiding. I never have to think about it or worry about it because each night, it just plain works. As a result, it's stayed as my mount despite the seemingly perpetual revolving door of gear.

The Spike-a mask is a lot like this. It's well-built and it just plain works. Toss it in the car with the rest of the gear and I know I won't be fighting focus issues and I know I won't be staring at a mangled focusing mask on the other end. I also know that in a year (or in 10), the mask will still be around performing exactly as it's doing now. **AT**



The advertisement features a central image of the SkyShed POD, a white, dome-shaped device with a rectangular panel on its side. The device is set against a background of a grid of various astronomical images, including galaxies, nebulae, planets like Saturn and Mars, and the Moon. The text "SkyShed" is written in a cursive font above the "POD" logo, which is in large, bold, white letters. To the right of the device, the text "Your Astro Photo Here" is displayed. At the bottom, there is a row of international flags and the text "Actual photos taken by POD owners" and "POD prices start at only \$1595 U.S.". The website address "www.skyshedpod.com" is also present.

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