

The Bahtinov Focusing Mask

Basic and Advanced Tips for Getting the Most Out of this Popular Focus Aid

By John Wunderlin

In 2009, Craig Stark reviewed our Spike-a Bahtinov mask for this publication. Since that time, I've gained a lot of experience with these focusing aids and thought I'd share with *ATT* readers some of the Bahtinov-masks tips and tricks I've learned since.

History

If you have not heard of the Bahtinov mask, it was invented by Pavel Bahtinov, an amateur astronomer in Russia, and the basic design evolved during discussions in a messaging forum that Pavel hosts. (A Spike-a example of the now-classic Bahtinov mask is shown in **Image 1**.) Relative to the Hartmann mask, the diffraction pattern created by the Bahtinov mask allows for much more precise focus thanks to its unique triple diffraction-spike pat-

tern. When the middle spike is centered between the outer two spikes, correct focus has been achieved.

Basic Tips

There are a few items of confusion on usage of the mask that I would like to clear up. First, it is not necessary to center the mask on the end of the scope. I've heard from some customers who were very concerned about exact centering of the mask on their equipment. I tested our Bahtinov masks with my 10-inch Dobsonian and found that they could be several inches off center, and the location of the central spike still did not change. This is because it's the angle of the slats in the mask which generate the spike pattern. As long as some of each of the three sets of differently an-

gled slats in the mask are included in the optical path, the pattern will be clear.

Second, the mask works equally well on the end of a dew shield as it does when positioned directly on the end of the telescope. This allows users of Hyperstar systems to use a standard mask placed on the dew shield beyond the extension of the Hyperstar lens assembly rather than needing a custom mask to be built with a central cutout for the Hyperstar unit.

Third, be sure to use a star, not a planet (or the moon) to create the pattern. The spikes created when using the planets are thick and overlap, making it difficult to center the middle spike.

Fourth, use a moderately-bright star near the object you want to image. This is especially true for Schmidt-Cassegrain telescopes which



Image 1 - A Spike-a-brand Bahtinov Mask. It's the relative angles of the groups of slats in the mask which generate the tell-tale spike pattern.

THE BAHTINOV FOCUSING MASK

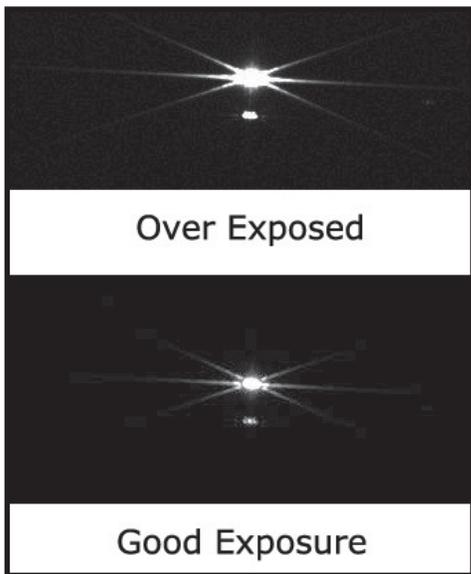


Image 2 - Overexposure makes it difficult to tell whether the middle spike is centered. Adjust image exposure until a small gap appears close to the star, which will allow easier detection of the relative position of the middle spike.

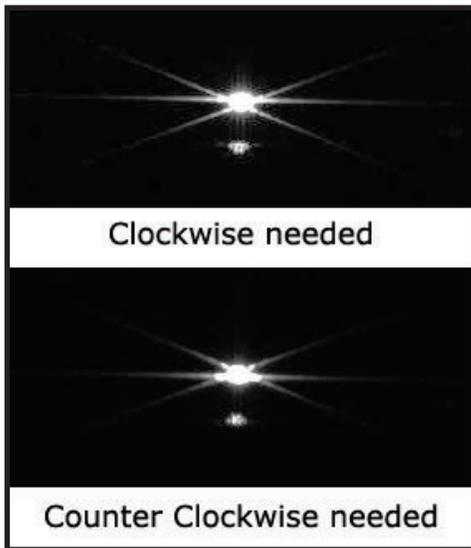


Image 4 - Required focus direction is easier to anticipate if the mask-to-scope orientation is always repeated.

achieve focus by moving the primary mirror within the optical-tube assembly. The focus point of these telescopes can change ever slightly, but enough to effect focus, if you move the scope significantly after your initial focus.

Finally, if you find that the pattern is faint, or if you are using narrowband filters, increase the exposure length of the test image to compensate.



Image 3 - Always place your mask on your scope in the same orientation. The author aligns his mask so the logo is upright and the center column of aluminum is in line with the counterweight shaft.

Advanced Tips

For most-accurate centering of the middle spike, set the black and white levels of the stretch adjustment in your acquisition software so the spikes are not overexposed. There is normally a small gap close to the star which will allow you to very accurately center the middle spike (See **Image 2**).

Always place your mask on your scope in the same orientation. I like to put the mask on my scope so the logo is upright and the center column of aluminum is in line with my counterweight shaft, as in shown in **Image 3**. If you image with “North up” as I do, this orientation causes the pattern to orient horizontally on the computer screen. If the central spike is above center, I know I must turn my focus knob in a clockwise direction. If it’s below, it needs a counter-clockwise turn (**Image 4**). Learn the pattern for your specific equipment. Once you do this a few times, adjusting focus becomes very fast based on the pattern you see.

If you are using a fainter star, try inverting the black and white points of your software’s

stretch function so the star appears as a black point on a white background. I find it easier to see the pattern on dim stars this way. (See **Image 5**)

Niels Noordhoek wrote a free software utility specifically for the Bahtinov mask, called *Bahtinov Grabber*, which is available on his website at www.njnoordhoek.com/?p=660. (See **Image 6**) This software analyzes the pattern created by the Bahtinov mask and reports how far from perfect focus you are. Although the software reports results within 1/100 of a pixel, my testing suggests it is only accurate to about one pixel, but, from a practical standpoint, this is more than enough as the effects of atmospheric turbulence will affect the focus point by more than this anyway. This software has the ability to automatically focus if you use an ASCOM-based motorized focuser. Another very nice feature of the software is that it can alert you with sounds when focus is achieved. If you are not able to see your computer screen when focusing, this is a very handy feature.

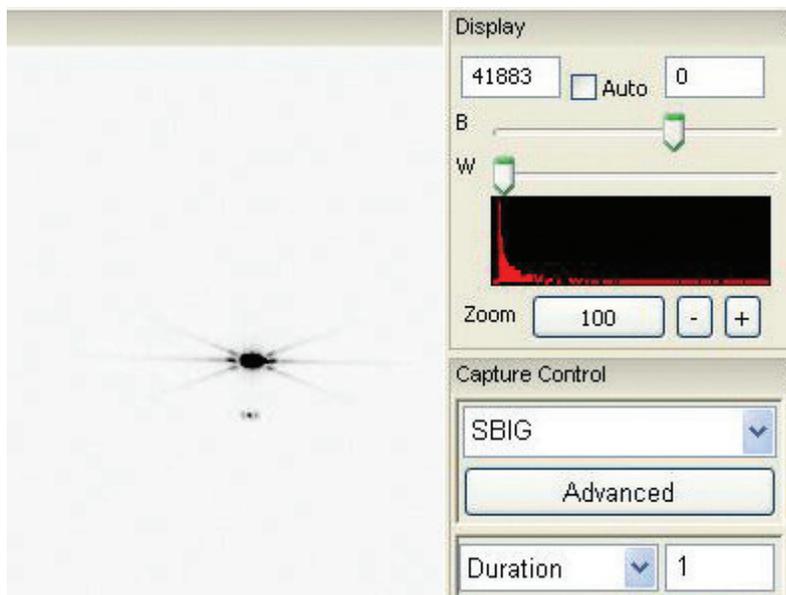


Image 5 - When focusing on faint stars, inverting the black and white points of your software's stretch function so the star appears as a black point on a white background makes it easier to see the each critical element of the pattern.

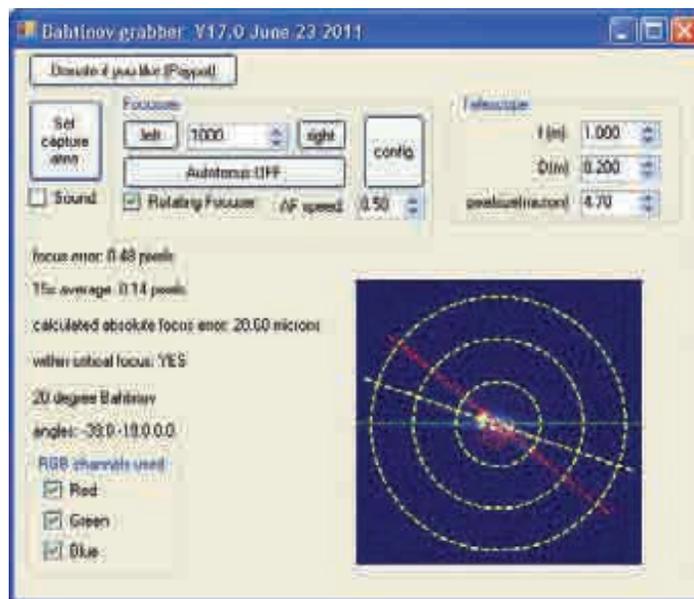


Image 6 - The Bahtinov Grabber freeware can automate the Bahtinov-mask focus routine.

Visual Use

Generally, the Bahtinov mask is considered an aid in astrophotography. However, if you happen to be a visual observer who enjoys viewing multiple star systems, the mask can help you get the best possible visual focus for that task as well.

It is interesting to watch the central spike when there is a lot of atmospheric turbulence. The central spike actually moves up and down as you watch. If you happen to use glasses, it's also interesting to note the shift of the central spike when removing your glasses. Because of this, it's also important you be in your normal viewing position when focusing your tele-

scope for visual work. I noticed even with my excellent Ethos eyepiece that a very slight position change with respect to my eyepiece would result in the center spike moving slightly – in other words, the best focus point of a given eyepieces may change based on where your head is positioned.

Acquiring a Bahtinov Mask

If you are someone who enjoys working with your hands, you can create your own mask by using the excellent free Bahtinov Mask Generator at astrojargon.net/MaskGen.aspx. One tip on this: Don't print the pattern on transparency material and ex-

pect to achieve focus. I tried this early on and found that the transparent material distorted the optics of the scope and gave an incorrect pattern. You've got to cut out the slats.

If you want to purchase a mask, there are several vendors who sell them, including my company, www.spike-a.com

Conclusion

If you enjoy spending a lot of time trying to achieve focus, don't try a Bahtinov mask. If you enjoy seeing fuzzy stars and out-of-focus details, don't try a Bahtinov mask. Otherwise, you owe it to yourself to give one a try! **AM**