Who Was That Masked Double Star?
By Richard Harshaw

As the owner of an 8" SCT located in the northern suburbs of Kansas City, MO, my chances to see faint and extended deep space objects are limited to the few nights each year we have that are really clear and steady since just twelve miles south of me lies several megawatts of high pressure sodium lighting that just loves to bounce off the airborne dust and other stuff in our midwestern skies. To compensate for this, I spend a lot of my time viewing double stars and star clusters.

It does not take much experience at observing double stars (or "binaries" as they are called) to notice that often the two (or more) stars differ quite a lot in magnitude, and if the stars are very close together, this "glare" difference can make seeing the faint companion difficult. That's where a simple home-made observing mask can help you immensely.

A Tip From The Webb Society

When I joined the Webb Society several years ago, I received their 8-volume observer's library, including an excellent volume on observing double stars. The first half of this wonderful little book contains technical information on viewing double stars and explains in detail the nomenclature used in double star observing (such as position angle and separation– terms I assume you are familiar with). Of particular interest to me was the discussion which began on page 15 of how telescope aperture and design can affect double star observations. A useful tip came from this section and it involves the construction of a simple regular polygonal "mask".

The concept is based on the fact that when two stars are very close together (say, less than 5 seconds of arc) and of significant magnitude difference, the Airy disk of the brighter star can be quite noticeable and, in some cases, actually overlay the faint glow of the companion, making it virtually impossible to detect the little fellow. A regular polygonal mask introduces optical interference in the light path, breaking up the Airy disk into a spoke pattern that has the same number of spokes as the number of angles in the polygon.

For example, the hexagonal mask I made changes the Airy disk of a bright star into a beautiful 6-spoked star with no Airy disk.

The nice thing about such a mask is that by rotating the mask over the telescope's aperture, I can "move" the "spokes" around too, and if I place the spokes just right, I can bracket the faint companion star and– voila!– the little fellow becomes easily visible!. Image #1 represents a sketch of my C-8 with the cardboard mask in place.

I glued three short (1/2") dowell rod tips (rounded and polished ends) to the back side to serve as "bearings" so I could rotate the mask easily against the corrector plate retainer ring. I also glued one dowell tip on the front side to act as a handle to make rotation easier.

With a Newtonian, Dob, or refractor, you'll need to make your mask more like an oatmeal box lid, with a flange that slips over the outside of your scope's tube or dew shield.

Note how I made my mask of such a size that the cardboard at the vertices was one inch thick. There is nothing magic about that size, but an earlier design with only ½ inch at the vertices proved to be too fragile to be much use.

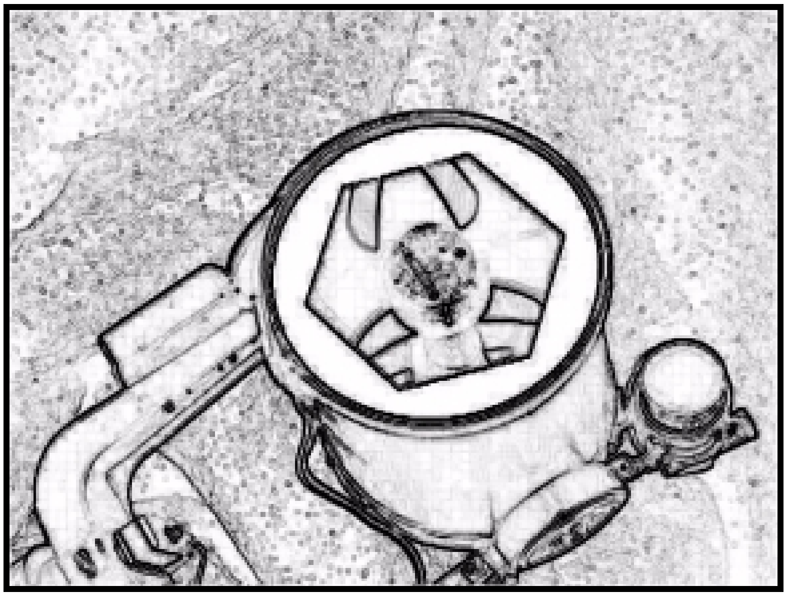

Image #1: Author’s Celestron C8 with Hexagonal Mask

The following diagrams shown in image #2 how a close bright/faint pair would look at high magnification without and with the hexagonal mask (taken from the Webb Society Deep Sky Observer’s Handbook, Volume 1):

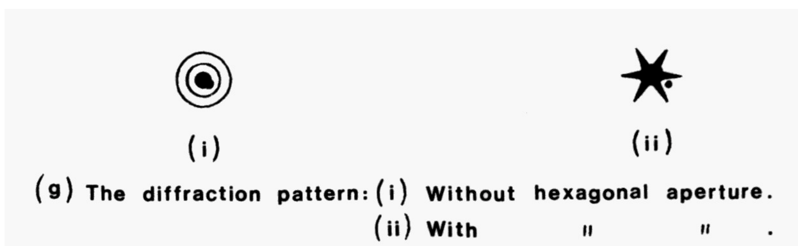

Image #2: A double star seen whithout and with Hexagonal Mask

This simple little home-made tool has made it possible for me to view close and high-contrast binaries that I would have never thought possible with my 8” scope! In fact, I found that the mask improved views on many pairs that I would not have suspected the mask to be of much help. Designed to make large magnitude gradient stars easier to resolve, it also works on close pairs of similar magnitude. It can enlarge your view of the universe too!

Seeing Is Believing

I would now like to offer you my comments and observations on 39 difficult binaries and challenge you to build a mask and try these for yourself! All these pairs will demand some of your highest magnifications, and all will be listed in a table at the end of this article (Page #18).

- *First Quarter Pairs*

In the first quarter of the year, I would have to rate α CMa (Sirius) as the unquestioned leader on my list! (Unfortunately, at this time, the separation between Sirius A and B is too small for an 8” scope and will be for a decade more or so, but larger scope owners and those who don't mind waiting a few more years should have no problem with this pair.) I had tried for years to view Sirius B but could never pick the little bugger out of the awful glare of A. The mask made it possible to find him!

I had to rotate the mask a bit so that the spokes had a gap in PA 150 (the PA at the time I saw the "Pup"), and I also used a lunar glare filter to dim Sirius down a bit, and when I went to the eyepiece, there was the B star as easy as any 8.5 magnitude star should be in more lonely quarters!

Another highly rated pair for the first quarter would have to be Σ718, a wonderful pair of 7.5 magnitude stars 7" apart. Here, the mask was not so much a help in picking out a faint companion but rather in making the two stars much easier to separate.

You should also try 55 Eri during this time of the year. Again, the two stars are of similar magnitude (6.7 and 6.8) and are only 9" apart, but the mask makes seeing each component easier than without it.

The pair Σ899 is a little more challenging. Its two stars shine at 7.3 and 8.3 magnitude respectively and are only 2 seconds apart with no noticeable change since discovery. The mask helped the 8.3 mag star pop out very nicely against the very close and brighter primary.

Sherburne Burnham was notorious for finding pairs of high magnitude difference and close spacing (he must have had incredible eyesight!). One of his difficult pairs is β94, a 5.5 / 9.5 pair only 2" apart. Here, I doubt if you could see the companion *without* a mask, although once I confirmed its presence with the mask I took the mask off and could still see it— but with great difficulty.

δ Gem is another tough pair— 3.5 and 8.2 magnitudes only 6" apart (and closing). Even with the mask, it was very difficult to see the 8.2 mag star.

θ Aur is another good mask candidate. Its stars are 2.6 and 7.1 magnitude and are only 3" apart. It can be resolved without a mask, but once you resolve it, pop the mask into place and see if it does not greatly enhance the view!

Four stars of slightly greater challenge would be 33 Ori (5.8 / 7.1, 1.6" apart), ψ Ori (4.6 / 10.2, 3"), Σ1318 (7.8 / 9.0, 2.5") and Σ928 (7.6 / 8.2, 3"). All of these were much easier to resolve with a mask than without it.

For a good first quarter challenge, I end up with this offering: ε CMa (1.5 / 7.4, 8"), h2534 (4.8 / 11.6, 19"), Hough 233 (7.8 / 10.6, 2"), ι UMa (3.1 / 10.8, 2"), ω Aur (5.0 / 8.0, 6"), and Winnecke 2 (7.8 / 9.1, 3"). All of these were made much easier with the mask.

- *Second Quarter Beasties*

Moving into the second quarter skies, the Milky Way thins out so the number of binaries drops off sharply. Still, there are a number of good mask targets overhead to tax your skills.

Try A1774, a 5.6 / 10.6 pair only 4" apart. This is an easy warm-up for the rest of the list!. A bit tougher are 1 Boo (5.8 / 8.7, 5") β Vir (3.8 / 8.8, 12") and ε Boo (2.4 / 5.1, 3"). All of these required over 200x and the mask to easily pick up the companion stars.

For a challenge, try splitting 61 Vir (4.8 / 10.3, 32"), Σ2022 (6.4 /10.0, 2"), and Stone 821 (7.5 / 11.5, 7"). You may have a tough time conquering this short list since often the first quarter skies are turbulent and you'll need rock-steady skies to split most of these close pairs.

- *Third Quarter Beauties*

The third quarter finds the Milky Way coming back into view, so the number of mask targets increases. I don't think any of my list for this quarter is easy. All will require extremely good seeing and high magnification. Here is my list:

13 Del (5.6 / 9.2, 1.6"); even with a mask it was very difficult!

α Sco (Antares, 1.2 / 5.4, 3"); you may find it easier to pick up the blue companion like I did at dusk using a mask and 200x. Even then, it will be hard to see.

γ Equ (4.7 / 11.5, 2"); unless you have a huge scope, I doubt if you can pick up the companion *without* a mask.

Σ2103 (5.9 / 10.8, 5"); a mask is *not* essential, but it definitely helped!

Σ2310 (6.8 / 10.1, 5"); no, this is not a transposition of the previous star. And here a mask is probably a requirement even though the magnitude gradient is not as great.

- *Fourth Quarter Wonders*

We end the year with some beautiful but challenging pairs.

First, try 39 Eri. This great pair (5.1 / 8.0) is 6" apart and is a beautiful view, even without a mask (which is not necessary to see the companion); but try the mask and see whether or not you think the companion is easier to see with it in place.

ϕ Psc (4.7 / 10.1, 8") is a little more difficult. To my surprise, the mask was of no help at all in picking up the companion star! I include it in this list only to show that whereas you'd suspect from the data that a mask would be a good asset, this is not always the case!

γ Cas (2.2 / 11.2, 2") will not be possible without a mask. At least not with a modest aperture!

ο Cas (4.5 / 11.2, 33") was a surprising mask candidate. When I first saw the pair, it was without the mask. I wondered if a mask would improve the view, so I attached the mask to my C-8 and was surprised how much it improved the view. Does it work for you?

41 Eri (3.6 / 11.8, 49") is a case like ο Cas– a surprise that the mask helped as much as it did even though the stars were far enough apart to make it unnecessary to see the companion.

Back to Mr. Burnham again— β6 with stars of 6.6 and 9.4 only 2" apart. (There is a third star, of 11.0 magnitude, 93" away too.)

This next one was a surprise to me, since the stars are really too far apart to be improved by a mask, but the mask nonetheless improved the view. I am speaking of β Per ("Algol"), with a 2.1 magnitude primary and three faint companions (12.7, 12.5 and 10.5 in order of increasing distance). The mask really made seeing the faint sidekicks an easy thing.

You'll probably find it easier to see the companion to γ Per with a mask too. These stars are 2.9 and 10.6 magnitude and 57" apart. Again, the distance betrays the value a mask can have in picking up a faint star in the same field as a brilliant one.

ω^2 Aqr is another good mask star— 4.5 / 10.5 and 6" apart.

And I close my list with π Ari, a 5.2 / 8.7 pair just 3" apart.

Some of the stars on this list of 39 difficult pairs can be resolved without a mask, but most of them will require a mask to see with modest apertures, and all of them have the views improved with a mask. Try it yourself. See if you don't see Sirius B for the first time with your own eyes, or start resolving double stars that you thought were just too close and too different in magnitude to see.

Table of Binaries in This Article

Star	RA	DEC	Mag of A	Mag of B	Sep (")	PA
α CMa	0645	-1643	-1.5	8.5	5 (closing)	150
Σ718	0532	+4923	7.5	7.5	7	74
55 Eri	0444	-0847	6.7	6.8	9	317
Σ899	0623	+1734	7.3	8.3	2	19
β94	0550	-1429	5.5	9.5	2	173
δ Gem	0720	+2159	3.5	8.2	6 (closing)	224
θ Aur	0600	+3712	2.6	7.1	3	318
33 Ori	0531	+0318	5.8	7.1	1.6 (closing)	26
ψ Ori	0527	+0306	4.6	10.2	3	350
Σ1318	0914	+4700	7.8	9.0	2.5 (closing)	235
Σ928	0635	+3832	7.6	8.2	3	134
ε CMa	0659	-2858	1.5	7.4	8	161
h2534	1033	+4026	4.8	11.6	19 (closing)	337
Hough 233	0623	+1631	7.8	10.6	2	36
ι UMa	0859	+4802	3.1	10.8	2	177
ω Aur	0459	+3753	5.0	8.0	6	1
Winnecke 2	0524	-0052	7.8	9.1	3	343
A1774	1103	-1118	5.6	10.6	4	271
1 Boo	1341	+1957	5.8	8.7	5	134
β Vir	1151	+0146	3.8	8.8	12	85
ε Boo	1445	+2704	2.4	5.1	3	341
61 Vir	1319	-1816	4.8	10.3	32	29
Σ2022	1613	+2640	6.4	10.0	2	145
Stone 821	1719	+6344	7.5	11.5	7	298
13 Del	2048	+0600	5.6	9.2	1.6	194
α Sco	1629	-2626	1.2	5.4	3	275
γ Equ	2110	+1008	4.7	11.5	2	268
Σ2103	1650	+1316	5.9	10.8	5	43
Σ2310	1821	+2248	6.8	10.1	5	236
39 Eri	0414	-1015	5.1	8.0	6	146
ϕ Psc	0114	+2434	4.7	10.1	8	225
γ Cas	0057	+6043	2.2	11.2	2	248
ο Cas	0045	+4816	4.5	11.2	33	302
41 Eri	0418	-3348	3.6	11.8	49	13
β6	0145	-0647	6.6	9.4	2	167
β Per	0308	+4057	2.1	12.7 12.5 10.5	58 67 82	156 145 192
γ Per	0305	+5330	2.9	10.6	57	325
ω^2 Aur	2343	-1433	4.5	10.5	6	86
π Ari	0249	+1728	5.2	8.7	3	120