

## A technique to estimate the separation of close doubles

By Inge Skauvik

Traditionally measurements of close double stars are made using a filar micrometer. This device is expensive, and it is generally not recommended to equip a small amateur telescope with such a micrometer. An alternative which can be used with larger amateur scopes is the *diffraction micrometer*. And with the advent of new CCD techniques, imaging of double stars makes accurate determination of separation and position angle possible, even with mid-sized equipment.

However, both the diffraction micrometer and the imaging techniques require an equatorial mount and precision tracking. For many hobbyists such equipment is beyond reach due to budget limitations. Many amateurs with economy in mind select a Dobsonian scope in order to get a reasonable light gathering power and resolution, but then also sacrificing tracking capabilities. Certainly driven Dob's are available, and it is also possible to equip the scope with an equatorial platform, but accurate tracking and positioning will anyhow represent a substantial extra cost.

This short article describes a method which can be used to estimate, at least with some accuracy, the separation of close double stars just by scrutinising the diffraction image. In order to do this, the optics of the telescope, of course, needs to be diffraction limited. Steady seeing is also necessary, and particularly with large apertures the number of useful nights may be limited. Separation estimates also often become difficult if one of the components is very bright, and it is easiest to determine the separation of doubles in the range 1 - 2 times Dawes' limit.

I presently use an 8-inch scope, and I use 0"6 as a rough figure for Dawes' limit. This is also the diameter of the Airy disc for a moderately faint star. From my experience, the working range with my set-up is:

Stellar magnitudes:	4 - 8
Separation:	0"6 - 1"2
Magnification:	300 - 500x

Somebody may think this is too high power for an 8-inch telescope. Indeed, 0"6 pairs can be split with lower power, but in order to estimate the separation, it is necessary to see the Airy discs properly, and relatively high power is therefore beneficial. I find it difficult to see the Airy disc of faint stars, and I prefer using the method on equal pairs in the 6 - 7 magnitude range. With a smaller telescope, the working range will be different. For a 3-inch scope, the best separation range will be about 1"4 - 2"8, a power of 200x will be fine, and the doubles could be somewhat brighter. The following Figure illustrates how separation estimates can be done.

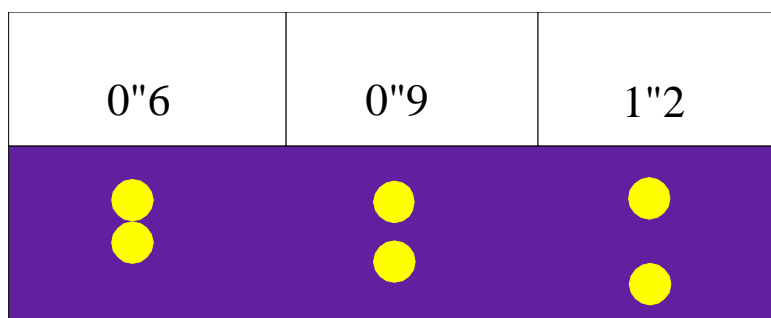


Fig.1: Separation estimates using an 8-inch

A double with a separation equal to the Dawes' limit of the telescope will appear as two discs just touching each other. Theoretically there will be some "bridge" formation at slightly higher separation, but my eyes, at

least, tend to sharpen out the edges of the discs, and I think this is a common experience. CCD images and computer simulations tend to enhance features which the eye will not see.

If the gap between the stars equals the diameter of the Airy disc, the separation equals twice Dawes' limit, and if the gap is half the diameter, the separation is 1.5 times Dawes' limit. With some experience, it is possible to estimate the separation with an accuracy of about 0"1 with an 8-inch telescope. For a smaller diameters, the accuracy will be lower, but the working range will be wider.

The visual diameter of the Airy disc will be slightly smaller for very faint stars. However, this hardly represents a problem, since estimates of very faint doubles generally becomes too difficult. In a situation where a 6-th magnitude star has a 9-th magnitude companion, the faint star may very well appear smaller. In this situation, however, it should be possible to use the disc of the brighter star as a scale.

For brighter stars some light becomes visible on the diffraction rings. I have som far not paid much attention to such doubles, but in principle the diffraction pattern could be used as a "grid" to estimate doubles with wider separation.

I have used the method with several close pairs. A good example is 1338 in Lynx. (Very near 38 Lyncis, another attractive double). The components of this double are pretty equal in brightness, and the total magnitude is 6 or slightly fainter. In my 8-inch this pair appears as two well defined discs separated by 50%(or slightly above) of their diameter. My separation estimate is therefore 0"9, or perhaps 1"0. Moving to Cancri, I find the separation between the close components to be slightly smaller, and my present estimate of the separation is 0"8. I generally use a power of 480x for these estimates, simply because I have an eyepiece/Barlow combination giving this power.

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