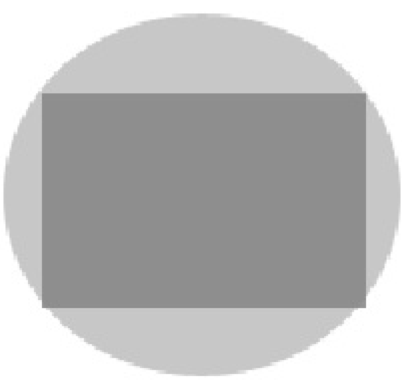
What's the prime focus FOV with my LPI/DSI/webcam/SLR/DSLR?

…from the Veep

Here's a question frequently seen on the various online astronomy forums. It's not nearly so mysterious as some of the common responses might make it seem. It depends on only two variables, no matter what type of telescope or camera is being used. Armed with this information, one can quickly decide whether a given object makes sense for a given setup, and whether adding a Barlow or two will help. Often folks ask what focal ratio they need to use to image planets, and are told F/20 to F/30 is best. That's not correct. The focal ratio doesn't enter into it - it's the focal length. A 100mm refractor will have a huge field of view at F/30 - a planet would be a tiny speck in the middle.

You'll need to know the dimensions of your imaging chip or film slide, and the focal length of the telescope. Focal lengths are published for pretty much every model you are likely to encounter so that's easy enough. It's worth being aware that the published figures are approximate, and in the case of designs with large ranges of focus accommodation, such as SCT's, the true focal length will vary with the length of any added hardware behind the telescope. The dimensions of the imaging chip are generally provided by the camera manufacturer. For a chart showing the sizes of the chips in some commonly used cameras, see the March issue of the "Night Sky" newsletter, available on the Club's website: www.acaoh.org .

The chips are rarely square, so it's normal to end up with two different dimensions for length and height - this is one reason that common attempts to equate a given camera to a given eyepiece view are suspect. The most common such approximation is to use the diagonal measure of the chip to calculate "magnification" and to then describe an eyepiece with the same magnification. Since the eyepiece is round rather then rectangular, this results in only a rough approximation - one on which I'd hate to base the planning of an imaging session. You can see by the (very) rough diagram below the difference between these shapes with the same diagonal measurement. The lighter gray area would be visible in an eyepiece but wouldn't be seen by the camera.



From this point it's just arithmetic or the use of commonly available charts or software. You can get a decent approximation of each dimension in arcminutes by multiplying the length or width of the imaging chip in use by 3000, then dividing that product by the focal length of the telescope. As an example, I do some planetary imaging with my 12" Meade LX200 and a SAC-7 camera. The focal length of the Meade is about 3000mm. The SAC-7's chip is 2.7mm X 3.6mm. The longer dimension is thus about (3.6 * 3000/3000), or 3.6 arcminutes, and the smaller is (2.7 * 3000/3000), or 2,7 arcminutes. Inserting a 2X Barlow at its design distance will cut the FOV in half, thus doubling the size of the object on the chip - and doubling the required exposure time. The same camera in my ED80, at 600mm, would image a field 5 times larger in both dimensions, or 15 X 20 arcminutes, even though the focal ratio is very similar - F/7.5 compared to F/10.

The easiest way to get these results is probably the free program, “CCD Calculator”, offered by Rod Wodowski and New Astronomy Press at:

http://www.wodaski.com/wodaski/pick_a_camera.htm

You can see the linear effect of focal length changes in the following picture, which is a composite of three shots taken using a Meade LPI imager on the Meade 12” LX200 at effective focal lengths of approximately 1500mm, 3000mm, and 6000mm. You can see that Jupiter is nicely framed in the LPI’s field of view (it has a chip a little larger than the SAC-7) when shot at 6000mm. Now the problem is to find a night when the seeing will support shooting at 6000mm!

John Crilly
jcrilly@neo.rr.com