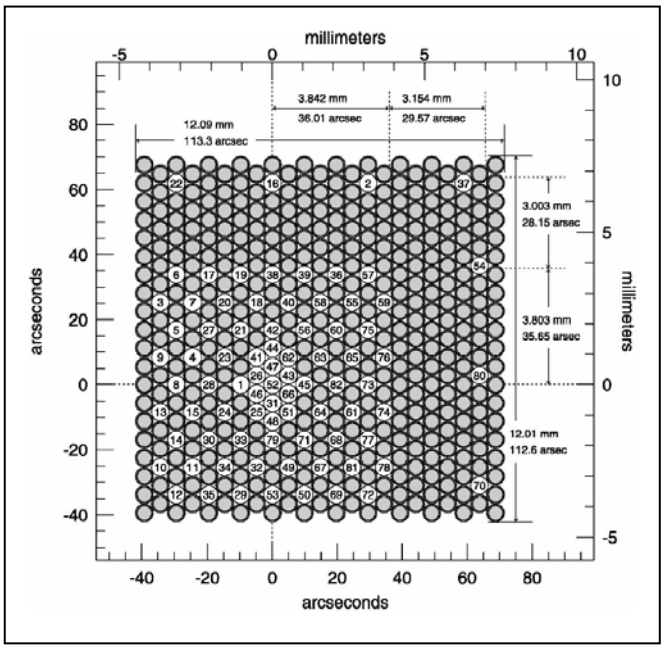

The image of an astronomical object forms at the focus of a telescope. It can be measured either in terms of its angular size in degrees or arcseconds, or in terms of the number of millimeters. For astronomy, you are interested in its 'angular size' but if you want to photograph it, you are interested in how big it will be compared to the size of your film or digital sensor array (called the CCD).

A very simple formula defines how to convert from angular size to millimeters at the focus of a telescope:

$$\text{Scale} = \frac{206265}{F}$$

where F is the focal length in millimeters and 'Scale' is the image scale in arcseconds per millimeter.

Problem 1 – Two telescopes are used for astrophotography. The first has a mirror diameter of 20-inches and a focal length of 5000 mm, the second one is more portable and has a diameter of 10-inches and a focal length of 2000 mm. What are the image scales of each telescope?

Problem 2 – An astronomer wants to design a camera so that each pixel views an angle of only 0.5 arcseconds. If the width of each pixel is 8 micrometers (0.008 millimeters), what is the image scale he needs for the telescope, and what will be its focal length?

Problem 3 - If a digital camera array measures 20 millimeters across and consists of 2048 pixels, what will the image scale have to be so that the array can be used to photograph a star cluster with a diameter of ¼ degree? What will the telescope focal length have to be.

Problem 1 – Two telescopes are used for astrophotography. The first has a mirror diameter of 20-inches and a focal length of 5000 mm, the second one is more portable and has a diameter of 10-inches and a focal length of 2000 mm. What are the image scales of each telescope?

Answer: The first one is Scale = 206265/5000 = **41 arcseconds/mm**. The second one has 206265/2000mm = **103 arcseconds/mm**.

Problem 2 – An astronomer wants to design a camera so that each pixel views an angle of only 0.5 arcseconds. If the width of each pixel is 8 micrometers (0.008 millimeters), what is the image scale he needs for the telescope, and what will be its focal length?

Answer: He needs a scale of 0.5 arcseconds/0.008 mm) = 62.5 arcseconds/mm. The focal length will be 62.5 = 206265/F so **F = 3300 millimeters**.

Problem 3 - If a digital camera array measures 20 millimeters across and consists of 2048 pixels, what will the image scale have to be so that the array can be used to photograph a star cluster with a diameter of ¼ degree? What will the telescope focal length have to be.

Answer: ¼ degree/20 millimeters = 3600 arcsec (1/4)/20 mm = 45 arcseconds/mm. The Focal length is 45 = 206265/F so **F = 4583 millimeters**.