ASTRONOMICAL LEAGUE

A FEDERATION OF ASTRONOMICAL SOCIETIES
A NON-PROFIT ORGANIZATION

- ★ *To promote the science of astronomy:*
- ★ *By fostering astronomical education;*
- ★ *By providing incentives for astronomical observation and research;*
- ★ *By assisting communication among amateur astronomical societies.*

ASTRO NOTES

Produced by the Astronomical League

Note 17: Astrophotography II - Projection Systems

Image Size

The linear size, *S*, of an object at the focal plane of a system will depend on the object's angular size, θ, and the focal length of the system, *F*, according to:

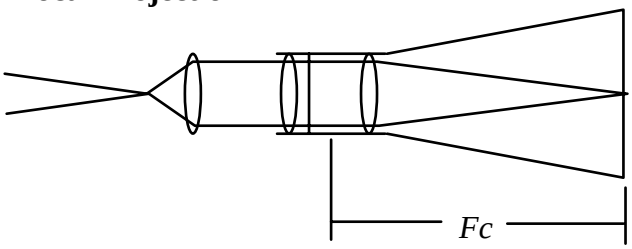
$$S = \frac{\theta \times F}{q}$$

where q = 57.3 if θ is in degrees,
= 3438 if θ is in minutes of arc,
= 206264 if θ is in seconds of arc

The units of *S* will be the same as the units of *F*.

For small diameter objects such as planets or lunar features, long effective focal lengths are required to produce a reasonable image size. The normal focal length of a telescope, *Fo*, can be increased by projection. Three common projection methods are used.

Afocal Projection

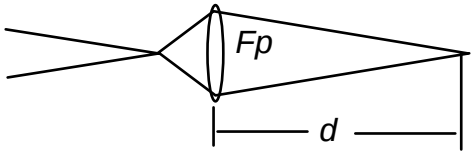


In the Afocal projection system, the telescope and eyepiece are focused on an abject and the camera, with its lens in place and focused at infinity, is placed behind the eyepiece. Given the camera lens focal length, Fc, and telescope/eyepiece magnification, M, the system focal length is:

$$F = M \times Fc$$

For best image formation, it is necessary that the eyepiece exit pupil have the same **location** as the camera entrance pupil. This is often impossible due to the mechanical design of the eyepiece and the camera.

Positive or Eyepiece Projection

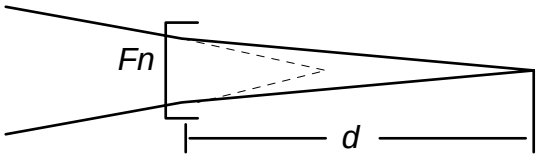


If a positive lens or eyepiece of focal length *Fp* is used to project the image a distance *d*, then magnification and resulting system focal length are found by:

$$M = \frac{d}{Fp} - 1$$ magnification

$$F = M \text{ x } Fo$$

Negative or Barlow Projection



If a negative lens such as a barlow lens of (negative) focal length *Fn* is used to project the image a distance *d*, then the magnification and resulting system focal length are found by:

$$M = \frac{d}{Fn} + 1$$ magnification

$$F = M \text{ x } Fo$$

Angular Size of Some Solar System Objects

Sun	32.6' (perihelion)	31.5' (aphelion)
Moon	32.7' (perigee)	28.5' (apogee)
Mercury	5" - 13"	
Venus	10" - 64"	
Mars	4" - 25"	
Jupiter	31" - 48"	
Saturn	15" - 21" (ball)	34" - 45" (rings)
Uranus	3" - 4"	
Neptune	2.5"	