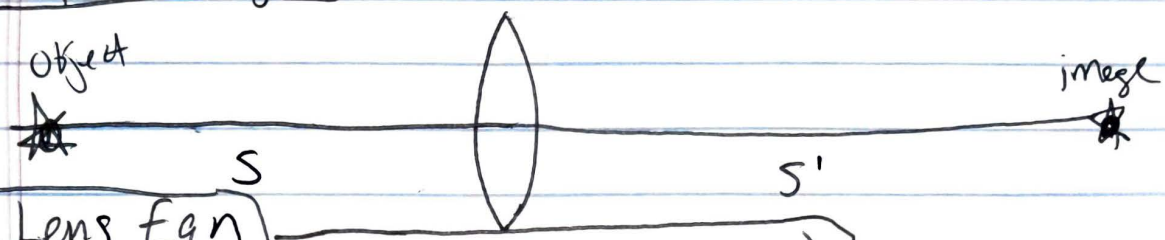
Astro 426 Lecture 5

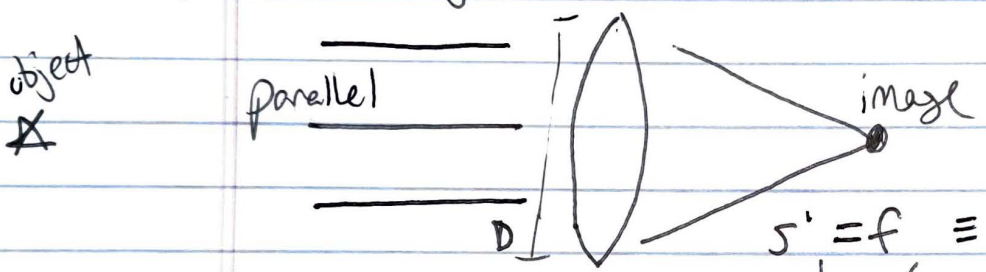
Focal length



Thin Lens Eqn

$$\frac{1}{s'} - \frac{1}{s} = (n-1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

What if object is at $s = \infty$?



$s' = f \equiv$ focal length

$$\frac{1}{f} = (n-1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

$$\frac{1}{s'} - \frac{1}{s} = \frac{1}{f}$$ Gaussian Lens formula

focal ratio $F = \frac{f}{D}$

Ray Tracing Rules

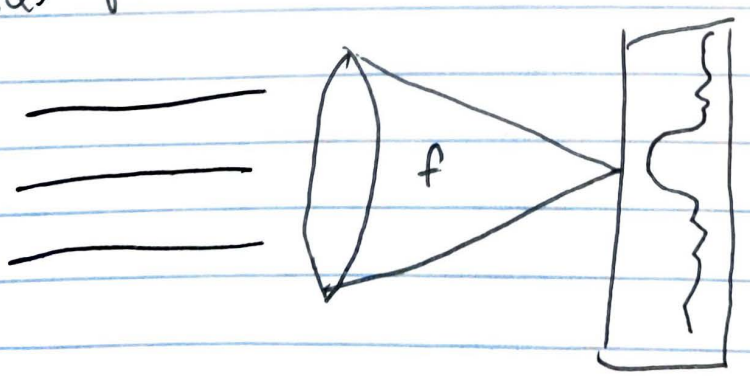
1) Ray through center is undeviated
2) Incoming parallel rays go through the focus (at distance f)

Magnification (lateral or transverse)

ratio of image height to object height

$$m = \frac{h'}{h} = \frac{s'}{s}$$

Basic Telescope



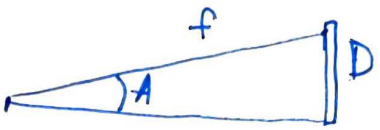
Airy Disk

$$\theta_{null} = 1.22\frac{\lambda}{D}$$

$$r_{null} = f\theta_{null} = 1.22\frac{f\lambda}{D}$$

$$r_{null} = 1.22 F\lambda$$

$F = f/D$ focal ratio



$\tan A = \frac{D}{F}$

$\tan A \approx A$

$A = \frac{D}{F}$

$\text{Plate Scale} = \frac{A}{D}$

$= (D/F)/D$

$= 1/DF$

Plate Scale angle on sky per unit physical distance on focal plane (e.g. arcsec/mm)

$$\text{Plate scale} = \frac{\theta}{r} = \frac{1}{f(mm)} \text{ rad/mm} = \frac{1}{FD(mm)} \text{ rad/mm}$$

$$= 206265 \cdot \left(\frac{1}{FD[mm]}\right) \text{ arcsec/mm}$$

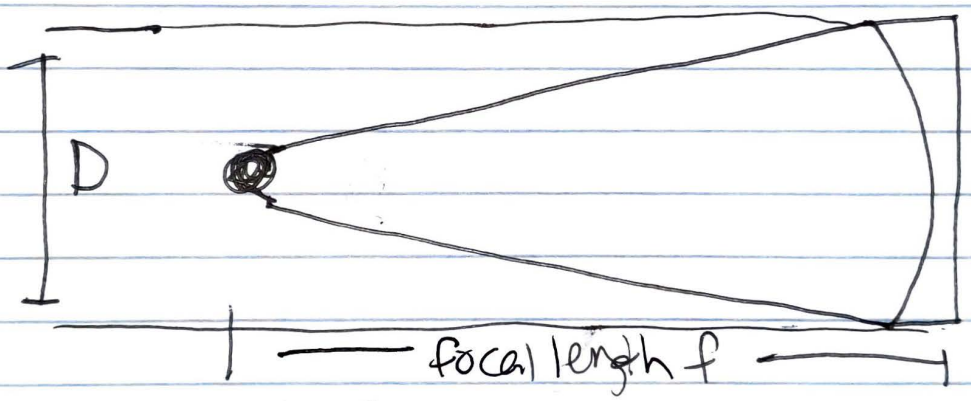
Multiple element systems have an "effective" focal length

$f_{eff} = DF$

D = still diameter of aperture / primary

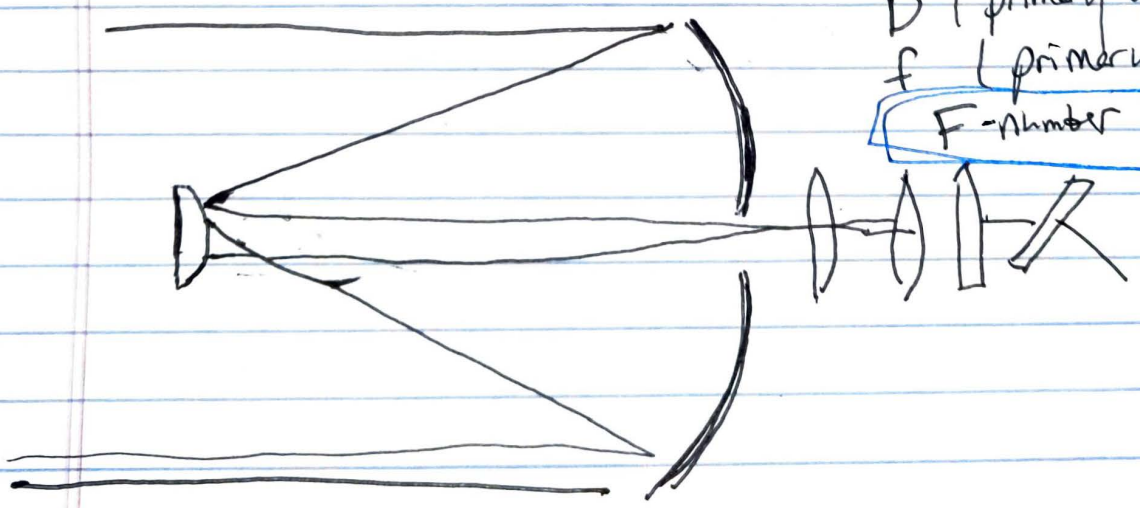
F = focal ratio at focal plane

Prime focus Telescope



Eq 2.1

More Complicated Telescope



D (primary aperture)

f (primary focal length)

F-number at focal plane