Astronomical Techniques I

Lecture 4

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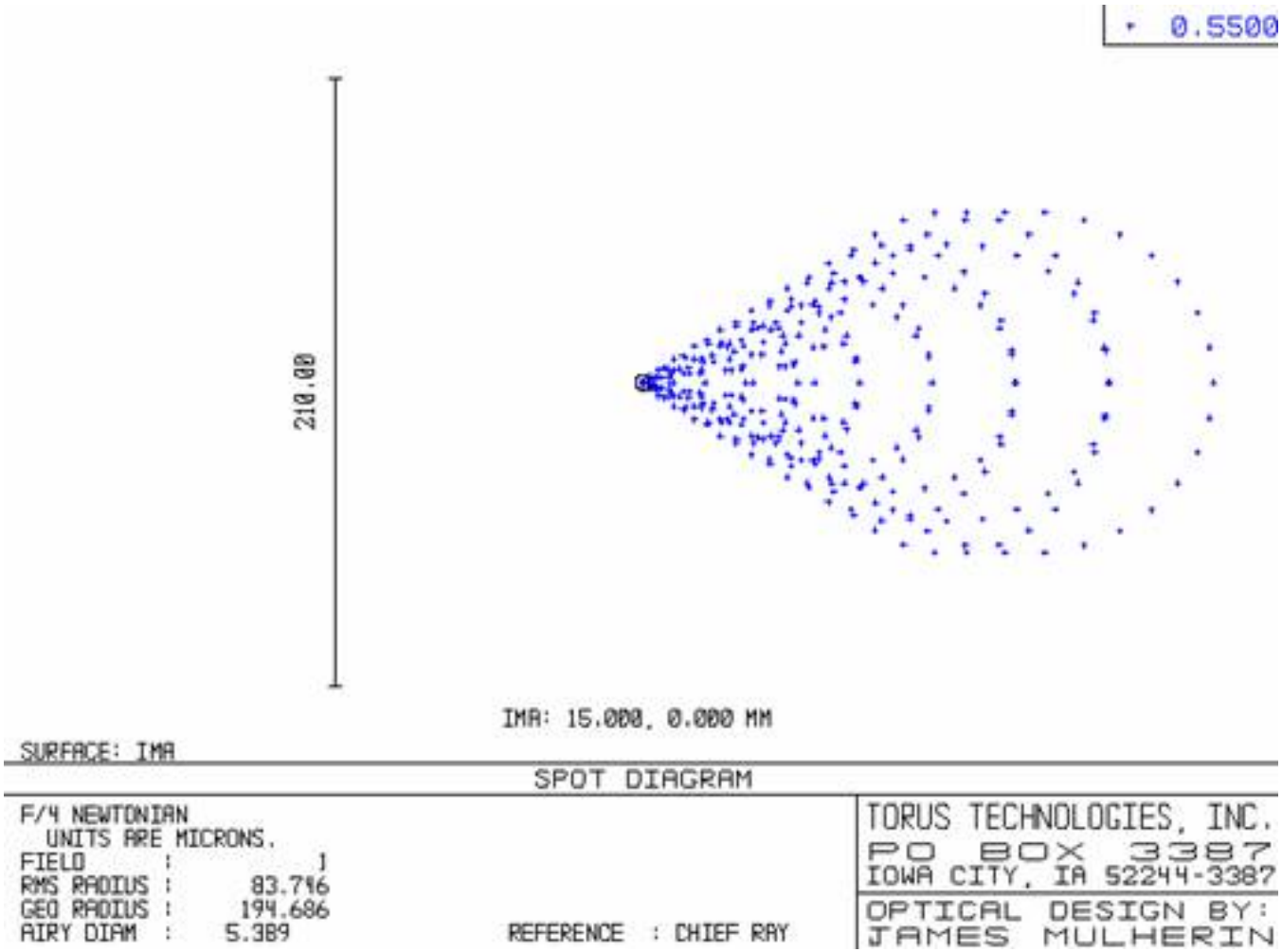
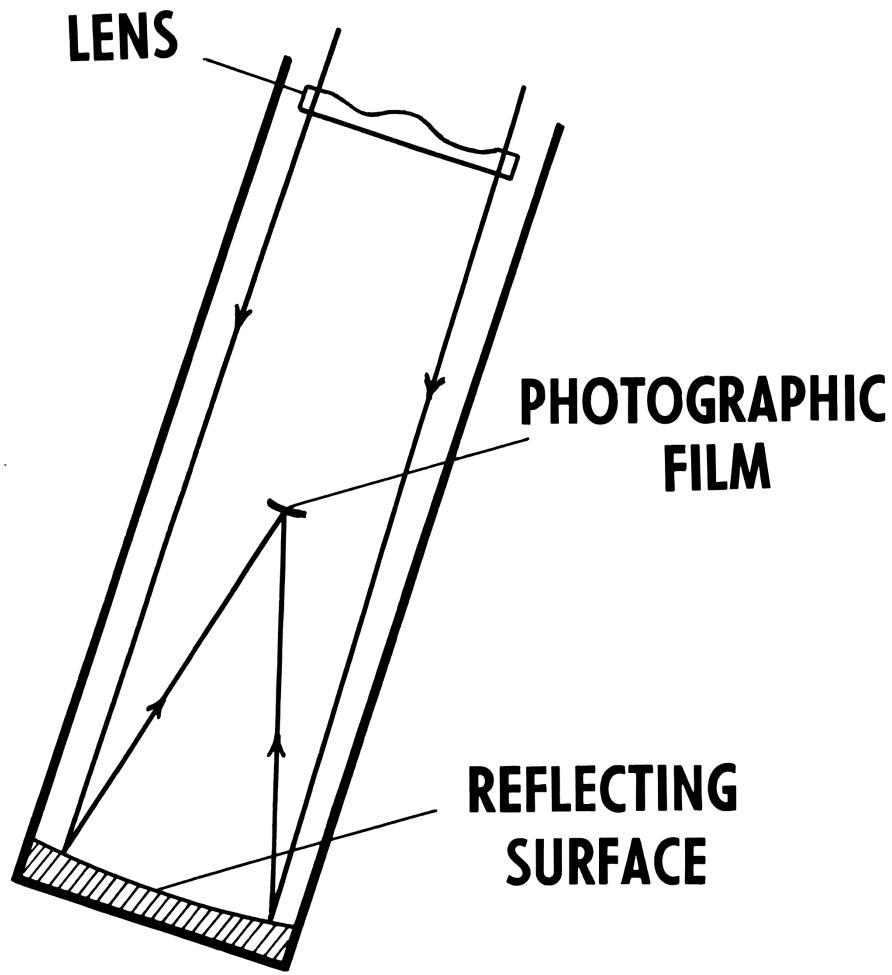
Jan-Feb 2015

Coma or comatic aberration - inherent to parabolic telescopes

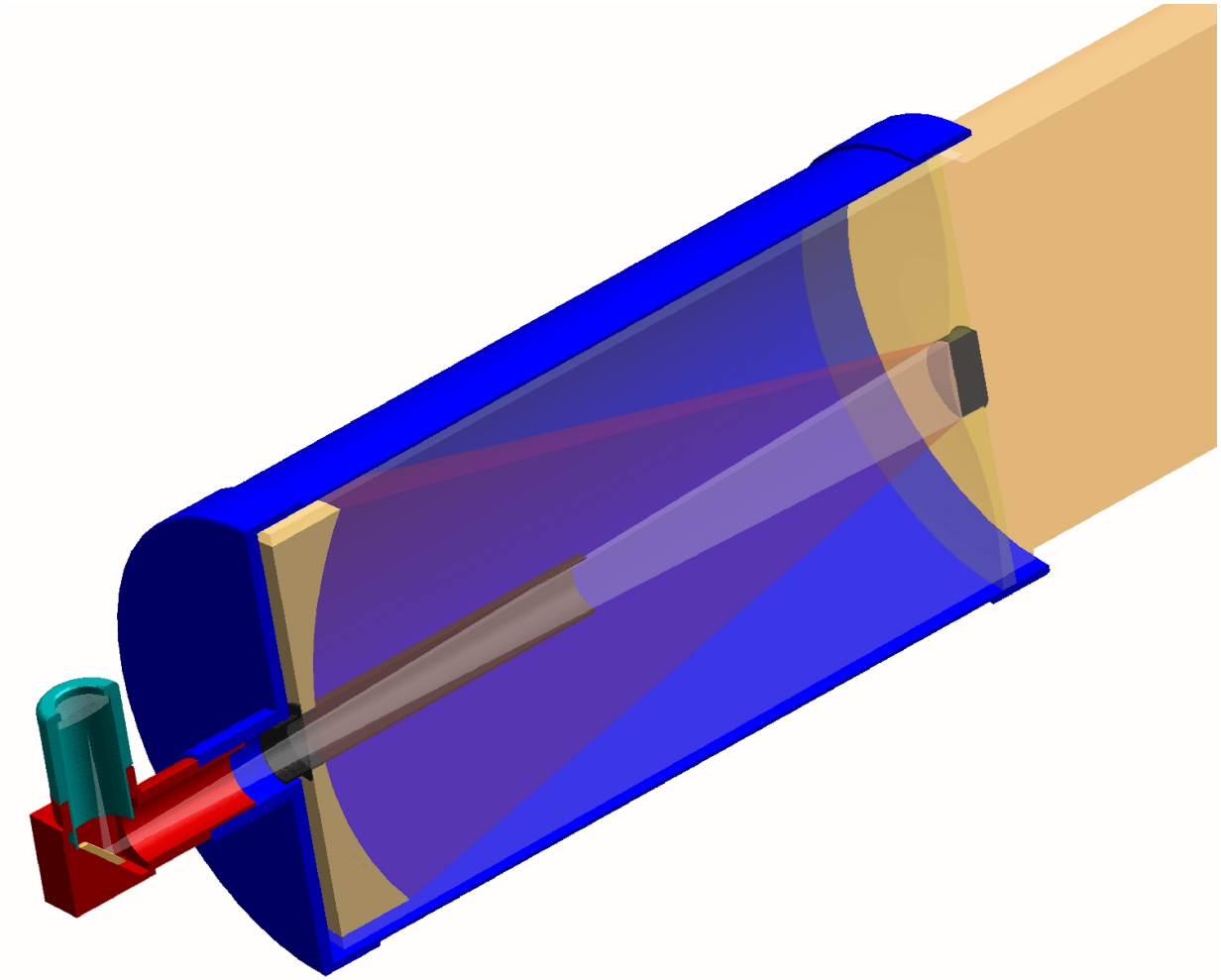


show video

Schmidt camera

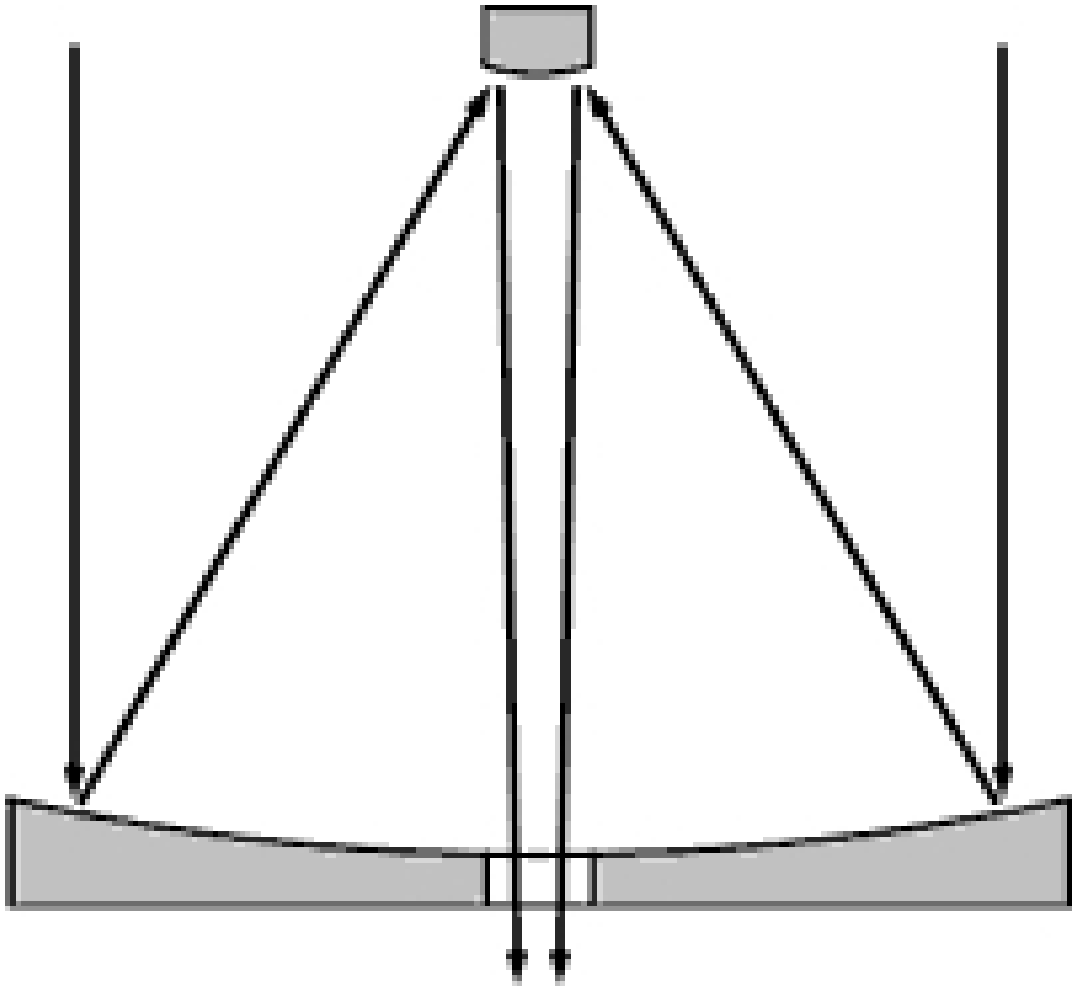


Schmidt Cassegrain



Schmidt Cassegrain

Ritchey Chretien

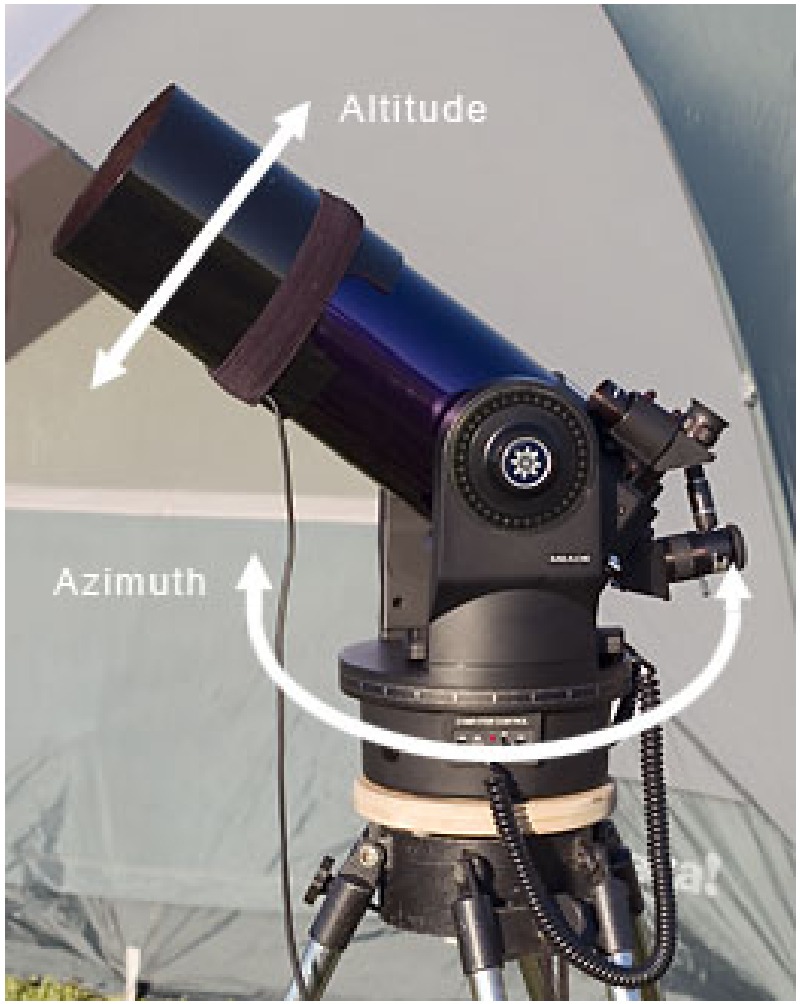


hyperboloid primary and secondary, no coma or spherical aberration!

Almost all large telescopes are RC

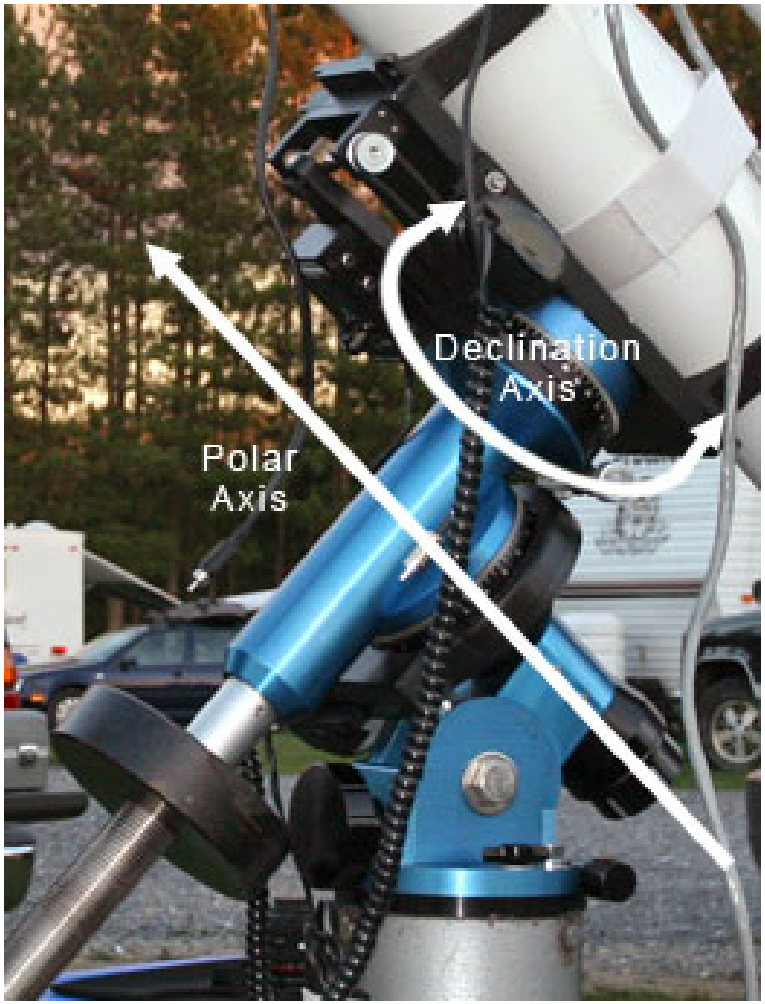
- two 10 m telescopes of the Keck Observatory
- four 8.2 m telescopes comprising the Very Large Telescope in Chile
- two 8 m telescopes comprising the Gemini Observatory
- 10.4 m Gran Telescopio Canarias
- 8.2 m Subaru telescope at Mauna Kea Observatory
- 3.5 m Herschel Space Observatory orbiting telescope
- 2.5 m Sloan Digital Sky Survey telescope (modified design)
- 2.4 m Hubble Space Telescope
- 85 cm Spitzer Space Telescope
- 30 m TMT

Altazimuth mount

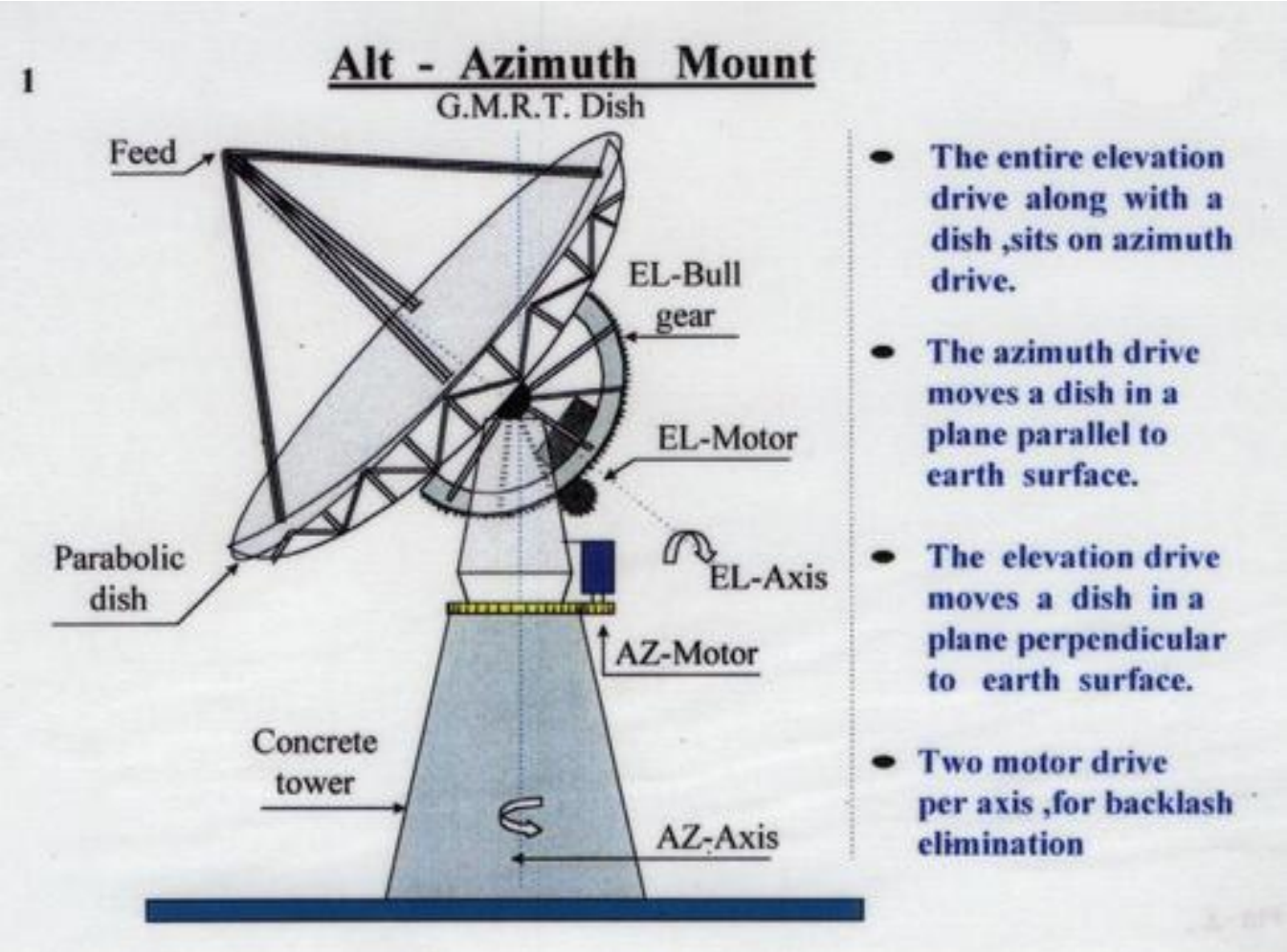


Dobsonian mount

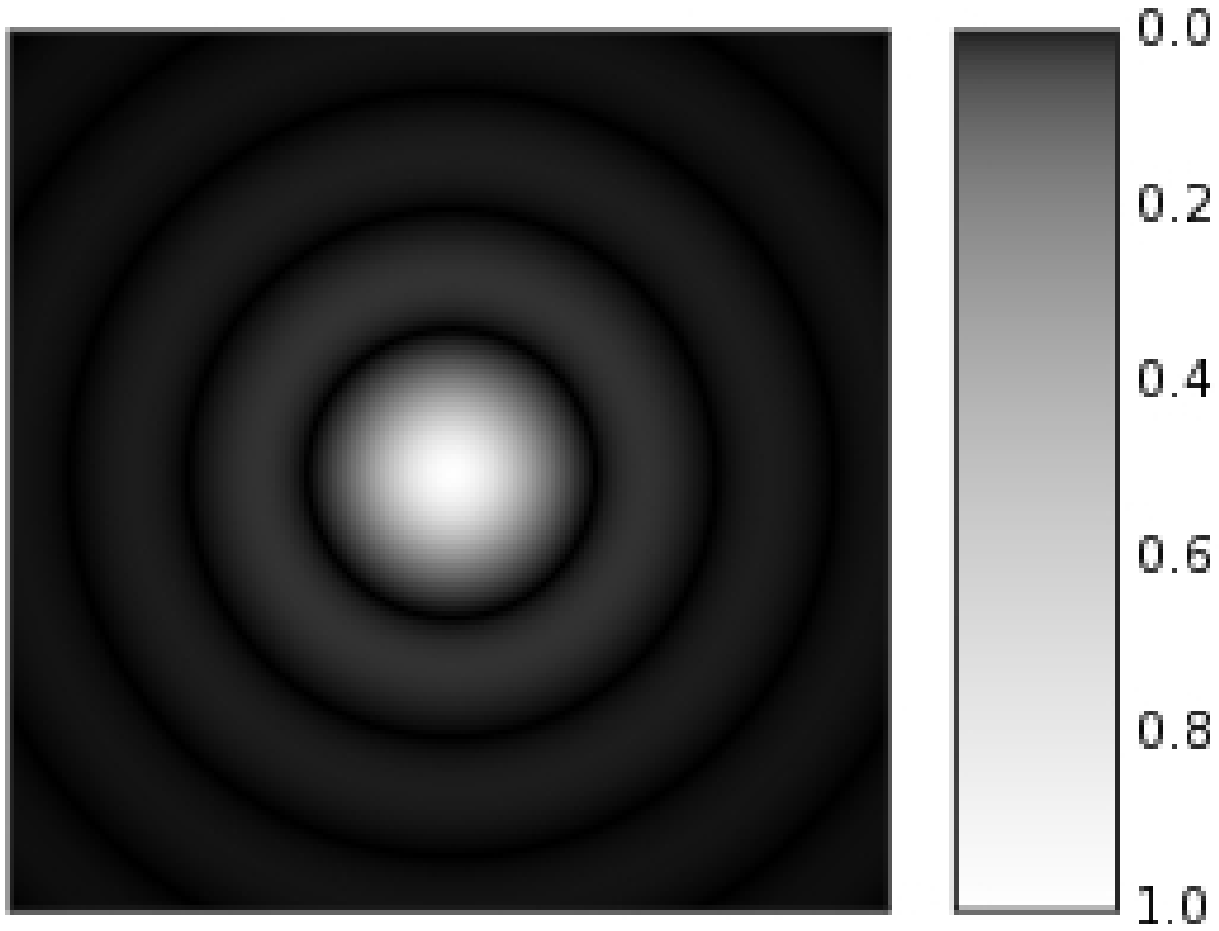
Equatorial mount



Most modern telescopes use altazimuth mounts



Fundamental limit on resolution - diffraction (Airy disk)

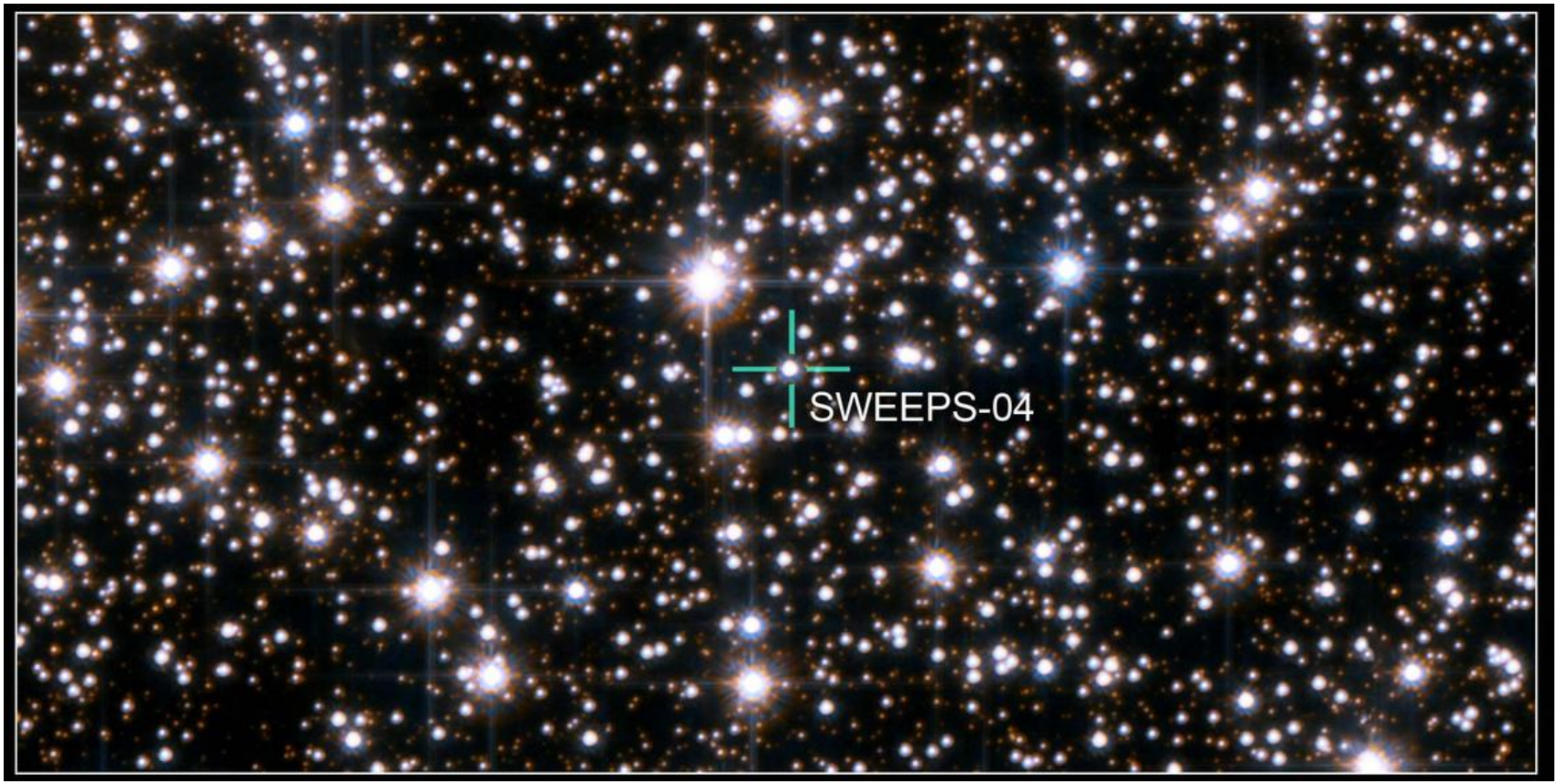


$\sin \alpha_n = m_n \lambda / D$

Rayleigh criterion

$1.22\lambda/D$

Diffraction in astronomy



Why do some stars show spikes? Where are the rings? Why are bright stars larger than faint stars?

Apparent magnitude - flux measure

$$m_1 - m_2 = -2.5 \log_{10}(f_1/f_2)$$

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- measurements relative

Absolute magnitude - luminosity measure

$$M = m - 5((\log_{10} D_L) - 1)$$

for cosmological distances, D_L is the luminosity distance.

Review questions

The two stars of a double star system are separated by 1.5 arcsec. Could these be resolved with a 10 cm diameter telescope?

Is there any location on Earth where a telescope with an altazimuth mount will function just as well as an equatorially mounted telescope for that location?

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- atmospheric turbulence affects wavefronts

Refraction and dispersion

Refractive index η of air at sea level at 15 degrees Celsius:

$$(\eta - 1) \times 10^8 = 8342 + \frac{2.4 \times 10^6}{130 - \lambda^{-2}} + \frac{1.6 \times 10^4}{40 - \lambda^{-2}}$$

where λ is in microns.

- changes position, important in high resolution (eg. adaptive optics) observation
- because $\eta = f(\lambda)$, refraction corrections depend on zenith angle and λ (called *chromatic* refraction correction.

Green flash

Temperature/Pressure/Density in the lower atmosphere