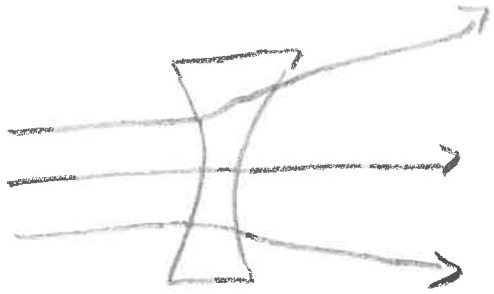
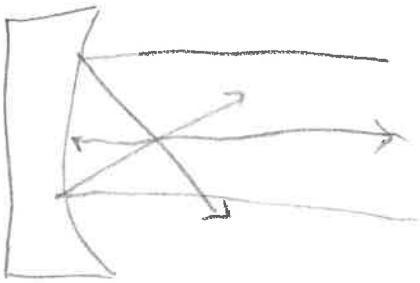
AST2469

HW #4

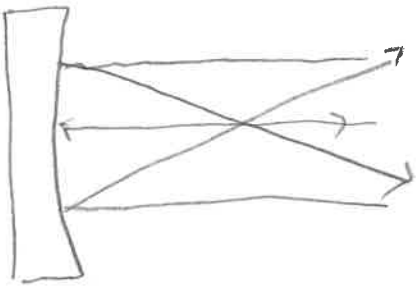
a) Assume $n_1 < n_2$



b)



c)



d) $D = 4cm \quad f = 1cm \quad N = \frac{f}{D} = \frac{1}{4}$

$D = 4cm \quad f = 3cm \quad N = \frac{3}{4}$

e) $D = 24in = 610mm \quad f = ND = 0.7 \cdot 610 = 427mm$

$$m = \frac{f_1}{f_2} = 50 \Rightarrow f_2 = \frac{427mm}{50} = 8.5mm$$

2a) Photon flux ratio is the same as the flux ratio.

$$\frac{F_1}{F_2} = 10^{0.4(1)} \cong 0.4$$

b) Larger telescope should observe 10th mag star.

photons proportional to aperture area so

$$A_{small} = 0.4\, A_{large} \quad \text{or}$$

$$\pi\left(\frac{D_{small}}{2}\right)^2 = 0.4 \cdot \pi\left(\frac{D_{large}}{2}\right)^2$$

$$D_{small} = 0.4^{1/2} D_{large}$$

3) Assume $\lambda = 500\,nm$

$$\theta = 1.22\,\frac{\lambda}{D} = 1'' = 4.85\times10^{-6}\ rad$$

$$\Rightarrow D = 1.22\,\frac{500\times10^{-9}}{4.85\times10^{-6}} = 0.125\,m = 12.5\,cm!$$

4) All use $\theta = 1.22 \frac{\lambda}{D}$

Multiply by 206265 to go rad → "

a) $D = 2m \quad \lambda = 500\,nm$

$\Rightarrow \theta = 3.05 \times 10^{-7} = 0.06"$

b) $D = 2m \quad E = 1keV = h\nu \Rightarrow \nu = 2.4 \times 10^{17} Hz$

$\lambda = c/\nu = 1.2 \times 10^{-9} m$

$\Rightarrow \theta = 7.32 \times 10^{-10} = 1.51 \times 10^{-4}"$

c) $D = 100m \quad \nu = 1.4\,GHz \Rightarrow 21.4 \times 10^{-2} m$

$\Rightarrow \theta = 2.61 \times 10^{-3} = 538"$

d) $D = 300m \quad \nu = 5\,GHz \Rightarrow 6.0 \times 10^{-2} m$

$\Rightarrow \theta = 2.44 \times 10^{-4} = 50.3"$

e) $D = 6m \quad \lambda = 2 \times 10^{-6} m$

$\Rightarrow \theta = 4.07 \times 10^{-7} = 0.084"$

f) $\lambda \uparrow \quad \theta \uparrow$

$D \uparrow \quad \theta \downarrow$

Radio telescopes must be huge to have good resolution