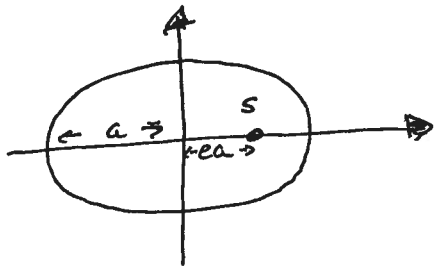
# HMRK #6

ASTR 252

(1.) $a_{\sigma} = 1.524$ AU $\quad e = 0.093$




$r_p = a - ea = 1.382$ AU

$r_a = a + ea = 1.666$ AU

Flux density $= F_{obs} \sim \frac{1}{D^2}$ . so the ratio of the flux densities at perihelion to aphelion are:

$$\frac{F(r_p)}{F(r_a)} = \frac{\frac{1}{r_p^2}}{\frac{1}{r_a^2}} = \left(\frac{r_a}{r_p}\right)^2 = 1.45 \Rightarrow$$

45% variation in observed flux density!

(2.) Same diagram as above <u>no</u>co $r_p = a - ea = 0.9833$ AU

$r_a = a + ea = 1.0167$ AU

$e_{\oplus} = 0.0167$

$a = 1$ AU (by definition!)

$V(r) = \sqrt{GM_{\odot}\left(\frac{2}{r} - \frac{1}{a}\right)}$ is the velocity around an elliptical orbit.

$\Delta V = V(r_p) - V(r_a)$

$$\Delta V = \sqrt{GM_{\odot}\left(\frac{2}{r_p} - 1\right)} - \sqrt{GM_{\odot}\left(\frac{2}{r_a} - 1\right)}$$

$\simeq 30.28 - 29.29$ km/s

$\Delta V \simeq 0.99 \simeq 1$ km/s !

(3.) $a = 67.7\,AU$
$e = 0.442$

$$P_{yrs} = a_{AU}^{3/2}$$

$$P = (67.7)^{3/2} = 557 \text{ years}$$

In general $m_1 - m_2 = -2.5 \log \frac{F_1}{F_2} = -2.5 \log \frac{d_2^2}{d_1^2} = -5 \log \frac{d_2}{d_1}$

$r_p = a - ea = 37.78\,AU$

$r_a = a + ea = 97.62\,AU$

$$m_p = -26.7 - 5 \log_{10} \frac{1\,AU}{37.78\,AU} = -18.8 \text{ mag}$$

$$m_a = -26.7 - 5 \log_{10} \frac{1\,AU}{97.62\,AU} = -16.7 \text{ mag}$$

The apparent magnitude of the full moon viewed from the Earth is $\sim -12.6$ mag - so the Sun would only be 4 magnitudes brighter when Eris is at perihelion!

(4.) $a_{dys.} = 37,370\,km$ $\quad P_{dys.} = 15.774$ days.

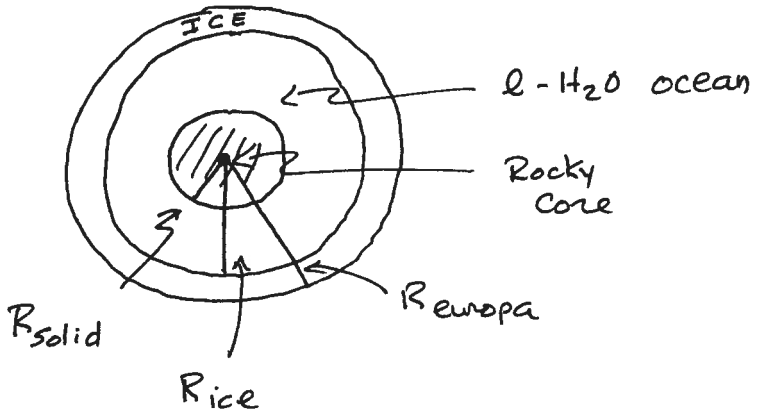
$$M_{eris} = \frac{4\pi^2}{G} \cdot \frac{a_{dys.}^3}{P_{dys.}^2} = \frac{4\pi^2}{6.67 \times 10^{-8}\,cm^3 \cdot s^{-2} \cdot g^{-1}} \cdot \frac{(3.737 \times 10^9\,cm)^3}{(15.774\,d \cdot 24\,h/d \cdot 3600\,s/h)^2}$$

$$= 1.66 \times 10^{25}\,g$$

$M_{pluto} \simeq 1.3 \times 10^{25}\,g \Rightarrow M_{eris} \simeq 1.27\, M_{pluto}$.

(5.)

$R_{europa} = 1565$ km




$R_{ice} = 1535$ to $1555$ km

$R_{solid} = 1435$ to $1530$ km

$$V_{\ell\text{-}H_2O} = \frac{4}{3}\pi \left( R_{ice}^3 - R_{solid}^3 \right)$$

$$V_{\ell\text{-}H_2O} \simeq 0.7 \times 10^9 \text{ km}^3 \text{ to } 2.8 \times 10^9 \text{ km}^3$$

So, nearly equal to as much as 3x as much water on Europa as in Earth's oceans !!!