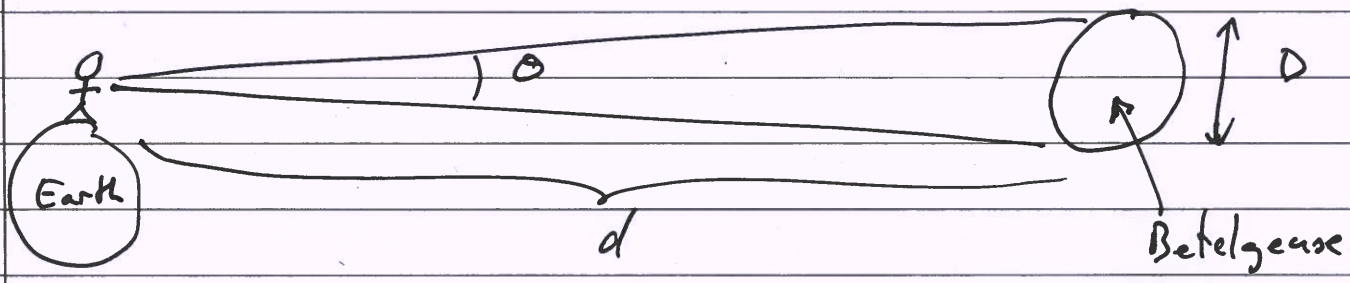
Friday, February 27, 2026

Example: Size of Betelgeuse

ALMA measured an angular size of $\theta = 0.05''$ (0.05 arcseconds) at 640 light years (Ly).

Q: What is the diameter of Betelgeuse?



Angular size $\theta = 0.05'' = \frac{0.05}{3600}$ degrees $= 1.39 \times 10^{-5}$ degrees

$$= 1.39 \times 10^{-5} \times \left(\frac{\pi}{180}\right) = 2.42 \times 10^{-7} \text{ rads}$$

$$\frac{D}{d} = \frac{\text{rise}}{\text{run}} = \tan\theta = \tan(2.42 \times 10^{-7} \text{ rads}) \simeq 2.42 \times 10^{-7}$$

$\tan(\theta_{\text{rads}}) \simeq \theta_{\text{rads}}$ (small)

d = distance $= 640$ Ly $= 640 \text{ Ly} \times 64.2 \times 10^3 \frac{\text{AU}}{\text{Ly}} = 4.04 \times 10^7$ AU

$$\Rightarrow D = d \tan\theta = (4.04 \times 10^7 \text{ AU})(2.42 \times 10^{-7}) = 9.78 \text{ AU}$$

$\Rightarrow$ Betelgeuse has a diameter of $\boxed{D = 9.78 \text{ AU}}$

Approximately the size of the orbit of Jupiter !!!