

40)

$$\Delta T_{\text{Earth}} = \frac{d}{v} = \frac{200 \text{ LY}}{v}$$

(Measure  $v$   
as a fraction of  $c$ )

$$\Delta T_{\text{astro}} = \Delta T_{\text{Earth}} \sqrt{1 - v^2/c^2}$$

$$\left( \Delta T = \frac{\Delta T_0}{\sqrt{1 - v^2/c^2}} : \Delta T_{\text{astro}} \text{ is the proper time } t_0 \right)$$

$$\Delta T_{\text{astro}} = \frac{200}{v} \sqrt{1 - v^2/c^2} = 10$$

Solve for  $v$

$$\frac{\sqrt{1 - v^2/c^2}}{v} = \frac{0.1}{20 \text{ LY}}$$

$$\sqrt{1 - v^2/c^2} = \left( \frac{1}{20} \right) v$$

$$1 - v^2/c^2 = \frac{1}{400} v^2$$

$$\text{let } c = 1 \text{ LY/y}$$

$$1 - v^2 = \frac{1}{400} v^2$$

$$1 - \left( 1 + \frac{1}{400} \right) v^2 = 0$$

$$v^2 = \frac{1}{1 + 1/400} = \frac{400}{401}$$

$$v = \sqrt{\frac{400}{401}} \text{ LY/y}$$