

2.2

Units first:

1 yr = 1 year, unit of time

1 ly = 1 light-year =  $c \times 1 \text{ year}$ , <sup>unit</sup> of length.

EARTH



In the  
SHIP  
Frame

$$\begin{cases} \Delta t' = \text{myr} \\ \Delta x' = 0 \end{cases}$$

STAR



$\Delta x = n \text{ ly}$  in the  
Earth frame.

②

$$\Delta x = \gamma(v) (\Delta x' + v \Delta t')$$

$$n \text{ ly} = \gamma(v) (0 + v \cdot \text{myr})$$

$$n \cdot c \text{ yr} = \gamma(v) v \text{ m} \cdot \cancel{\text{yr}}$$

$$m_c = \frac{nm}{\sqrt{1 - v^2/c^2}}$$

solve for  $v$ ,  $v = \frac{m_c}{\sqrt{n^2 + m^2}}$

b) Note that  $v < c$  always, so there are no limitations on  $n$  and  $m$  (as long as they positive, obviously ...).

c)  $4 \times 10^{13} \text{ km} \approx 4.23 \text{ ly}$

$$v = \frac{4.23}{\sqrt{4.23^2 + 10^2}} c = 0.389 c$$