

26. (a) In the messenger's rest system (called S_m), the velocity of the armada is

$$v' = \frac{v - v_m}{1 - vv_m/c^2} = \frac{0.80c - 0.95c}{1 - (0.80c)(0.95c)/c^2} = -0.625c .$$

The length of the armada as measured in S_m is

$$L_1 = \frac{L_0}{\gamma_{v'}} = (1.0 \text{ ly}) \sqrt{1 - (-0.625)^2} = 0.781 \text{ ly} .$$

Thus, the length of the trip is

$$t' = \frac{L'}{|v'|} = \frac{0.781 \text{ ly}}{0.625c} = 1.25 \text{ y} .$$

- (b) In the armada's rest frame (called S_a), the velocity of the messenger is

$$v' = \frac{v - v_a}{1 - vv_a/c^2} = \frac{0.95c - 0.80c}{1 - (0.95c)(0.80c)/c^2} = 0.625c .$$

Now, the length of the trip is

$$t' = \frac{L_0}{v'} = \frac{1.0 \text{ ly}}{0.625c} = 1.6 \text{ y} .$$

- (c) Measured in system S , the length of the armada is

$$L = \frac{L_0}{\gamma} = 1.0 \text{ ly} \sqrt{1 - (0.80)^2} = 0.60 \text{ ly} ,$$

so the length of the trip is

$$t = \frac{L}{v_m - v_a} = \frac{0.60 \text{ ly}}{0.95c - 0.80c} = 4.0 \text{ y} .$$