

66. (a) According to ship observers, the duration of proton flight is  $\Delta t' = (760 \text{ m})/0.980c = 2.59 \mu\text{s}$  (assuming it travels the entire length of the ship).

(b) To transform to our point of view, we use Eq. 2 in Table 38-2. Thus, with  $\Delta x' = -750 \text{ m}$ , we have

$$\Delta t = \gamma (\Delta t' + (0.950c)\Delta x'/c^2) = 0.57 \mu\text{s} .$$

(c) and (d) For the ship observers, firing the proton from back to front makes no difference, and  $\Delta t' = 2.59 \mu\text{s}$  as before. For us, the fact that now  $\Delta x' = +750 \text{ m}$  is a significant change.

$$\Delta t = \gamma (\Delta t' + (0.950c)\Delta x'/c^2) = 16.0 \mu\text{s} .$$