

16. The “coincidence” of $x = x' = 0$ at $t = t' = 0$ is important for Eq. 38-20 to apply without additional terms. We label the event coordinates with subscripts: $(x_1, t_1) = (0, 0)$ and $(x_2, t_2) = (3000, 4.0 \times 10^{-6})$ with SI units understood. Of course, we expect $(x'_1, t'_1) = (0, 0)$, and this may be verified using Eq. 38-20. We now compute (x'_2, t'_2) , assuming $v = +0.60c = +1.799 \times 10^8$ m/s (the sign of v is not made clear in the problem statement, but the Figure referred to, Fig. 38-9, shows the motion in the positive x direction).

$$x'_2 = \frac{x - vt}{\sqrt{1 - \beta^2}} = \frac{3000 - (1.799 \times 10^8)(4.0 \times 10^{-6})}{\sqrt{1 - (0.60)^2}} = 2.85 \times 10^3$$

$$t'_2 = \frac{t - \beta x/c}{\sqrt{1 - \beta^2}} = \frac{4.0 \times 10^{-6} - (0.60)(3000)/(2.998 \times 10^8)}{\sqrt{1 - (0.60)^2}} = -2.5 \times 10^{-6}$$

The two events in frame S occur in the order: first 1, then 2. However, in frame S' where $t'_2 < 0$, they occur in the reverse order: first 2, then 1. We note that the distances $x_2 - x_1$ and $x'_2 - x'_1$ are larger than how far light can travel during the respective times ($c(t_2 - t_1) = 1.2$ km and $c|t'_2 - t'_1| \approx 750$ m), so that no inconsistencies arise as a result of the order reversal (that is, no signal from event 1 could arrive at event 2 or vice versa).