PHYS 200: Problem Set III

Due: 4:30 pm February 8, 2005

1. [8] The frames S and S' are in the standard configuration with relative velocity $0.8c$ along Ox.

   (a) What are the coordinates (x_1, y_1, z_1, t_1) in S of an event that occurs on the x'-axis with $x'_1 = 1500$ m, $t'_1 = 5$ μs?

   (b) Answer the same for a second event on the x'-axis with $x'_2 = -1500$ m, $t'_2 = 10$ μs.

   (c) What are the time intervals (Δt and $\Delta t'$) between the two events, as measured in S and S'?

2. [6] Observers in a frame S arrange for two simultaneous explosions at time $t = 0$. The first explosion is at the origin ($x_1 = y_1 = z_1 = 0$) while the second is on the positive x-axis 4 light years away ($x_2 = 4c \cdot \text{years}, y_2 = z_2 = 0$).

   (a) Use the Lorentz transformation to find the coordinates of these two events as observed in a frame S' traveling in the standard configuration at speed $0.6c$ relative to S.

   (b) How far apart are the two events as measured in S'?

   (c) Are the events simultaneous as observed in S'?

3. [6] Observers in S and S' synchronize their clocks to read 0 at their origins when they coincide. The observer in S reads the clock in S' through a telescope. What time does he see when *his* clock reads 30 minutes if $v^2 = \frac{8}{9}c^2$? Hint: do not forget the propagation time of light.