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**Messing With Lorentz Transformations Lab**

**Physics 205**

**Prof. Singal**

(adopted from M. Trawick)

Open the Mathematica notebook “lorentz\_transform.nb.” Hit Control-A (to select all text) and

hit Shift-Enter to execute all of these lines of code. (If a window pops up asking to enable

dynamic content, select “Enable”.) There are two plot modules, one for a Galilean transformation between frames, and one for a Lorentz transformation between frames. The relative velocity of the observer can be adjusted in each with the slide bar. In each is a line that starts with ListPlot[{ and this is where you can enter the x,y coordinates for two points.

**Answer each of these questions for both the Galilean and Lorentz transformations:**

1. Consider two events with (x,t) coordinates of (1,2) and (1,5) (it should be initially set to these values). Does the velocity of the observer affect the time elapsed between the two events? Is there a reference frame in which these two events are simultaneous (occur at the same time)?

2. Now consider two events with (x,t) coordinates of (1,2) and (0,5). In what reference frame is the time between these two events the smallest that it can be? For the Lorentz case, does this make sense in light of what we know about the proper time?

3. Consider two events with (x,t) coordinates of (5,1) and (3,2). In what reference frame S’ are these two events simultaneous? That is, what is the speed *v* of the reference frame S’ relative to S in which the events occur at the same time?

4. Consider two events with (x,t) coordinates of (1,1) and (3,3). In this reference frame, can a photon travel fast enough to travel from the event at (1,1) to the event at (3,3)? Is there a reference frame in which a photon is NOT fast enough to travel between these two events?