Physics H190
Spring 2013
Homework 1
Due Wednesday, January 30, 2013

About Homework: I will try to have weekly homework, but there may be some weeks without it. I will post the homework assignment by Friday of each week, and the homework will be due the following Wednesday in class. I'll try not to assign too much homework, but you can't learn physics without doing problems, so there must be some. See the web site for the homework late policy.

Reading Assignment: Please read the lecture notes for last Wednesday's lecture. The lecture notes are posted on the web site.

1. Send me an email with a question regarding the lecture notes. "I didn't understand this" or "Could you explain that better" are acceptable questions. We'll spend some time on Wednesday going over the questions. Of course you can come to office hour on Tuesday to ask questions, too.

2. Show that if two events are separated by a time-like interval, then there exists a Lorentz frame in which they have the same spatial location. You can do this in $1 + 1$ dimensions. Show that if two events A and B are separated by a space-like interval, then there exists a Lorentz frame in which $t_A < t_B$; $t_A = t_B$; $t_A > t_B$. Thus, for space-like intervals, the time sequencing of the events is relative to the observer.

3. Why do we add rotations to the mix when talking about Lorentz transformations? Why not just restrict them to the boosts? Suppose frame 0 is the "stationary" or "lab" frame. Let frame 1 be moving down the x-axis of frame 0 with velocity v. Let frame 2 be moving down the y-axis of frame 1 with velocity v. Let frame 3 be moving down the x-axis of frame 2 with velocity $-v$. Let frame 4 be moving down the y-axis of frame 3 with velocity $-v$. Find the Lorentz transformation connecting frame 0 with frame 4. Hint: Since none of the transformations affects the z-coordinate, you can just work with 3×3 matrices. Expand the final matrix in powers of v, neglecting terms of order v^3 and higher. The result is a pure rotation (through order v^2). What is the axis, and what is the angle?