Astro 260, Spring 207
Homework Set 1
Due at the beginning of Class, 02/01

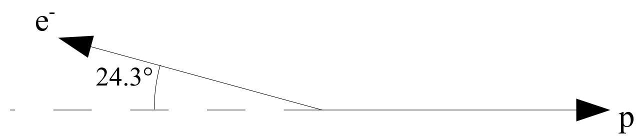
- Problems marked [***Solo Problem***] must be completed without consulting anybody other than Prof. Knop.
- You may freely speak with each other about the other problems. However, the solution you turn in must be your own solution. As a rule of thumb, it should express what you understand, and you should be able to explain your solution if asked. Clearly, if you are sitting next to a friend and just making sure that you both have the same things written down, you aren't just turning in your own work. However, I do encourage you to talk to each other as you try to understand the non-solo problems.

1. [***Solo Problem***]

(a) Starting from the constancy of the speed of light for all observers, and using the time dilation formula we derived in class, derive the Lorentz contraction formula in a similar manner. (I.e., do what I started to do in class, but do it right.)

(b) Draw the spacetime diagram showing the experiment you've done. Draw this spacetime diagram in our frame of reference, i.e. the frame of reference in which the clock construct is moving to the right at speed V. Be sure to clearly show the world lines for the front and back of the clock, and the path that the pulse of light takes. Also indicate the lengths l (our measurement for the length of the clock construct) and $\bar{l}$ (the proper or rest lenght of the clock construct) on the diagram. (This is a busy diagram– draw it large enough so that all of the above is clear!)

2. A neutron at rest in the lab decays into a proton, an electron, and an antineutrino. Suppose that the electron is observed moving off at a velocity of $0.75c$, moving at an angle of $24.3°$ with respsect to the opposite direction of the proton.



Calculate each of the following:

- The total energy of the proton
- The total energy of the antineutrino
- The momentum of the antineutrino
- The direction that the antineutrino is going
- How long it will be before the proton decays

You will want the rest mass of the neutron, proton, and electron in order to do this problem. A great source for all of these things is the particle data book.

3. Hartle problem 5.15.

4. Hartle problem 5.16.

5. [***Solo Problem***] Hartle problem 5.22.