Physics 201: Assignment #2

Instructor: Carl Adams

Due: Mar. 12, 2013

1. Tipler 6e 1-57 (corresponds to 1-56 in the 5th ed.) (10 points)

   (Note: in the problem in the 5th edition the 3rd line should read $t'_2 - t'_1$.)

   You should find this question is similar to the discussion we had in class. In addition to the questions in the book answer the following: (e) Show that if you use $T_{\min} = D/c$ the events are separated by a light-like interval but if you use the alternate $T_{\min} = D/c'$ the interval changes to space-like. Hence light-like is the boundary between events that are causally connected and disconnected.

2. Tipler 2-12 (same in both editions)

   In addition make a transform to frame that is moving at $\beta = -0.5$ and recalculate the energy, momentum, rest mass, and velocity. (Assume the proton is moving in the positive-x direction in the original S frame.) (10 points)

3. Tipler 2-14 (same in both editions) Just calculate the percentage difference in E_K (don't need to work out momentum) (6 points)

   You can likely do this problem with a calculator but you might find

   $$\frac{1}{\sqrt{1-x^2}} = 1 + \frac{1}{2}x^2 + \frac{3}{8}x^4 + \dots \tag{1}$$

   useful if you set $x = u/c$. You'll find that the $\frac{3}{8}$ term is what is leftover in the E_K calculation.

4. Tipler 2-39 (2-37 in the 5th edition) You may assume that g is still 9.8 m/s^2 even at an altitude of 300 km. Just calculate the general relativistic effect. (10 points) To account for the general relativistic effect I suggest you use

   $$\Delta\tau_{\text{lower}} = \Delta\tau_{\text{upper}}\left(1 - \frac{gh}{c^2}\right) \tag{2}$$