Winter Quarter 2018 – UCSB Physics 24
Homework 1
Due Friday, Jan 26, 5 pm

- **Problem 1**

  Show that the Lorentz transformation in equation 12.1 of Kleppner & Kolenkov can be written as

  $x' = x\cosh\alpha - ct\sinh\alpha$
  $t' = t\cosh\alpha - \frac{x}{c}\sinh\alpha$

  with $\tanh\alpha = \frac{v}{c}$. Note that this looks very much like the coordinate transformation due to a rotation by an angle α around the z axis:

  $x' = x\cos\alpha + y\sin\alpha$
  $y' = y\cos\alpha - x\sin\alpha.$

  There are trivial differences due to the factors of c that are necessary to make the units consistent. The main difference is the use of cosh and sinh as opposed to cos and sin. There is also an extra minus sign. Lorentz transformations can be thought of as rotations in space-time (sort of).

  Hint: you may want to use some of the identities in
  `http://www.alcyone.com/max/reference/maths/hyperbolic.html`.

- **Problem 2**

  Two clocks located at the origins of systems S and S' are synchronized when the origins coincide. System S' is moving with constant velocity v with respect to system S. After a time t, an observer at the origin of the the S system observes the S' clock by means of a telescope. What does the S' clock read?

- **Problem 3**

  A muon is moving with speed $v = 0.999c$ vertically down through the atmosphere. Its half life in in its own rest frame is 2 μsec. What is its half-life as measured by an observer on the earth?

- **Problem 4**

  K&K, problem 12.5

- **Problem 5**

  K&K, problem 12.6

- **Problem 6**

  K&K, problem 12.10