

## PH673 - High Energy Astrophysics

### Assignment 3 - Aug 27, 2007

1. Assume the Lorentz transformation of space-time coordinates between two inertial frames:

$$\begin{aligned}x &= \gamma(x' + vt') \\ t &= \gamma\left(t' + \frac{v}{c^2}x'\right)\end{aligned}$$

in which  $\Sigma$  is the lab frame, and  $\Sigma'$  is a frame that moves with speed  $v$  along the  $x$  axis (no need to prove, despite what was said in class).

Start with the definitions  $v_x = dx/dt$ ,  $v'_x = dx'/dt'$  etc., to show that velocities transform according to:

$$\begin{aligned}v_x &= \frac{v + v'_x}{1 + \frac{v}{c^2}v'_x} \\ v_y &= \frac{1}{\gamma} \left( \frac{v'_y}{1 + \frac{v}{c^2}v'_x} \right) \\ v_z &= \frac{1}{\gamma} \left( \frac{v'_z}{1 + \frac{v}{c^2}v'_x} \right)\end{aligned}$$