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PHYS 230 Midterm Formula Sheet
11 October 2016

Galilean Transforms:

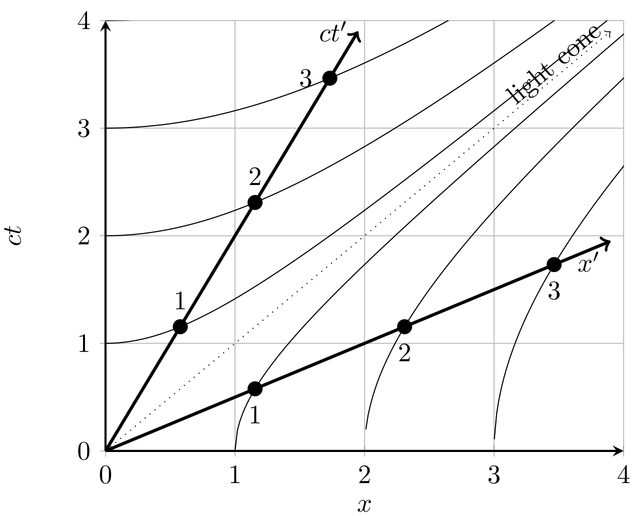
$$\begin{aligned} x' &= x - Vt & v'_x &= \frac{\mathrm{d}x'}{\mathrm{d}t'} = \frac{\mathrm{d}(x-vt)}{dt} = v_x - V \\ y' &= y & v'_y &= \frac{\mathrm{d}y'}{\mathrm{d}t'} = v_y \\ z' &= z & v'_z &= \frac{\mathrm{d}z'}{\mathrm{d}t'} = v_z \\ t' &= t & & \end{aligned}$$

Lorentz Transforms: $\gamma = \frac{1}{\sqrt{1-\frac{V^2}{c^2}}}$

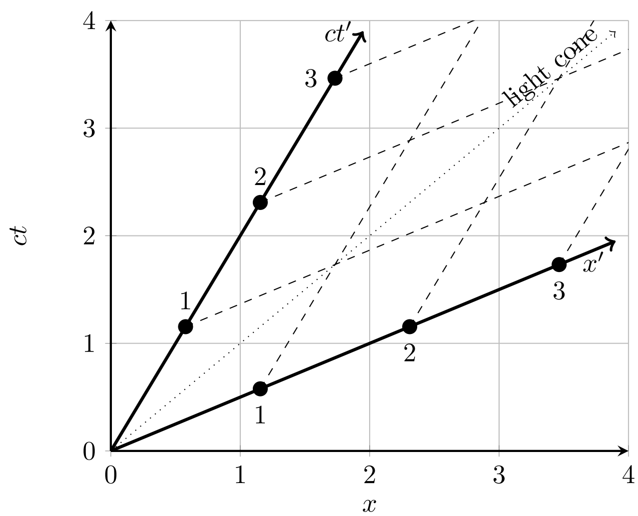
$$\begin{array}{cc|cc} x' = \gamma(x - Vt) & v'_x = \frac{\mathrm{d}x'}{\mathrm{d}t'} = \frac{\frac{\mathrm{d}x'}{\mathrm{d}t}}{\frac{\mathrm{d}t'}{\mathrm{d}t}} = \frac{v_x - V}{1-\frac{v_x V}{c^2}} & x = \gamma\left(x' + Vt'\right) & v_x = \frac{v'_x + V}{1+\frac{v'_x V}{c^2}} \\ y' = y & v'_y = \frac{\mathrm{d}y'}{\mathrm{d}t'} = \frac{\frac{\mathrm{d}y'}{\mathrm{d}t}}{\frac{\mathrm{d}t'}{\mathrm{d}t}} = \frac{v_y\sqrt{1-\frac{V^2}{c^2}}}{1-\frac{v_x V}{c^2}} & y = y' & v_y = \frac{v'_y\sqrt{1-\frac{V^2}{c^2}}}{1+\frac{v'_x V}{c^2}} \\ z' = z & v'_z = \frac{\mathrm{d}z'}{\mathrm{d}t'} = \frac{\frac{\mathrm{d}z'}{\mathrm{d}t}}{\frac{\mathrm{d}t'}{\mathrm{d}t}} = \frac{v_z\sqrt{1-\frac{V^2}{c^2}}}{1-\frac{v_x V}{c^2}} & z = z' & v_z = \frac{v'_z\sqrt{1-\frac{V^2}{c^2}}}{1+\frac{v'_x V}{c^2}} \\ t' = \gamma\left(t - \frac{VD}{c^2}\right) & ct' = \gamma\left(ct - \frac{VD}{c}\right) & t = \gamma\left(t' + \frac{VD'}{c^2}\right) & ct = \gamma\left(ct' + \frac{VD'}{c}\right) \end{array}$$

Minkowski Spacetime:

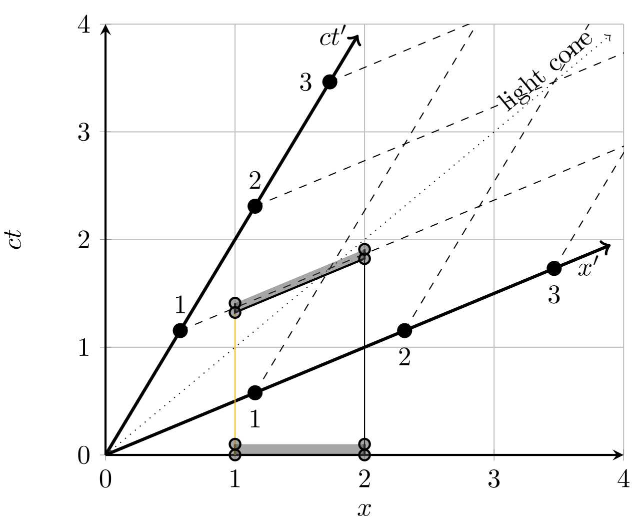
$\frac{V}{c} = \frac{1}{2}$



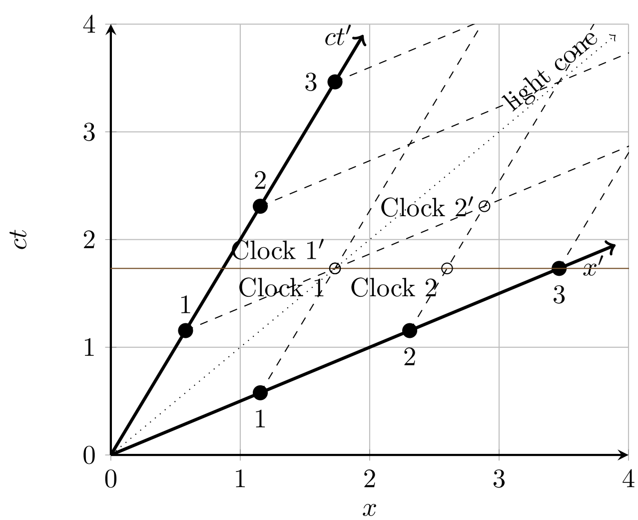
$\frac{V}{c} = \frac{1}{2}$

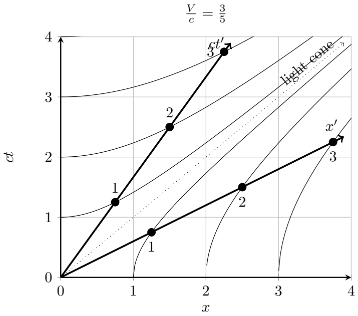


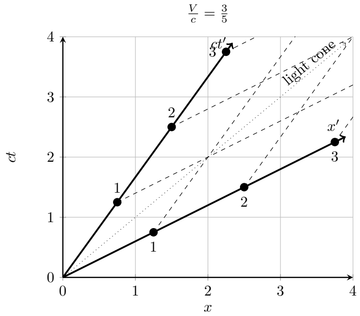
$\frac{V}{c} = \frac{1}{2}$, Length Contraction

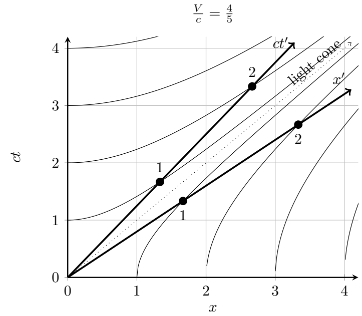


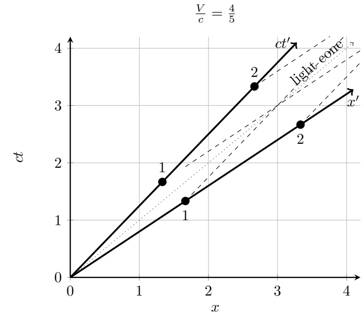
$\frac{V}{c} = \frac{1}{2}$, Clocks in-sync in S'











Invarient:

$$(x')^2 - (ct')^2 = x^2 - (ct)^2 = \pm a^2$$

Einstein's Postulates:

1. Absolute uniform motion cannot be detected.
2. The velocity of light does not depend upon the velocity of its source.