Introduction to Special Relativity

Sunday, November 8th, 2015
10:00 - 10:45 AM
3:00 - 3:45 PM
Room 160-317

Class Goals

- What is special relativity, anyway?
- Time Dilation: "moving clocks tick slower"
  Derive Formula
- Length Contraction: "moving objects appear shorter"

What is Special Relativity?

Use special relativity when you're dealing with speeds close to the speed of light. As a result of Einstein's postulates, weird stuff starts to happen then...

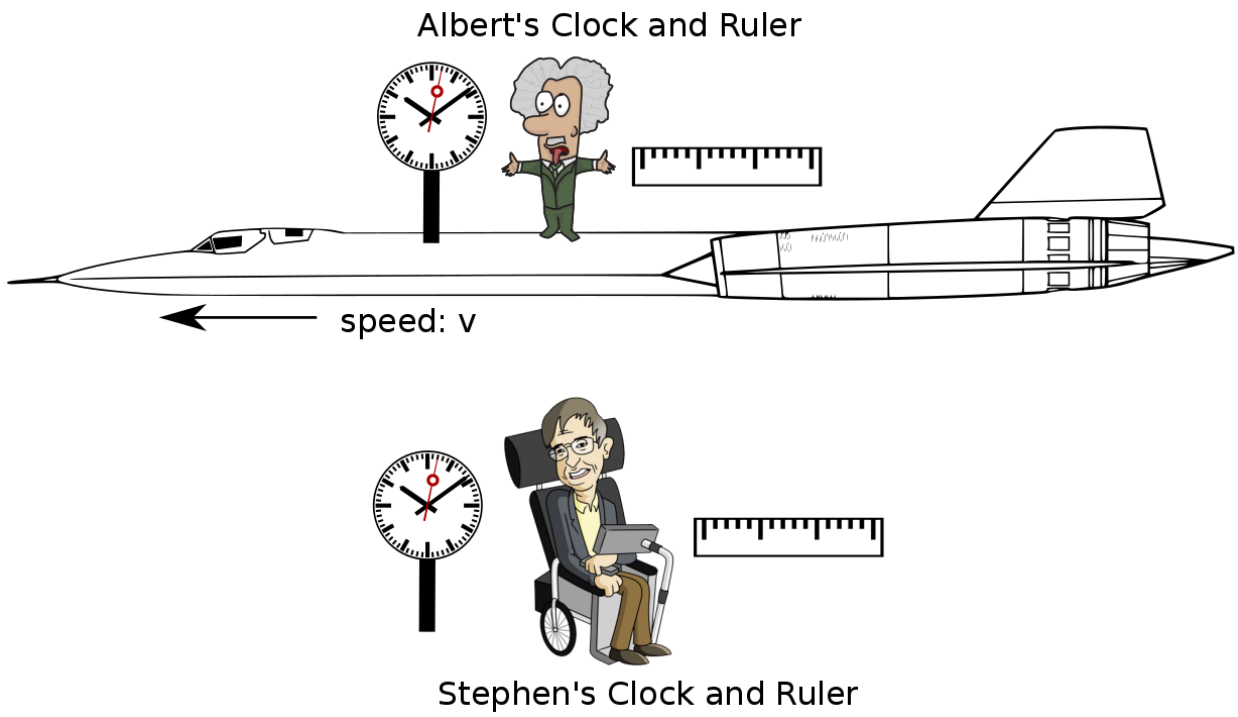
Einstein's Postulates form the basis of special relativity:

1. The laws of physics are the same in all non-accelerating reference frames
2. The speed of light is the same in all reference frames

Reference Frame - Set of coordinate axes you use to measure distances. If you're in a train, your reference frame is different than someone on the ground. Other reference frames are: the moon, the sun, a spaceship, etc.

The **special** part of special relativity is that it only works for non-accelerating reference frames. If you want to find out what happens to a spaceship that's speeding up or slowing down, you need to consider **general** relativity, which is much harder.

Time Dilation & Length Contraction Cheat Sheet



Stephen Says: Albert, your clock is ticking slower than mine by a factor of γ. Your ruler is also shorter than mine by a factor of γ.

Albert Says: No, Stephen, *your* clock is ticking slower by a factor of γ. And *your* ruler is shorter by a factor of γ.

Time Dilation

$$\Delta t' = \gamma \Delta t_0$$

Moving clocks tick slower
Δt_0 = time in clock's reference frame
$\Delta t'$ = time in observer's reference frame

Length Contraction

$$L' = \frac{L_0}{\gamma}$$

Moving Objects Appear Shorter
L_0 = object's length in it's own frame
L' = object's length in observer's frame

Lorentz Factor

$$\gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}$$

v = speed of observer relative to clock or object
c = speed of light = 186,000 miles per second