Special Relativity and The Doppler Effect

September 14, 2016

8.286 Lecture 3
\( \cdot e/a \equiv g \), \( \frac{e^g - 1}{I} \equiv \gamma \)

Greek letter \( \gamma \) (gamma), and \( \gamma \) by

GREEK (see gamma) and \( \gamma \) by

reference frame (to run slower than normal by a factor denoted by the

reference frame) or an observer using that

reference frame will "appear" to an observer using that


\( \gamma \)

TIME DILATATION: Any clock which is moving at speed \( v \) relative

\( \gamma \)

\( \gamma \)

\( \gamma \)

\( \gamma \)

\( \gamma \)
\[ \frac{t}{c} = \frac{t_0}{c_0} \quad \frac{x}{c} = \frac{x_0}{c_0} \]

**TIME DILATION:** Any clock which is moving at speed \( \beta \) relative to two reference frames will show a time difference between events compared to that of a clock at rest in one of the frames. The time interval \( \Delta t \) as measured in one frame is related to the time interval \( \Delta t_0 \) in the other frame by

\[ \frac{\Delta t}{\Delta t_0} = \frac{1}{\gamma} \]

where \( \gamma = \frac{1}{\sqrt{1 - \beta^2}} \) is the Lorentz factor.
(3) RELATIVITY OF SIMULTANEITY: Suppose a rod which has rest length \(L\) is measured with a clock at each end. The clocks can be synchronized in the rest frame of the system by adjusting light pulses. If the system is not at rest, a light pulse sent out from one end takes a longer time to reach the other end than it would in the rest frame. This means that the rods measured in different frames are not at rest, and the rods do not have the same length.

(4) LORENTZ-FITZGERALD CONTRACTION: Any rod which is not at rest will appear to be shorter than its length in the rest frame.