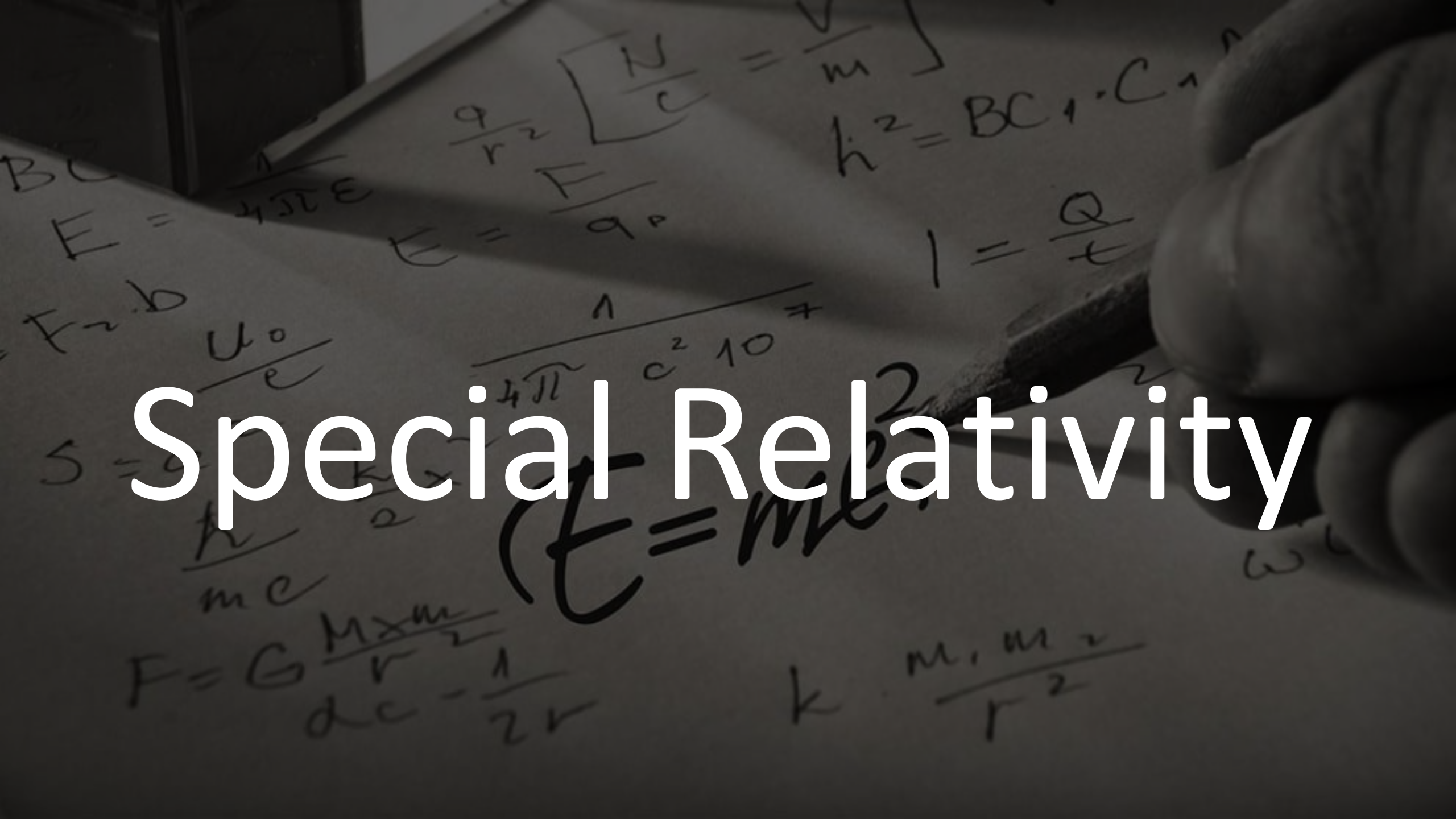
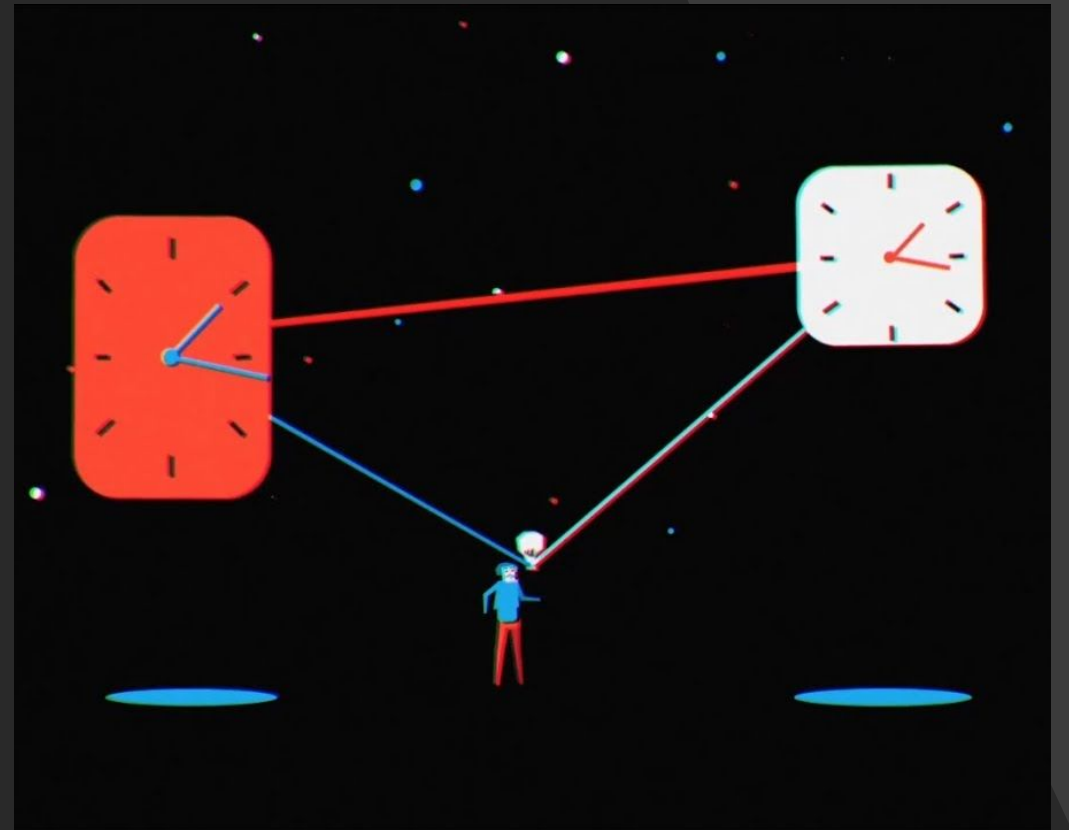


# Special Relativity



# Introduction

- In 1905, Albert Einstein determined that the laws of physics are the same for all non-accelerating observers, and that the speed of light in a vacuum was independent of the motion of all observers. This was the theory of special relativity. It introduced a new framework for all of physics and proposed new concepts of space and time.
- It helps explain the physics behind objects moving extremely fast, where Newtonian physics doesn't always apply.





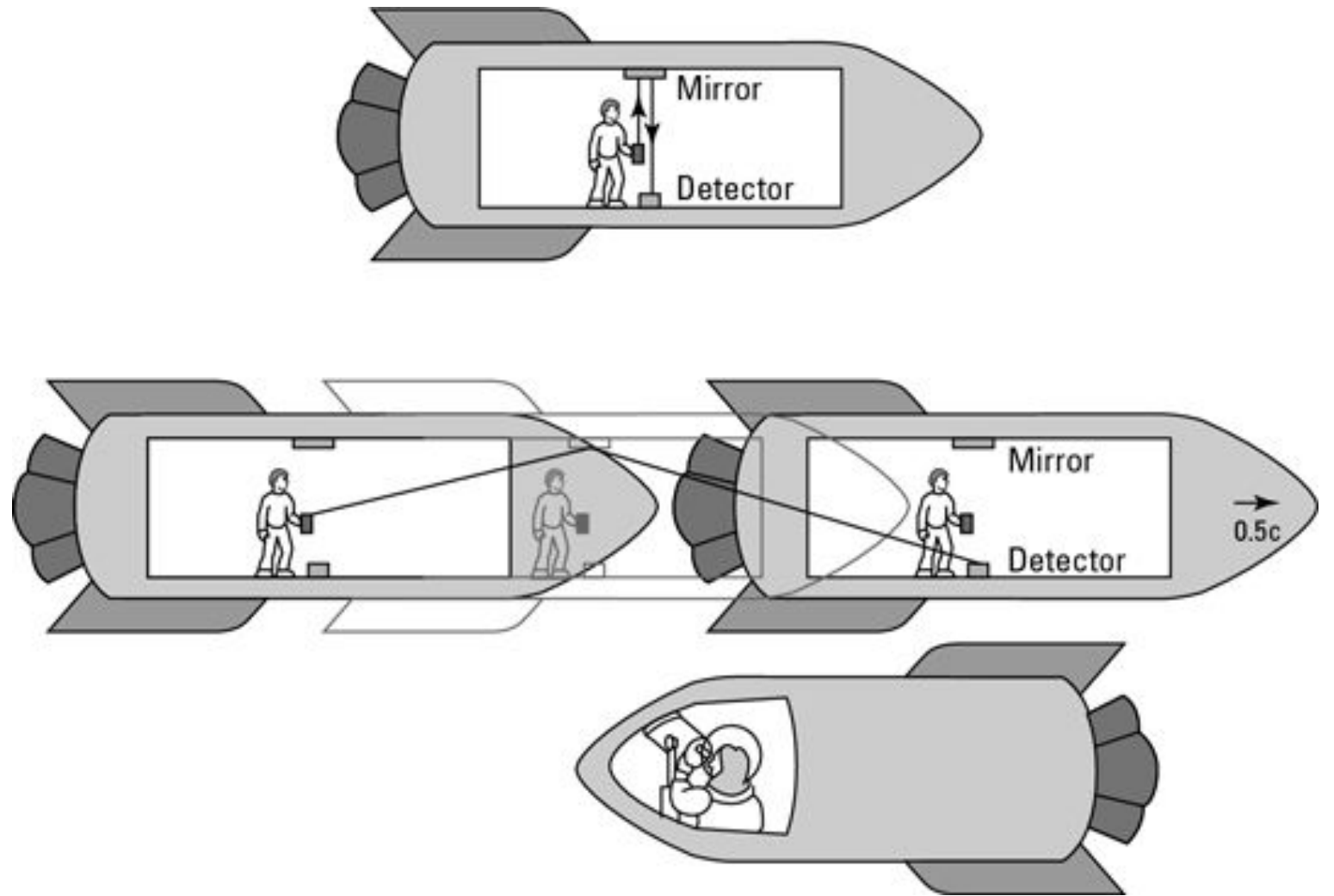
# Assumptions

The objects aren't accelerating  
Light always travels at a constant speed  
The same laws of physics apply to both objects

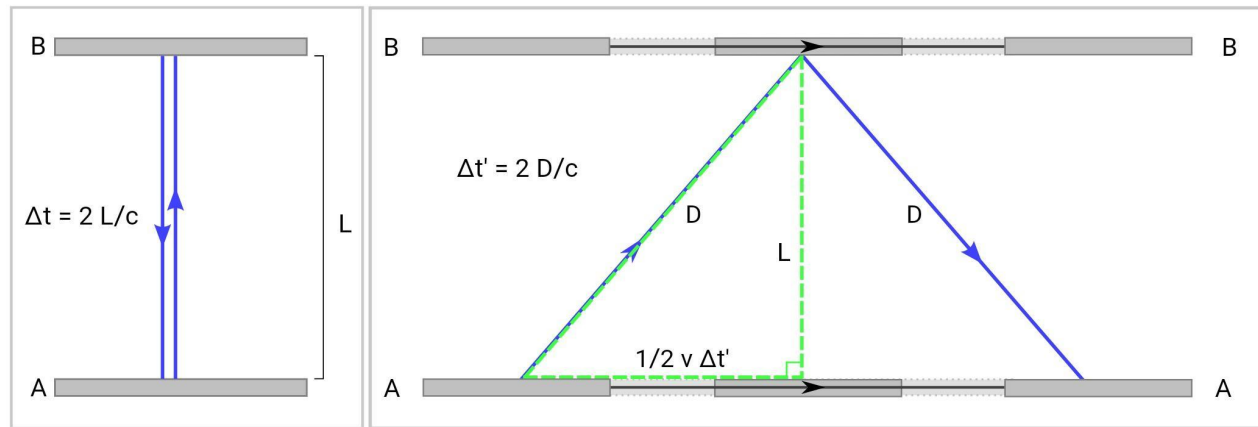
# The jet example



# Time Dilation and Length Contraction



# Light clock thought experiment



## Time Dilation

$$\Delta t = \frac{\Delta t_0}{\sqrt{1 - \frac{v^2}{c^2}}}$$

the observer time, or two-position time

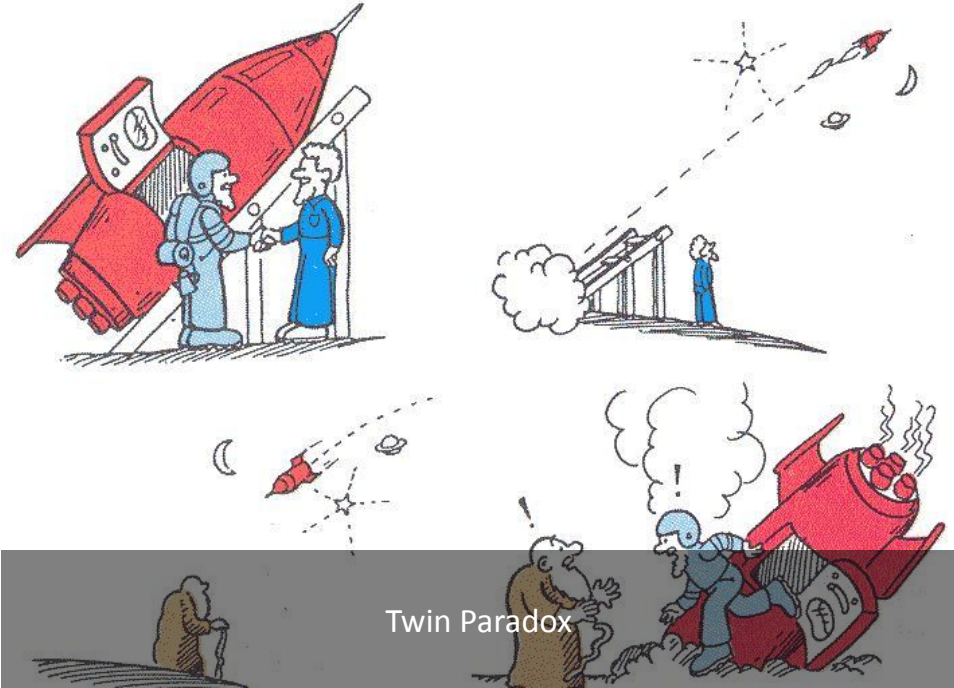
the proper time, or one-position time

- v is the relative velocity between inertial reference frames
- c is the speed of light in a vacuum

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

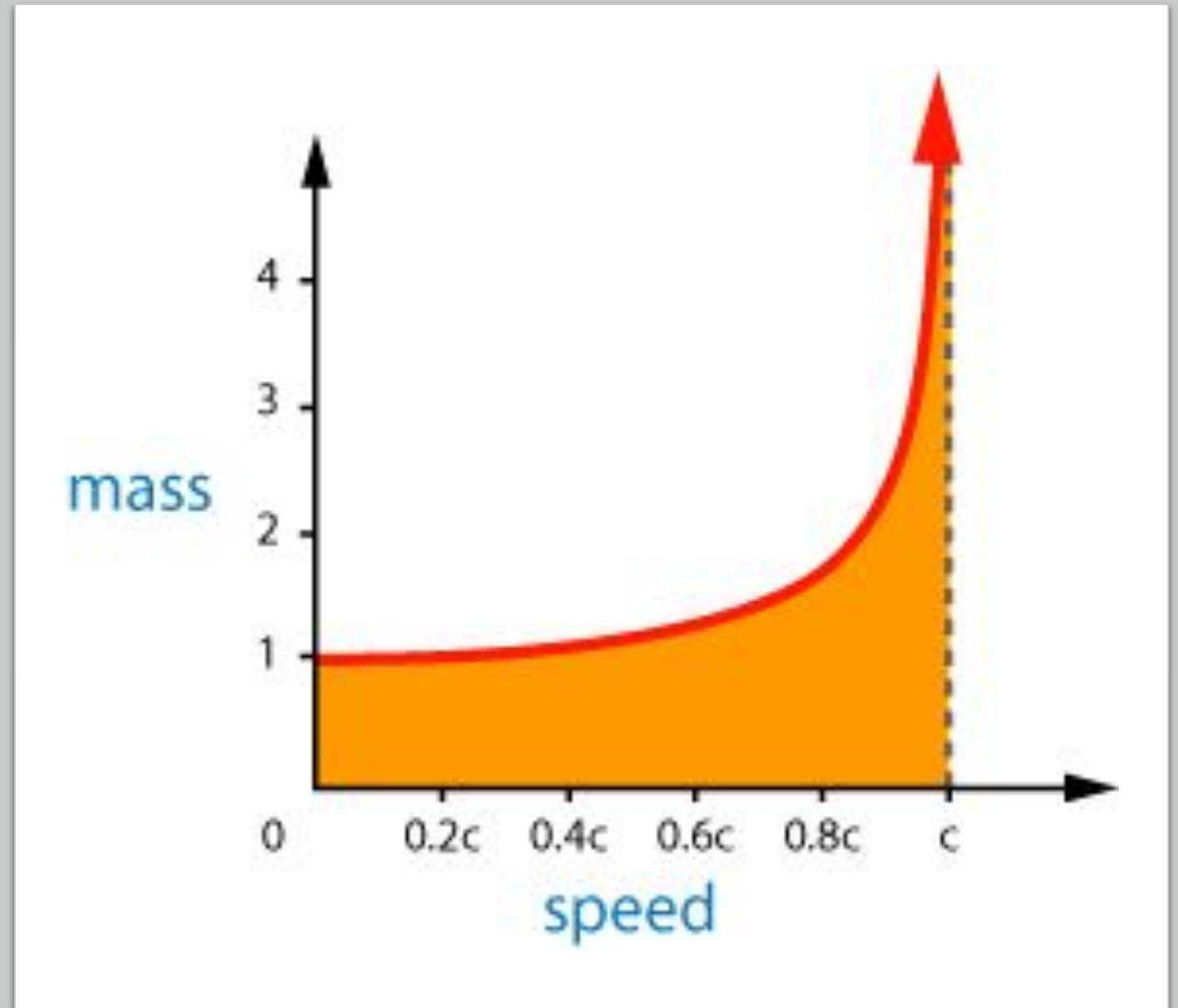
- l' Length measured from an observer outside the frame of reference.
- l Length measured from an observer inside the frame of reference.
- v Speed of the object.
- c Speed of light

# Examples of Time Dilation in real life



# Mass

- In physics, mass is interchangeable with energy as seen from  $E = mc^2$ .
- when we think of mass as energy, we can begin to understand why an object will increase its 'mass' as it speeds up.
- As an object increases in speed, so does the amount of energy that it has.
- An increase in energy relates to an increase in mass. Therefore, as speed increases, so does the mass of an object



# UNIVERSAL SPEED LIMIT

A long-exposure photograph of a city highway at night. The image shows light trails from cars and buildings in the background, creating a sense of motion and speed. The text 'UNIVERSAL SPEED LIMIT' is overlaid in white, bold, sans-serif font.

In 1967, Gerald Feinberg theorized the existence of tachyons. These hypothetical particles have imaginary mass and move faster than the speed of light. The existence of these particles has not been confirmed or refuted. Do you think that tachyons could exist?



**THE PROBLEM  
OF BEING  
FASTER THAN  
THE SPEED  
OF LIGHT...**

**...IS THAT  
YOU LIVE IN DARKNESS.**