Relativity

Summary

http://quantumspotacademy.org/videos/relativity/

In the sixteen hundreds, Galileo Galilei discovered that objects in relative motion make different observations; however, the laws of physics are the same for all reference frames. This is the principle of relative motion.

Relative motion stated that there is no such thing as absolute motion, but electromagnetism stated that the speed of light is absolute; as a consequence the two theories were in conflict.

In the 1900s, Albert Einstein resolved this conflict by making time relative in the same way that Galileo made motion relative. Just as an object's speed through space depends on your point of view, an object's speed through time also depends on your point of view.

Objects in relative motion perceive other object's times to pass more slowly. This is called time dilation.

Time dilation only occurs for other reference frames, i.e. reference frames in relative motion.

Although we don't experience time dilation occurring in our daily lives, the effects are still there; however, they are effectively much too small to detect.

All objects with mass must travel slower than light. If an object went faster than light, it would go backwards in time, resulting in causal loops.

Objects approaching the speed of light appear to gain mass.

Einstein developed the equation $E = mc^2$ in relation to this phenomenon. It says that energy and mass can be converted by the factor of the speed of light squared.