Special theory of relativity research paper example

Introduction

The special theory of relativity is a theory proposed by Albert Einstein in 1905 that illustrates light and matter propagation at high speeds.

Einstein's theory is based on two main ideas:

The principle of relativity: stipulates that the law of physics is invariable for anything that is in constant motion.

The principle of speed of light: stipulates that the speed of light is also constant for any object in any point from which it is being referred. This means that it the same for various observers regardless of their movement in relation to the source of light. Einstein established this principle after noticing a rational flaw in the existing notions of space and time (frames of reference) and light as an electromagnetic wave. Einstein suggested that light speed is actually acts as a motion's upper limit. Observers can only move slower than light's velocity and that only particles that have no mass (for instance photons) can actually attain the velocity of light. This was in fact the basis of the special relativity theory.

The genius of this special relativity theory is that Einstein looked at his experiments and made an assumption that his findings were correct. This was in fact opposite to what many other physicists had been doing. Instead of making an assumption that the experiments had failed in spite of the theory correctness, Einstein assumed that it was indeed the experiments which were correct and that the theory had essentially failed (Bohm, 2000).

Background

Prior to the generation of Einstein's special theory of relativity, scientist had generally understood that motion occurred against an absolute rest backdrop (hence the " ether"). They understood that this backdrop acted as a reference point for all kinds of motions. In his dismissal of this concept, Einstein advocated for a reassessment of all motion. What he actually did was to remove this ' ether' completely and make an assumption that the laws of physics including light speed worked similarly regardless of the nature of one's movement just as shown by mathematics and experiments. In formulating the theory, Einstein dismissed the " ether" concept and replaced it with the " absolute rest" idea. The ether was a mysterious thing that many 19th century physicists were looking for because they believed that it was the medium that lights waves waved through. This mediocre belief had led to a large mess of facts according to Einstein because it introduced a medium that made the physics laws to work in a different way depending on the movement of an observer relative to this medium that is the ether (Einstein Online 2013).

The legitimacy of the classical conceptions of independent and absolute time and space had actually been previously challenged by other physicists such as H. A Lorentz.

However, most of them had not been able to come with alternative explanations of these two principal concepts. Scientists were particularly starting to show that the Newtonian physics had a lot of deficiencies particularly when it came to explaining the need for absolute time and space when making reference to interactions or events (Bohm 2000).

It was Einstein who took the critical step of suggesting that since objective

measurement could not confirm absolute motion, the whole idea should be discarded or scrapped from all physical reasoning. From the two main hypothesis or postulates mentioned earlier, Einstein was able to deduce the full logical implications and was also able to reformulate some of the mathematical equations and expressions of physics basing some of them on the equations of H. A Lorentz (for instance, the Lorentz contraction) where it is possible to correlate measurements from a homogeneously moving system with others in a second system if the speed of one motion relative to the other is actually known (Katz 2004).

He then came up with the theory where he proposed that all kind of motion is relative and that every concept incorporating time and space must be measured in comparative terms. The underlying meaning of this proposal is that there is no specific reference point against which motion can be measured. Einstein proposed that motion measurement can never be absolute but is rather relative to a specific position in time and space. Einstein actually used the theory to explain the Michel-Morley experiment results.

The theory of Special Relativity introduced by Einstein helped to change scientist’s understanding of space, time and motion. By extending his theory even further , Einstein made a proposal that time and space are relative and that they should not be treated differently but should rather be treated as space-time. Although there has been no specific experiment that has proved this theory, many have however been significantly consistent with it.

The principle of relativity which is one of the most basic claims of the special theory of relativity stipulates that when one inertial observer in his individual space station sets up an experiment, any other observer who performs the

experiment in a similar manner should get the same results. For instance, if the first observer measures a certain frequency for a particular atom transition, the second observer should make a similar measurement. If the first observer measures a fluid' boiling point under certain pressure conditions, the second observer should measure the same values. The above is only true for experiments that in nature give repeatable and definite results (Katz 2004).

Unifying Space and Time

The theory of special relativity built a primary link between time and space. According to the theory, the universe can essentially be viewed as possessing a onetime dimension and 3 space dimensions- left/rights, up/down, forward/backward. This space of four dimensions is known as the space-time continuum. Through the time dilation phenomena, Einstein proved that space and time are linked together intimately.

Unifying Energy and Mass

Einstein also came up with the equation E= mc2 that was a representation of the relationship between energy and mass (Naber, 1992). In simple terms, Einstein established that as a moving object approached the velocity of light (c), there was a general increase in the mass of the object. The object essentially goes faster and at the same time gets heavier. If the object actually managed to move at the speed of light c, the object's energy and mass would be finite. However, it is very hard to increase the speed of a heavy object and thus, it is virtually impossible to get an object to attain the speed of light, c.

Until this establishment by Einstein, energy and mass concepts were treated

as totally separate. Einstein however proved that the two principles of mass conservation and energy conservation are actually part of a larger unified principle and that is the conservation of mass and energy. In a nutshell, it is possible to turn matter into energy and vice versa because there essentially exists a fundamental connection between the two.

Einstein qualified his theory as special because it only makes reference to uniform velocities that is objects that are either at rest or that are motion at a constant speed. The special theory of relativity helps to resolve the conflict between Maxwell’s electrodynamics and Newton’s mechanics by incorporating elemental changes in the theory of Newton.

In actual sense, the results from the special theory of relativity approximated those of the Newtonian dynamics. However, the results deviated greatly for phenomena that occurred at velocities that approached the speed of light. In some few cases where results that were predicted by the two theories are incompatible, more of the experimental evidence is inclined towards the Einstein’s theory. Some of the consequences and assertions of the theory include the proposition that in the universe, the maximum speed that is attainable is the one of light, that energy and mass are interchangeable and equivalent properties (confirmed by nuclear fission), that objects seem to shrink in the motion direction, the rate of a moving watch appears to decrease as its speed increases, that events or situations appearing simultaneous to one observer in a certain system may appear as simultaneous to another observer in a different system and finally that since there is an exclusion of absolute time from all forms of physical reasoning due to its immeasurability, the varying observations two observers are correct equally. For instance, in trying to explain his theory further, Einstein

made a reference to Galileo’s cannon ball where he stated that an observer on the ship’s deck viewing the ball falling from the ship’s mast would see like the ball is falling in a straight line trajectory while another observer on the shore would see the same ball falling in a curved trajectory as it moves down to the ship mast’s base. This ultimately creates dilemma as to which is the real trajectory of the ball. The dilemma can be solved using the special theory of relativity which states that although each observation by the two different observers is valid in it s own frame of reference, each one of them is however no more than a measurement artifact or just an “ observation” (Baierlein 1992).

The scope of relativity does not actually mean that everything is relative. Rather, the special relativity scope is very narrow and applies to very special situations, questions, observers and absoluteness.

It is critical to note that most of the predictions made by the special theory of relativity have been confirmed by actual experiments using sub-atomic particles usually in high energy accelerators. It should also be noted that relativity effects are actually dramatic particularly when objects in motion move towards the velocity of light.

Criticism

The special relativity theory is however not devoid of criticism. Although it has been accepted to be fairly accurate in most science circles, there are still some who treat it with apprehension. The reasons for apprehension and criticism are many and varied and they include proposals of alternate theories, denunciation of the abstract mathematical method alleged theory errors amongst others. Although some of the criticisms to the special theory

of relativity have had the backing of reputable physicists, the theory is however currently recognized as self-consistent one and one that is in accordance with a lot of experiments.

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