Relativity: The Theory vs The Principle

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***Abstract**: While it appears to be a common practice today to refer to the "Theory of Relativity" as if it were the same as the "Principle of Relativity," according to Albert Einstein, his "Theory of Relativity" is that the "Principle of Relativity" is an illusion.*

Key words: Relativity; Theory; Principle; Postulate.

I. INTRODUCTION

When Albert Einstein wrote his 1905 paper titled paper *On the Electrodynamics of Moving Bodies*,[1] which introduced his **Theory** of Special Relativity to the world, he did not give his theory a name. The paper was just a description of his **theory** and how it worked. And since the paper was also about the long-existing ***Principle*** of Relativity that had been a basis for physics since the time of Galileo Galilei, Einstein's theory was eventually described by others as Einstein's "*Theory* of Relativity."

In a book Einstein co-wrote many years later,[2] Galileo's Principle of Relativity is given as follows:

> if the laws of mechanics are valid in one C.S. [coordinate system], then they are valid in any other [coordinate system] moving uniformly relative to the first.

Physicist Richard Feynman, who appears to have been in general agreement with Einstein's theories, stated in one of his published lectures on "the principle of relativity,"[3]:

> **The principle of relativity was first stated by Newton, in one of his corollaries to the laws of motion: "The motions of bodies included in a given space are the same among themselves, whether that space is at rest or moves uniformly forward in a straight line."** This means, for example, that if a space ship is drifting along at a uniform speed, all experiments performed in the space ship and all the phenomena in the space ship will appear the same as if the ship were not moving, provided, of course, that one does not look outside. **That is the meaning of the principle of relativity.** This is a simple enough idea, and the only question is whether it is true

> that in all experiments performed inside a moving system the laws of physics will appear the same as they would if the system were standing still.

Einstein's 1905 paper begins with a paragraph about how a magnet possesses different electromagnetic properties than a conductor, such as an iron rod, regardless of whether tests of those properties are performed in a stationary location or a moving location. When you move the magnet past the iron rod, it might seem that the electromagnetic forces are reciprocal, the magnet pulls at the iron rod and the iron rod pulls at the magnet. However, when separated, the iron rod possesses no magnetic force. It merely *conducts* such a force. Only the magnet generates a magnetic field. And this will hold true whether the tests are done in a stationary location or a moving location. Performing such tests will not tell you if the test location is moving or stationary.

The second paragraph is:

> Examples of this sort, together with the unsuccessful attempts to discover any motion of the earth relatively to the "light medium," suggest that the phenomena of electrodynamics as well as of mechanics possess no properties corresponding to the idea of absolute rest. They suggest rather that, as has already been shown to the first order of small quantities, **the same laws of electrodynamics and optics will be valid for all frames of reference for which the equations of mechanics hold good.** We will raise this conjecture (the purport of which will hereafter be called the "Principle of Relativity") to the status of a postulate, and also introduce another postulate, which is only apparently irreconcilable with the former, namely, that light is always propagated in empty space with a definite velocity c which is independent of the state of motion of the emitting body. These two postulates suffice for the attainment of a simple and consistent theory of the electrodynamics of moving bodies based on Maxwell's theory for stationary bodies. The introduction of a "luminiferous ether" will prove to be superfluous inasmuch as the view here to be developed will not require an "absolutely stationary space" provided with special properties, nor assign a velocity-vector to a point of the empty space in which electromagnetic processes take place.

Note that Einstein initially refers to the Principle of Relativity as a "**conjecture**," which is defined by Oxford's on-line dictionary [4] as "**An opinion or conclusion formed on the basis of incomplete information.**" And Einstein then "raises" it from "conjecture" to a "postulate." "Postulate" is another word which needs a definition. The on-line Oxford Dictionary provides this definition for "postulate" when used as a noun: "A thing suggested or assumed as true as the basis for reasoning, discussion, or belief, [example:]'*perhaps the postulate of Babylonian influence on Greek astronomy is incorrect*'."

Therefore, Einstein's First Postulate, which he calls the "Principle of Relativity," and which is merely ***assumed to be true*** for the sake of discussion, is

> the same laws of electrodynamics and optics will be valid for all frames of reference for which the equations of mechanics hold good.

And Einstein then adds a Second Postulate:

light is always propagated in empty space with a definite velocity c which is independent of the state of motion of the emitting body.

Einstein explains that the Second Postulate might initially *appear* to be "irreconcilable" with the First Postulate, but that appearance is *not real*. The two postulates he provided are fully reconcilable in the **theory** he is proposing.

This poses a question: What is the difference between a principle and a theory?

II. Definitions: Theory vs Principle

The copy of the *Illustrated Oxford Dictionary*[5] I have on a shelf behind my desk defines the word "principle" this way: "**a fundamental truth or law** as a basis for reasoning or action." It also has a definition used in physics: "A general law in physics, etc.," and it provides as an example "the uncertainty principle." The on-line *Cambridge Dictionary* has this definition of the word "principle": "**a basic truth** that explains or controls how something happens or works: the principles of Newtonian physics."

So, an idea that might be considered by some to be a "fundamental truth or law" is being described by Einstein as nothing more than a "conjecture" that he is opening up for analysis and discussion for the purpose of developing a theory.

My *Illustrated Oxford Dictionary* has this definition for the word "theory": "a supposition or system of ideas explaining something, esp. one based upon general principles independent of the particular things to be explained." The on-line *Cambridge Dictionary* has this definition for the word "theory": "something suggested as a reasonable explanation for facts, a condition, or an event, esp. a systematic or scientific explanation."

III. Defining "Time"

Einstein's Theory of Relativity says that because "the same laws of electrodynamics and optics will be valid for all frames of reference for which the equations of mechanics hold good," an experiment performed in a supposedly **stationary** frame of reference will ***<u>appear</u>*** to produce the same results as an identical experiment in a **moving** frame of reference. ***However***, if the results are compared **between** frames of reference, clear differences in the results may be found due to differences in the input data, specifically Time. For example, if the speed of light is measured to be 299,892,458 meters **per second** in Frame-A and is also measured to be 299,892,458 meters **per second** in Frame-B, these apparently identical results can nevertheless be actually very different if the **length of a second** is not the same in Frame-A as in Frame-B.

However, Einstein explains that before you can determine if the length of a second is different, you must first define what is meant by the word "time." If you define "time" by the movement of the hands of a clock, then you can claim that "time" is the same for Frame-A as for Frame-B if the hands of identical clocks in both frames show the same positions and move at the same rate. How do you then determine if the length of a second is the same in both Frame-A and Frame-B?

Einstein explains:

> We have not defined a common "time" for A and B, for the latter cannot be defined at all unless we establish *by definition* that the "time" required by light to travel from A to B equals the "time" it requires to travel from B to A.

In other words, if two clocks show the exact same time to the nearest picosecond and each picosecond on one clock passes at the same rate of the other clock, then the clocks are not only synchronous, ***they are also stationary relative to each other***. If, however, one clock is stationary and the other is moving, or if they are both moving but not at the same velocity, time will pass at a different rates for the two clocks. And, that means if you **emit** a pulse of light from Frame-A to Frame-B and then reflect it back from Frame-B to Frame-A, the pulses will **not** travel at the same speed between the two clocks.

IV. Synchronous and non-synchronous Time

Einstein proposed this test to determine if two clocks are synchronous or not:

> Let a ray of light start at the "A time" t_A from A towards B, let it at the "B time" t_B be reflected at B in the direction of A, and arrive again at A at the "A time" t'_A.
>
> In accordance with definition the two clocks synchronize if
>
> $$t_B - t_A = t'_A - t_B.$$

When using clock times instead of symbols, that test translates as follows:

> Let light be emitted from Clock-A at 5:30 PM (t_A) towards Clock-B. Let the light be reflected from Clock-B at 5:32 PM (t_B) back toward Clock-A. It arrives at Clock-A at 5:34 PM (t'_A)
>
> The clocks are synchronized if 5:32 PM (t_B) minus 5:30 PM (t_A) equals 5:34 PM (t'_A) minus 5:32 PM (t_B).
>
> It does:
>
> 5:32 – 5:30 = :02
>
> 5:34 – 5:32 = :02.

It would have been helpful if Einstein had described why and how the movement of the clock in one frame would cause the **measured** speed of light to differ. But he didn't. For example, he could have written: If Clock-A is **moving away from** stationary Clock-B, and the same experiment as described above is performed, the translated test using times instead of symbols would work this way:

Let light be emitted from Clock-A at 5:30 PM (t_A) towards Clock-B. Let the light be reflected from Clock-B at 5:32 PM (t_B) back toward Clock-A. It arrives at Clock-A at 5:35 PM (t'_A)

The clocks are synchronized if 5:32 PM (t_B) minus 5:30 PM (t_A) equals 5:35 PM (t'_A) minus 5:32 PM (t_B).

It does NOT:

5:32 – 5:30 = :02

5:35 – 5:32 = :03.

The movement by Clock-A did not affect the light signal it emitted to reach stationary Clock-B. This is because of Einstein's Second Postulate: "light is always propagated in empty space with a definite velocity *c* which is independent of the state of motion of the **emitting** body." The emitting body is Clock-A, and therefore movement by Clock- A will not change the speed of the light it emits. It will always be *c* (just as his Second Postulate stated). The light traveling from Clock-A to Clock-B can be depicted this way:

A---------->-----------B

However, the reverse is very different. When light is reflected/emitted from **stationary** Clock-B back toward **moving** Clock-A, it can be depicted like this if Clock-A is **moving away from** Clock B:

A'-A----------<----------B

Clock-B reflected/emitted the light signal when Clock-A was at Location-A, but because Clock-A was **moving away** from the oncoming light signal, Clock-A did not encounter the signal until it was at Location-A'. The light traveled at *c*, but because Clock-A was **moving away** from Clock-B, Clock-A encountered the signal as if light had traveled at *c-v*, where *v* is the velocity of Clock-A away from B. And, of course, the situation where A is moving **toward** B will look like this:

A-A'-------<----------B

The light traveled at *c*, but because Clock-A was moving **toward** Clock-B, Clock-A encountered the signal at Location-A', as if the light had traveled at *c+v*, where *v* is the velocity of Clock-A toward Clock-B.

Interestingly, this type of test is done many times every day with police Lidar guns which emit timed pulses of light toward a speeding car and then measure the difference in the pulse rate that is returned. The Lidar gun emits the pulses toward the oncoming car at *c* in accordance with Einstein's Second Postulate. The pulses hit the car at *c+v*, where *v* is the speed of the car. Atoms in the surface of the car then emit the pulses back to the Lidar gun at *c*, but at the higher pulse rate (i.e., with less time between pulses). The Lidar gun measures the incoming pulse rate against the pulse rate it emitted and determines the speed of the oncoming car.

A similar measurement was done in 2009 when a NASA scientist examined data gathered by the University of California, San Diego (UCSD), during their Apache Point Lunar Laser-ranging Operation.[6] The scientist, Daniel Gezari, found that timed light pulses emitted by UCSD lasers toward reflectors left on the moon by NASA's Apollo 15 mission confirmed Einstein's statements. The light pulses traveled to the moon at c, but due to the rotation of the Earth, when the pulses returned to the ground station, they arrived at $c+v$ where v was the rotation speed of the Earth and the UCSD receiver moving toward the reflector on the moon.

What is so interesting about that experiment is that Gezari seemingly questioned his own findings, since they seemed to conflict with his interpretation of Einstein's **First** Postulate. He wrote in his paper:

> This result is a first-order violation of local Lorentz invariance; the speed of light seems to depend on the motion of the observer after all, as in classical wave theory, which implies that a preferred reference frame exists for the propagation of light. However, the present experiment cannot identify the physical system to which such a preferred frame might be tied.

In their book of *The Evolution of Physics*,[7] Einstein and Enfeld partially explained the problem Gezari encountered:

> If we have two [co-ordinate systems] moving **non-uniformly**, relative to each other, then the laws of mechanics cannot be valid in both. "Good" co-ordinate systems, that is, those for which the laws of mechanics are valid, we call inertial systems. The question as to whether an inertial system exists at all is still unsettled. But if there is one such system, then there is an infinite number of them. Every [co-ordinate system] moving uniformly, relative to the initial one, is also an inertial [co-ordinate system].

The moon and the Earth do not move uniformly relative to each other. Very few objects in the universe do.

V. Clarifying Einstein's "Theory of Special Relativity"

Einstein was fully aware that his "Theory of Special Relativity" was being misunderstood by many people, and the misunderstandings began almost from the moment his paper was first published. When he published his General Theory of Relativity in 1916,[8] the result was even more misunderstandings. He tried to explain things in a book published in German in 1925,[9] but it didn't stop the misunderstandings. In 1938, Einstein co-authored with his friend Leopold Infeld a 313 page book written in English and edited by Infeld titled "*The Evolution of Physics*." The book is virtually devoid of mathematics and explains very carefully that Einstein's theories of Relativity are intended to show that the Principle of Relativity developed by Galileo Galilei is in error or incomplete.

On page 166 they make it clear that an observer in one coordinate system may disagree with what is seen in a different coordinate system:

> Let us consider the case of two [coordinate systems] starting from a known position and moving uniformly, one relative to the other, with a known velocity. One who prefers concrete pictures can safely think of a ship or a train moving relative to the earth. The laws of mechanics can be confirmed experimentally with the same degree of accuracy, on the earth or in a train or on a ship moving uniformly. **But some difficulty arises if the observers of two systems begin to discuss observations of the same event from the point of view of their different [coordinate systems]. Each would like to translate the other's observations into his own language.**

The two observers of two systems get the same results to experiments done in their own coordinate systems, but if they compare or discuss those results, they will find they actually were not the same. Usually it is because the length of a second is longer in the coordinate system that is moving, so anything involving time will have a different rate of measurement in one coordinate system versus the other.

On page 173, Einstein and Infeld begin to describe a thought experiment which shows the problem clearly. The thought experiment begins by using sound waves instead of light photons. Then, on page 175, they start talking about the same experiment using light. But they complicate the situation by having an "ether" surround everything. So, their explanation spends a lot of time disproving the notion of an "ether" surrounding everything. Like so many explanations in physics (and like most of what Einstein wrote in his 1925 book), they do not just explain what is actually happening, they spend a lot of time explaining what is NOT happening that was once thought to be happening.

It is not until page 186 that Einstein and Enfeld describe how things really work:

> Our new assumptions are:
>
> (1) The velocity of light in vacuo is the same in all [coordinate systems] moving uniformly, relative to each other.
>
> (2) All laws of nature are the same in all [coordinate systems] moving uniformly, relative to each other.
>
> The relativity **theory** begins with these two assumptions.

So, taking those assumptions back to their thought experiment, we have a situation where there are observers in two different coordinate systems that are NOT "moving uniformly, relative to each other." So, light will NOT be seen to travel at the same speeds in both coordinate systems.

The experiment involves having an observer in a rapidly moving room (like on a space ship) that has a transparent side so that another observer in a stationary position somewhere can theoretically look into the room.

The observer in the fast moving room turns on a light bulb in the center of the room. He observes the light from the bulb illuminate the front wall and the rear wall at the same time. The observer who is stationary, however, does not see that. He sees the light illuminate the rear wall first, and then the front wall.

Why?

It is because, when the observer in the space ship turns on the light, the photons **emitted** next to him travel at *c* toward both walls, unaffected by the movement of the ship. However, because the forward wall is moving away from the point of emission at *v* (the velocity of the ship), the light photons take longer to get to that wall. The photons arrive at the forward wall at *c-v*. The atoms in that wall absorb the photons and then **emit new photons** at *c* back to the observer standing in the center of the room. And because the observer is moving toward the point where the **new** photons were emitted, his eye receives the photons traveling at *c+v*. The *c-v* speed of the original photons going in one direction and the *c+v* speed of the new photons going in the other direction mean that the speed of the ship is canceled out: $c+v-v = c$.

The reverse holds true with the rear wall. The original photons reached the rear wall at *c+v* and the new photons were returned at *c* but ***encountered*** at *c-v*. So the observer on the ship sees everything as happening normally. He turned on the light bulb, and the front wall was illuminated at the same time as the rear wall.

However, the outside observer sees things happen differently. He is stationary and not moving with the ship. So, just like the observer on the ship, the stationary observer sees the photons hit the front wall at *c-v* and he sees them hit the rear wall at *c+v*. But unlike the observer on the ship, the stationary observer sees the new photons emitted by those walls traveled at *c* to reach his eyes. He sees the rear wall as illuminated first, then the front wall.

Einstein's Theories of Special and General Relativity argue that the **Principle of Relativity** is actually an optical illusion. What one person sees – or even measures - can actually be very different from what some other person sees or measures, even though the "fundamental truth" or "law" known as "The Principle of Relativity" works equally well in both situations and appears to give identical results.

VI. "The Mathematicians' All Observers Theory"

Einstein spent much of his life after the 1905 publication of his paper arguing with the mathematicians' misinterpretations of his theory. Mathematicians seemed to think that a "law" is as the dictionary says, a "fundamental truth" that cannot be disputed. As a result, for over a hundred years they have misinterpreted Einstein's theories to be nothing more than confusing or mistaken restatements of a "law" which mathematicians seem to consider to be unquestionable.

In early 1912, seven years after his Special Theory of Relativity was published, Einstein famously lamented, "Since the mathematicians have invaded the theory of relativity I do not understand it myself anymore."[9] Nine years later, in a talk he gave to the Prussian Academy of Sciences, he stated, "As far as the laws of mathematics refer to reality, they are not certain, and as far as they are certain, they do not refer to reality."[10] In one of his letters, he referred to the interpretations by mathematicians as a ***disease*** when he wrote to his friend Paul Ehrenfest, "You are one of the few theoreticians who has not been robbed of his common sense by the mathematical *contagion*."[11]

Today, the mathematicians seem to be winning. It is the **Principle** of Relativity that is taught in colleges and universities, not the **Theory** of Relativity. Or, to put it more accurately, they teach the Principle of Relativity ***as if it was*** the Theory of Relativity. The pattern seems to have started with American mathematical physicist Richard C. Tolman who wrote this in a scientific paper published in 1910:

> The second postulate of relativity is obtained by a combination of the first postulate with a principle which has long been familiar in the theory of light. This principle states that the velocity of light is unaffected by a motion of the emitting source, in other words, that the velocity with which light travels past any observer is not increased by a motion of the source of light towards the observer. **The first postulate of relativity adds the idea that a motion of the source of light towards the observer is identical with a motion of the observer towards the source. The second postulate of relativity is seen to be merely the combination of these two principles, since it states that the velocity of light in free space appears the same to all observers regardless both of the motion of the source of light and of the observer.**[12]

That explanation shows the source of the misunderstanding. First Tolman writes:

> the velocity with which light travels past any observer is not increased by a motion of the source of light towards the observer.

This is true, but it is *very* misleading. If the light passes a ***moving*** observer, the speed of the light is not increased, however the observer would ***measure and observe*** the speed of the light combined with his own speed, and would thus get $c+v$ or $c-v$. The next sentence in Tolman's paper is:

> The first postulate of relativity adds the idea that a motion of the source of light towards the observer is identical with a motion of the observer towards the source.

That is a ***total*** misunderstanding. It is just the ***opposite*** of what Einstein intended. It is a common mathematician's belief that "all motion is reciprocal," so mathematically, there is no way to tell if you are moving toward me, or if I am moving toward you. Knowing who is moving would involve "cause and effect," which mathematicians abhor and ignore. Einstein is saying that you ***can*** tell who is moving – at least who is moving faster or slower. Time will move slower for the observer who is moving fastest.

The next sentence in Tolman's paper shows his total misunderstanding or total non-acceptance of Einstein's Second Postulate, since Tolman interprets it this way:

> The second postulate of relativity is seen to be merely the combination of these two principles, since it states that the velocity of light in free space appears the same to all observers regardless both of the motion of the source of light and of the observer.

That is a total distortion of Einstein's Second Postulate which stated specifically that the velocity of light in free space is ***only*** independent of the motion of the ***emitter***.

More importantly, however, it is also what colleges and universities ***today incorrectly teach*** as being Einstein's Second Postulate.

Here is what it says on page 888 of the 9th edition (the 2012 edition) of a widely used college text book, *College Physics* by Raymond A. Serway and Chris Vuille:

> In 1905 Albert Einstein proposed a theory that explained the result of the Michelson–Morley experiment and completely altered our notions of space and time. He based his special theory of relativity on two postulates:
>
> 1. The principle of relativity: All the laws of physics are the same in all inertial frames.
>
> 2. The constancy of the speed of light: The speed of light in a vacuum has the same value, c = 2.997 924 58 x 10^8 m/s, in all inertial reference frames, **regardless of the velocity of the observer** or the velocity of the source emitting the light.[13]

A little research will find other college text books with minor variations on that same "all observer" wording. Here is another example from page 91 of *Foundations of Astronomy, Enhanced* by Michael A. Seeds and Dana Backman, the 11th edition published in 2011:

> "Second postulate: The speed of light is a constant and will be the same for **all observers** independent of their motion relative to the light source."[14]

There are many more college physics textbooks which promote the "All Observers" misinterpretation of Einstein's Second Postulate. But what is most damnable about some of the most popular textbooks is that they attempt to squelch all objections.

What may be, according to one on-line source,[15] the most highly recommended and commonly used college physics textbook says this about Einstein's first postulate:

> Einstein's first postulate, called the principle of relativity, states: The laws of physics are the same in every inertial frame of reference. **If the laws differed, the difference would distinguish one inertial frame from the others or make one frame somehow more "correct" than another.** [16]

No, it wouldn't. It would just make one frame *different* from the other, and thus the movement could not be purely "relative" or reciprocal. (In one of his lectures,[17] Richard Feynman basically ridiculed "the people who believe that the principle of relativity means that "all motion is relative," since such people ignore the fact that **nothing** moves without some ***cause*** to make it move (Newton's First Law) and that cause involves **acceleration**, which means that until the acceleration stops it is no longer in an "inertial" frame.")

That same textbook then squelches all arguments from students by stating:

> **This result contradicts our elementary notion of relative velocities, and it may not appear to agree with common sense. But "common sense" is intuition based on everyday experience, and this does not usually include measurements of the speed of light.**[18]

In other words, you have to accept it as true if you want to pass the course, regardless of whether it makes any sense or not. And, presumably, if the student points out and argues that it isn't what Einstein wrote, he'll be told that it may not be what Einstein **wrote**, but you must ***believe*** that it is what Einstein ***meant***.

The second-most popular college physics text book gives this as Einstein's Second Postulate:

> **Second postulate (constancy of the speed of light)**: Light propagates through empty space with a definite speed c independent of the speed of the source **or observer**.[19]

And the book then goes on to explain:

> The second postulate may seem hard to accept, for **it seems to violate common sense.** First of all, we have to think of light traveling through empty space. Giving up the ether is not too hard, however, since it had never been detected. But the second postulate also tells us that the speed of light in vacuum is always the same, 3.00×10^8m/s, **no matter what the speed of the observer or the source**. Thus, a person traveling toward or away from a source of light will measure the same speed for that light as someone at rest with respect to the source. This conflicts with our everyday experience: we would expect to have to add in the velocity of the observer. **On the other hand, perhaps we can't expect our everyday experience to be helpful when dealing with the high velocity of light.**

So, once again, if it seems to violate common sense and even if the student can easily determine that it ***isn't*** what Einstein actually wrote, the student must still accept it if he or she wants to pass the course.

The third book on the list has different versions of the Second Postulate in different editions, but the fourth book contains more of what we saw above.

On page 1027 it has an illustration which shows a woman, Amy, on the left shining a flashlight at Cathy who is in the middle of the illustration on bicycle peddling fast toward Bill, who is on the right shining another flashlight at Cathy. The following text goes with that illustration:

> *All* experimenters, regardless of how they move with respect to each other, find that *all* light waves, regardless of the source, travel in their reference frame with the same speed *c*. If Cathy's velocity toward Bill and away from Amy is $v = 0.9c$, Cathy finds, by making measurements in her reference frame, that the light from Bill approaches her at speed c, not at $c + v = 1.9c$. And the light from Amy, which left Amy at speed *c*, catches up from behind at *c relative to Cathy*, not the $c - v = 0.1c$ you would have expected.
>
> **Although this prediction goes against all shreds of common sense, the experimental evidence for it is strong. Laboratory experiments are difficult because even the highest laboratory speed is insignificant in comparison to *c*.**[20]

The evidence is "strong," but "experiments are difficult"??? In reality, the experiments are fairly simple, and **all** the experiments say students are being taught ***<u>nonsense</u>***. The only experiments which mathematicians **claim** "support" the "Mathematicians' All Observers Theory" are experiments which have **only** a ***moving emitter***[21][22], **<u>no</u>** moving observer, and mathematicians just ***falsely assume*** that if movement by the emitter doesn't affect the speed of light, then movement by an outside observer also won't affect the measured speed of light, because that would be in violation of the "fundamental truth" of the Principle of Relativity.

VII. Conclusion

Richard Feynman famously stated in one of his lectures that it does not make any difference how beautiful your theory is, it does not make any difference how smart you are, who developed the theory, or what his name is, "**If it disagrees with experiment, it is wrong.** In that simple statement is the key to science."[23]

The mistaken **belief** that all observers will encounter light traveling at the same speed can be easily demonstrated to be false. Any physics class can ask for a demonstration of a police Lidar gun, and then they can discuss how it works. Or they can ask to view the Lunar Laser Ranging Experiment data collected by the University of California, San Diego. They can also study the "Sagnac Effect"[24] or the Michelson-Gale experiment of 1925.[25]

Einstein's Special Theory of Relativity and his General Theory of Relativity both argue that the "Principle of Relativity" as defined by Galileo and Newton are descriptions of ***illusions.*** Although it *appears* certain fundamental principles and laws work the same way in different **inertial** frames of reference, and duplicate experiments in those inertial frames *appear* to produce the same results, that is just an ***illusion***. When you compare the basic data used (such as the length of a second or the speed of light) between experiments, you will find that assumed numbers are different, and therefore the final test results are also different.

And if a teacher is teaching they **cannot** be different even if experiments clearly show they **are** different, then what the teacher is teaching is ***demonstrably wrong***. If students are required to believe it, it should be made clear to one and all that the students are being taught ***mathematical or religious dogma***, not physics or science.

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