A REPORT ON HOW THE OPTICAL LASER DISPROVES THE SPECIAL THEORY OF RELATIVITY

SUBMITTAL FOR PEER REVIEW

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OVERVIEW

This report uses the innate characteristics of the optical laser to identify an irreparable flaw in Einstein's special theory of relativity. The flaw is sufficiently material as to invalidate the general theory as well. The technologies available in the early 1900s to observe the propagation of light failed to adequately detect the significance of its directionality. As a result, Einstein's understanding of the propagation of light was incomplete. He correctly recognized that light propagates through empty space at a definite, constant speed c. But speed is a scalar value. The propagation of light is a vector quantity, consisting of both speed and direction. Any given small unit of light, such as a photon, will propagate at a definite speed c on a definite straight line trajectory from the specific point in space at which it is emitted. It's the directional part that Einstein missed. A directional light source, such as a simple pocket laser, discloses that Einstein's first postulate of relativity is invalid. Light does not conform to the principle of relativity.

The history of Einstein's theories is a classic example of the constant conflict between the discipline of the scientific method and the vagaries of the human condition. The scientific method builds its theories on the results of scientific observations of physical phenomena. These observations must be consistently repeatable and the theory's predictions must be observationally confirmed to assure their validity. The entire process is based on verifiable facts. In contrast, the human condition places hidden but very real limits on our ability to detect physical phenomena. As a result, there are unrecognized ambiguities in all scientific observations, no matter how carefully conducted. This is exacerbated by psychological roadblocks on the path to understanding what the observations mean. Some examples are blind spots, implicit assumptions, and circular reasoning. Even hubris can play a part in leading us astray. And in the grand scheme of things, it appears that the human condition has the upper hand. Even the most brilliant mind can be led astray by the human condition.

This report tells the whole story:

- Section 1 provides a brief background on the special theory of relativity. It is not included as material for peer review. It is provided only as background for scientists in fields other than physics who may be interested in the report. Physicists can feel free to begin at Section 2.
- Section 2 begins the analysis presented herein for peer review. It shows how a simple pocket laser, by forcing us to recognize the vector nature of light's propagation, proves that Einstein's first postulate, which extends the principle of relativity to the propagation of light, is factually incorrect. As predicted by Maxwell's equations, electromagnetic waves, including light, do not conform to the principle of relativity.
- Section 3 brings the flaw into focus with a demonstration of how it causes incorrect predictions.
- Section 4 addresses some characteristics of the human condition which are particularly harmful to mankind's efforts to understand reality. It also gives specific examples of how they impaired the validity of Einstein's theories and then protected them from observational challenge for more than a century.

SECTION 1

BACKGROUND FOR SCIENTISTS IN OTHER FIELDS

Einstein's theories of relativity are the very foundation of modern physics. His special theory of relativity is the basis of our understanding of such fundamental phenomena as motion, time, space and mass. His general theory of relativity provides our understanding of gravity. Einstein's theories of relativity have been consistently sustained by experimental validation over the past century. They are universally accepted as the gold standard of generally accepted theory.

Prior to Einstein's theories of relativity both Galileo and Newton had determined that the laws of physics that govern the motion of physical objects take the same form in all inertial reference frames.[1] In other words, if you are in a reference frame that is either stationary or in motion at a constant speed in a straight line, any experiment you make involving the movement of physical objects will produce the same result. You will feel that your reference frame is stationary and any experiment you conduct with moving physical bodies will produce the same result as if your reference frame were stationary. More specifically, it means that the mathematical equations that describe the result will take the same form regardless of your reference frame's state of inertial motion. The laws that govern the motion of physical bodies are called the laws of mechanics[2] and their consistency of form in all inertial reference frames is called the principle of relativity:

> "The basic laws of physics are the same
> in every inertial reference frame."[3]

This means that there is no experiment involving the movement of physical objects which will inform an observer whether he or she occupies a reference frame that is at rest or one which is in inertial motion. And if the observer's reference frame is in inertial motion, there is no experiment involving the movement of physical objects which will indicate how fast it is moving. Any such experiment will produce the same result in any inertial reference frame. Hypotheses which can be drawn from the principle of relativity for the motion of physical objects are:

- All observations involving the movement of physical objects which are made in any inertial reference frames have equal merit (i.e., are equally valid).[4]
- An observer in an inertial reference frame cannot determine his own inertial state of motion by means of observing physical objects in motion. Therefore, he cannot determine a physical object's state of motion other than relative to himself. He cannot determine its absolute rate of motion by any test involving the motion of physical objects.[5]

In 1864, the renowned Scottish physicist James Clerk Maxwell produced his insightful and comprehensive theory of electromagnetism.[6] His theory showed that the movements of electrically charged particles create electromagnetic waves which propagate through empty space at a precise, constant speed of 299,792,458 m/s.[7] Because that was exactly the same as the previously determined speed of light, Maxwell realized that light could be considered to be an electromagnetic wave and that it always will propagate through open space at that precise speed.[8] Maxwell also predicted the existence of other kinds of electromagnetic waves which were not visible to the human eye. We now know of many kinds, such as radio waves, microwaves, infrared, ultraviolet, X-rays and gamma rays. All electromagnetic waves propagate through empty space at the same speed. They differ only in their respective frequencies (aka wavelengths) which alters the manner in which they interact with matter. Unfortunately, Maxwell's equations did not take the same form in all inertial reference frames.[9]

If light were a wave, as shown by Maxwell's equations, that wouldn't necessarily be a problem. Generally accepted theory would require it to have a medium of propagation, just as does every other kind of wave. Thus, it was generally accepted that there must exist some kind of undetectable medium for the propagation of light that permeated all of open space. It was called the ether.[10] The reference frame for which Maxwell's equations took their simplest form was taken to be the one which was at rest in the ether.[11] The additional terms required for other reference frames were to adjust for their movement relative to the ether. This would account for the differences in the form of Maxwell's equations and would resolve the apparent conflict with the principle of relativity.

To resolve the matter, an endeavor began in the late 1800s to detect the existence of the ether and to determine the speed at which our own reference frame, the Earth, is moving through it. The most famous and most conclusive experiment was conducted by A. A. Michelson and E.W. Morley in the 1880s.[12] Unfortunately, what their experiment proved was that there was no ether. There was no explanation for why Maxwell's equations took a different form in different inertial reference frames. This was one of the great puzzles of physics at the beginning of the 20th century.[13]

Einstein solved the puzzle using his famous thought experiments.[14] Einstein concluded that the inconsistencies in Maxwell's equations resulted from the assumption that an absolute space exists.[15] In his famous 1905 paper, Einstein proposed eliminating both the ether and the corresponding belief in the existence of a reference frame at rest.[16] Based on this proposal, Einstein stated his two postulates of relativity. His first postulate declares:

"The laws of physics have the same form
in all inertial reference frames."[17]

The first postulate extends Galileo and Newton's principle of relativity to include not only the laws of mechanics but the laws that govern all physical phenomena, including not only electricity and magnetism but even phenomena not yet discovered.[18]

Einstein's second postulate of relativity specifically addresses the propagation of electromagnetic waves:

"Light propagates through empty space with a definite speed *c*
independent of the speed of the source or observer."[19]

These two postulates are the conceptual foundation of Einstein's special theory of relativity. Related hypotheses which underlie and add specificity to the postulates include:

- There is no such thing as an absolute state of rest.[20] This is the single, most important hypothesis underlying the theory. It is the basis for the two postulates.[21]
- All inertial motion is relative and can be identified only in terms of motion relative to a specified reference frame. This follows from the nonexistence of an absolute state of rest.[22]
- Observations made from any and all inertial reference frames have equal merit (i.e., are equally valid). [23]
- The observer in any inertial reference frame who measures the speed of light will obtain the same number c = 299,792.5 km/s.[24]

Based on the postulates and their related hypotheses, Einstein's special theory predicts a strange and totally different universe from that of our everyday experience.

- Time, space and mass, which had been generally accepted as the absolutes of physics, were demoted to mere variables. They are no longer the same throughout the universe. The passage of time, the dimensions of space and an object's mass depend on the speed of their reference frames relative to that of their observer.[25]
- As the relative speed of a reference frame increases, the passage of time in that reference frame slows down. If the reference frame were to move at the speed of light, time would stop.[26]
- As the relative speed of a reference frame increases, the dimensions of space in that reference frame will contract. The length of physical objects in that reference frame, as measured in the direction of travel, will become shorter. If the reference frame were to move at the speed of light, the objects' lengths in the direction of travel would be reduced to zero.[27]
- As the relative speed of a physical object approaches the speed of light, its effective mass approaches infinity. It would take an infinite amount of energy to bring its speed fully up to the speed of light.[28]

Everything predicted by the special theory results from the two postulates and their underlying hypotheses. Accordingly, if it can be shown that the propagation of light does not conform to the principle of relativity, the theory is prima facie invalid. The theory also will be rendered invalid if it can be shown that the special "at rest" reference frame predicted by Maxwell's equations does exist. All motion relative to that reference frame then would be absolute. Thus, the premise that motion can exist only relative to its observer, without any means to define it in absolute terms, would be shown to be incorrect. Section 2 does both of the above. It uses a tool which didn't exist until more than a half century after Einstein developed the special theory. The new information provided by this tool proves both that light is not subject to the principle of relativity and that the "at rest" reference frame predicted by Maxwell's equations does exist.

SECTION 2

HOW A LASER'S DIVERGENCE DISPROVES EINSTEIN'S FIRST POSTULATE OF RELATIVITY

I. Introduction

If Dr. Einstein had possessed a simple pocket laser, he probably would not have developed the special theory of relativity. Unfortunately, neither the science nor the technology required to produce a laser existed at the beginning of the 20th century. As a result, the observations upon which Einstein depended were fatefully deficient. His awareness of the constancy of light's propagation was limited to its speed, a scalar value, rather than its velocity, a vector quantity consisting of both speed and direction. The laser shows that any specific unit of light[29] will propagate at the speed of light on its own, specific straight-line trajectory. This new information removes two degrees of freedom when interpreting observations of the propagation of light. The more obvious of the new constraints is the direction of the light's propagation, which is the direction in which it is emitted from its source. The other new constraint comes from the fact that a unit of light's velocity vector has a point of origin, namely the source's location in the universe's three-dimensional space at the instant of emission. *The velocity vector for any specific unit of light can have only one point of origin, and only one direction of travel from that point of origin regardless of how many observers may observe them from different reference frames.*

Einstein's special theory is based on interpretations of observations which satisfy only one of the three constraints of light's vector constancy, namely its speed. Starting from his postulate that light conforms to the principle of relativity; Einstein was able to reconcile different observations of its speed made from different reference frames by altering time and space in the different reference frames. However, as shown in Figures 2-1 through 2-4, when all three parameters of light's velocity vector are recognized as constant, the propagation of light is not and cannot be subject to the principle of relativity.

The analysis in this section unabashedly uses thought experiments. This is because Dr. Einstein created his postulates using thought experiments and the postulates are the source of the problem. The special theory's flaws originate in the postulates upon which it is based, rather than in the mathematical equations used to execute them.

II. Abstract

If a laser is at rest in three-dimensional space, each photon it emits will start from the same location in space and will travel on the same straight-line trajectory as every other photon it emits. That trajectory will be the same line as the one on which the laser is pointed. If the laser is in inertial motion in any direction other than along the line on which it is pointed, each photon it emits will be emitted at a slightly different location at a slightly later point in time and will travel on a straight-line trajectory that is slightly displaced from and parallel to those of adjacent photons. An observer

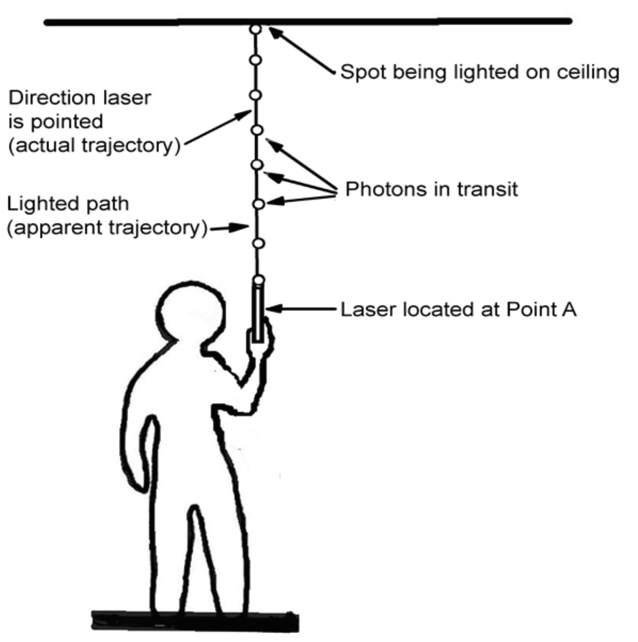
will observe a beam of light along which the photons will appear to be moving which diverges from the direction in which the laser is pointed. The faster the laser is moving, the greater will be the angle of divergence. What this means is that the behavior of a laser's emissions is different in kind between the inertial states of rest and motion and is different in degree between different rates of inertial motion. Thus, the principle of relativity does not apply to the propagation of light.

III. Definitions

- Actual trajectory: The actual trajectory of a laser is the straight line on which it is pointed. The actual trajectory of a photon (or other extremely small unit of light) is the straight line on which it travels from the location at which it was emitted.
- Apparent trajectory: A laser's apparent trajectory is the visible, lighted, straight-line path along which its emitted photons (or other extremely small units of light) will appear to be traveling.
- Divergence: Divergence is defined as the amount of difference between a laser's actual trajectory and its apparent trajectory.

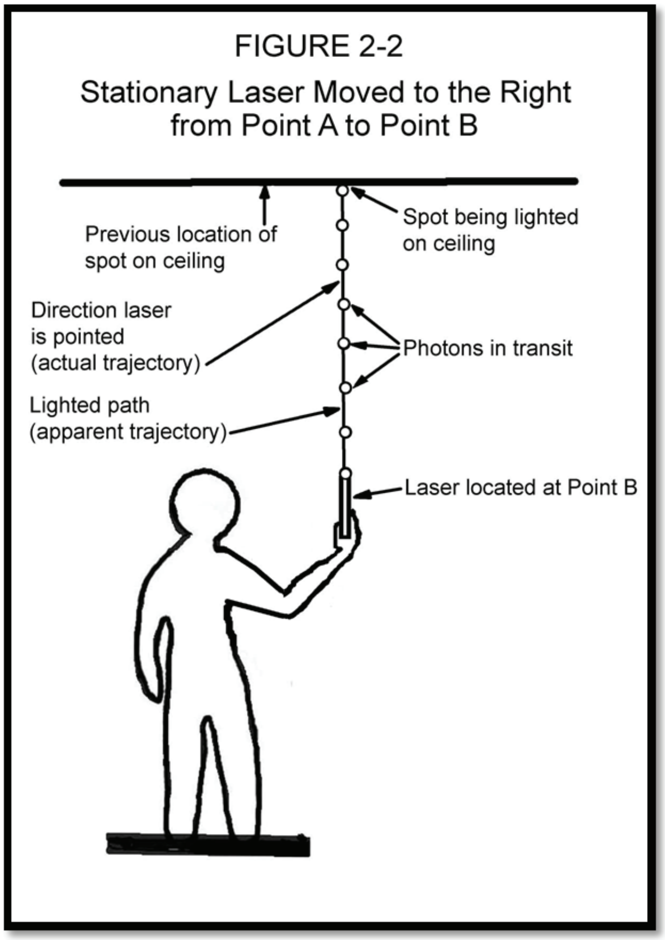
IV. What a Laser Tells Us

FIGURE 2-1
Stationary Laser in a Darkened Room



The laser tells us that there is a difference in kind between the inertial states of rest and motion and a difference of degree between different rates of inertial motion. Provided he has sufficiently sensitive and accurate measuring apparatus, an observer in an inertial reference frame can determine from the behavior of a laser's emissions whether he is at rest or in motion and, if in motion, the speed at which he is moving relative to the state of rest.

Figure 2-1 shows an observer in a darkened room holding a laser which is pointed vertically toward the ceiling. Assuming there is some dust in the air, there will be a vertical lighted path between the laser and a lighted spot on the ceiling. The lighted path is precisely on the same line as the laser is pointed and the spot on the ceiling is directly above the laser.



In Figure 2-2, the observer has moved the laser one foot to the right and is again holding it stationary pointed vertically toward the ceiling. Again, the line on which the laser is pointed (i.e., its actual trajectory) is exactly the same line as the lighted path between the laser and the ceiling (i.e., the laser's apparent trajectory). The lighted path does not diverge from the laser's actual trajectory and the lighted spot on the ceiling is directly above the laser where the laser is pointed.

In both Figures 2-1 and 2-2, the laser is stationary relative to the observer and the behavior of its emissions is identically the same. The laser's apparent and actual trajectories are not divergent and the lighted spot on the ceiling is directly above the laser. The important question, however, is: "What was the relationship between the two trajectories when the laser was in motion between the two different locations? To answer that question, one must recognize that the speed of light, while almost unimaginably fast, still is finite. There will be a delay between when a photon leaves the laser and when it completes its vertical path to the ceiling. And if the laser moves after the photon has been emitted, by the time the photon reaches the ceiling, the laser will no longer be directly beneath it. However, the speed of light is great enough that the difference can't be determined with available instruments unless the laser is moving at a high enough speed. This, of course, is no different from measuring the special theory's relativistic effects, which pose the same practical problem. To deal with that problem, one must assume, for purposes of illustration, that the observer has a bionic arm which is capable of moving the laser at a very high speed. And, for the same reason that Dr. Einstein deferred the matter of acceleration to the general theory, it will be assumed that the observer moves the laser between the two locations at a uniform speed.

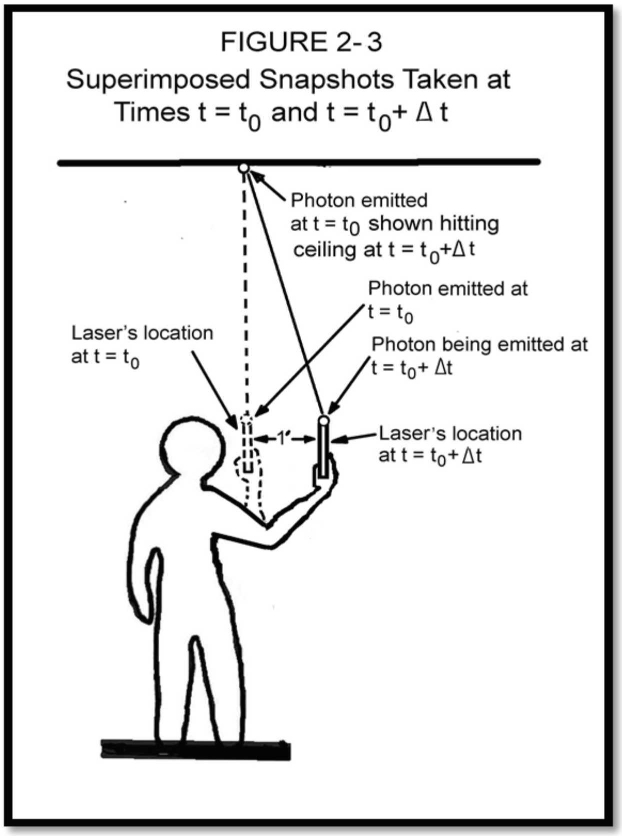
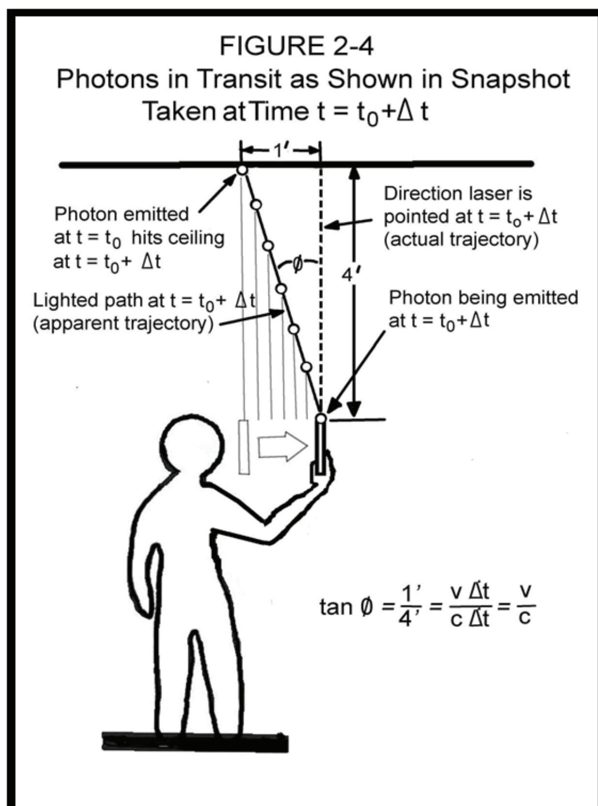


Figure 2-3 shows the results of two superimposed snapshots, one taken at the instant the laser leaves its first position and the other at the instant it arrives at the new one. For purposes of illustration, it is assumed that the vertical distance from the laser to the ceiling is four feet and that the laser moves between the two locations at a constant speed equal to one-fourth of the speed of light. The interval between snapshots Δt is the time it takes for a photon to travel the vertical distance from the laser to the ceiling. The first snapshot, taken at time $t = t_0$, is shown in dotted lines. The second snapshot, taken at time $t = t_o + \Delta t$, is shown in solid lines. Because of the time it takes for the photon emitted at $t = t_o$ to reach the ceiling, the snapshot taken at $t = t_o + \Delta t$ shows its location to be four feet above and one foot behind the location of the laser. As the photon moved four feet vertically, the laser moved one foot to the right.

Note that a vast multitude of photons will have been emitted during the interval between snapshots. In the second snapshot, those photons all will be captured in transit, on their respective vertical trajectories, from where the laser's was located at the instant when each was emitted. Since the laser moved horizontally at a constant speed v while the photons propagated vertically at a constant speed c, the photons in transit will be arrayed uniformly along a straight diagonal line between the laser and the lighted spot on the ceiling. This is shown schematically in Figure 2-4. As shown, the visible path being lighted by the photons in transit diverges from the direction in which the laser is pointed by the angle Ø. The tangent of Ø is equal to the ratio of the horizontal distance traveled by the laser to the vertical distance traveled by the photon during the interval of time between snapshots.

$$tan\ \emptyset = \frac{1'}{4'} = \frac{v\Delta t}{c\Delta t} = \frac{v}{c}$$



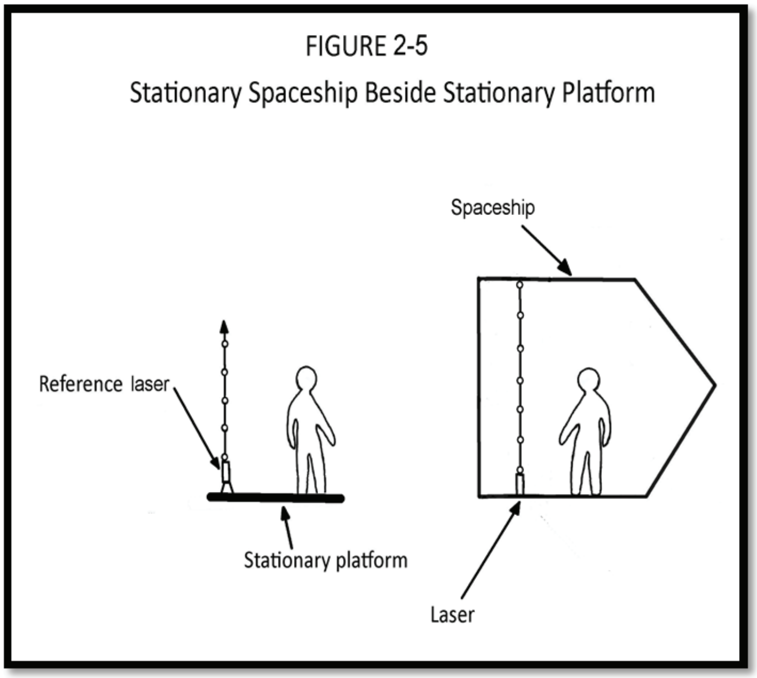
In summary, the following facts are shown by Figures 2-1 through 2-4:

- Even though it appears that the photons propagate on a diagonal path when the laser is in motion, each photon actually propagates on the same vertical trajectory as it was emitted starting from where the laser was located at its instant of emission. The appearance that light is bent by the laser's motion is an illusion.
- If the laser were to continue in motion, the divergence pattern shown in Figure 2-4 would continue in effect.
- When the laser's location does not change relative to the trajectories of the photons it emits, the laser's apparent and actual trajectories are identical. When the laser's location does change between the emissions of its own photons, the laser's apparent and actual trajectories are divergent. This is a difference in kind between the inertial states of rest and motion.
- As the laser's rate of inertial motion v changes, the amount of divergence between its apparent and actual trajectories changes. This is a difference of degree between different rates of inertial motion.
- Because the divergence between a laser's trajectories is different when the laser is in different inertial reference frames, the principle of relativity does not apply to the propagation of light.

The above analysis is sufficient to show that Einstein's first postulate is invalid and that the special theory of relativity is fatally flawed at its very foundation. However, it is not sufficient to demonstrate that an inertial reference frame which is both universal and at absolute rest does exist. That is addressed in the remainder of this section.

As discussed in Section 1, Maxwell's equations predict that there is a unique inertial reference frame which is at rest. An experiment involving the propagation of light must be conducted from that reference frame if Maxwell's equations in their simplest form are to describe the result. If the experiment is made in a different reference frame, additional terms are required to account for the difference in motion. It is reasonable to suggest that the "at rest" (i.e., non-divergent) reference frame shown in Figure 2-1 is the one predicted by Maxwell's equations. But it would be appropriate to first resolve some areas of possible ambiguity. This requires answering the following four questions:

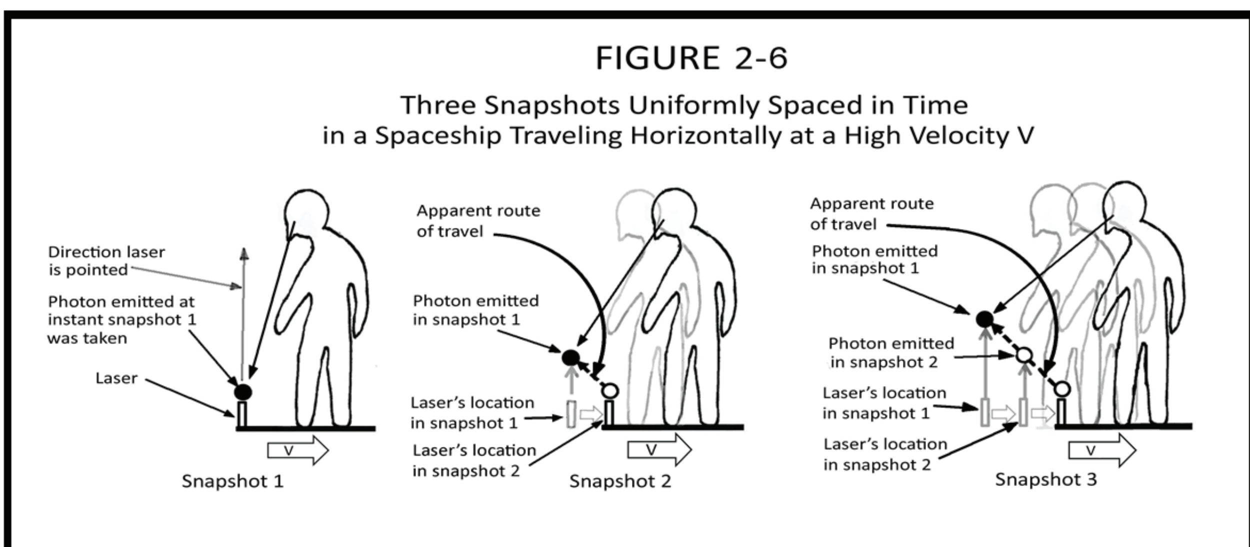
1. In Figures 2-3 and 2-4, the laser is in motion relative to both the trajectories of its own photons and to the observer's reference frame. Is it possible that the divergence the observer observes is caused by the laser's motion relative to him rather than its motion relative to the trajectories of its own photons?
2. Is the "at rest" state indicated by a laser's non-divergence a state of absolute rest?
3. Is the "at rest" reference frame identified by one laser the same as that identified by all lasers (i.e., is there a single, unique "at rest" reference frame?
4. Does the "at rest" reference frame "permeate" all of empty space (i.e., is it universal as to location)?



To address the first question, the thought experiment is moved from the stationary room to the interior of a spaceship. Within the coordinate system of the spaceship, the laser and observer remain stationary both relative to each other and to the spaceship. The spaceship is used to put the laser in motion relative to its state of rest rather than using the observer's bionic arm.

The experiment begins in empty space with the spaceship parked beside a platform. As shown in Figure 2-5, the observer on the platform has a reference laser which is in the state of non-divergence. Because the spaceship is at rest relative to the platform, its laser must be in the same inertial state as the laser on the platform. If one laser is non-divergent, the other must be also.

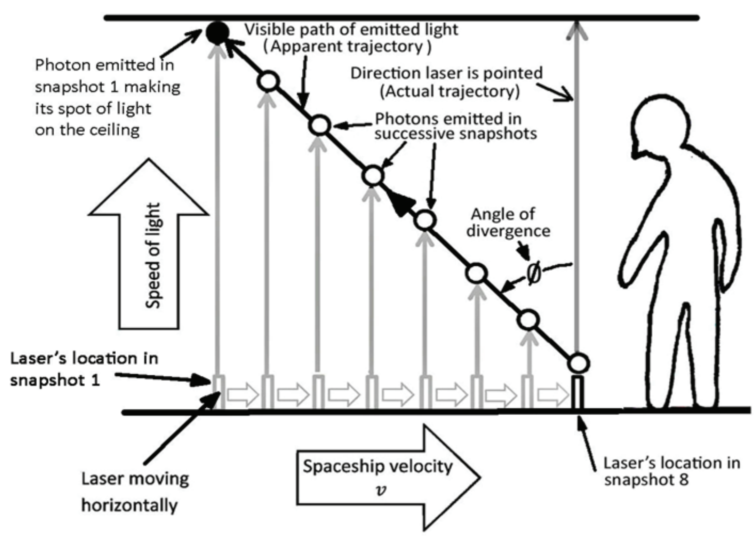
The spaceship then is put into horizontal inertial motion at velocity v relative to both its own initial state of rest and that of the platform. This is verified by going past the platform to assure that the platform laser remains at rest and the spaceship is passing the platform horizontally at velocity *v*. A high speed camera has been set up in the spaceship with a very precise timer. When the observer starts the timer, the timer signals the laser to emit a photon and the camera to simultaneously take a snapshot at precise intervals of time. The results of the first three snapshots are shown in Figure 2-6.



The first snapshot catches a photon in the act of being emitted from the vertically-oriented laser. Knowing the behavior of lasers, one might expect the observer to see that photon travel vertically to light a spot on the ceiling directly above the laser. However, snapshot 2 shows a different result. The second snapshot shows that in the interval of time between snapshot 1 and snapshot 2 the photon, as expected, continued on its vertical trajectory toward the ceiling. However, the laser, ceiling, camera and observer all have moved to the right, away from that photon's trajectory. This is exactly the same as what happened when the observer moved the laser from its state of rest in Figures 2-3 and 2-4. Once the photon leaves the laser, it will neither know nor care that the laser has moved sideways. Indeed, Einstein's second postulate says the photon, once emitted, will be independent of the motion of its source. Since the photon is moving vertically at a constant speed c while everything else is moving horizontally at a constant speed v, it will feel and look to the observer as if everything except the photon is stationary and the photon moves smoothly away from him on a diagonal trajectory. In snapshot 3, the photon emitted in snapshot 1 will appear to have continued on its diagonal path and the photon emitted in snapshot 2 will appear to be following along behind it. In reality, both photons are propagating vertically while the laser and observer are moving horizontally away from them at a constant speed.

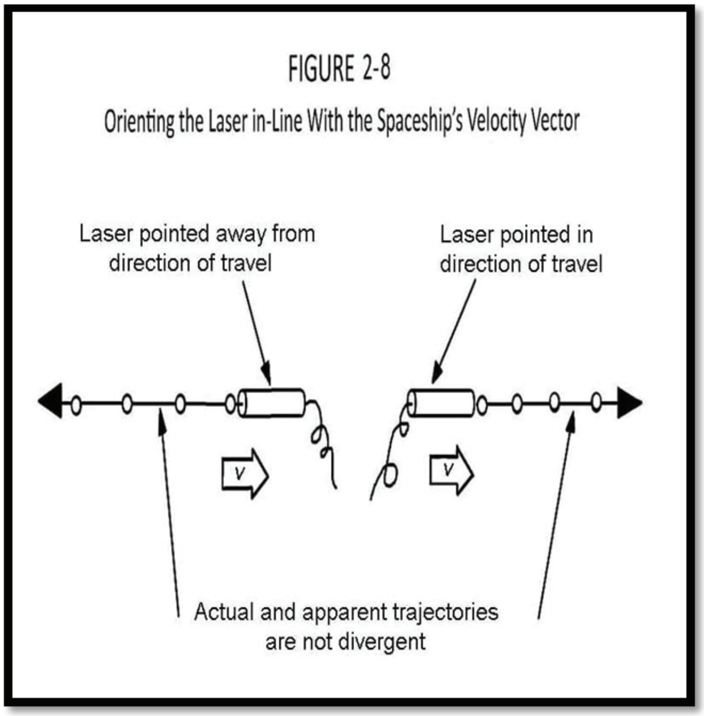
FIGURE 2-7

Spaceship's Velocity Causes Divergence Between Apparent and Actual Trajectory



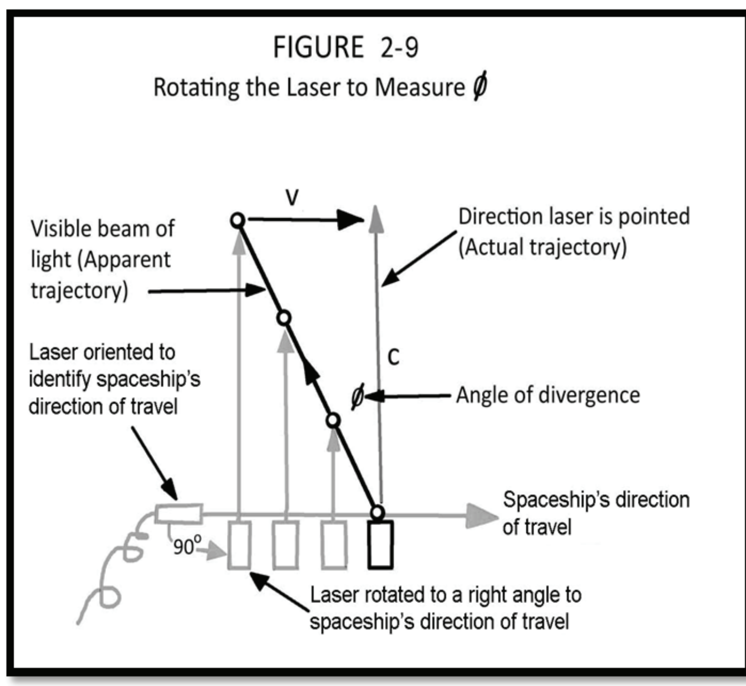
As shown in Figure 2-7, if we were to continue taking snapshots they would show photons moving diagonally from the laser to the ceiling, lighting a spot on the ceiling behind where the laser is pointed. This state of convergence will continue for as long as the spaceship continues in that state of inertial motion. This answers the first question, above, as to whether the laser's divergence in Figures 2-3 and 2-4 was caused by the laser's motion relative to the observer. The answer is no. The divergence pattern is the same whether the observer moves the laser in Figure 2-4 or the spaceship moves the laser in Figure 2-7. Divergence is caused exclusively by the laser's motion relative to the locations at which its own photons are emitted during the time interval of interest. A laser's state of divergence is independent of the motion of its observer. A laser's trajectories will be non-divergent only when the laser remains totally stationary in three-dimensional space.

V. Determining a Laser's State of Motion in Three-Dimensional Space



For simplicity, the previous examples have used a two-dimensional reference frame. To deal with inertial motion in three-dimensional space, all one needs to do is to turn it into a two-dimensional problem. The first step would be to turn the laser in all directions to determine the spaceship's direction of travel. As shown in Figure 2-8, when the laser's actual trajectory is precisely in line with the spaceship's velocity vector, the laser's trajectories will be non-divergent.

The second step is to rotate the laser 90° from its in-line orientation. As shown in Figure 2-9, that will place the laser's orientation at a right angle to the spaceship's velocity vector. It doesn't matter whether the laser was pointed in the same direction as the spaceship's velocity vector, or in the opposite direction, as is shown in Figure 2-8. When you rotate it 90° from in-line, you end up in the same place. The laser's trajectory and the velocity vector of its inertial motion are at a right angle to each other and lie on a plane in three-dimensional space which is oriented in the laser's direction of travel. Determining the spaceship's velocity has become a two-dimensional problem. Just as it is in two-dimensional space, the vector direction of the laser's inertial motion is the same as that of a line drawn from the apparent trajectory to the actual trajectory at a right angle to the actual trajectory. Its speed of travel is:



$$v = c \tan \emptyset$$

VI. The State of Rest is Absolute

FIGURE 2-10

A Two-Laser-Reference-Assembly at Absolute Rest in Three-Dimensional Space

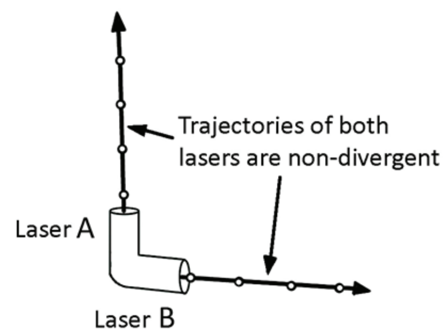


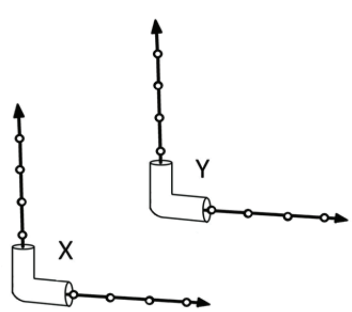
Figure 2-10 shows a reference assembly consisting of two lasers connected together at right angles to each other. If laser A is moving laterally to its actual trajectory in any direction, its trajectories will be divergent. If it is moving in-line with its actual trajectory, it will be non-divergent. However, laser B then would be divergent. The only way both lasers can be non-divergent is if, as time passes, the reference assembly remains in the same, exact, orientation and location in three-dimensional space as each photon is emitted. In other words, the laser-reference-assembly must be completely at rest in three-dimensional space. Any motion from that state of complete rest in any direction will cause divergence in either or both of the lasers. And the direction and amount of divergence is a function of the direction and amount of motion. Thus, in answer to the second question, above, a state of absolute rest does exist and motion relative to that state of rest is absolute.

VII. The State of Absolute Rest is Unique and Universal

Figure 2-11 shows two two-laser-reference-assemblies in three-dimensional space. If laser assembly X is stationary relative to assembly Y and Y is at absolute rest, then X also must be at absolute rest. Both assemblies are in the same reference frame. Thus, any two two-laser-reference-assemblies which are non-divergent are in the same reference frame. Since X can be located anywhere in three-dimensional space, anywhere in the universe, and be stationary relative to Y, every unique location in the "at rest" coordinate system of space is in the same reference frame and is at absolute rest. Everything in the universe may be in motion relative to that reference frame, but the coordinate system of that reference frame is universe-wide and at absolute rest. Contrary to Dr. Einstein's position in his 1905 paper, space is absolute and a universe-wide reference frame at absolute rest does exist. Any observer in any inertial reference frame can use a laser to determine his absolute state of motion. Thus, the answers to the last two questions, above, are that there is only one, unique reference frame at absolute rest and its coordinate system extends throughout the universe.

FIGURE 2-11

All Non-Divergent Reference Assemblies Are at Absolute Rest and Are in the Same Reference Frame



VIII. Conclusions

Einstein's first postulate of relativity states that electromagnetic phenomena (such as the propagation of light) are subject to the same principle of relativity as are the motions of physical objects. The optical laser demonstrates that observations of the propagation of light using a directionally focused source will be different in different inertial reference frames. Thus, the propagation of light is not subject to the principle of relativity. Einstein's special theory of relativity, which is based on his first postulate, is prima facie invalid.

- Because the divergence between a laser's actual and apparent trajectories is different in different inertial reference frames, the principle of relativity does not apply to electromagnetic phenomena, such as light.
- The universal reference frame at absolute rest whose existence is predicted by Maxwell's equations does exist. That is the reference frame in which Maxwell's equations apply in their simplest form. The additional terms are required when the source of light is in motion relative to the state of absolute rest.
- All space in the universe, which includes every unique location within it, constitutes a universe-wide reference frame which is at absolute rest. A two-laser-reference-assembly which is non-divergent, located anywhere in space, marks a fixed location in the "at rest" reference frame of space. Everything in the universe may be in motion relative to that location, but the location, itself, is at absolute rest.
- Space is external to all other reference frames and its dimensional characteristics are unaffected by their movement. Each unique point in the universal "at rest" coordinate system of space is a stationary reference point from which the movement of any and all other reference frames can be defined. This is why a collision occurs whenever objects which are at rest in the coordinate systems of different reference frames pass through the same point in the coordinate system of space. The coordinate system of space is shared, in common, by all other reference frames. The coordinate systems of all other reference frames move through the coordinate system of space, which is at absolute rest. That is the only coordinate system in which a two-laser-reference-assembly which is stationary relative to any chosen point within it will be completely non-divergent. It is the only reference frame in which Maxwell's equations apply in their simplest form.

All one needs to know to prove Einstein's first postulate of relativity invalid is that:

- A laser emits tightly focused light on a straight line trajectory which is the same as the direction in which it is pointed.
- A photon (or other small unit of light), once emitted, will continue to propagate on the same trajectory as that on which it was emitted.
- The speed of light is both constant and finite.

The characteristics of a laser demonstrate that the propagation of light is a vector phenomenon. Einstein's theories are based on an understanding of light that is limited to its scalar speed. Treating light as a vector phenomenon reverses the findings of relativity.

SECTION 3

HOW A LASER'S DIVERGENCE DISPROVES THE SPECIAL THEORY'S PREDICTION OF TIME DILATION

I. Introduction

Section 2 shows how treating the propagation of light as a vector phenomenon, rather than a scalar value, proves that Einstein's expanded principle of relativity (aka his first postulate of relativity) is invalid. That's a direct route to "game over" for relativity theory. Its very foundation is factually incorrect. A reference frame at absolute rest does exist and all motion can be measured against that state of absolute rest. What this section shows is how the error in the special theory's conceptual foundation causes false predictions. It begins with a description of how and why the special theory predicts time dilation and then uses a laser to show why that prediction is incorrect.

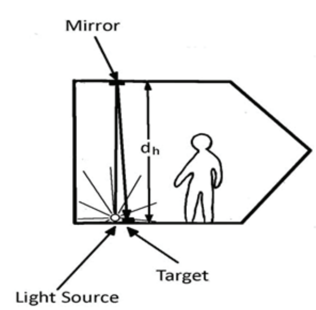
II. How Standard Physics Textbooks Explain and Validate Time Dilation

As mentioned in the Introduction, one of the key predictions of the special theory of relativity is that as a reference frame's relative velocity increases, the passage of time in that reference frame slows down. This is called time dilation. University textbooks commonly use a thought experiment similar to those used by Dr. Einstein both to explain how time dilation occurs and to validate the prediction. The thought experiment compares and interprets the observations of a single burst of light as made by observers in two different inertial reference frames. One observer is assumed to be stationary relative to another who is moving at a high velocity.[30] Since we now are accustomed to relating spaceships to high speeds, this illustration uses one observer standing on Earth looking up at another observer passing overhead in a spaceship at a high inertial velocity *v*.

FIGURE 3-1

Textbook Example of Time Dilation

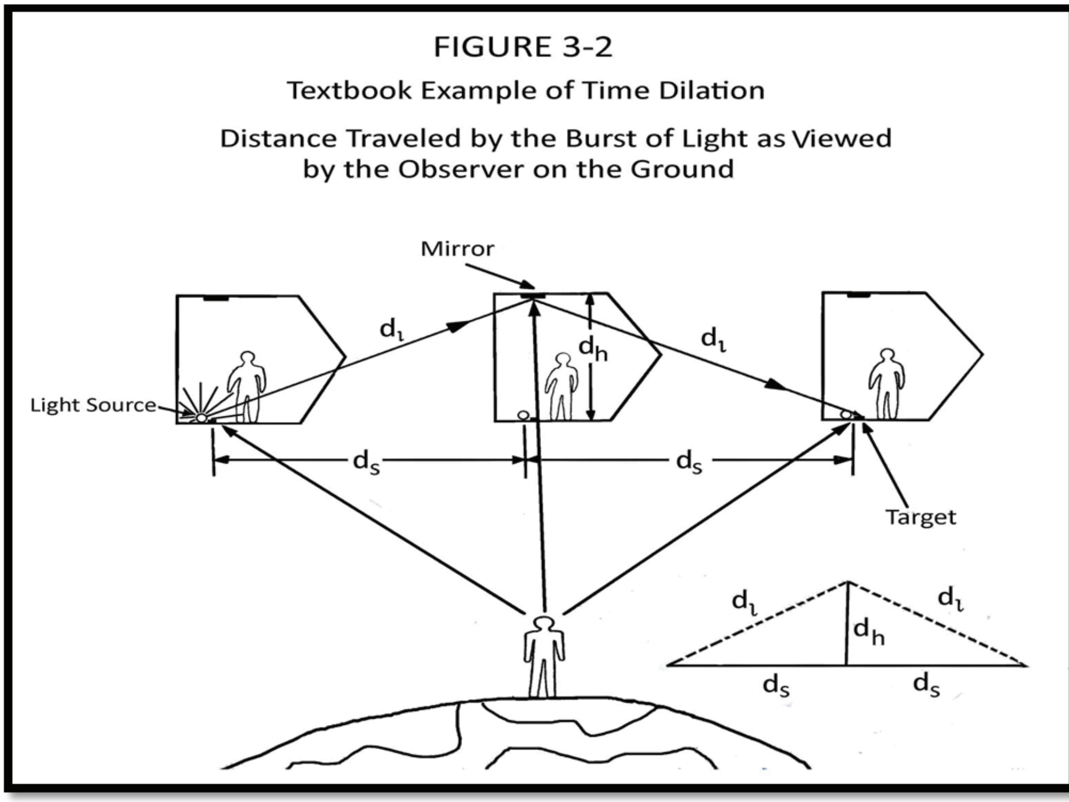
Distance Traveled by the Burst of Light as Viewed by the Observer in the Rapidly Moving Spaceship



As shown in Figure 3-1, the spaceship observer triggers a pulse of light which travels vertically from a source on the floor to a mirror on the ceiling. It then is reflected vertically back down to a target on the floor immediately adjacent to the source. Since light always must be observed to travel at the speed of light *c*, as discussed in Section 1, the interval of time required for it to travel from its source to the target in the spaceship Δt_s is:

$$\Delta t_s = \frac{2\, d_h}{c}$$

where d_h is the height of the spaceship's cabin and c is the universal speed of light.



Because the spaceship is moving rapidly above the earth, the ground observer will see the light travel a greater distance. As shown in Figure 3-2, the light travels on a diagonal trajectory up to the mirror and returns on a mirrored downward trajectory to the target.

The distance traveled by the light from its source to the mirror is the hypotenuse of a right triangle whose other sides are d_h and d_s. d_s is the distance traveled by the spaceship at velocity *v* during the same interval of time it takes the light to travel the length of the hypotenuse (d_l) at its speed *c*. The formula for the hypotenuse of a right triangle is the square root of the sum of the squares of the two sides:

$$d_l = \sqrt{d_s^2 + d_h^2}$$

The length of the hypotenuse for the trip from the mirror to the target is the same as for the trip from the source to the mirror. Thus, the total interval of time for the light to make the whole trip (Δt_g) is:

$$\Delta t_g = \frac{2\,d_l}{c} = \frac{2\sqrt{d_s^2+d_h^2}}{c}$$

What the formula says is simply that the time it takes the light to make the whole trip from source to mirror to target is the distance it travels divided by its speed *c*. Textbook examples typically do additional manipulations of the above equations to prove that the time interval in the rapidly moving spaceship always will be less than it is on the ground. However, it really isn't necessary to do that to make the case. Since the hypotenuse of a right triangle always is longer than either of the other sides, it follows that whatever the spaceship's velocity may be, the value of twice the spaceship's height always will be less than twice the length of the hypotenuse; i.e., since:

$$2\,d_h < 2\sqrt{d_s^2 + d_h^2}$$

It follows that

$$\Delta t_s < \Delta t_g \,.$$

Since less time passes in the spaceship, time must pass more slowly in the spaceship than on the ground. That relationship holds for any spaceship velocity, relative to the ground observer's frame of reference, that is greater than zero. Einstein expressed this phenomenon as: "clocks moving relative to an observer are measured by that observer to run slowly (as compared to clocks at rest)".[31] This result is explained to be because time has slowed, rather than having anything to do with the clock.

Before redoing the experiment using a laser, it's worth examining how the prediction of time dilation is created by the *concepts* upon which the special theory is based.

1. As presented in Section 1, Einstein's postulates and their underlying hypotheses result from the belief that all inertial motion is relative between different frames of reference.
2. That belief, in turn, comes from the hypothesis that there can be no such thing as a reference frame at absolute rest.
3. The hypothesis underlying Einstein's first postulate (i.e., "all reference frames that move at constant velocity have equal merit")[32] requires us to accept both observers' observations as being accurate descriptions of reality. We must believe that the observed burst of light actually did travel vertically when observed from inside the spaceship and diagonally when observed from the ground. Both observations, having been made from inertial reference frames, are equally valid.
4. The hypothesis underlying Einstein's second postulate (i.e., "the observer in any inertial frame of reference who measures the speed of light will obtain the same number c=299,792.5 km/s")[33] requires us to alter the rate at which time passes in the spaceship's frame of reference to achieve the right speed.

In other words, the math is just implementing the concepts. The prediction of time dilation is caused by the *interpretations* of the observations, which are commanded by the postulates and their related hypotheses.

Finally, one must take note that the propagation of light is treated as being a scalar phenomenon; only its speed must be constant. Its direction of travel is treated as being whatever an observer might think it is. The fact that one observer perceives it as being vertical and the other perceives it as being diagonal is assumed to have no significance. However, as now will be shown, this inattention to the light's vector direction fatally flaws the interpretation of the spaceship observer's observation.

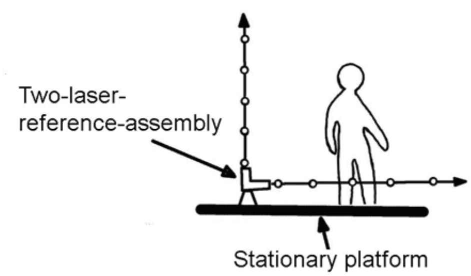
III. Using a Laser as the Light Source Removes Ambiguity Regarding the Vector Direction of the One Burst of Light Being Observed by Both Observers

Lasers are used in two ways in this redo of the textbook proof of time dilation. The first is to use a two-laser-reference-assembly to assure that the observer who is assumed to be stationary actually is at absolute rest in three-dimensional space. The second is to use a laser as the light source in the spaceship. This removes all ambiguity about the vector direction in which the observed burst of light is traveling, regardless of who is observing it.

Figure 3-3 shows the ground observer on a platform in open space. The platform has been maneuvered into a state of inertial motion where both lasers are non-divergent. As was shown in Section 2, this proves the platform is at absolute rest in three-dimensional space.

FIGURE 3-3

Observer on a Platform in Space Which is at Absolute Rest

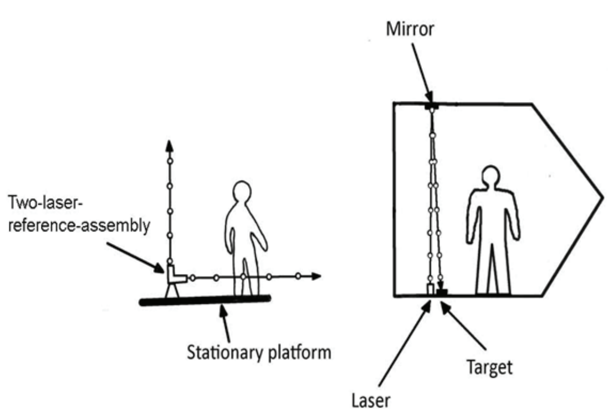


In Figure 3-4, the spaceship observer parks his spaceship beside the platform. Because the spaceship is stationary relative to the platform and the platform is at absolute rest, the spaceship also is at absolute rest. The spaceship observer aims a laser vertically toward a small mirror on the ceiling which reflects the light back down to the target.

The spaceship observer puts his spaceship in motion and passes horizontally over the stationary platform at a high speed *v*, as shown in Figure 3-5. Just as in Figure 3-2, the spaceship is shown moving horizontally to the right relative to the stationary observer.

FIGURE 3-4

Stationary Spaceship Beside Stationary Platform

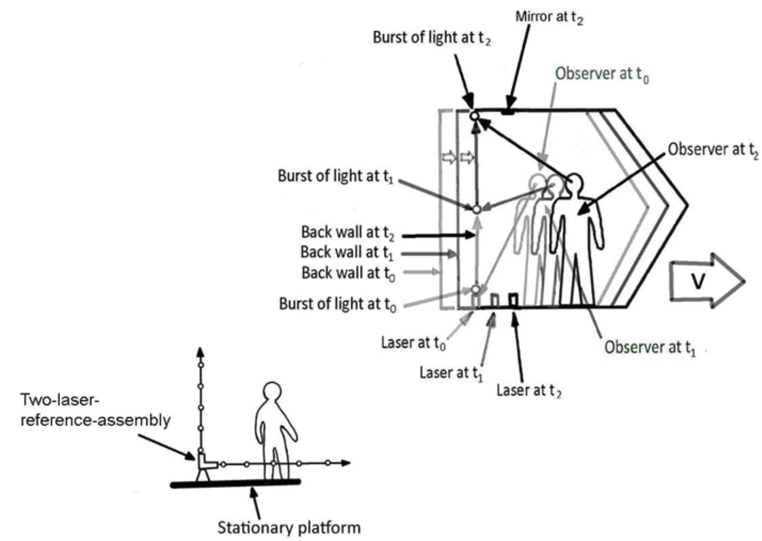


In Figure 3-5, it is assumed for purposes of illustration that the spaceship is moving horizontally to the right relative to the platform observer at one-fourth the speed of light and that the height of its cabin is 8 feet. At that speed, the spaceship will move one foot to the right for every four feet the light moves vertically. Figure 3-5 shows the results of three snapshots taken by a stationary camera at times t_0, t_1 and t_2. The interval between snapshots is the amount of time (Δt) it takes for the spaceship to move to the right one foot. That's also the time it takes the burst of light to move four feet vertically:

$$\Delta t = \frac{1}{v} = \frac{4}{c}$$

FIGURE 3-5

Small Burst of Light from a Vertically Oriented Laser in a Horizontally Speeding Spaceship as Seen from the Platform

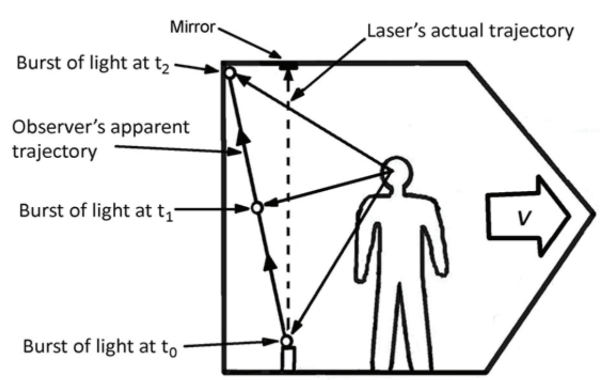


The snapshots are superimposed to show the spaceship's back wall, the laser, the observer and the burst of light as they change location from snapshot to snapshot. The snapshots are arrayed in time sequence with the earliest (t_0) at the left and the latest (t_2) at the right. The latest snapshot is darkest and the earlier ones get lighter as they go back in time.

In the first snapshot (t_0), the burst of light is just departing from the laser. The laser is permanently mounted two feet to the right of the back wall. The observer's head is roughly three feet to the right of the laser's vertical trajectory.

FIGURE 3-6

Small Burst of Light from a Vertically Pointed Laser in a Horizontally Speeding Spaceship as Seen by the Spaceship Observer



In the second snapshot (t_1), the back wall, the laser and the observer all have moved one foot to the right (into the middle positions shown). The burst of light has continued on its vertical path from where the laser was located when it was emitted. It is now half way from the floor to the ceiling. Note that the laser, along with the back wall and observer, has moved one foot to the right but the burst of light has not. There's no reason for it to change course simply because the laser moved after the light was emitted. Indeed, it couldn't do so even if it wanted to. A change in direction is a form of acceleration. Light has only one speed, it can't accelerate.

In the last snapshot (t_2), the back wall, the laser and the observer all have moved another foot to the right and the burst of light has continued vertically to reach the ceiling. Note that the burst of light was two feet to the right of the back wall when it was emitted by the laser. It was one foot from the back wall at the midpoint of its vertical trip. By the time it reached the ceiling, the back wall has moved two feet to the right and has just caught up with the light.

Because the spaceship observer is in an inertial reference frame, he will feel that he is stationary. And because he is not moving relative to the back wall and the laser, it will both feel and look to him as if the path followed by the burst of light bent diagonally backward from the laser to where the back wall meets the ceiling. His point of view is shown in Figure 3-6. Note that the divergence he observes is exactly the same phenomenon that is described in Figures 2-4, 2-6, and2-7. It is caused by the laser's horizontal motion away from the vertical trajectory of its own small burst of light. The light appears to have fallen behind the mirror simply because the mirror also moved horizontally out of its path while it was in transit. What this tells us is that *light propagating vertically in a spaceship that is rapidly moving horizontally won't hit the mirror.* Also, an observer in the moving spaceship will misperceive both the burst of light's vector direction and the speed at which it traveled. He will think the burst of light traveled diagonally to the ceiling during the time interval of his observation, when it actually traveled vertically, a shorter distance. We were told in the textbook proof of time dilation (Figure 3-1) that a vertically propagating burst of light in a horizontally speeding spaceship would travel vertically to hit the mirror and vertically back down to hit the target. But that cannot physically happen. If the observed burst of light *were* traveling vertically, it wouldn't hit the mirror.

IV. Rotating the Laser So the Light Can Keep up With the Spaceship

In Figure 3-6, it is clear that the laser's light won't hit the mirror unless the laser is rotated in the direction the spaceship is traveling. The question is: how much must it be rotated? Too much and the light will hit the ceiling ahead of the mirror. Too little and it will hit the ceiling behind the mirror. The angle-of-rotation θ must be just enough to overcome the time delay between when a light burst leaves the laser and when it arrives at the ceiling.

Figure 3-7 shows how to determine the correct angle-of-rotation θ. It is assumed for illustration that the spaceship is speeding horizontally to the right at velocity v. The laser and target are located immediately adjacent to each other on the spaceship's floor and the mirror is located vertically directly above them. This is the arrangement used in the textbook "proof" of time dilation as shown in Figure 3-1. It is assumed that the laser has been rotated from vertical in the spaceship's direction of travel at the correct angle θ. A high speed camera driven by a timer is located in the spaceship. The timer is used to trigger bursts of light from the laser at uniform intervals of time. After triggering several light bursts, the timer triggers the camera to take a snapshot concurrently with the last light burst. The contents of that snapshot are shown in black. Other information provided for reference is shown in gray.

As shown in Figure 3-7, the snapshot captures all of the in-transit light bursts aligned vertically on a straight line between the laser and the mirror. However, as shown in gray, each burst of light actually traveled diagonally from where it was emitted to where it is located at the time of the snapshot. The angle-of-rotation θ at which the light bursts will hit the mirror is the same angle of rotation at which they will appear to be traveling vertically. This should not be surprising. The mirror is mounted vertically above the laser. Thus, if the laser has been rotated just enough for its emissions to keep up with the mirror, it *must* appear to the spaceship observer that they are moving vertically. The angle at which that occurs is determined as follows:

- The light burst being emitted from the laser at the instant the snapshot was taken will propagate at the speed of light on the trajectory marked C for the distance d_1.
- The time required for that light burst to travel from the laser to the ceiling is $\Delta t_l = d_1/c$.
- While that light burst is in transit, the mirror will move horizontally at velocity v. The time required for the mirror to travel the distance d_2 horizontally at velocity v is $\Delta t_m = d_2/v$.
- The light will hit the mirror and be reflected back toward the target only if $\Delta t_m = \Delta t_l$. This will occur under the following condition:

If $\Delta t_m = \Delta t_l$ then both can be replaced by the same time interval Δt.

$$\text{If:} \quad \Delta t_m = \Delta t_l = \Delta t$$

$$\text{Then: } \Delta t = \Delta t_m = \frac{d_2}{v} \quad \text{and} \quad \Delta t = \Delta t_l = \frac{d_1}{c}$$

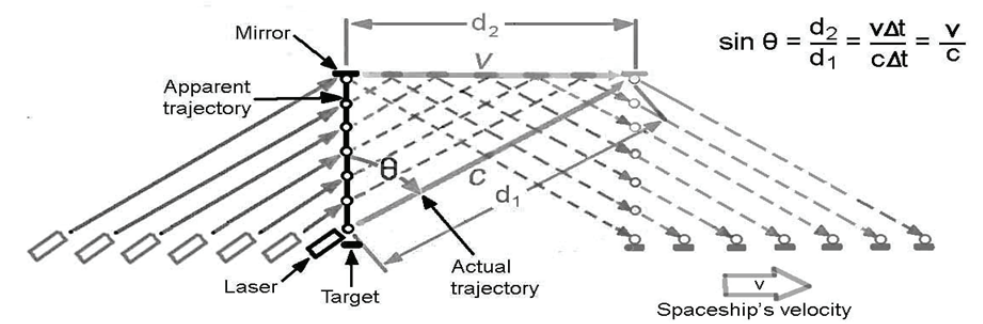
$$\text{Thus:} \quad d_2 = v\,\Delta t \quad \text{and} \quad d_1 = c\,\Delta t$$

$$\text{Which means:} \quad \sin\theta = \frac{d_2}{d_1} = \frac{v\,\Delta t}{c\,\Delta t} = \frac{v}{c}$$

Thus, light emitted by a laser in a horizontally speeding spaceship will strike a mirror located vertically above it only if the laser is rotated from vertical in the spaceship's direction of travel by the angle θ whose sine is equal to the ratio of the spaceship's velocity to the speed of light. Light propagating on any other trajectory will not hit the mirror.

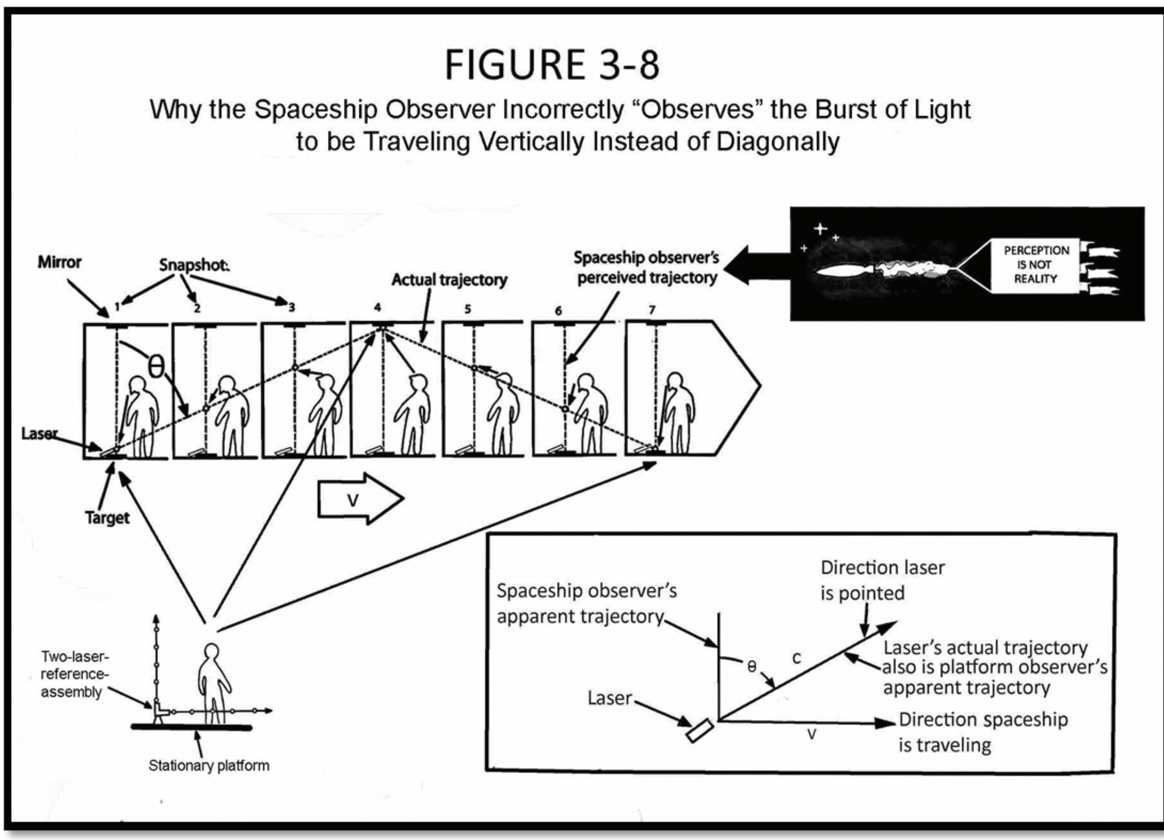
As shown by the dotted gray lines in Figure 3-7, each light burst captured in the snapshot will continue thereafter on its own diagonal trajectory. It will arrive at the ceiling just when the mirror

FIGURE 3-7
Rotating the Laser So the Light Will Hit the Mirror and Target



arrives to reflect it. It then will travel a mirrored diagonal path back down to where the target will be when it arrives at the floor. At a later instant in time, after all of the light bursts shown in the snapshot have been reflected, they will again be seen arrayed vertically as they travel from the mirror toward the target. This is shown to make it clear that bursts of light which actually propagate diagonally at the angle θ, both up and down, will appear to be travelling vertically, both up and down.

Now that we know how to rotate the laser by the correct angle θ, we are ready to rerun the textbook "proof" of time dilation using a tightly focused laser instead of an omnidirectional light source. Figure 3-8 is comparable to the textbook example's Figure 3-2 except that the omnidirectional light source has been replaced with a laser. Using a laser in lieu of the omnidirectional source removes the ambiguity regarding the vector direction of the light being observed from inside the spaceship. The laser has been rotated from a vertical trajectory in the spaceship's direction of travel by the angle θ whose sine is equal to the ratio of the spaceship's



velocity v to the speed of light.

As was done in Figure 3-2, Figure 3-8 shows the spaceship moving horizontally at its velocity v above the stationary observer. Because the spaceship is in continuous, uniform motion relative to the stationary observer, its positions in space at various points in time are captured for illustration in seven snapshots. The snapshots are taken from a camera which is stationary relative to the stationary observer. The interval of time between snapshots is set at one-sixth of the time it takes the burst of light to travel the entire trip from the laser up to the mirror and back down to the target. The snapshots, numbered 1 through 7, are shown superimposed with the earliest one at the left and the last one at the right. The snapshots show the progress through the moving spaceship of a single burst of light emitted at the instant snapshot 1 was taken.

Note the direction in which the spaceship observer must look to see the burst of light in each snapshot. The platform observer, being at absolute rest, will accurately observe what happens inside the spaceship. He will see the light travel diagonally. However, the spaceship observer observes the light as traveling a shorter distance vertically. He is experiencing a motion-induced illusion. Because of his own horizontal motion, he has no means to detect the horizontal component of the light's trajectory. But the fact that he can't detect it doesn't mean it isn't there.

Here is how that illusion happens. Being in an inertial state of motion, the spaceship observer has no sense of motion. It feels to him that he, the spaceship and every physical object in it are stationary. None of them are moving relative to him. If one were to draw an invisible vertical line between the laser, mirror and target, it also would remain stationary relative to the spaceship observer. The only thing moving relative to the spaceship observer is the burst of light. However, because the laser is rotated at precisely the correct angle, the burst of light never leaves the imaginary vertical line between the laser, mirror and target. The only part of the light burst's movement the spaceship observer can see is the vertical part. This is why the ground observer sees the burst of light travel diagonally while the spaceship observer "sees" the same burst of light travel vertically. The spaceship observer's observation differs from that of the stationary observer due to observation error rather than time dilation.

It is essential at this point to be absolutely clear about what Figure 3-8 shows:

- The observations of observers in different states of inertial motion do not have equal merit.
- The difference in the observed distances traveled by the light results from observation error, not from time dilation.
- There is no basis for concluding that the *difference* between the "observed" distances traveled by the light has anything to do with a *difference* in the passage of time between the two reference frames.

V. Why a Directional Light Source is Necessary for a Full Understanding of the Propagation of Light

The conceptual flaw in the special theory of relativity results from treating the propagation of light as if its only absolute is its scalar speed. Its direction of travel is simply accepted as being whatever an observer might think it is when viewed from his own inertial reference frame. Section 2 uses a laser to show that the propagation of light is a vector phenomenon. A photon's speed, its direction of travel, and its point of origin are absolute and invariant from the instant in time when the photon leaves its source. Thus, Einstein's second postulate, while not technically incorrect (it is true as far as it goes, but is incomplete), contains a fatal deficiency. A correct statement of the second postulate would be:

"Light propagates through empty space at a definite speed *c* from the specific point in space at which it is emitted and in the specific direction in which it is emitted independent of the velocity of its source or observer." (Additions and substitutions underlined.)

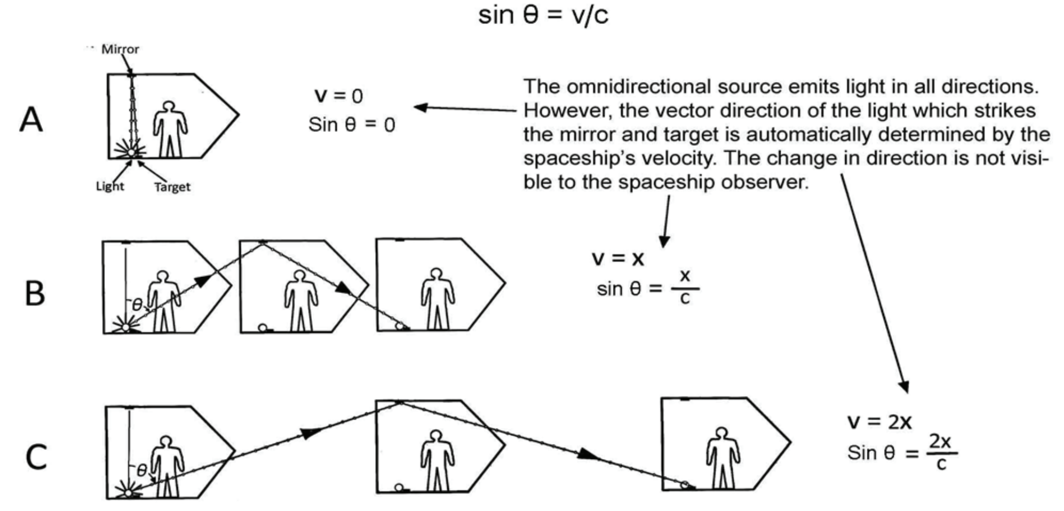
When we first examined the standard textbook "proof" of time dilation, as shown in Figures 3-1 and 3-2, it appeared to be quite reasonable and correct. With an omnidirectional light source, it is entirely reasonable in Figure 3-1 to *assume* that the burst of light in the spaceship must propagate vertically, given that the paths from the source to the mirror and from the mirror to the target were both vertical. It is entirely reasonable to assume that the same burst of light would have to travel farther in the ground observer's reference frame than it does in the spaceship because the spaceship is moving horizontally in that reference frame. These apparently reasonable and virtually obvious beliefs lead inexorably to the predictions that time must dilate, space must contract and mass must increase inside the spaceship as its velocity increases. Once one accepts both observers' observations as having equal merit, this is the only way to reconcile the disparate observations. However, when a laser is substituted for the omnidirectional light source (in Figures 3-5 and 3-6), one finds that a vertically oriented burst of light in a horizontally speeding spaceship won't even hit the mirror. As shown in Figure 3-7, the directional light source must be rotated in the direction of the spaceship's travel by a specific angle θ (the angle whose sine is equal to the ratio of the spaceship's velocity to the speed of light). Otherwise, the light won't keep up with the mirror and target. When the laser is rotated at the correct angle, the trajectory followed, and the distance traveled, by the single burst of light is the same inside the spaceship as it is when viewed from the stationary platform. The difference between the two observations results from the spaceship observer's inability to perceive the horizontal component of the light burst's diagonal travel.

What actually happens in the textbook demonstration of time dilation (Figures 3-1 and 3-2) is obscured by the use of an omnidirectional light source. As shown in Figure 3-9, the angle of

FIGURE 3-9

Vector Direction is Hidden When Using an Omnidirectional Light Source

$\sin \theta = v/c$



emission for the light that hits the mirror does change when the spaceship's velocity changes, even if we have an omnidirectional light source. In the textbook example of time dilation we simply were not aware of the change in direction; first, because the omnidirectional light source accommodates the change in direction without having to be manually reoriented; and second, because the question of vector direction wasn't even recognized as an issue. But as shown in Figure 3-9, the spaceship's velocity automatically determines the vector direction of the specific ray of light coming from the omnidirectional light source which is able to hit the mirror. The rest of the light simply lights the interior of the spaceship.

In Figure 3-9A, the spaceship is at rest. The ray of light from the triggered burst that hits the mirror and reflects back down to the target is only that ray which propagates vertically from the source. (Since $v = 0$, $\sin\theta = 0$ and, thus, $\theta = 0$.) The rest of the light emitted by the source simply lights the interior of the cabin.

In Figure 3-9B, the spaceship is in motion horizontally at a high speed x. Thus, the spaceship's velocity v is equal to x:

$$v = x$$

If $v = x$, the ray of light which will hit the mirror is only that which is emitted at the angle θ whose sine is:

$$\sin\theta = \frac{x}{c}$$

The rest of the light emitted by the source, including that which was emitted vertically, simply lights the cabin. In Figure 3-9C, the spaceship's horizontal velocity is doubled.

$$v = 2x$$

At that velocity, the mirror will be hit only by the ray of light which leaves the source at the angle θ whose sine is:

$$\sin\theta = \frac{2x}{c}$$

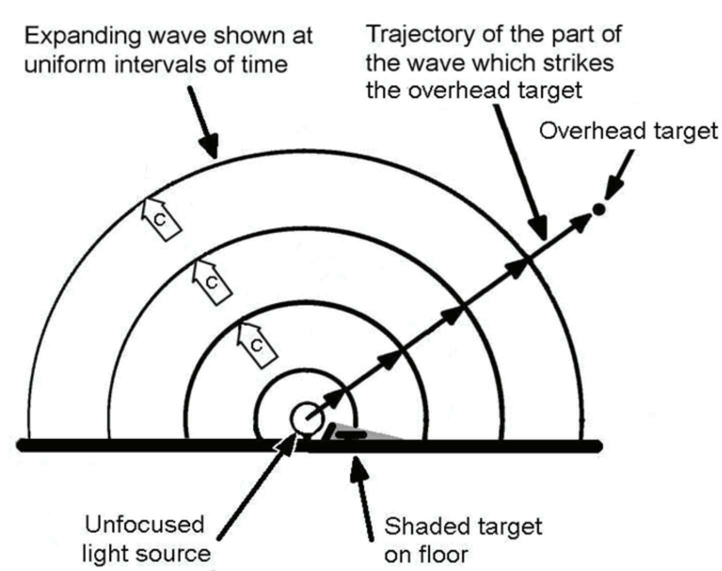
Again, the rest of the light simply lights the cabin.

In Figure 3-9, it is clear that the specific ray of light from the omnidirectional source which hits the mirror shifts automatically from vertical toward horizontal as the spaceship's velocity increases. However, with an omnidirectional light source, we can remain blissfully unaware of that shift in direction. We have no way to observe the shift since everything still looks and feels the same from inside the spaceship. The omnidirectional burst of light lights the cabin and some part of that light is reflected by the mirror to strike the target. But one cannot tell by observation which ray that is. When we use a laser for the light source, we have to manually adjust its direction when the spaceship's speed increases so that the thin beam of light can hit the mirror. This forces us to become aware that the vector direction of the burst of light must change as the spaceship's velocity changes. Because it doesn't recognize the significance of directionality to the propagation of light, the special theory accepts the spaceship observer's inaccurate observation in Figure 3-1 as being a valid description of what actually happens. But as shown in Figures 3-7 through 3-9, the light actually travels on the same diagonal path whether being viewed from inside the spaceship or from the ground. The only difference between the two observations is that the spaceship observer is blind to the horizontal part of the diagonal trajectory. There is no difference in distance traveled or in elapsed time. The light burst *looks* like it travels too slowly on a vertical path when observed from inside the spaceship, but it actually travels at its correct speed *c* on the same diagonal path observed by the stationary observer. Time dilation does not occur.

VI. The Need to Address Directionality is Independent of the Topology of Light

Depending on the apparatus used to emit and detect the light being observed, one might perceive its topology as consisting of particles, rays or waves and as being either focused or omnidirectional. However, the need to account for the directionality of light is independent of what one might believe to be its topology. To demonstrate this point, the tightly focused laser used in Figure 3-8 can be replaced with an unfocused, omnidirectional light source. This source is assumed to emit a single electromagnetic wave which expands in three-dimensional space as a continuous wave-form. The wave is unfocused, its surface is continuous and it expands concentrically from its point of emission. (This is the electromagnetic wave described in Maxwell's equations.) It does not have any characteristics either of particles or of a tightly focused emission, such as from a laser. The light source and the expanding, unfocused wave it emits are shown in Figure 3-10.

FIGURE 3-10
Expanding Wave From Unfocused Light Source



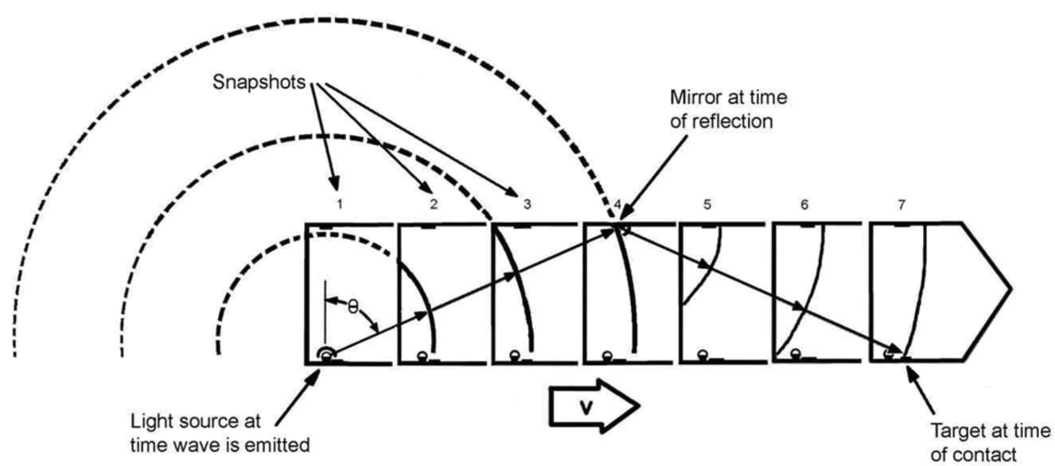
The floor-mounted target, as shown in Figure 3-10, is shielded from the wave where it leaves the source to prevent the wave from hitting it before being reflected off the mirror.

Although the wave expands outward in all directions, any target it strikes will encounter only that portion of the wave which strikes it. The rest of the wave just passes by or is already headed in another direction. The part of the wave which strikes the small target located diagonally above the source is only a specific tiny piece of the wave which traveled in a specific direction. That direction, like any uniform trajectory, is a straight line from the source's location at the instant of emission to the target's location at the instant of contact. The trajectory for that tiny part of the wave is precisely the same as it would be for an emitted particle or a ray of light which starts from the same source and strikes that same target.

Figure 3-11 shows the same spaceship as in Figure 3-8 traveling at the same horizontal velocity. Seven snapshots are shown which are taken at the same intervals of time as in Figure 3-8. The tightly focused laser used in Figure 3-8 is replaced by the unfocused source shown in Figure 3-10. The wave is emitted at the same instant as the first snapshot is taken and expands outward in all directions at the speed of light. Each snapshot from number one through number four shows the location of that portion of the incident wave which still exists at the time of the snapshot. The rest of

FIGURE 3-11

Expanding Light Wave Emitted in a Spaceship Traveling Horizontally at a High Velocity *v*



where the wave would have been, had it not been extinguished by the walls and ceiling of the spaceship, is shown in dotted lines. As shown in snapshot number four, the mirror is contacted by that part of the wave which is traveling on the same trajectory as the laser's burst of light in Figure 3-8. The mirror reflects that part of the wave back down toward where the target will be in the seventh snapshot. Again, the part of the reflected wave which will strike the target travels on the same trajectory as did the quick burst of reflected light from the laser in Figure 3-8. Snapshots five and six show the reflected wave in transit and snapshot seven shows the wave front encountering the target.

As shown in Figure 3-11, the part of the incident wave which strikes the mirror and the part of the reflected wave which strikes the target must follow the same trajectory for the same distance at the same speed as did the laser's tightly focused, quick burst of light in Figure 3-8. One's beliefs about the topology of light have no effect on the need to understand and account for the propagation of light as a vector phenomenon. As shown in Section 2 and in Figures 3-7 through 3-11, the issues are the same whether one considers the topology of light to be particles, rays or waves and whether the light is focused or not. Unless the observed light is treated as a vector phenomenon, with proper recognition of directionality, one almost certainly will misperceive both the direction and the speed at which he “observes” the light to travel. The only exception is when the observer is in the at-rest reference frame predicted by Maxwell’s equations (i.e., the reference frame in which a laser’s trajectories will be non-divergent).

The reason why it is important to know that the findings of this report do not indicate a particular topology for light is because there are valid reasons to doubt that energy is quantized and that photons exist.[34]

VII. Conclusions

- Section 2 of this report has shown how a laser’s characteristics prove that the principle of relativity does not apply to electromagnetic phenomena, such as the propagation of light. That proves that the special theory of relativity is prima facie invalid.
- This section shows how the theory’s treatment of the propagation of light as a constant scalar phenomenon (speed only) instead of a constant vector phenomenon (speed, direction, and point of origin) leads to incorrect interpretations of observations.
- Time is invariant to any reference frame’s state of motion. The theory’s predicted time dilation results from incorrect interpretations of observations made by observers who are in absolute motion (i.e., in motion with respect to the stationary coordinate system of space). Such observer’s will experience a motion-induced illusion which renders their observations invalid. They will misperceive both the vector direction and the speed at which the light they observe is propagating.
- An object’s mass also is invariant to any reference frame’s state of motion. That prediction results from the same incorrect interpretations of incomplete observations that cause the predictions of space compression and time dilation.

This new information raises a number of questions: How can this have happened? How can someone as brilliant as Dr. Einstein build an invalid theory based on misinterpreted observations? How did it become accepted as the gold standard of generally accepted theory? Why has it survived unscathed through a century of experiment? The answers to these questions are to be found in the innate and unavoidable nature of the human condition. That is the subject of Section 4.

SECTION 4

HOW THE HUMAN CONDITION FLAWED THE SPECIAL THEORY AND PROTECTED THE FLAW FROM DISCOVERY

I. Introduction

There are two branches of the science of physics: theoretical and experimental. Stated very briefly, experimental physics observes physical phenomena at work under carefully controlled conditions. Theoretical physics determines what the observations mean (i.e., what they tell us about the laws that govern the behavior of physical phenomena). Both of these fields of endeavor encounter significant unavoidable ambiguities that arise from the human condition.

II. The Ambiguity of Observations

To understand the innate ambiguity of observations, it is useful to note that the definition of observe is: "To perceive; notice; see."[35] What we can perceive, notice or see is limited by the capabilities of our human senses as augmented by whatever sensing apparatus we are clever enough to devise. There is no way to assure that any observation detected everything that occurred and no way to determine the significance of that which was not detected. Thus, every observation has an undefinable but very real exposure to ambiguity and error.

III. The Ambiguity of Interpretations

The second unavoidable exposure to ambiguity and error is encountered when we decide what the observation means. What we call an observation begins its existence as nothing more than a perception in search of an interpretation. It is our interpretation that gives it meaning and our interpretation is the result of a human decision process. That decision process is guided by what we "know" which is just another word for what we believe. Our most dependable beliefs are, themselves, based on past interpretations of previous observations. We call the ones on which we agree "generally accepted theory." Other beliefs reside both unknown and unexamined in our subconscious. But the fact that we are unaware of them doesn't mean they don't influence our decisions.

Considering the above, it is important to recognize that an "observation," no matter how carefully made nor how carefully controlled, is not a fact. It is an interpretation of perceived events based on a human decision process guided by pre-existing beliefs. And some of the beliefs even may be subconscious, which also means that they are unexamined.

IV. The Innate Exposure to Magical Thinking

If an experimental observation fails to detect something significant, our interpretation may be based, unknowingly, on insufficient evidence. This creates an exposure to what can be called magical thinking. *Magical thinking consists of assigning false causation to observed events based on pre-existing beliefs rather than on a full understanding of their physical cause*. An extreme example of magical thinking is the causation our early ancestors attributed to violent thunderstorms. Absent all the cleverly devised apparatus available today, their observations failed to detect the build-up of electric charges in the clouds, leading to undetected, rapid flows of electric charge between differently charged domains, creating undetected electromagnetic waves and undetected turbulence in the air. Their observations detected only the effect of the electromagnetic waves on their human eye-brain mechanisms (bright flashes of light) and of the turbulent air on their human auditory systems (loud grumbling sounds). This massive knowledge gap caused by the undetected phenomena and their undetected interactions forced our early ancestors to rely heavily on their pre-existing beliefs to give meaning to that which was observed. It is not surprising that they attributed the causation of thunderstorms to their having done something to anger the gods.

What our early ancestors failed to realize is that everything that happens in the universe is caused by objective physical phenomena operating under the laws of physics. The term "objective" is used to emphasize that reality is what actually happens, not whatever we may think happens, and is caused by the laws of physics as they really are, not by whatever we may think they are. Reality is blissfully indifferent to whatever we might think we observed and whatever we might think caused it. In the real world, nothing happens by chance (despite the visions arising from quantum mechanics). Every effect has a cause and their relationship lies in the laws of physics. We simply don't yet know what all of them are, nor are we likely to as long as we remain subject to the human condition.

Neither Dr. Einstein nor any physicist in the early part of the 20th century had the benefit of possessing a laser. The observations upon which Einstein depended to inform his thought experiments addressed only the scalar speed at which light travels. The directionality of light wasn't even recognized as an issue. Because the technology for observing light hadn't developed sufficiently to capture the significance of directionality, Einstein did not recognize that light can appear to be propagating in one direction while actually propagating in another. He also didn't recognize the potential for observation errors caused by motion-induced illusions. He was willing to accept incorrect observations as being valid simply because they were made by observers in inertial reference frames. In essence, the failure of available observations to detect the directionality of light required him to rely on his faith in the universal applicability of the principle of relativity rather than on a full understanding of the behavior of light.[36] As a consequence, he assigned a false causation (i.e., time dilation) to the difference in observations of the speed of light made from different inertial reference frames. As shown in Section 3, the difference is caused by observation error, not by time dilation.

Unless we are ready to close the patent office, it is likely that we still need unknown kinds of new apparatus to detect as yet undetected phenomena. While the apparatus we have in modern times significantly reduces the magnitude of our knowledge gaps, at least relative to those of our early ancestors, we still can't know what our observations fail to detect. If the gaps remain large, the exposure to magical thinking remains large. And there is no way of determining how large the gaps are. Thus, we should take care not to be unduly confident that our shiny array of modern apparatus has rendered us immune to magical thinking.

V. The Innate Exposure to Blind Spots

Another innate problem humans face in their efforts to understand reality is blind spots, which can be encountered in at least two kinds of situations.

The significance of a new discovery to all of the myriad beliefs already embedded in generally accepted theory often is not recognized. That may occur simply because the new information arises from a different area of specialty than the one which is directly concerned with the affected theory. The two simply are never brought together. An example is the finding based on coronal observations of a NASA space probe in 1999 that the magnetic fields in the sun's corona are multiple orders of magnitude greater than previously believed.[37] Since the magnetic fields are in violent motion, Maxwell's equations tell us that the corona's electric fields also must be correspondingly denser than previously believed. Magnetic fields are known to push and pull on each other. So are electric fields. The stronger-than-expected electric and magnetic fields in the sun's corona will push and pull on the electric and magnetic fields of the light that transits the corona, thereby slowing down its forward propagation and causing optical refraction. Generally accepted theory holds that the sun's corona is non-refractive since there are virtually no charged particles there.[38] The NASA finding has been of interest to physicists working to explain the corona's unexpectedly high temperature, yet it appears that no one has considered other possible implications of the significantly greater coronal density. Given the history of Einstein's general theory of relativity, this would appear to be a potentially significant blind spot.

The expectation that the sun's corona is optically non-refractive is the reason why, in 1919, Einstein's theories were catapulted virtually overnight from raging controversy to general acceptance.[39] Einstein's general theory is based on his principle of equivalence between gravity and acceleration.

"No observer can determine by experiment
whether he or she is accelerating or is
rather in a gravitational field."[40]

Because light would be seen to bend if a reference frame were moving at a high rate of acceleration, Einstein's principle required him to conclude that light would bend in the same manner if the reference frame were stationary in a strong gravitational field.[41] The first opportunity to test that extraordinary and controversial prediction was a full solar eclipse occurring in 1919. The renowned British scientist Sir Arthur Eddington traveled to the location of the full eclipse for the sole purpose of verifying Einstein's prediction. Eddington's observation of starlight being bent as it passed through the sun's corona was accepted as irrefutable proof of Einstein's general theory.[42] However, to the extent that the corona's previously unrecognized field density can account for the observed refraction, the interpretation given to Eddington's observation is brought into question.

This issue becomes particularly relevant now that the laser has emerged from its own blind spot to disprove the beliefs that underlie the special theory. As it happens, the information provided in Section 2 also disproves Einstein's principle of equivalence between gravity and acceleration. As shown in Figures 2-3 through 2-7, the apparent bending of light due to motion is an illusion, not the actual bending of light, and is caused by velocity, not by acceleration. Even if light were bent by gravity, the result in a reference frame that is stationary in a gravitational field would be a stationary, bent beam of light. The gravitational field would be steady and the light's bend would not change. However, if a reference frame is accelerating in open space, the amount of apparent bending, which is caused by velocity, would not be steady. The light would appear to bend farther and farther away from where the laser is pointed as acceleration increases velocity. Thus, the presumably "equivalent" sources of bending not only are different in kind (i.e., one real and one illusionary) but can't even be made to look the same (i.e., one being stable and the other ever-changing). Clearly, there is a problem with the principle of equivalence. For more than a decade, we have had evidence of much greater optical refraction in the sun's corona than is recognized in generally accepted theory. And we have had the laser for more than half of a century. Yet, this information is only now emerging from a communal blind spot with respect to their applicability to the theories of relativity.

The other kind of blind spot is encountered when we believe in something so absolutely that no merit is seen in even bothering to question it. Indeed, anyone foolish enough to do so is dismissed out of hand. An example is the subject of this report, Einstein's theories of relativity.

VI. The Exposure to Circular Reasoning

As mentioned previously, the human decision process is guided by what we know, aka what we believe. Sometimes we believe in something so absolutely that it becomes its own proof. A simple example might be the proud owner of Fido the dog. Owner: "Everyone just loves Fido because he is such a terrific dog!" Listener: "What makes him so terrific?" Owner: "He's the kind of dog everyone loves!"

A more subtle form of circular reasoning can be found in the long history of experimental validation of Einstein's theories of relativity. For an example, we need go no farther than the prediction of time dilation described in Section 3. *The reason why the theory predicts time dilation is the same reason why the prediction survives experimental validation*. Both will occur as long as the scientists involved believe, either consciously or subconsciously, that observations made from all inertial reference frames are equally valid.

- The postulates of the special theory require it to accept the observations of observers in different inertial reference frames as being equally valid. They also require that observations of the speed of light produce the same speed *c*. Given these commands, the theory must adjust the passage of time in the more rapidly moving reference frame to reconcile the conflict between the disparate observations. Section 2 and Figures 3-7 and 3-8 all show that an observer whose reference frame is in motion, as measured from a state of rest in three-dimensional space, will experience a motion-induced optical illusion. It is the treatment of this illusion as reality which leads inexorably to the prediction of time dilation.

- The mathematics of the special theory execute the postulates with great precision. They predict with great accuracy what the observers in different inertial reference frames will “observe,” based on their motion relative to each other. They also calculate with great accuracy the amount of time dilation required to bring the disparate observations in line with the correct speed of light. No matter what experiment we may run, the theory will correctly predict the experiment’s “observations,” including the ones which are illusionary, and will correctly calculate the amount of time dilation required to reconcile them. But because the propagation of light is a vector phenomenon rather than scalar, some of the predicted “observations” are illusionary. (Recall that the spaceship observer in Figure 3-8 will “see” the diagonally propagating burst of light as moving vertically on a shorter path.)
- As long as physicists believe that all observations made in inertial reference frames have equal merit (i.e., what is observed must be accepted as real) the results of experiments always will show that “reality” matches the theory’s predictions.
- What we’ve been doing is subconsciously using the flawed logic of the two postulates to validate experimental observations, some of which were illusionary. We then used the spuriously validated observations to validate the theory’s predictions, which were produced by the same two postulates. A more classic example of circular reasoning would be difficult to find.

The examples presented in this section are by no means an exhaustive study of the problems posed to science by the human condition. But they do illustrate the merits of humility, an open mind and an alertness to the pitfalls posed by virtue of being human. If one’s vocation is the discovery of reality, being human can be a serious impediment.

AFTERWORD

It may be a truism that information is never explained in the same manner as it was discovered. Discovery is a messy process. It is rife with unproductive sojourns down myriad paths through a veritable briar patch of suppositions, conflicting interpretations and competing alternatives. It is full of fits and starts, repeated corrections of wrong assumptions, wasted effort and much frustration. If the effort eventually succeeds in producing new and useful information, it often is almost intuitively obvious. One's response to its disclosure often is "That's pretty obvious. Why didn't I think of that?" At the very least, once one is in possession of the information there are far simpler ways to explain it than to regurgitate the pig's breakfast of disheveled ruminations that unearthed it. The same is true of this paper.

In November 2011, I published a book titled *Relativity Revisited*[43] which presents the thought process I used to unveil the flaws in Einstein's theories. The book takes a more circuitous route than what is presented in this paper. It's still a far cry from regurgitating the pig's breakfast if only because it omits the plethora of paths through the briar patch that weren't productive. However, at the time the book was published, I had learned only how to use the laser's characteristics to disprove Einstein's interpretation of specific observations, as shown in Section 3's analysis of time dilation. I hadn't yet realized that they can be used to disprove Einstein's expanded principle of relativity itself. Armed with that information, Section 2 of this paper takes the direct approach to "game over." That is done here quite deliberately. The purpose is to demonstrate directly and unequivocally that the special theory is fatally flawed at its very foundation. Because the divergence of a laser's trajectories will be different in different inertial reference frames, the principle of relativity does not apply to the propagation of light. The intent of this direct approach is to interest professional scientists in reexamining Einstein's theories with a more open mind. That includes encouraging colleagues to accept this paper into peer review.

Neither well established scientists nor the general public are aware of how difficult it is to get new information accepted into peer review. Established scientists have no problem with having material accepted for peer review and the general public only hears about what has been accepted. And even material which is accepted for peer review faces significant obstacles to an unbiased review. Dr. Lee Smolin, a Harvard Ph.D. and a founder of the innovative Perimeter Institute, has been moved to write a book about how hard it is both to introduce new information into the realm of physics and to obtain a full and unbiased review.[44] Dr. Smolin's concern is that scientific progress is being impaired by the scientific community's tendency to summarily reject new ideas that conflict with generally accepted theory and to disregard information that originates from outside the recognized professional community. A few of the examples he describes in his book are:

- A general unwillingness to consider new and surprising information.[45]
- Active opposition to startling and controversial new ideas, even when they come from professional physicists.[46]

- A tendency to not take seriously any proposal that comes from people who do not have recognized status in the academic world.[47]
- A disregard for and absence of interest in the work even of recognized experts who are not a part of one's own specialty.[48]

Even the formal procedures created specifically to accept and review new information are closed to anyone who is not already an established professional with recognized credentials. For example, here are some quotes from the submittal instructions of a major peer review administrator, the Cornell University Library (arXiv.org):

- "Endorsement is a necessary but not sufficient condition to have papers accepted in arXiv ..."[49]
- "It's best for you to find an endorser who (i) you know personally and (ii) is knowledgeable in the subject area of your paper – a good choice for graduate students would be your thesis advisor or another professor in your department working in your field."[50]
- "… people who fail to get endorsement are still free to post articles on their web site … "[51]

In other words, even a Ph.D. candidate on the honors program is barred from entering material into the official channels for peer review unless it is endorsed by an established professional with full academic credentials. The same is true of the other peer review paths I examined. For an amateur physicist, no matter how knowledgeable he may be and no matter how clearly his paper may support his findings, the door is firmly closed. His material won't even be looked at, let alone accepted for professional review.

As suggested in arXiv's submittal instructions, this paper is formally submitted for professional review by its publicly announced availability, without charge or obligation, on its author's website calkinspublishing.com. The professional physics community is respectfully requested to subject it to review.

With my regards, Richard O. Calkins

ENDNOTES

[1] A reference frame is a physical place or a set of coordinates relative to which measurements can be made. An inertial reference frame is one in which Newton's first law of motion applies. This includes only reference frames that are either 0olstationary or moving at a constant velocity in a straight line. Giancoli, Douglas C., *Physics*, 4th edition (Englewood Cliffs, New Jersey: Prentice Hall, 1995), 20-21, 76, 743-746.
[2] Ibid., 744-745.
[3] Ibid., 743.
[4] Goldsmith, Dr. Donald, and Robert Libbon, *Einstein: A Relative History* (New York: Simon & Schuster, Inc., 2005), 48. Cutnell, John D. and Kenneth W. Johnson, *Physics,* 5th edition (New York, John Wiley & Sons, Inc., 2001), 865.
[5] Gribbin, John and Mary Gribben, *Annus Mirabilis: 1905, Albert Einstein, and the Theory of Relativity* (New York: Chamberlain Bros., Penguin Group, Inc., 2005), 96-97.
[6] Perkowitz, Sidney, *Empire of Light: A History of Discovery in Science and Art* (New York: A John Macrae Book, Henry Holt and Company, 1996), 61.
[7] Cox, Brian and Jeffery Forshaw, *Why Does E=MC^2: (and why should we care?),* (Cambridge, Massachusetts: Da Capo Press, A Member of the Perseus Books Group, 2009), 28, 41. Goldsmith, *Einstein: A Relative History*, 67. (Note that the value for the speed of light *c* is expressed as 299,792,458 m/s, 299,792.5 km/s, or 3.00x10^8 m/s depending on the reference source. All are essentially the same number with only slight differences in rounding.)
[8] Ibid.
[9] Giancoli, *Physics,* 745-746.
[10] Aczel, Amir D., *God's Equation* (New York: Four Walls Eight Windows, 1999), 22. Cox, *Why Does E=MC^2: (and why should we care?),* 29.
[11] Giancoli, *Physics, 745.*
[12] Perkowitz, *Empire of Light*, 66-68. Giancoli, *Physics,* 746-749.
[13] Giancoli, *Physics*, 749.
[14] Aczel, *God's Equation*, 24. John S. Rigdon, *Einstein 1905: The Standard of Greatness* (Cambridge, Massachusetts: Harvard University Press, 2005), 95.
[15] Giancoli, *Physics,* 750.
[16] Ibid. Goldsmith, *Einstein: A Relative History*, 67.
[17] Giancoli, *Physics,* 750.
[18] Goldsmith, *Einstein: A Relative History, 70.*
[19] Giancoli, *Physics,* 750.
[20] Hey, Tony and Patrick Walters, *Einstein's Mirror,* (New York: Cambridge Press, 1997), 43. Goldsmith, *Einstein: A Relative History,* 67.
[21] Giancoli, *Physics,* 750.
[22] Goldsmith, *Einstein: A Relative History*, 67-70.
[23] Ibid., 48. Gribbin, *Annus Mirabilis,* 96-97.
[24] Goldsmith, *Einstein: A Relative History*, 49.
[25] Aczel, *God's Equation*, 22. Goldsmith, *Einstein: A Relative History*, 73.
[26] Goldsmith, *Einstein: A Relative History,* 73.
[27] Ibid.
[28] Ibid.
[29] A unit of light used for the purpose of observing its speed and direction of propagation need be only small enough to assure accurate measurement. It might be a single photon or, more commonly, a small burst of photons. It might also be defined as a very short burst of tightly focused coherent light from a laser or as a specific, very small area on the surface of a concentrically expanding electromagnetic wave.
[30] Giancoli, *Physics,* 753-757. Cutnell, *Physics,* 5th edition , 867-871. Young, Hugh D., and Roger A. Freedman, *Sears and Zemansky's University Physics, Volume 3,* 11th edition (San Francisco, California: Pearson Addison Wesley, 2004), 1409-1413.
[31] Giancoli, *Physics*, 755.
[32] Goldsmith, *Einstein: A Relative History*, 48.
[33] Ibid., 49.
[34] Calkins, Richard O., *Relativity Revisited* (Sammamish, Washington: A Different Perception, 2011), 69-92.
[35] *The American Heritage Dictionary of the English Language*, (Boston, Houghton Mifflin Company, 1981), 906.

[36] Giancoli, *Physics,* 750.
[37] V. M. Nakariakov, et al, "TRACE Observations of Damped Coronal Loop Oscillations: Implications for Coronal Heating. " *Science,* 285, August 6, 1999.
[38] Faughn, Jerry S., Jonathan Turk and Amos Turk, *Physical Science*, (San Francisco, California: Saunders College Publishing, 1991), 589.
[39] Goldsmith, *Einstein: A Relative History*, 164-165.
[40] Giancoli, *Physics*, 948.
[41] Goldsmith, *Einstein: A Relative History*, 132.
[42] Ibid., 164-166
[43] Calkins, Richard O., *Relativity Revisited*
[44] Lee Smolin, *The Trouble With Physics: The Rise of String Theory, the Fall of Science, and What Comes Next* (New York, Houghton Mifflin Company, 2006).
[45] Ibid., 203, 204.
[46] Ibid., 224, 225.
[47]Ibid., 266, 267.
[48] Ibid., 270, 284.
[49] http://arXiv.org/help/endorsement, 1, accessed on 6/26/2012.
[50] Ibid., 2.
[51] Ibid., 1.