Experiments to Test Whether or Not Light Acquires the Velocity of Its Source, Using Current Technology

Richard O. Calkins and Raymond HV Gallucci, PhD, PE

2125 Sahalee Drive E., Sammamish, Washington, rocalkins@msn.com; 8956 Amelung St., Frederick, Maryland, 21704, gallucci@localnet.com, r_gallucci@verizon.net

A friendly debate between the authors characterizes one that is prevalent among the community of 'dissident' physicists who do not accept Einstein's relativity as the final explanation for the behavior of light. They wonder whether or not light acquires the velocity of its source. Maxwell's equations strongly suggest a fixed speed for light upon its emission from a source. Is the emission point fixed in space? Would motion of the emitter alter the trajectory (and speed?) of the emitted light? Light's immense speed makes determining this extremely difficult to answer on a scale less than astronomical. For example, despite supposed 'definitive' proof that there is no aether and light speed is universally constant alleged by proponents of a 'null' result from the 1887 Michelson-Morley Interferometer Experiment, debate continues over both of these subjects. The authors propose experiments using current technology that might be able to offer a definitive resolution to this debate, or possibly open up even more speculation.

Keywords: light, relativity, experiments, airplane, optical laser, rocket sled

1. Introduction

Author Richard Calkins (The Problem with Relativity) and his editor, Raymond Gallucci, have continued a friendly debate as to whether or not light acquires the velocity of its source. [1] Their contentions characterize a debate prevalent throughout the community of 'dissident' physicists, i.e., those who do not worship at the altar of Einstein's relativity, the Big Bang, black holes, dark matter, dark energy, etc.

Calkins believes in the primacy of Maxwell's equations and contends that light will always be released in a straight-line vector if uni-directional, e.g., from a laser, or spherical array or straight-line vectors if omni-directional, e.g., a light bulb, at constant speed c from a fixed point regardless of whether or not the source (e.g., laser or light bulb) is in motion. Besides Calkins' The Problem with Relativity, *Relativity Revisited* and *A Report on How the Optical Laser Disproves the Special Theory of Relativity* [1]; other proponents of this viewpoint include Justin Jacobs in *The Relativity of Light* [2], and Carel van der Togt in *Unbelievable: From Paradox to Paradigm* [3].

Gallucci believes that, while Maxwell's equations are valid relative to light's emission from its source, light can acquire the source's velocity as well, as in classical mechanics, such that it travels from its fixed release point as the vector sum of $\underline{c}$ and $\underline{v}$ (source velocity). [4], [5], [6] Similar proponents include Stephen Bryant in his website www.RelativityChallenge.com, Bernard Burchill in *Alternative Physics: Where Science Makes Sense* and the late Paul Marmet in *Stellar Aberration and Einstein's Relativity*. [7], [8], [9]

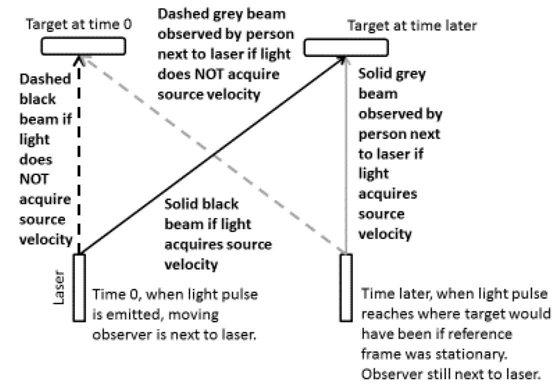

Figure 1. Competing Perspectives Depending upon whether or not Light Acquires the Velocity of its Source

Figure 1 illustrates the competing theories. If light does not acquire its source's velocity, it travels the dashed paths. A stationary observer would see the dashed black path, while a moving observer would next to the laser would see the dashed grey path. If light acquires its source's velocity, it travels the solid paths, the black seen by the stationary observer while the moving observer sees the grey path.

This paper asks if current technology can resolve this

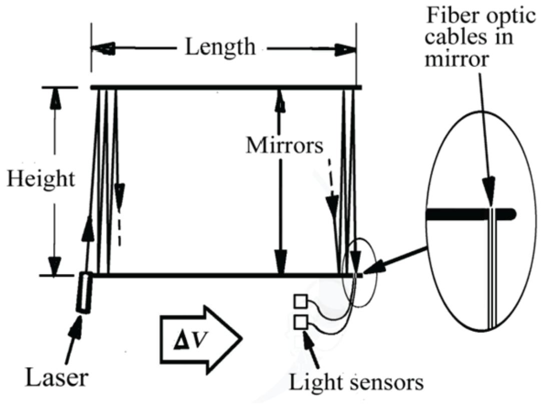

Figure 2. Calkins' Generic Experimental Apparatus

debate experimentally? Both Calkins and Gallucci propose experiments that can be performed here on Earth using current technology that might be able to do so, without having to resort to astronomical observations over vast distances where independent verification of the distances and times is difficult, if not for all practical purposes impossible, to achieve definitively.

2. Calkins' Airplane Experiment

A complete description of Calkins' proposed experiment and the theory behind it are provided in The Problem with Relativity [1] They are too extensive to reproduce here; therefore, only the experiment itself is described.

To keep the physical dimensions of the experimental apparatus tractable and increase the accuracy of measuring distance, a design similar to the one illustrated in Figure 2 is proposed. The test apparatus consists of a horizontal assembly of two mirrors facing each other vertically. A laser is mounted at one end of the bottom mirror and two fiber optic cables are terminated at the other end of the bottom mirror. The fiber cables are placed one behind the other in terms of the vector direction of travel (i.e., the laser, optical fiber and the test platform's velocity vector all are on the same straight line).

The laser is oriented vertically except for the miniscule angle required to reflect through the mirror array. The optical fibers route the light to the light intensity sensors. The mirror assembly allows a much longer optical path between the laser and the targets than would be manageable using a long, straight vertical pole. The fiber optic cables can be mounted either on the top mirror or the bottom mirror depending on whether an even number or an odd number of reflections best matches the expected test conditions.

The experiment consists of aligning the laser so that its beam of light strikes the open end of the farthest optical fiber (the alignment detector) while the test platform is in an inertial state of motion. The test platform then is accelerated to a new inertial reference frame which is moving horizontally at Δv relative to the first reference frame. The specific value for Δv will be determined by the total length of the path through the mirror assembly and the distance $d_{\Delta v}$ between the centers of the optical fiber detectors. The multiple reflections through the mirror assembly and the short distance between the optical fibers allow one to measure a change in the light beam's trajectory with a physically small test assembly at an achievable platform velocity.

2.1. Example Test Assembly

The design objective is to make it possible to perform the experiment using available optical technologies and an existing physical reference frame while maintaining the integrity of the empirical results. The following assumptions are used for illustration based on a cursory review of available technologies.

1. The optical laser can be focused to have a beam width of $100\mu m$ at a distance of up to $135m$.
2. Fiber optic cables can be used to detect the laser's light beam and direct it to the light intensity sensors.
3. Fiber optic cables which are suitably shielded and clad can be obtained with a total diameter no greater than $100\mu m$.
4. Existing light intensity sensors can determine within acceptable limits of accuracy when the light intensities received from two fiber optic cables are equal to each other and when the respective light intensities have been reversed from what they were in the first reference frame.
5. Mirrors up to $1.5m$ in length facing each other at a distance of up to $0.5m$ can be made with tolerances which will not significantly alter the total length of their reflections or interfere with the ability to deliver the laser's beam to the distant end.

The following terms, symbols and conversions are used in the example design.

1. $d_{\Delta v}$ is the distance between the alignment detector and the test detector (i.e., the fiber optic cables mounted in the bottom mirror at the far end from the laser). This is the distance the laser's vertical light beam will shift when the laser's horizontal velocity is changed by Δv.
2. d_c is the total length of the reflected laser beam between the laser and the alignment detector.
3. d_h is the vertical distance between the faces of the mirrors.
4. d_m is the distance between the center line of the laser's output window at one end of the bottom mirror and the center line of the alignment detector at the other end.

5. d_r is the distance between adjacent reflections on the surface of the mirrors.

6. d_{RT} is the distance the laser beam travels on one round trip (RT) between the mirrors. It includes the effect of the vertical distance between the mirrors and the horizontal distance between reflections.

7. d_v is the vertical component of the laser beam's total reflected path through the mirror assembly. This is what the length of the reflected path would be if it were not necessary to put space between reflections to avoid interference.

8. Δv is the change in the laser's horizontal velocity which is required to shift the laser's beam from the alignment detector to the test detector.

9. $1km = 0.62317mi$.

10. $c = (299,792.5km/s)(0.62317km/mi)(3600s/hr)$, i.e., $6.7062x10^8 mph$.

2.2. Example Design Procedure

The design begins with the selection of a practicable size for the experimental assembly and a practicable speed for the mobile test platform. It also must be large enough to assure accurate alignment with the mobile test platform's in-motion velocity vector and to allow enough distance between adjacent reflections on the mirror surfaces to avoid interference. The two countervailing objectives must be apporpriately balanced.

It appears that a practicable size for the experimental assembly would be horizontal mirrors not longer than $1.5m$ and spaced not more than about $0.5m$ apart. The laser must be rotated slightly from vertical to reflect through the mirror assembly to the fiber optic detectors. The test velocity Δv should be such that it can be achieved by virtually any readilyu available business jet. After several trial attempts, the example design was developed by selecting the following starting objectives:

1. The objective speed Δv to conduct the experiment was set at $500mph$.

2. The vertical distance between the facing mirrors d_h was set at $0.5m$.

3. The distance $d_{\Delta v}$ between the center line of the alignment detector and the center line of the test detector was set at $100\mu m$.

4. The distance between adjacent reflections on the mirrors d_r was set at $10mm$.

Given the above design selections, the objective value of d_c would be $cd_{\Delta v}/\Delta v = (6.7062x10^8 mph)(100x10^{-6}m)(500mph) = 134.124m$. That is the total length of reflected beam required for a horizontally moving laser's beam to shift $100\mu m$ from the alignment detector tot he test detector at a velocity of $500mph$. With a vertical distance between the mirrors d_h of $0.5m$ and a horizontal distance between reflections d_r of $10mm$, the distance d_{RT} traveled by the light beam in one RT between the mirrors is

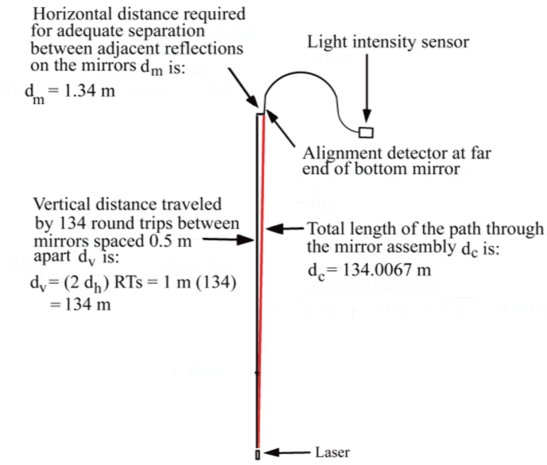

Figure 3. How the Optical Path through the Test Assembly Compares with a Vertical Path

$2\sqrt{d_h^2 + (0.5d_r)^2} = 1.00005m$. The number of RTs required to produce the beam length of $134.124m$ would be equal to the beam length d_c divided by the distance traveled in each RT between the mirrors d_{RT}, i.e., $(134.124m)/(1.00005m) = 134.117RTs$. Because the number of RTs must be an integer number, this is set at $134RTs$.

With $134RTs$ required between the mirrors and a distance between reflection of $10mm$, the physical distance between the laser and the alignment detector on the bottom mirror will be $(134RTs)d_{\Delta v} = (134RTs)(10x10^{-3}m/RT) = 1.34m$. d_m is the horizontal component of the light beam's travel through the mirror assembly. The vertical component of its drip d_v is $2d_h(134RTs) = 2(0.5m)(134) = 134m$. The resulting length of the trip through the mirror assembly d_c is the hypoteneuse of a right triangle whose horizontal side is d_m and whose vertical side is d_v, i.e., $\sqrt{d_v^2 + d_m^2} = \sqrt{134m^2 + 1.34m^2} = \sqrt{17957.7956m^2} = 134.0067m$.

As shown in Figure 3, this produces an essentially vertical path between the laser and the alignment detector. Also, the effect of the mirrored design's limitation to an integer number of RTs and for an adequate distance between reflections has very little effect on the velocity required to perform the experiment. The effect of all of these limitations imposed by the architecture of the mirror assembly is simply to change the required value of Δv from $500mph$ to $500.44mph$, i.e., $cd_{\Delta v}/d_c = (6.7062x10^8 mph)(100x10^{-6}m)(134.0067m) = 500.44mph$.

The resulting experimental design is shown in Figure 4. It is intended to create an effectively vertical path from the laser to the alignment detector within a readily trans-

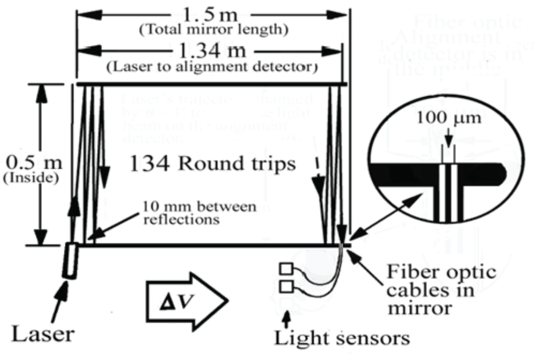

Figure 4. Example Experimental Design

portable test assembly which can ride in a jet aircraft. The dimensions of the mirror assembly can be modified tosuit a wide variety of available test platforms, of which this design is only one example.

2.3. Conducting the Experiment

The experiment consists of the following stages:

1. Install the experimental assembly in the mobile test platform (e.g., jet aircraft). Align the laser and optical fibers (mounted at opposite ends of the bottom mirror) so that they will be in line with the aircraft's velocity vector when in flight. Secure the assembly to maintain that orientation. The alignment between the laser and the detectors must be on the same straight line as the aircraft's velocity vector when the aircraft is in level flight in a constant direction.

2. Pre-align the laser so that the center of its beam is aligned at the center of the alignment detector when the number of RTs is equal to 134.

3. with the aircraft on the runway for take-off, fine tune the laser to assure that the light's maximum intensity is directly centered on the alignment detector. Record the light intensity on both detectors.

4. Place the aircraft in flight and establish a straight, level flight path which is in the same vertical and horizontal orientation as when the laser was aligned.

5. Increase the velocity of the aircraft to $240mph$. Then, very slowly, increase its velocity until the alignment detector and the test detector have identically the same level of light intensity. Record the aircraft's velocity and the light intensity at the detectors either continuously or at short intervals of time to assure detecting the specific velocity at which equal intensity occurs. If light responds to the momentum of its source ()i.e., acquires its source's velocity), as required by the first postulate of Einstein's relativity, the intensity measured at the alignment detector and the test detector will be unchanged from what it was at alignment and the test detector will remain essentially non-illuminated. If light does not respond to momentum (i.e., does not acqire its source's velocity), the light intensity measured at the alignment detector and the test detector should be equal when the aircraft is at a velocity of approximately $250.2mph$.

6. Increase the aircraft's velocity to $490mph$. Then, very slowly, increase its velocity until the light intensities of the alignment detector and the test detector are precisely reversed from what they were at alignment. If light responds to momentum (i.e., acquires its source's velocity), the light intensity measured at the alignment detector during alignment will remain unchanged and the test detector will remain essentially dark. However, if light does not respond to momentum (i.e., does not acquire its source's velocity), the intensity readings at the alignment detector and the test detector should be fully reversed when the aircraft reaches a velocity of approximately $500.44mph$.

3. Gallucci's Rocket Sled Experiment

As illustrated in Figure 5, a rocket sled (star) accelerates from Points A to O, reaching a speed of $(10,000km/h)(2.8km/s)$, then decelerates to Point B. This distance between A and B is $50,000ft(15km)$. (Speed and distance taken from Hollomon High Speed Test Track, Hollomon Air Force Base, Alamogordo, New Mexico [10]). At O, the rocket sled shoots a pair of laser rays (perhaps a beam split from one laser to ensure uniformity) in opposite directions such that each travels $15/2 = 7.5km$ to reach detectors at A and B. To account for the curvature of the Earth (radius $6,400km$), each is raised by $\sqrt{6400^2+7.5^2}-6400 = 0.0044km(4.4m)$ relative to the track along which the rocket sled travels. This ensures the pair of laser rays traveling in straight lines reach each detector.

When stationary, the laser rays each take $(7.5km)/(300,000km/s) = 2.5x10^{-5}s(25\mu s)$ to reach each detector when released at O. If light does not acquire the velocity of a moving source, both rays will reach the detectors at this same time when the rocket sled is speeding at $2.8km/s$ when it shoots the laser rays at O (as per Special Relativity with time dilation/length contraction). If light acquires the velocity of a moving source (contrary to Special Relativity), the ray traveling from O to B will speed at $300,000+2.8km/s$, reaching B in $7.5/300,002.8s$, while the ray traveling from O to A will speed at $300,000-2.8 = 299,997.2km/s$, reaching A in $7.5/299,997.2s$. The difference in arrival times will be $7.5(\frac{1}{299,997.2}-\frac{1}{300.002.8}) = 4.7x10^{-10}s$ $(0.47ns)$. This is measureable with today's technology (e.g., [11]).

3.1. A Stationary Counterpart?

As per Calkins, et al., assume light does not acquire

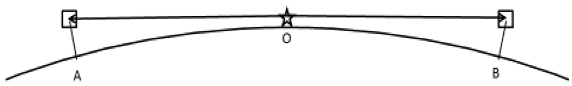

Figure 5. Rocket Sled Accelerates to Constant Speed at O, where Laser Beam is Emitted Simultaneously toward Equidistant Detectors at A and B

the velocity of its source, i.e., it is released from a fixed point in some sort of absolute space in a straight-line vector at constant speed c. Since the Earth rotates about its axis, the Earth orbits the Sun, and the Sun (solar system) orbits the galactic center, there is no such thing as a stationary point in absolute space anywhere within our galaxy except at its absolute center (ignoring possible movement of the galaxy itself relative to other galaxies). So, by definition, any light emitted from a laser on Earth, if not acquiring this velocity relative to our galactic center, should always veer off any vertical path - the laser need not be "moving" relative to the Earth's surface in any way.

Since the Earth orbits the Sun at $30km/s$, and the solar system orbits the galactic center at $220km/s$, then any object on the Earth's surface would be moving from 190 to $250km/s$ relative to this "absolute space" (ignoring the Earth's equatorial rotational speed of $0.5km/s$). As discussed below, light that does not acquire source velocity (in this case the Earth relative to the galactic center) should exhibit a rather profound shift from the vertical without its source moving at all relative to the Earth's surface.

If light does not acquire the velocity of its source (and note that Einstein appears to assume it acquires the direction but not the speed of its source, with the latter being held constant at $c = 300,000km/s$ via time dilation), then light from a laser pointing vertically upward at the equator to a target $1km$ immediately above it at midnight when the Earth and Sun lie directly in line with the galactic center would have to veer away from the target as a result of both the laser and target moving together somewhere between 190 and $250km/s$ away from the initial emission point of the laser light.

Independent of the source velocity, the light beam will travel at speed $c = 300,000km/s$ over a distance of $(1km)/cos[arcsin(\frac{190\ to\ 250km/s}{300,000km/s})] = 1.00000020\ to\ 1.00000035km$. For all practical purposes, this is still $1km$, so the time for light to travel this distance is $(1km)/(300,000km/s) = 3.33\mu s$. Over this time, the target and laser, in perfect vertical alignment, will have moved $(3.33x10^{-6}s)(190\ to\ 250km/s) = 0.00063\ to\ 0.00083km$, or 0.63 to $0.83m$ away from the point from which the laser initially emitted its light.

Therefore, if we could find (or construct) a vertically clear span at the equator (or actually anywhere on Earth, since the Earth's rotational speed is negligible compared to the speed about the galactic center) 1-km high (e.g., a sheer cliff?), we may be able to settle the issue as to whether or not light acquires the velocity of its source since $0.63-0.83m$ would be an indisputable shift off the vertical. A cliff such as El Capitan, 900-m high, would suffice, since the shift would still be a quite observable and indisputable $(0.63\ to\ 0.83m)(0.9km/1km) = 0.57\ to\ 0.75m$.

4. Summary

Calkins and Gallucci continue to engage in a friendly debate over whether or not light acquires the velocity of its source, characteristic of a difference of opinion among many 'dissident' physicists. Both have proposed experiments using current technology which might be able to come to a definitive conclusion, or else open up even more speculation if the results favor neither.

REFERENCES

1. R. Calkins, The problem with relativity; relativity revisited; a report on how the optical laser disproves the special theory of relativity (2011-2015), URL `www.calkinspublishing.com`.
2. J. Jacobs, The relativity of light (2009-2011), URL `www.RelativityOfLight.com`.
3. C. van der Togt, Unbelievable: From paradox to paradigm (2009), URL `www.paradox-paradigm.nl`.
4. R. Gallucci, Does light acquire the velocity of a moving source? (Proceedings of the 2nd Annual CNPS Conference (2016)), URL `www.naturalphilosophy.org`.
5. R. Gallucci, Questioning the cosmological doppler redshift (Proceedings of the 1st Annual CNPS Conference (2015)), URL `www.naturalphilosopy.org`.
6. R. Gallucci, Michelson-morley interferometer experiment of 1887: 'null' result (Proceedings of the 1st Annual CNPS Conference (2015)), URL `www.naturalphilosophy.org`.
7. S. Bryant, The relativity challenge (2016), URL `www.RelativityChallenge.com`.
8. B. Burchill, Alternative physics: Where science makes sense (2016), URL `http://alternativephysics.org/index.htm`.
9. P. Marmet, Stellar aberration; einstein's relativity (1996), URL `www.newtonphysics.on.ca/`

aberration/index.html.
10. Hollomon-Air-Force-Base, Hollomon high speed test track (Alamogordo, New Mexico (2015)), URL http://en.wikipedia.org/wiki/Rocket_sled.
11. Surface-Concept, Time measurement: Electronics devices for time measurement down to the picosecond range: Compact, fast and user-friendly (2011), URL www.surface-concept.com/products_time.html.