One Way Speed Of Light Based on Anderson's Experiment

Eric Su
eric.su.mobile@gmail.com
(Dated: September 9, 2018)

Based on Wilmer Anderson's experiment in 1937, the light detector is put in motion relatively to the mirror. Two light pulses are emitted from the mirror toward the detector. The elapsed time between two emissions is recorded on the oscilloscope. This elapsed time is larger if the detector moves away from the mirror faster. By comparing the elapsed time in the rest frame of the mirror to the elapsed time in the rest frame of the detector, the speed of light pulse in the rest frame of the mirror is found to be different from the speed of light pulse in the rest frame of the detector.

I. INTRODUCTION

In 1937, Wilmer Anderson carried out an experiment[1] to measure the speed of light. In his experiment, a light source emits light which passes through a Kerr Cell shutter to a distant half-silvered mirror. This mirror splits the light pulse from the shutter into two light pulses. One light pulse goes straight to the detector. The other light pulse takes a different and longer path to the detector. The detector consists of a photomultiplier connected to an oscilloscope. The speed of light pulse is calculated from the elapsed time between two light puslses recorded on the oscilloscope.

Anderson had measured the one-way speed of light with a stationary detector. It is the speed of light between a stationary light source and a stationary detector. However, his experiment can be adjusted to measure the one-way speed of light for a moving detector.

By moving the detector further away from the mirror, the oscilloscope will display a greater elapsed time between two light pulses. In the rest frame of the detector, the speed of light has changed according to this greater elapsed time.

II. PROOF

Consider one-dimensional motion between the mirror and the detector. Two light pulses are emitted from the mirror toward the detector sucessively.

A. Half-Silvered Mirror

Let the mirror be stationary in a reference frame F_1 Let the detector move at a speed of V relatively to F_1.

Let C_1 be the speed of light pulse in F_1. Let T_1 be the elapsed time between two light pulses leaving the mirror in F_1. Let L_1 be the distance between the detector and the mirror when the first light pulse leaves the mirror.

t_1 is the time for the first light pulse to travel from the mirror to the detector. The detector has moved an extra distance of $V * t_1$ when the first light pulse reaches the detector.

$$L_1 + V * t_1 = C_1 * t_1 \tag{1}$$

$$t_1 = \frac{L_1}{C_1 - V} \tag{2}$$

By the time the second light pulse leaves the mirror, the detector has moved a distance of $V * T_1$. Let L_2 be the distance between the detector and the mirror when the second light pulse leaves the mirror.

$$L_2 = L_1 + V * T_1 \tag{3}$$

t_2 is the time for the second light pulse to travel from the mirror to the detector. The detector has moved an extra distance of $V * t_2$ when the second light pulse reaches the detector.

$$L_2 + V * t_2 = C_1 * t_2 \tag{4}$$

$$t_2 = \frac{L_2}{C_1 - V} \tag{5}$$

The detector records two light pulses and displays the difference in arrival time on the screen of the oscilloscope. Let this time difference be td_1.

$$td_1 = t_2 + T_1 - t_1 \tag{6}$$

From equation (6,2,5),

$$td_1 = \frac{L_2}{C_1 - V} + T_1 - \frac{L_1}{C_1 - V} \tag{7}$$

From equation (7,3),

$$td_1 = T_1 + \frac{V * T_1}{C_1 - V} \tag{8}$$

$$= T_1 * (1 + \frac{V}{C_1 - V}) \tag{9}$$

B. Detector

Let the detector be stationary in a reference frame F_2. Therefore, the mirror moves at a speed of -V relatively to F_2.

Let C_2 be the speed of light pulse in F_2. Let T_2 be the elapsed time between two light pulses leaving the mirror in F_2. Let L_1 be the distance between the mirror and the detector when the first light pulse leaves the mirror.

t_1 is the time for the first light pulse to travel from the mirror to the detector.

$$L_1 = C_2 * t_1 \tag{10}$$

$$t_1 = \frac{L_1}{C_2} \tag{11}$$

By the time the second light pulse leaves the mirror, the mirror has moved a distance of V*T. Let L_2 be the distance between the detector and the mirror when the second light pulse leaves the mirror.

$$L_2 = L_1 + V * T_2 \tag{12}$$

t_2 is the time for the second light pulse to travel from the mirror to the detector.

$$L_2 = C_2 * t_2 \tag{13}$$

$$t_2 = \frac{L_2}{C_2} \tag{14}$$

The detector records two light pulses and displays the difference in arrival time on the screen of the oscilloscope. Let this time difference be td_2.

$$td_2 = t_2 + T_2 - t_1 \tag{15}$$

From equation (15,11,14),

$$td_2 = \frac{L_2}{C_2} + T_2 - \frac{L_1}{C_2} \tag{16}$$

From equation (16,12),

$$td_2 = T_2 + \frac{V * T_2}{C_2} \tag{17}$$

$$= T_2 * (1 + \frac{V}{C_2}) \tag{18}$$

C. Oscilloscope

Two wave forms are displayed on the screen of the oscilloscope. This display is identical in any reference frame.

$$td_2 = td_1 \tag{19}$$

From equation (19,9,18),

$$T_1 * (1 + \frac{V}{C_1 - V}) = T_2 * (1 + \frac{V}{C_2}) \tag{20}$$

The elapsed time is independent of reference frame, according to this paper, "Time and Reference Frame"[14].

$$T_1 = T_2 \tag{21}$$

From equation (21,20),

$$1 + \frac{V}{C_1 - V} = 1 + \frac{V}{C_2} \tag{22}$$

$$C_1 - V = C_2 \tag{23}$$

The speed of light pulse in F_1 differs from the speed of light pulse in F_2 by V. In the rest frame of the detector, the light pulse moves slower if the mirror is moving away. The light pulse moves faster if the mirror is approaching.

III. CONCLUSION

As the detector moves away from the mirror, the speed of light pulse in the rest frame of the detector become smaller than the speed of the same light pulse in the rest frame of the mirror. If the mirror moves away from the detector, the speed of light pulse in the rest frame of the detector also become smaller than the speed of the same light pulse in the rest frame of the mirror.

The speed of light remains constant only in the rest frame of the light source.

The speed of light depends on the reference frame. The relative motion between two reference frames determines the different speeds of the same light in these two reference frames.

Lorentz Transformation[2] was proposed on the assumption[8] that the speed of light is independent of inertial reference frame.

As the result of this incorrect assumption, Lorentz Transformation violates Translation Symmetry[3] and Conservation of Momentum[9,10,11,12,13] in physics. Translation Symmetry requires conservation of simultaneity[4], conservation of distance[5], and conservation of time[6]. All three conservation properties are broken by Lorentz Transformation.

Therefore, Lorentz Transformation is not a valid transformation in physics. Consequently, any theory based on Lorentz Transformation is incorrect in physics. For example, Special Relativity[7]

[1] Wilmer C. Anderson: Final Measurements of the Velocity of Light. (1941 Optical Society of America). https://www.osapublishing.org/josa/abstract.cfm?uri=josa-31-3-187

[2] H. R. Brown (2001), The origin of length contraction: 1. The FitzGeraldLorentz deformation hypothesis, American Journal of Physics 69, 1044 1054. E-prints: gr-qc/0104032; PITT-PHIL-SCI00000218. http://vixra.org/abs/1712.0130

[3] Eric Su: Special Relativity and Coordinate Transformation. viXra: Relativity and Cosmology/1711.0354 (2017), http://vixra.org/abs/1711.0354

[4] Eric Su: Simultaneity and Translational Symmetry. viXra: Relativity and Cosmology/1706.0498 (2017), http://vixra.org/abs/1706.0498

[5] Eric Su: Coordinate Transformation Between Inertial Reference Frames. viXra: Relativity and Cosmology/1709.0120 (2017), http://vixra.org/abs/1709.0120

[6] Eric Su: Reflection Symmetry and Time. viXra: Relativity and Cosmology/1704.0187 (2017), http://vixra.org/abs/1704.0187

[7] Reignier, J.: The birth of special relativity - "One more essay on the subject". arXiv:physics/0008229 (2000) Relativity, the FitzGerald-Lorentz Contraction, and Quantum Theory

[8] B. J. Hunt (1988), The Origins of the FitzGerald Contraction, British Journal for the History of Science 21, 6176. http://vixra.org/abs/1802.0010

[9] Eric Su: Twin-Body Orbital Motion in Special Relativity. viXra: Relativity and Cosmology/1803.0090 (2018), http://vixra.org/abs/1803.0090

[10] Eric Su: Gravitational Force and Conservation of Momentum. viXra: Relativity and Cosmology/1803.0005 (2018), http://vixra.org/abs/1803.0005

[11] Eric Su: Conservation of Momentum vs Lorentz Transformation. viXra: Relativity and Cosmology/1802.0326 (2018), http://vixra.org/abs/1802.0326

[12] Eric Su: Lorentz Transformation and Elastic Collision. viXra: Relativity and Cosmology/1802.0099 (2018), http://vixra.org/abs/1802.0099

[13] Eric Su: Standing Wave and Reference Frame. viXra: Relativity and Cosmology/1712.0130 (2017),

[14] Eric Su: Time and Reference Frame. viXra: Relativity and Cosmology/1807.0027 (2018), http://vixra.org/abs/1807.0027