Translational Symmetry and FitzGerald-Lorentz Contraction

Eric Su
eric.su.mobile@gmail.com

(Dated: March 16, 2017)

Translational symmetry in one-dimensional space requires the distance between two objects moving at equal speed under equal acceleration to be constant in time. However, motion between the object and the observer is relative. Therefore, this distance is constant in time for an accelerating observer. Consequently, the length of an accelerating object is constant in time. The length of an object is invariant to its motion.

I. INTRODUCTION

FitzGerald-Lorentz Contraction is a hypothesis proposed by George FitzGerald in 1889[1] and Hendrik Lorentz in 1892[2] in an attempt to explain the null result of the Michelson-Morley experiment in 1887[3]. This hypothesis claims that a moving body will contract more in the direction of motion if it moves faster.

During 1899-1904[4], Hendrik Lorentz proposed Lorentz Transformation which asserts that the distance between two locations in a moving reference frame will become shorter if the speed of this reference frame is greater.

In this paper, translational symmetry will be the fundamental concept of a rigorous examination on both FitzGerald-Lorentz Contraction and Lorentz Transformation.

II. PROOF

Consider one-dimensional motion.

A. Conservation of Distance

An object moving at a constant speed will travel a certain distance over certain time. According to translational symmetry, such distance is invariant to the starting location of this object. Two such objects of equal speed at different starting locations will travel an equal distance over the same duration. Therefore, the distance between these two objects is constant in time.

Put both objects under equal acceleration at the same time. Both will travel an equal distance over the same duration. Therefore, the distance between these two objects is still constant in time while both objects accelerate.

Proof 1.**To an observer at rest, the distance between these two objects is invariant as long as both objects move at the same speed.**

B. Reference Frame

Consider two reference frames in motion relative to each other. Place this pair of objects at rest in one reference frame F1. Place the observer at rest in another reference frame F2. Put F1 under acceleration relative to F2.

Proof 2.**As stated in *Proof 1*, the distance between two objects in F2 is constant in time to the observer in F2 and irrelevant to the relative speed between F1 and F2.**

C. Relative Motion

In one-dimensional space, motion between the object and the observer is relative.

Let a rod and an observer both be at rest. The observer starts to accelerate along the longitudinal axis of this rod. The observer will claim that this rod is moving and the distance between both ends of this rod remains constant in time as stated in *Proof 2*.

Proof 3. **Therefore, the length of a moving object in the direction of motion is invariant with respect to its speed.**

III. CONCLUSION

In one-dimensional space, translational symmetry leads to conservation of distance. The distance between two locations in a reference frame is invariant to the observer in another reference frame. The relative speed between two reference frames is irrelevant to conservation of such distance. Consequently, the length of an object is invariant with respect to its motion.

This contradicts the hypothesis of FitzGerald-Lorentz Contraction. Therefore, FitzGerald-Lorentz Contraction is invalid for one-dimensional motion. Consequently, Lorentz Transformation violates translational symmetry in one-dimensional motion.

For more than a century, many physicists have been under the wrong impression that a moving body should contract in the direction of motion. This paper provides a rigorous proof that such belief is absolutely false and should be absent from physics.

[1] FitzGerald, G. F.: The ether and the earth's atmosphere. Science. 13: 390 (1889)

[2] Lorentz, H. A.: De relatieve beweging van de aarde en den aether. Zittingsverlag Akad. v. Wet. 1, 74 (1892), English trans. The relative motion of the earth and the aether. In: Zeeman, P., Fokker, A. D. (eds.) Collected Papers. Nijho, The Hague (1937)

[3] James D and Edward S. Dana (1887), Albert Michelson, 1852 1931., American Institute of Physics, http://history.aip.org/exhibits/gap/PDF/michelson.pdf.

[4] H. A. L. Lorentz (1899) Simplified Theory of Electrical and Optical Phenomena in Moving Systems, Koninklijke Akademie van Wetenschappen te Amsterdam, Section of Sciences, Proceedings 1, 427442.

[5] O. Lodge (1905), G. F. FitzGerald, Proceedings of the Royal Society 75, 15260.

[6] A. A. Michelson and E. W. Morley (1887), On the Relative Motion of the Earth and the Luminiferous Ether, American Journal of Science 34,

[7] O. Heaviside (1888), The electro-magnetic effects of a moving charge Electrician 22,147148. 333345.

[8] B. J. Hunt (1988), The Origins of the FitzGerald Contraction, British Journal for the History of Science 21, 6176.

[9] 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.

[10] J. M. Bennett, D. T. McAllister and G. M. Cabe (1973), Albert A. Michelson, Dean of American OpticsLife, Contributions to Science, and Influence on Modern-Day Physics, Applied Optics 12, 22532279.

[11] S. G. Brush (1967), Note on the History of the FitzGerald-Lorentz Contraction, Isis 58, 230232.

[12] J. S. Bell (1992), George Francis FitzGerald, 1989 lecture, abridged by Denis Weare in Physics World 5, 3135.

[13] M. Janssen (1995), A comparison between Lorentzs Ether Theory and Special Relativity in the Light of the Experiments of Trouton and Noble, Ph.D. thesis, University of Pittsburgh.

[14] C. W. Misner, K. S. Thorne and J. A. Wheeler (1973), Gravitation, W. H. Freeman, San Francisco.

[15] Larmor, J.: Aether and Matter. Cambridge University Press, Cambridge (1900)

[16] 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

[17] W. F. G. Swann (1941), Relativity, the FitzGerald-Lorentz Contraction, and Quantum Theory, Reviews of Modern Physics 13, 197202.

[18] J. M. D. Coey (2000), George Francis FitzGerald, 1851 1901. The Millenium Trinity Monday Memorial Discourse, http://www.tcd.ie/Physics/History/Fitzgerald/FitzGerald.html.