Fizeau Interferometer and Doppler Effect

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The interference pattern from a Fizeau interferometer is conserved in all inertial reference frames. Its constructive pattern requires the wavelength to be proportional to the width of the interferometer at the point of interference. The length contraction from Lorentz transformation assumes the interferometer to be contracted in the direction of the relative motion. The wavelength is contracted as well. For two observers moving at the same speed, the contracted wavelength appears to be identical for both of them. If one of them moves in the opposite direction, they will observe an identical wavelength but two different frequencies due to the Doppler effect. Consequently, they observe two different speeds from the same light.

I. INTRODUCTION

The interference pattern generated by a Fizeau interferometer[1] is useful in the detection of the flatness of a surface. The test surface and the reference surface form a wedge. The test surface is not perfectly flat if the interference pattern displays curved fringes.

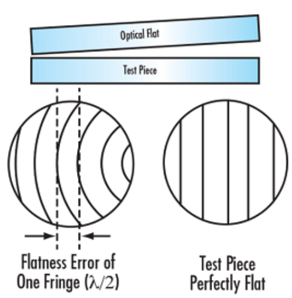

FIG. 1. Fizeau Wedge

The constructive pattern only appears at certain gap where the width of the gap is proportional to the wavelength of the light. This proportionality between the wavelength and the gap width indicates that the length contraction from Lorentz transformation[2] is applicable to the wavelength as well. Such length contraction depends on the speed of the relative motion, not the direction of the motion.

For two observers in motion relative to a stationary Fizeau interferometer, both will observe the same wavelength if they move at the same speed but in the opposite direction.

II. PROOF

Consider one dimensional motion.

A. Fizeau Interferometer

Let a Fizeau interferometer and its light source be stationary relative to a reference frame F_0. Light is emitted in the positive x direction toward two semi-transparent surfaces which form an interferometer in the y-z plane. Let the wavelength of the coherent light be λ. The length of light path between two surfaces is d at the point of interference.

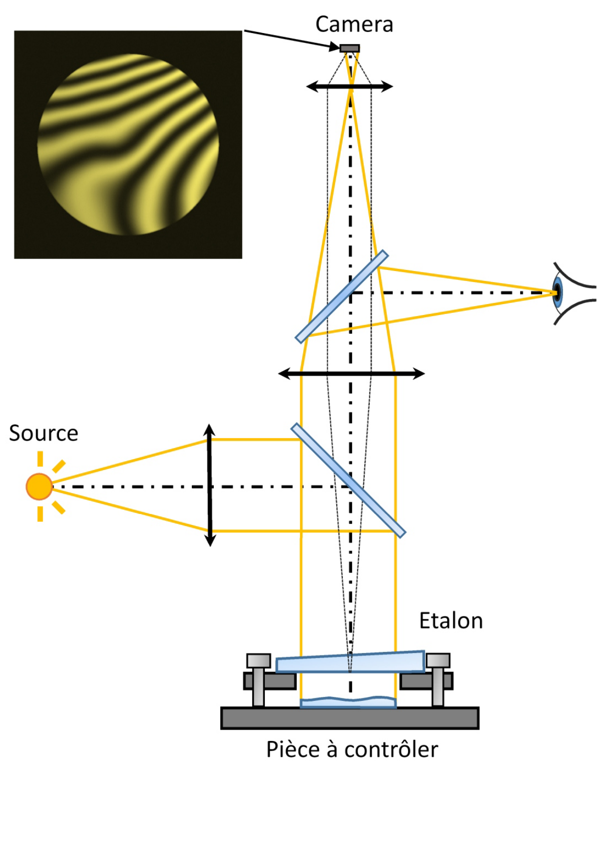

FIG. 2. Fizeau Interferometer

The condition for the constructive interference is

$$m\lambda = 2 * d \quad (1)$$

m is a positive integer.

Let another reference frame F_1 moves at a velocity of (v,0) relative to F_0. The constructive interference in F_1 is represented by

$$m\lambda_1 = 2 * d_1 \quad (2)$$

Let another reference frame F_2 moves at a velocity of (-v,0) relative to F_0. The constructive interference in F_2 is represented by

$$m\lambda_2 = 2 * d_2 \quad (3)$$

According to Lorentz transformation, length contraction is independent of the direction of the relative motion.

$$d_1 = d_2 \quad (4)$$

From equations (2,3,4),

$$\lambda_1 = \lambda_2 \quad (5)$$

The wavelength is conserved in both F_1 and F_2.

B. Doppler Effect

To a stationary observer in F_1, the light source of the Fizeau interferometer is moving away with an apparent frequency f_1. To a stationary observer in F_2, the same light source is moving closer with an apparent frequency f_2. According to the Doppler effect,

$$f_1 < f_2 \quad (6)$$

The apparent frequency of the light source decreases in F_1 but increases in F_2.

C. Speed of Light

The speed of light in F_1 is C_1.

$$C_1 = f_1 * \lambda_1 \quad (7)$$

The speed of light in F_2 is C_2.

$$C_2 = f_2 * \lambda_2 \quad (8)$$

From equations (5,6,7,8),

$$C_1 < C_2 \quad (9)$$

The apparent speed of the light decreases in F_1 but increases in F_2.

III. CONCLUSION

The apparent speed of light is different in a different reference frame. The speed of light in the rest frame of the observer depends on the relative motion between the observer and the light source.

A stationary Fizeau interferometer shows that the wavelength of its light source is conserved for two observers moving at the same speed but in the opposite direction. These observers detect the same wavelength but different frequencies. Therefore, they observe the same light at two different speeds.

Lorentz transformation is based on the assumption that the speed of light is identical in all inertial reference frames. This is proved to be incorrect by the interference pattern of the Fizeau interferometer. Lorentz transformation has contradicted itself with its length contraction.

Therefore, Lorentz transformation fails to describe physics properly. It is an impractical mathematical description that does not describe the real world. It is not suitable for physics. All theories that are based on Lorentz transformation are proved to be unsuitable for physics.

[1] "Interferential devices - Fizeau Interferometer". http://www.optique-ingenieur.org/en/courses/OPI_ang_M02_C05/co/Contenu_25.html

[2] H. R. Brown (2001), The origin of length contraction: 1. The FitzGeraldLorentz deformation hypothesis, American Journal of Physics 69, 10441054. E-prints: gr-qc/0104032; PITT-PHIL-SCI00000218.

[3] Eric Su: List of Publications, http://vixra.org/author/eric_su