

# One Way Speed Of Light Based on Fizeau's Experiment

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Based on Fizeau's experiment, the single cogwheel is replaced with two rotating disks to measure the one-way speed of light. A single slit is cut out in the radial direction on each disk for the light to pass through the disk. With both disks rotating at the same angular speed, the light can pass through both disks only if the second slit is in a different radial direction from the first slit. The light takes time to travel from the first disk to the second disk. With both slits rotating into the straight path of light, the one-way speed of light can be calculated from the distance between two disks, angular speed of the disks and the angular difference between two slits.

## I. INTRODUCTION

In 1849, Armand Hippolyte Louis Fizeau carried out an experiment[1] to measure the speed of light. In his experiment, a light source emits light which passes through a rotating cogwheel to a distant mirror. This mirror reflects the light back to the light source through the same rotating cogwheel.

Fizeau had measured two-way speed of light. It is the average speed of light in round trip. It is not the one-way speed of light. However, his experiment can be adjusted to measure the one-way speed of light.

Replace the cogwheel with a thin disk. A single slit is cut out in the radial direction near the edge of the disk. Place another identical disk in the path of light and let the light pass through both slits.

By rotating both disks at the same angular speed but aligning the second slit in a different radial direction from the first slit, the speed of light can be determined if the light passes through both slits

## II. PROOF

Let the position of the center of a rotating disk  $D_1$  be  $(x_1, 0, 0)$ . Let its axis of rotation point to the positive x direction. Its angular velocity is  $\omega$ . Place another identical disk  $D_2$  at  $(x_2, 0, 0)$ . Its angular velocity is also  $\omega$ . Its slit is in the same radial direction of the slit of  $D_1$ .

$$x_2 > x_1 > 0 \quad (1)$$

Let a light source be at the origin and emit light toward  $D_1$ .

### A. Stationary Disks

The light passes through the slit of  $D_1$  but can not pass through the slit of  $D_2$  because it takes time for the light to travel from  $x_1$  to  $x_2$ . The slit of  $D_2$  has rotated out of the straight path of the light by the time the light reaches  $D_2$ .

In order for the light to pass through the slits of both disks, the slit of  $D_2$  can not be in the same radial direction of the slit on  $D_1$ . Let this angular difference between the slits of  $D_1$  and  $D_2$  be  $\theta_0$ .

At the time when the slit of  $D_1$  is in the path of the light,  $D_2$  needs to rotate an extra angle of  $\theta_0$  in order for the slit on  $D_2$  to be in the straight path of the light.

Let  $T$  be the time required for this extra rotation of  $\theta_0$ .

$$T = \frac{\theta_0}{\omega} \quad (2)$$

$T$  is also the time duration for the light to travel from  $x_1$  to  $x_2$

$$T = \frac{x_2 - x_1}{C} \quad (3)$$

Therefore,

$$\frac{\theta_0}{\omega} = \frac{x_2 - x_1}{C} \quad (4)$$

The one-way speed of light can be determined from equation (4).

$$C = (x_2 - x_1) * \frac{\omega}{\theta_0} \quad (5)$$

### B. Moving Disks

Let  $F_1$  be the rest frame of the light source. Let both  $D_1$  and  $D_2$  move at the same speed  $v$  relatively to  $F_1$  in the positive x direction.

Let the time when the light passes through the slit of  $D_1$  be  $t_1$ . At this moment, the x position of  $D_1$  is  $x_1$  while the x position of  $D_2$  is  $x_2$ . By the time the light reaches  $D_2$ ,  $D_2$  has moved away from  $x_2$ .

Let the time be  $t_2$  when the light reaches  $D_2$ .  $T$  is the difference between  $t_1$  and  $t_2$ .

$$T = t_2 - t_1 \quad (6)$$

$R$  is the difference between  $x_1$  and  $x_2$ .

$$R = x_2 - x_1 \quad (7)$$

The total distance for the light to travel from  $D_1$  to  $D_2$  is

$$R + v * T = C * T \quad (8)$$

In order for the light to pass through the slit of  $D_2$ , the angular difference between the slits of  $D_1$  and  $D_2$  needs to be

$$\theta = T * \omega \quad (9)$$

From equation (8) and (9),

$$\theta = T * \omega = \frac{R}{C - v} * \omega \quad (10)$$

### C. Reference Frame

Let  $F_2$  be the rest frame of  $D_1$ . Both  $D_1$  and  $D_2$  move at the same speed relatively to  $F_1$ .  $D_2$  is stationary relatively to  $D_1$ . Therefore,  $F_2$  is also the rest frame of  $D_2$ .

Let  $F_2$  be stationary relatively to  $F_1$ . The speed of light  $C_2$  in  $F_2$  can be calculated from equation (5).

$$C_2 = (x_2 - x_1) * \frac{\omega}{\theta_0} \quad (11)$$

Let  $F_2$  move at the speed of  $v$  in the  $x$  direction relatively to  $F_1$ . Due to this relative motion, the angular difference  $\theta_0$  needs to be  $\theta$  for the light to pass through both slits.

$$C_2 = (x_2 - x_1) * \frac{\omega}{\theta} \quad (12)$$

$\theta$  is of the same value in both  $F_1$  and  $F_2$ . It can be determined from equation (10).

$$\theta = \frac{R}{C - v} * \omega \quad (13)$$

Therefore, the speed of light  $C_2$  in  $F_2$  can be calculated from equations (12) and (13).

$$C_2 = (x_2 - x_1) * \frac{\omega}{\frac{R}{C - v} * \omega} \quad (14)$$

$$C_2 = (x_2 - x_1) * \frac{C - v}{R} \quad (15)$$

From equations (7) and (15)

$$C_2 = C - v \quad (16)$$

The speed of light  $C_2$  in  $F_2$  differs from the speed of light in  $F_1$  by  $v$ .

### III. CONCLUSION

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.

If the light can pass through both slits when both rotating disks are stationary, then the same light can not pass through the second disk if both disks move at the same speed along the axis of rotation.

In the rest frame of the disks, the light may or may not be detected beyond the second disk. The speed of light has changed.

By adjusting the alignment of the slit on the second disk, the light can pass through both disks again. This new alignment indicates that the speed of light has changed in the rest frame of the disks. This new speed of light can be calculated from the new alignment and depends on exclusively the relative motion between the light source and the disks.

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] 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] <https://en.wikipedia.org/wiki/Fizeau>

[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),