One Way Speed Of Light Based on Wineland's Laser Cooling Experiment

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Based on David Wineland's experiment in 1978, a laser beam points at an electromagnetcally trapped magnesium ion. The frequency of the laser light in the rest frame of the laser becomes a different frequency in the rest frame of the ion. If this new frequency matches the absorption frequency of the ion, the light will be absorbed by the ion. The wavelength is independent of reference frame. Therefore, the faster the ion moves toward the laser, the higher the frequency detected by the ion will be.

I. INTRODUCTION

In 1978, David Jeffrey Wineland carried out experiments[1] to manipulate the temperature of magnesium ion with laser. In his experiment, a laser emits light on an electromagnetically trapped magnesium ion. The frequency of the laser is chosen to be slightly lower than the ideal frequency for aborption by the ion. If the ion happens to move toward the laser, the frequency of the light will appear to be higher to the ion.

The light will be absorbed by the ion if this higher frequency matches the absorption frequency of the ion. The absorption is an inelastic collision that reduces the momentum of the ion. The motion of the ion is eventually reduced drastically. Therefore, the temperature of the ion becomes lower.

Wineland had measured the one-way speed of light with a moving ion as the light detector. It is the relative speed of light between a stationary light source and a moving detector. His experiment presents a stark evidence that the speed of light depends on the motion of the detector.

II. PROOF

Consider one-dimensional motion between the laser and the ion.

A. Speed of Light

The relative speed of light depends on the rest frame of the detector according to "One Way Speed Of Light Based on Fizeau's Experiment"[14] and "One Way Speed Of Light Based on Anderson's Experiment"[15]. The speed of light is always C, 299,792 kilometers per second, in the rest frame of the light source.

$$C = 2.99792 * 10^8 m/s \tag{1}$$

let F_1 be the rest frame of the laser. let c_1 be the speed of light in F_1.

$$c_1 = C \tag{2}$$

let F_2 be the rest frame of the ion. Let c_2 be the speed of light in F_2. let F_2 move at a speed of -v relatively to F_1 so that the ion is moving toward the laser.

According to the proof in "One Way Speed Of Light Based on Fizeau's Experiment"[14],

$$c_2 = C + v \tag{3}$$

The speed of light is greater in the rest frame of the ion.

B. Wavelength

A single wavelength can be represented by two wave crests in F_1. $x1_a$ is the position of first wave crest. $x1_b$ is the position of an adjacent wave crest. The same two crests are represented in F_2 by $x2_a$ and $x2_b$ respectively.

According to the proof in "Coordinate Transformation between Inertial Reference Frames"[5], the distance between two positions is independent of reference frame. Therefore,

$$x1_b - x1_a = x2_b - x2_a \tag{4}$$

Let L_1 be the wavelength in F_1.

$$L_1 = x1_b - x1_a \tag{5}$$

Let L_2 be the wavelength in F_2.

$$L_2 = x2_b - x2_a \tag{6}$$

From equation (4,5,6),

$$L_1 = L_2 \tag{7}$$

The wavelength of a wave is independent of reference frame.

C. Laser Cooling

The relationship for frequency, speed, and wavelength of a wave is

$$frequency = \frac{speed}{wavelength} \tag{8}$$

Let the wavelength of the light from the laser be L in both F_1 and F_2.

Let the frequency of light be f_2 in F_2

$$f_2 = \frac{c_2}{L} = \frac{C+v}{L} \tag{9}$$

Let the frequency of light be f_1 in F_1.

$$f_1 = \frac{c_1}{L} = \frac{C}{L} \tag{10}$$

From equation (9,10), f_2 is greater than f_1.

$$f_2 - f_1 = \frac{v}{L} > 0 \tag{11}$$

The ion moves toward the laser and detects higher frequency in F_2.

If the ion happens to move at certain v that makes f_2 the same frequency as the absorption frequency of the ion, the light from the laser will be absorbed by the ion.

The absorption results in inelastic collison which reduces the momentum of the ion.

III. CONCLUSION

The faster the ion moves toward the laser, the faster the light moves toward the ion.

The faster the light moves, the higher the frequency is detected. Both the speed and the frequency of light depend on the relative motion between the rest frame of the light source and the rest frame of the light detector.

However, the wavelength of light is independent of reference frame. This is a direct property of the Translation Symmetry[5].

The speed of light remains constant and is 299,792 kilometers per second only in the rest frame of the light source.

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]

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