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Measuring speed of light emitted by a moving frame

Abstract

At first glans, this paper would be off-topic, but it would hopefully contribute to physical science as it suggests novel methods for measuring speed of light emitted from moving objects.

Speed of light has been measured by various methods and to current knowledge is believed to be constant. These techniques include accurately known measurement methods of the day; e.g. cavity resonator, radio and laser interferometry etc. and are persistently revised. Despite the fact that there exists some controversy regarding the limit of speed of light, but there also methods like FEL (A free-electron laser or FEL, is a type of laser whose lasing medium consists of very-high-speed electrons moving freely through a magnetic structure).

Proposed method is based on a conception of measuring the speed of light from a moving frame which according to the principal of special relativity would be a constant quantity in vacuum and is independent of the frame and its relative velocity whether the light is received or emitted. In spite of the theoretical part i.e. relativity and Doppler Effect and the fact that Michelson and Morley experiment doesn't measure the speed of light directly, this method suggests an applied measurement which needs to be tested.

In addition another method based on fringe shift is suggested on a rotating Michelson-Morley platform. In fact the Sagnac effect has already shown a non-null result [1] as it is done on a rotational platform, but this method is somewhat different as one of the mirrors has a slower linear/angular velocity then the other one.

Proposed experiment

An emitting source of light (emitting frame) which is the moving frame has a relative uniform velocity *v* with respect to the stationary frame. The measuring frame which comprising of measuring devices, is stationary relative to the emitting frame. Furthermore the light is assumed to propagate in vacuum. Referring to *figure 1*, the emitting frame, includes a coherent light source, a light splitter, and two mirrors. The two light pulses from mirror *A* and *B* can then be made to be in-phase and coherent.

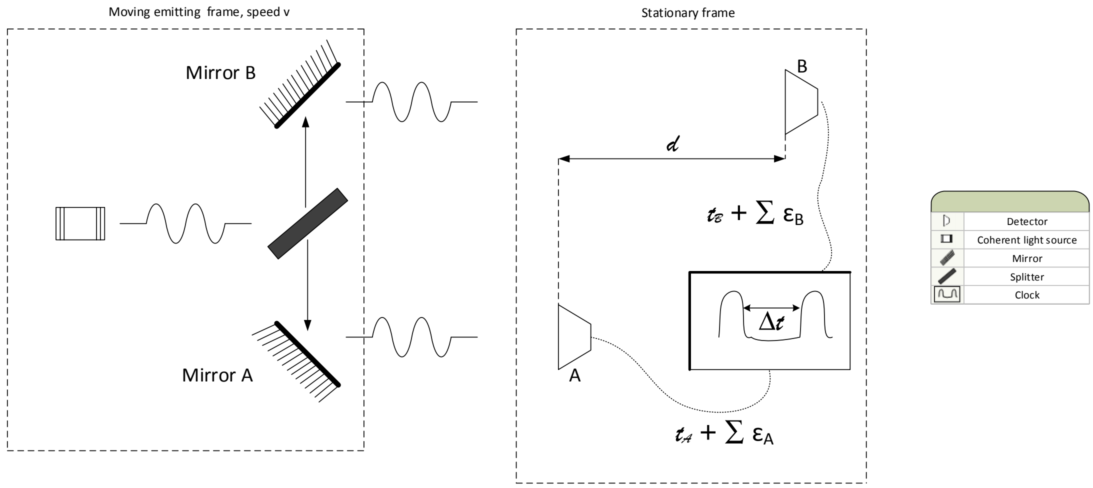

Figure 1

The stationary frame consists of two light detectors *A* and *B* with a distance *d* that can presumably be an integer multiple of the light's wavelength and a clock that registers a signal from the detectors (see figure 1). The signal path from each detector to the clock are also presumed to be equivalent. Let $\sum\varepsilon$ be the sum of possible time errors of the signal from each detector to the clock after light hits the detector. These can of course be calibrated by e.g. setting the velocity of the emitting frame to zero before carrying out the experiment.

Furthermore the light path from each mirror are sent in parallel and two detectors are separated by same distance as the mirrors. Additionally the detectors having a direct line of sight to the respective mirror.

Determining distance *d* and times t_A and t_B at each detector in the stationary frame, are local measurements, then one can easily calculate the following *expression 1*:

$$C = \frac{d}{(t_B + \sum\epsilon_B) - (t_A + \sum\epsilon_A)} \qquad (1)$$

In addition, the possible time errors $\sum\varepsilon$ and can be calibrated to be discretionary equivalent to certain precision for each signal path between each detector and the clock and finally be eliminated when calculating *Δt*, the time where light actually travels distance *d*.

$$\sum \epsilon_B \approx \sum \epsilon_A \qquad (2)$$

And finally with arbitrary precision, one can conclude:

$$C \cong \frac{d}{t_B - t_A} = \frac{d}{\Delta t} \qquad (3)$$

Expression 3 takes a simple form that is independent of frequency and wavelength. The conclusion should be then, speed of light in *expression 3* should always be the same and independent of the moving frame's velocity.

The test case

As the light propagation of light has to be happen in vacuum, then basically it is proposed that the experiment should be carried out for instance at the space station ISS, where there exists practically a vacuum. This could of course be measured at the moon surface or elsewhere.

The two detectors A and B will be installed on the surface of ISS in our case. The distance *d* between the detectors *A* and *B* (*figure 2*) should be such that when calibrating the detectors as described above, the time for the light beam traveling between the two detectors would be e.g. *100ns*. This would roughly speaking be equal to a distance of approx. 30 m.

Once the calibration is performed, distance would be:

$$d \sim c.10^{-7}\ \text{m} \quad (5)$$

For execution of the actual test, the moving emitting frame installed should be installed on a rocket (figure 2, left hand side) that would be fired away from (i.e. on the opposite direction) the detectors, in such way that, a line of site from the mirrors *A* and *B* to the respective detectors A and B would be maintained during the test. Once the racket has reached its highest limit i.e. *v* then it would emit a light flash that would then be measured at detectors *A* and *B* respectively.

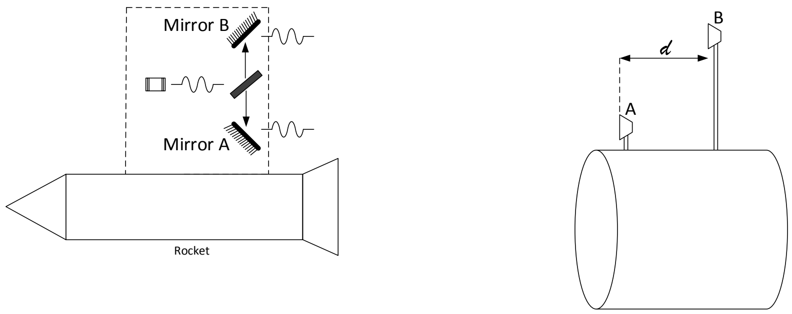

Figure 2

Showing detectors installed on the ISS (right hand side) and the moving light emitting source installed on a rocket (left hand side)

Proposed Michelson-Morley experiment on a rotating platform

Assume performing the Michelson-Morley experiment on a rotating platform in such way that one of the mirrors is placed in the center of the rotating platform and the second mirror is placed on the periphery of the rotating disk as shown in the figure 3.

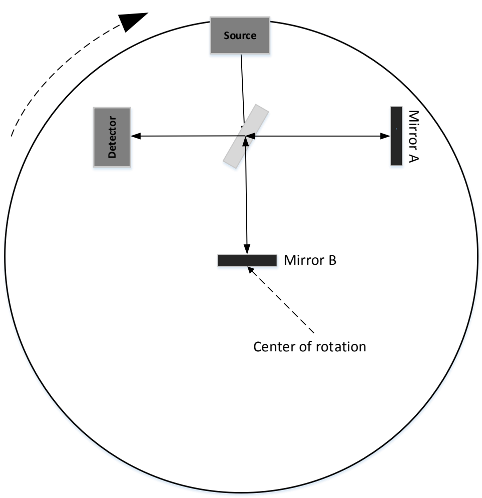

Figure 3. Michelson-Morley interferometer with mirror B placed at the center of the rotating disk and mirror A placed at the periphery

Refrences

[1] Einstein, Relativity and Absolute Simultaneity; edited by William Lane Craig and Quentin Smith, Published by Routledge 2000; ISBN13: 978-0-415-70174-7