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An Orbital Interference Experiment for the Detection of Light Speed Greater than C.

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The basis of special relativity is its second postulate which states that the speed of light is invariant in an absolute vacuum and depends neither on the motion of the light source nor on the motion of the observer. In accordance with this postulate, a moving observer, when measuring the speed of light, always receives the same value, $C = 299792458$ m/sec. However, the independence of the speed of light with respect to an observer has not been confirmed by any reliable experiment or observation.

The falsity of the statement that the speed of light does not depend on the motion of the observer can be proven by the orbital interference experiment we proposed in [1,2]. In this experiment, the speed with which the photons move in a medium with a refractive index, n relative to an observer is compared with a known speed.

A new analysis of the interferometer is given and an improved version of the interferometer is proposed in this paper. The analysis takes into account the effect of the phase deviation discovered in the Fizeau's interferometer with moving water [3].

1. Speed, frequency and phase of the photons in a moving medium

In any transparent medium, the speed of the photons is determined by the index of refraction. The photons are continuously absorbed and re-emitted by the atoms of the medium and therefore move intermittently. Every photon is periodically absorbed by an atom of the medium. After some delay, the atom radiates a new photon in the same direction. The photon moves relative to the re-radiating atom at speed C until it meets the next re-radiating atom, and the process repeats. The average speed of the photons relative to the medium is less than C and equals $\frac{C}{n}$. The value of the index of refraction n, is determined by the duration of the process of re-emission and by the number of the re-emissions.

Every photon of a monochromatic beam has its own frequency ν_0. When a photon moves in an absolute vacuum, its phase changes by 2π for the time, $T_0 = 1/\nu_0$.

In time $t_C = \frac{L}{C}$, while the photon covers a distance L in the vacuum, its phase changes by $\Delta\varphi = t_C 2\pi\nu_0 = \frac{2\pi\nu_0 L}{C}$. In a medium, the photon covers the same distance L in the time $t = \frac{Ln}{C}$ which is more than $t_C = \frac{L}{C}$ but in this case, the phase changes by the same value, $\Delta\varphi = \frac{2\pi\nu_0 L}{C}$. That is, the change of the phase of the photon is determined only by its frequency ν_0 and the distance L covered in the medium. The phase deviation does not depend on the index of refraction n because the phase of the photon changes only during the time, $t_C = \frac{L}{C}$ when the photon really exists and moves between the re-emitting atoms. It does not change during processes of re-emission [3].

The speed of the photons, their frequency, and speed of the change of phase are changed when the light enters another moving medium. In order to simplify our reasoning, let us consider the motion of a single photon.

When a **single photon passes** from some medium into another **immovable medium**, (for example from air into a glass plate,) its frequency does not change because the photon arrives at the atom of the new medium with the same speed, C. The atom of the glass absorbs the photon with frequency ν_0 and re-emits a new photon, which has the same frequency.

The average speed of the photon changes from $\frac{C}{n_A}$ in the air to $\frac{C}{n_G}$ in the glass. The photon covers the distance L in the glass with an average speed of $\frac{C}{n_G}$ in time $t_L = \frac{Ln_G}{C}$. Its phase changes during this time by $\Delta\varphi_0 = \frac{2\pi\nu_0 L}{C}$.

When a **single photon passes into a moving medium**, its frequency changes in accordance with the Doppler effect.

If the photon of frequency ν_0 moves in air with the speed $\frac{C}{n_A}$ and the glass plate moves counter to the air with the speed V relative to the air, the photon meets the first atom of the glass with the speed $C+V$. The atom absorbs the photon and re-emits a new photon which moves relative to this atom with speed C but has a frequency $\nu = \nu_0(1+\frac{V}{C})$, greater than ν_0. It is not the photon with the frequency ν_0 but a different photon which has a frequency $\nu = \nu_0(1+\frac{V}{C})$ that moves in the glass after the first re-emission. This photon propagates relative to the glass with the same average speed $\frac{C}{n_{CT}}$ and therefore covers the distance L in the glass in the same time, $t_L = \frac{Ln_{CT}}{C}$. Relative to the air and relative to an immovable observer, the photon moves with speed $\left(\frac{C}{n_{CT}} - V\right)$ and therefore covers the distance L in the observer's frame of reference for the time $t = \frac{L}{\frac{C}{n_{CT}} - V}$. That is, a complete dragging of the photon by the moving glass takes place.

In Fizeau's experiment with moving water and in other similar experiments, the fringe shift is less than expected because the additional phase deviation, missed in the standard calculation, arises when the photons are dragged by the moving medium. The additional phase deviation arises because the photons propagate in the moving medium with a changed frequency.

If it is assumed that the photons do not change frequency and propagate in moving glass with the frequency ν_0, the phase of every photon must change by $\Delta\varphi_0 = \frac{2\pi\nu_0 L}{C}$. In reality, the photons propagate in moving glass with the frequency $\nu > \nu_0$ and therefore their phase changes by $\Delta\varphi = \frac{2\pi\nu L}{C} > \Delta\varphi_0$.

The photons cover the distance L in the time, $t = \frac{L}{\frac{C}{n_{CT}} - V}$ corresponding to the complete dragging of light, but the fringe shift in the interferometer is less because their phase is more by $\Delta\varphi - \Delta\varphi_0 = \frac{2\pi L}{C}(\nu - \nu_0)$.

In the experiment which we propose for the detection of light speed greater than C, the effect of the phase deviation has an influence on the fringe shift because the speed $C + V$ is compared with the speed with which the photons cover the distance L in a moving glass plate.

2. The method of measuring light speed greater than C

In all real situations, without exception, light propagates, not in an absolute vacuum but in some medium. It propagates relative to the interstellar gaseous medium with speeds practically to equal C. The photons can move relative to the observer with a speed greater than C only in the case when the observer moves sufficiently fast relative to the medium in which the light propagates with speed C. Such an experiment can be carried out in a satellite orbit where the light propagates relative to the rare atmosphere with a speed practically equal to C and where the observer can move with speed V of about 8 km/sec.

The measuring of a speed greater than C can be done with the help of the interferometer shown in Fig.1.

When the **interferometer is at rest** in a rare gaseous medium in which light propagates at speed C, the photons of a laser beam would move relative to the interferometer with speed C.

In Fig. 1, a part of beam (B) enters the glass bar G, changes its speed and covers the distance L with speed $\frac{C}{n_G}$ in the time $t_L = \frac{Ln_G}{C}$. Then beam (B) is transferred by a translucent mirror M, to screen S.

The main beam A, covers the distance L with speed C for a time $t_0 = \frac{L}{C}$ and then is transferred by prism P to screen S and interferes with beam B. In this case, the interference fringes are in some initial position.

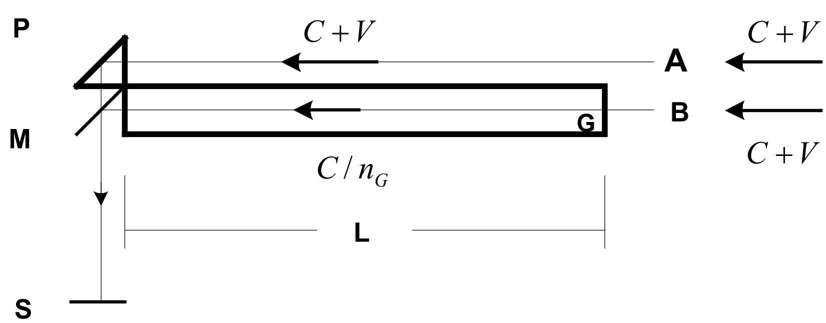

Fig.1.

When the **interferometer moves** with speed V relative to the atmosphere **in a direction counter to the laser beam**, the photons enter the interferometer with the speed $C+V$.

Although beam B enters the glass bar G with speed $C+V$, it propagates within the glass with the same speed $\frac{C}{n_G}$ as in immovable interferometer and therefore the photons cover the distance L in the same time, $t_L = \frac{Ln_G}{C}$.

The main beam A covers the distance L with speed $C+V$ in time, $t_V = \dfrac{L}{C+V}$ which is less than $t_0 = \dfrac{L}{C}$. As a result, the interference fringes shift. However because of the effect the of phase deviation in moving glass, the fringe shift differs by $(1-1/n)$ from the shift calculated only in accordance with the difference $(t_0 - t_V)$.

3. Description of the experiment.

One of the possible versions of the experiment for the detection of light speed greater than C is shown in Fig.2. The glass bar G, the prism P, the translucent mirror M and screen S are fixed to the end of the long rigid frame which is placed outside a space station. The prism $P1$, fixed on other end of the frame 1-1.5 m out from the interferometer, sends the beam of laser L to the interferometer. The frame is oriented in the direction of motion of the space station. When the station moves at speed V relative to the rare atmosphere, the photons reflected from prism $P1$ are re-emitted by the atoms of the atmosphere and move relative to the atmosphere at speed C. Their speed relative to the interferometer is $C+V$.

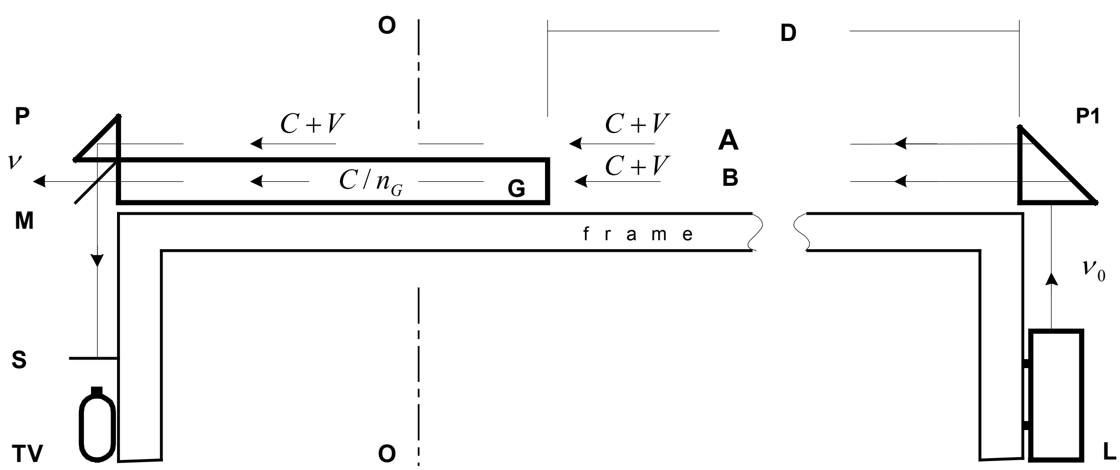

Fig.2

With the speed $C+V$ and with an identical phase, the photons of both beams enter the interferometer. The photons of beam A pass the base distance in the interferometer with speed $C+V$ but the photons of the beam B change their speed and move relative to interferometer with speed $\dfrac{C}{n_G}$.

The position of the interference fringes is controlled by a television camera TV. If the orientation of the interferometer relative to the direction of motion changes, the speed with which the photons of beam A move relative to the interferometer changes but the speed of the beam B does not change and the interference pattern shifts. If the interferometer is oriented in the opposite direction, the photons of beam A move relative to the interferometer with speed $C - V$ and the fringes shift maximally. The shift of the interference fringes proves that the speed of the photons relative to the interferometer and relative to the observer changes from $C + V$ to $C - V$.

As stated above, the fringe shift additionally depends on the index of refraction of the glass and is proportional to speed V at which the interferometer moves relative to the rare atmosphere.

The frequency of the photons decreases from ν_0 to $\nu = \nu_0(1 - V^2 / C^2)$ when the light is re-emitted by a moving medium [3]. A comparison of the frequency ν_0 of the laser with the frequency ν of the beam which passes through mirror M allows measuring the speed of motion relative to any rare medium.

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