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The Doppler effect in Optics: The experiment for ISS.

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In special relativity, the Doppler effect is determined by expression

$$\nu = \nu_0 \sqrt{\frac{C - V_R}{C + V_R}} \quad . \qquad (1)$$

This means that the relative movement of the light source and the observer is the only cause of a frequency change: if the observer is motionless relative to the source (the relative speed V_R is equal to zero), he receives a frequency ν, equal to the frequency of the source ν_0. In accordance with special relativity, the frequency of light does not change when the source and the observer move with identical speed relative to the medium in which the light propagates.

In this paper, we propose an orbital experiment in which the observer and the source move relative to the medium with identical speed V (that is, the relative speed V_R=0) and the frequency of light passing through the medium is compared with the frequency of the source ν_0. The purpose of the experiment is to prove the falsity of the relativistic expression (1) for the Doppler effect.

The experiment is based on the fact that the speed of light relative to any transparent medium is determined only by its index of refraction and, independent of the movement of the source, is equal to $\frac{C}{n}$. The refractive index n depends on the properties and the density of the medium. The independence of light speed from the movement of the source is explained by the re-emitting of the photons by the atoms of the medium [http://wbabin.net/sokolov2/sokolov2.htm, and http://wbabin.net/sokolov2/sokolov5.pdf] The re-emitting of the photons by the atoms of the medium we imagine as follows.

If the source moves relative to the medium with speed V, every photon moves relative to the medium with the speed $C+V$ until it meets an atom of the medium and this atom absorbs the photon. After some delay, the atom emits the new photon in the same direction, which moves relative to the atom with speed C. Because the speed $C+V$ with which the photon is absorbed is greater than speed C with which it is re-emitted by the atom, the new photon has a frequency ν_1 which is greater than ν_0. Intermittently re-emitting by the atoms of the medium, the photons of frequency ν_1 move from atom to atom with the speed C relative to the atoms. Because of delays during re-emitting, their average speed relative to the medium is less than C and is equal to $\frac{C}{n}$.

In the experiment proposed below, the light source and the observer move with identical speed relative to a rare gaseous medium. The photons moving through this medium are re-emitted and change their frequency. It is convenient to consider the change of frequency for an equivalent scheme in which the light source and the observer are fixed relative to some inertial frame and the re-emitter (the glass rod) moves with speed V between the source and the observer in an absolute vacuum as shown on Fig.1

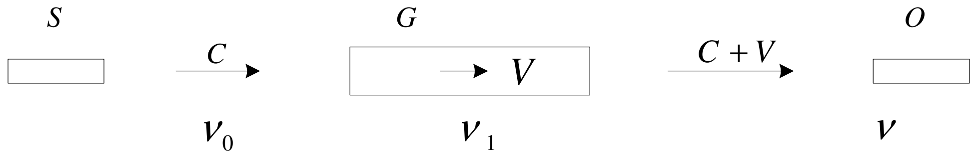

Fig.1

The photons of frequency ν_0 travel with the speed C toward the moving glass re-emitter G, meet the first atoms of the glass and are re-emitted by them. Re-emitted photons have the frequency $\nu_1 = \nu_0(1-\frac{V}{C})$ which is less than ν_0 and move in the glass from atom to atom with the speed C relative to the atoms. The speed of the photons relative to the source and the observer is equal to $C+V$. The photons of frequency ν_1 exit from the glass rod with the speed $C+V$ and with this speed, go toward observer O. Impinging on the measuring instrument of the observer with the speed $C+V$, the photons are re-emitted and change speed. As result of it, their frequency changes by $(1+\frac{V}{C})$: $\nu = \nu_1(1+\frac{V}{C}) = \nu_0(1-\frac{V}{C})(1+\frac{V}{C}) = \nu_0(1-\frac{V^2}{C^2})$. Thus, because of the re-emission by the moving glass rod, the frequency of the photons decreases from ν_0 to ν and the measuring instrument of the observer sees the frequency

$$\nu = \nu_0(1-\frac{V^2}{C^2}) \qquad (2)$$

In the case when the re-emitter G moves with speed V in the opposite direction, the frequency of the photons is determined by the same expression (2).

In the proposed experiment, the laser source and the detector of the frequency are placed on the International Space Station (ISS). The laser beam traverses a distance L which is directed at some angle to the velocity V. The laser and the detector have to be positioned so that the beam could not interact with the atmosphere of the Space Station (Fig.2,a).

The laser beam is divided by the mirror $M1$ into two beams. The main beam traverses distance L in open space, interacts with the rare atmosphere moving relative to

ISS and changes its frequency from ν_0 to ν. The second beam propagates through the optical fiber cable and does not interact with the moving atmosphere. Therefore it reaches the detector with unaltered frequency ν_0. The change of the frequency measured by the detector, $\Delta\nu = \nu_0 - \nu = \nu_0 \frac{V^2}{C^2}$ shows that the frequency changes when light interacts with a moving medium and proves the falsity of expression (1) determining the Doppler effect in special relativity.

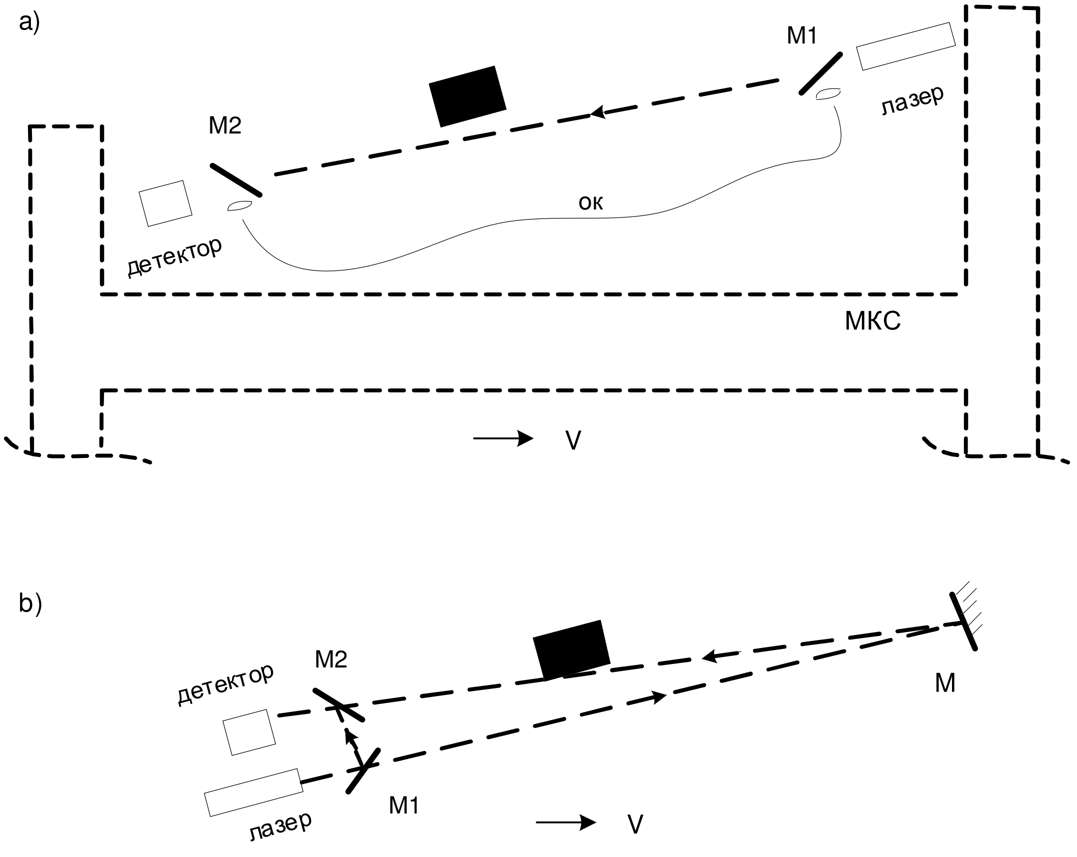

Fig.2

If the speed V is 7.8 km/s, in accordance with expression (2), the change of frequency $\nu_0 \frac{V^2}{C^2}$ is equal to $\nu_0 6.76 \text{ x } 10^{-10}$. In order to simplify the experiment, an additional mirror (or corner reflector) M can be used instead the fiber optic cable (and the laser and mirror $M1$ are placed beside the detector as shown on Fig.2,b). In that case, the frequency of the laser beam will change twice by $(1-\frac{V^2}{C^2})$.

The proposed experiment is very simple, does not demand great expense. At the same time, it allows testing one of the important conclusions of special relativity.