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On the Measurement of Absolute Velocities

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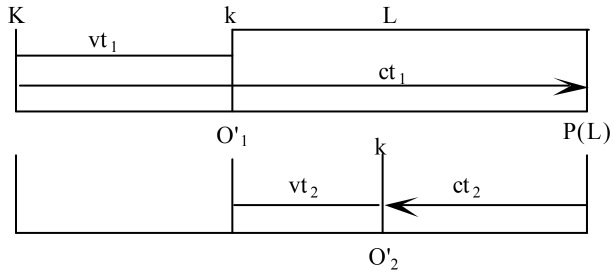
Abstract: Inertial observers can not only measure their absolute velocities but that of light as well, thereby being able to shed insight into the principle of the constancy of light velocity. The light speeds c±v, though considered to conflict with this principle, are shown herein to not be true physical entities.
Keywords: special relativity theory, time, coordinate systems, relative velocity.

Consider the uniform rectilinear motion of an inertial observer assumed to be 'blind', i.e., to have no physical contact with the outer world. At a time when in every branch of physics work professionals, it is illogical to further presume in the special relativity theory (SRT) that such an observer performs measurements and provides correct interpretations of results by the Lorentz transformations (LT) without possessing a priori most elementary knowledge on the relative motion. This because, to accomplish his charges, an inertial observer must be able to represent his motion relative to an 'unseen' coordinate system (CS) just as another inertial observer sees his motion relative to him. We prove that the CS that he should imagine is one at absolute rest and the results do not depend on the existence or the non-existence of a reference frame (RF) at absolute rest in Nature[1]. Only under such conditions can a 'blind' inertial observer identify an experiment which would define the parallel CS's enabling him to write mathematical equations and reveal his absolute motion, as well as that of light.

Such an experiment at his hand consists in light signals traveling to and fro in arbitrary directions relative to the axes of his CS, just like Einstein did in his 1905 thought experiment as discussed in [1]. The inertial observer assumes that at time $t_0=0$, his CS **k** coincides with the unseen CS **K** at absolute rest, and that at time $t_0=0$ the origin of **k** and a light signal emitted by a light source situated at the origin of **k** (or just reaching the origin of **k**) leaves the origin of **K**, moving along the positive common x', x axis at the absolute velocities **v** and **c**, respectively. The diagrams in Figure 1 are drawn and are only examined by the observer in the RF carrying **k**, an ability gained by his prior knowledge on relative motion.

[1] The CS is conceived here as being an assembly of three straight lines orthogonally that cross at a point, while the RF is an assembly of physical bodies defining the coordinate axes that carry measuring instruments, observers, and so on..

Figure 1.



In the time t_1, the origin of **k** and the tip of the light signal should cover, respectively, the distances OO'_1 and OP, as shown in the upper diagram, where P(L) in Figure 1 is a fixed point in **k**. Instantaneously reflected at P, the light signal should reach the origin of **k** at O'_2 in the time interval t_2, as shown in the bottom of the diagram. The resulting equations

$$ct_1 - vt_1 = L, \quad ct_2 + vt_2 = L \qquad (1)$$

have as solutions the absolute velocities **v** and **c**, as given respectively by

$$v = L(t_1 - t_2) / 2t_1t_2 \text{ and } c = L(t_1 + t_2) / 2t_1t_2 \quad . \qquad (2)$$

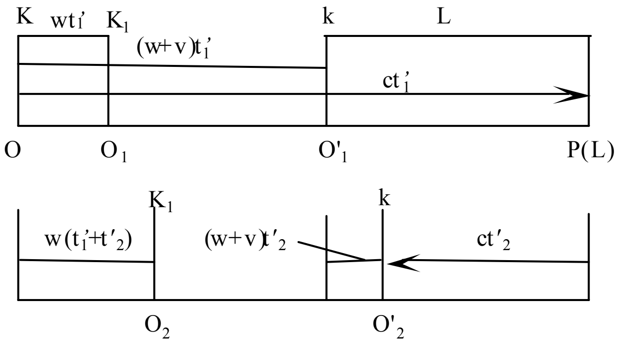
Whether the measured times t_1 and t_2 are equal with each other, the experiment must be repeated along other directions of the common *x'*, *x* axis until differing values are recorded for them. The true direction of the *x', x* axis will be finally defined by the path of the light signal for which **v** in (2) reaches a maximum value. Therefore, the 'blind' inertial observers with a training in physics can measure their absolute velocities. Moreover, by the last of (2), they can always determine the absolute light velocity.

Let us now assume that, contrary to all reason, **K** would not be at absolute rest but (together with **k**) would belong as $\mathbf{K}_1$, to an inertial space moving at absolute velocity **w** along the common *x'*, *x* axis. At time $t_0=0$, the additional uniform collinear motion of velocity **v** is imparted to **k** relative to $\mathbf{K}_1$. This results the diagrams shown in Figure 2 that are analogous to those in Figure 1, with absolute velocities **V**=**v**+**w** and **c**. From them we get equations:

$$ct'_1 - (w+v)t'_1 = L, \quad ct'_2 + (w+v)t'_2 = L \quad .$$

Whether the motion of the inertial space is not referenced to the CS at absolute rest but rather to a $\mathbf{K}_2$, and $\mathbf{K}_2$, is moving at constant velocity $\mathbf{w}_1$ relative to the CS at absolute rest, the **k** will move at absolute velocity $\mathbf{V}=\mathbf{v}+\mathbf{w}+\mathbf{w}_1+\ldots$. Thus any isolated inertial observer -reasoning as a physicist- can always determine experimentally the absolute velocity of his RF [as the maximum of the values of **v** given by (2)], his direction of motion, as well as for v=0, the absolute light velocity (known as the velocity of light in empty space). He does not need to identify in this aim the RF at absolute rest as this method depends only on considering the CS at absolute rest.

Figure 2.



The physics behind this experiment are very simple. For a better understanding, consider an object M_2 moving rectilinearly at the constant velocity $\mathbf{v}_2$ on the surface of another object M_1, at the constant velocity v_1 (either in the same or opposite direction). The relative velocities $v_1 \pm v_2$ are true physical quantities; they appear as absolute velocities of M_2 in both its kinetic energy and linear momentum. Imagine that M_1 and M_2 are moving rectilinearly, uniformly, simultaneously, and independently in a vacuum at velocities $\mathbf{V}_1$ and $\pm\mathbf{V}_2$ respectively. This time the relative velocities $\mathbf{V}_1 \pm \mathbf{V}_2$ are not true physical quantities; they do not appear as the true velocities of an object. They manifest physically by a transfer of linear momentum when one of the two bodies collides with a part of the other.

The last is the case with the quantities $\mathbf{c} \pm \mathbf{v}$, appearing by the factorization that is mathematically required to resolve each of Equation (1) in terms of **t**. The simultaneous parallel motions, that of the light signal traveling in empty space between O'_o and P(L), and that of **K**, are wholly independent. Like $\mathbf{V}_1 \pm \mathbf{V}_2$ and unlike the true velocities $\mathbf{v}_1 \pm \mathbf{v}_2$ above, $\mathbf{c} \pm \mathbf{v}$ are not true velocities of light manifesting frequency shifts at the instant of collision between light and a body that is in the RF carrying **k**, exclusively due to the motion with velocity –v or +v of that body at that instant of time.

The hypothesis 'stipulated' by the principle of the constancy of light velocity, that the paths of the light signal from the moving origin of **k** to the moving point P(L) and back to the origin of **k** would be equal for the inertial observer in **k**, is evidently false. So long as the light signal is not made of elastic balls rolling on a surface embodying the *x*', *x* axis from the origin of **k** to P(L) and back to the origin of **k**, but rather of photons traveling in vacuum parallel to the *x*', *x* axis between these points, the simultaneous and independent motion of the line segment O'P along the *x* axis as a part of **k** alters these paths as shown in the lower diagram of Figure 1. In order to complete Einstein's challenging formulation of the principle of the constancy of light velocity, this result requires that <<light in empty space always propagates with a definite velocity **c** which is independent of the state of motion of the emitting body>> [1] *and can be measured as such by any inertial observer.* This formulation is in accordance with the independent result obtained in [2], that (against Einstein's belief) the CS at absolute rest is actually present in SRT by his 1905 derivation of the LT in [1]. In view of our result, the generally accepted formulation of the principle of the constancy of light velocity [1], <<every light ray moves in the 'stationary' CS with the fixed velocity c, independently of whether this ray is emitted by a stationary or a moving body>>, adapted SRT to the anachronous 'innocent' and non-professional inertial observers.

Finally, we point out that for the exacerbated relativism of the century, most of the paradoxical interpretations in SRT (and yet the limited range of the applications of SRT) are responsible for the anachronous 'innocent' inertial observers, who in consequence of their isolation and lack of knowledge on the relative motion, perform measurements and draw pseudo-scientific conclusions from the LT. That concerning the velocity of light is but just one of them.

References:

[1] A. Einstein, Ann. Phys. 17 (1905) 891.

[2] A.C.V. Ceapa, Physical Grounds of Einstein's Theory of Relativity (3rd ed., Bucharest, 1998) 16.

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