MEASUREMENT OF ABSOLUTE VELOCITIES BY INERTIAL OBSERVERS

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Inertial observers can actually measure their absolute velocities and that of light as well, what enlightens the principle of the constant light velocity and pleads for turning 'blind', 'innocent' inertial observers to professionals in order to remove perennial paradoxical interpretations in Einstein's special relativity theory, and extend its applications.

1. Introduction

Consider the uniform rectilinear motion of an inertial observer assumed to be 'blind', i.e., to have no physical contact with the outer world. It happens that at a time when in every branch of physics work professionals, yet in Einstein's special relativity theory (SRT) such observers perform measurements and provide interpretations of their results without possessing a priori most elementary knowledge on the relative motion. Instead to adapt these observers to represent their motions relative to 'unseen' coordinate systems (CS's), just as observers "at rest" see their motions relative to them, the SRT was adapted to them by the standard formulation of the principle of the constant light velocity (with the ignorance of its challenging formulation relative to empty space also in [1]). It will become evident below that the CS that a 'blind' observer should imagine is one aimed by no motion at all, i.e., one at absolute rest (K), his results do not depending on the existence or the non-existence in Nature of a reference frame (RF)[1] at absolute rest. Only in such conditions an inertial observer can identify an experiment which to reveal both his absolute velocity and the light absolute velocity c, by identifying in his RF a CS k parallel to K which enables him to write mathematical equations.

2. Experiment

The experiment at hand for a professional inertial observer consists in light signals traveling to and fro along arbitrary directions relative to the coordinate axes of his CS k, just like in Einstein's 1905 thought experiment discussed in [1]. This inertial observer assumes that at the time t=0 his CS k coincides with the CS K at absolute rest which he cannot see, and that, also at time t=0, the origin of k and a light signal emitted by a source of light situated at the origin of k (or just reaching the origin of k) leave the origin of K, moving along the positive common x',x axis at absolute velocities v and c, respectively. The diagrams in Fig. 1 are drawn and examined by the observer in the RF carrying k, an ability due to his training in physics.

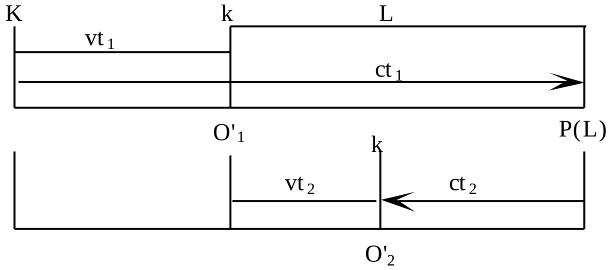

Figure 1

Figure caption: At time t=0, the origin of k and a light signal leave the origin of the CS K at absolute rest, moving to the right along the x',x axis. At a time t_1, they reach, respectively, the points O'_1 and P(L) in upper diagram; P(L) is a fixed point in k. In the time interval t_2, the reflected light signal and the origin of k cover, respectively, the line segments PO'_2 and $O'_1O'_2$.

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 Fig. 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 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 given, respectively, by

$$v=L(t_1-t_2) / 2t_1t_2,\quad c=L(t_1+t_2) / 2t_1t_2. \qquad (2)$$

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 will be 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.

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[1] A CS is here conceived as an assembly of three straight lines orthogonally crossing at a point, while a RF as an assembly of physical bodies defining the coordinate axes that carry measuring instruments, observers and CS's.

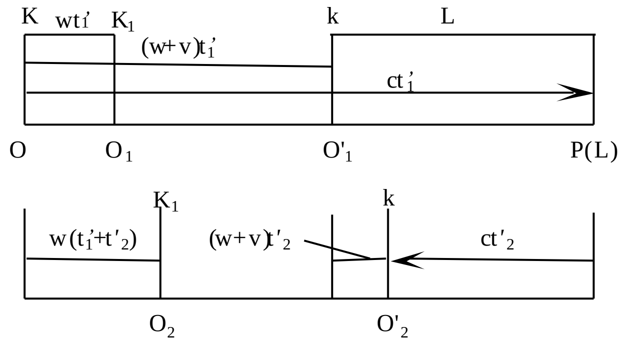

Figure 2

Figure caption: K and k move with velocity w along the x',x axis. At time t=0, a light signal is emitted along the x',x axis and an additional velocity v is imparted to k relative to K along the same axis. At time t_1, the origin of k, that of K, and the tip of the light signal reach, respectively, the points O'_1, O_1 and P(L) in the upper diagram. In the time interval t'_2, they cover, respectively, $O'_1O'_2$, O_1O_2 and PO'_2 in the bottom diagram

Let us now assume that K would not be at absolute rest but (together with k) would belong as K_1 to an inertial space moving at absolute velocity w along the common x',x axis. At time t=0, the additional uniform collinear motion of velocity v is imparted to k relative to K_1. There result the diagrams in Fig. 2 that are analogous to those in Fig. 1, with absolute velocities V=v+w and c. From them we get equations

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

Whether the motion of the inertial space is not referred to the CS at absolute rest but rather to a K_2, and K_2 is moving at constant velocity w_1 relative to the CS at absolute rest, etc., the k will move at absolute velocity $V=v+w+w_1+\ldots$ Thus, despite the general belief, any isolated ('blind') inertial observer with a training in physics 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 light velocity in empty space). He does not need to identify in this aim the RF at absolute rest in Nature; this method depends only on considering the CS at absolute rest in his reasoning.

3. Physical interpretation

The physics behind this experiment is very simple. For its better understanding, consider an object M_2 moving rectilinearly with constant velocity v_2 on the surface of another object M_1, along the constant velocity v_1 of M_1 or oppositely. 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, M_2 are moving rectilinearly, uniformly, simultaneously and independently in vacuum at velocities V_1 and $\pm V_2$ respectively. This time the relative velocities $V_1 \pm V_2$ are not true physical quantities: They do not appear as true velocities of an object. They manifest physically by 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 c±v, appearing by the factorization mathematically required to resolve each of Eqs. (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 $V_1 \pm V_2$ and unlike the true velocities $v_1 \pm v_2$ above, c±v are not true velocities of light, manifesting physically by frequency shifts at the instant of collision between light and a body carried by the RF carrying k, exclusively due to the motion with velocity –v or +v of that body at that instant of time.

4. Principle of constant light velocity

As concerns the hypothesis 'stipulated' by the principle of the constant light velocity, that the paths of the light signal from the origin of k to the point P(L) and back to the origin of k would be equal for the inertial observer in k, it 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 last diagram in Fig. 1. This result requires to complete Einstein's challenging formulation of the principle of constant light velocity in [1], namely <<light in empty space always propagates with a definite velocity c which is independent of the state of motion of the emitting body>> with*: and can be measured as such by any inertial observer*. This formulation is in accordance with the independent result proved in [2], that -against Einstein's belief- the CS at absolute rest is actually present in SRT by Einstein's 1905 derivation of the Lorentz transformation in [1]. As concerns the official version of the principle of the constant light velocity, also given in [1], namely that <<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>>, it is merely wrong and misleading for the reason just explained above, and was chosen just to adapt SRT to the anachronical non-professional observers.

5. Conclusions

Finally, we point out that responsible for most paradoxical interpretations in SRT, the exacerbated relativism of the 20^{th} century, and yet the limited range of applications of SRT are the anachronical 'blind' and 'innocent' inertial observers, who, in consequence of their isolation, perform measurements and often interpret them falsely due to their lack of knowledge of most elementary physical representations. That concerning the light velocity was 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 (3^{rd} Ed., Bucharest, 1998) 16.