One Way Speed of Light and Why Nothing Can Be Faster Than Light

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Abstract— The problematic nature of synchronizing clocks consists of the use of the condition of the equality of the speed of light in opposite directions for clock synchronization in the STR, while the experimental verification of this equation is considered impossible in principle. Einstein, by alluding to the impossibility of measuring velocity in one direction without arbitrary assumptions, assumed that the speed of light propagation in a vacuum from point A to point B is equal to the speed of light passing from B to A. Does nature not permit us to measure the speed of light in one direction without arbitrary assumptions? Did S. Marinov and his followers measure the one way speed?

In the paper method and device for measuring the speed of light in a single direction without arbitrary assumptions are discussed.

A possible cause of the boundedness of the velocity of material objects is demonstrated without reference to the provisions of the special theory of relativity. A condition is formulated on the basis of which the assumption of the movement of material objects at any arbitrarily prescribed velocities proves to be self-contradictory in instances when the arbitrarily prescribed velocities of the objects exceed a certain value. This condition consists of the existence of massles signals and particles that are propagated in space and inside material objects at a velocity greater than any prescribed velocity of the material objects and particles that do have mass.

1. INTRODUCTION

The problematic nature of synchronizing clocks consists of the use of the condition of the equality of the speed of light in opposite directions for clock synchronization in the STR, while the experimental verification of this equation is considered impossible in principle. In order to measure the speed of light from point A to point B, then from point B to point A, and then to compare these speeds, it is necessary to have synchronously running clocks at points A and B. However, in the STR it is only possible to synchronize the clocks at points A and B using the Einstein method by assuming that these velocities are equal even before they are measured. Naturally, after this assumption is made, they also become equal based on the measurement results.

It is also not possible to measure velocity by synchronizing a pair of clocks at point A, then moving one of them to point B, since the result of the synchronization and measurement of the speeds of light from point A to point B and back, v_{AB} and v_{BA}, respectively, is dependent upon the speed at which the clocks are transported from one point to the other.

It is frequently said that Rømer measured the speed of light in one direction. It may seem strange, but Rømer velocity is also the velocity obtained under the tacit assumption of the equality of the speeds of light in opposite directions. The fact of the matter is that Rømer and Cassini were speculating about the movement of Jupiter's satellites, automatically assuming that the observers' space was isotropic. The Australian physicist L. Karlov [1] showed that Rømer actually measured the speed of light by implicitly making the assumption of the equality of the speeds of light back and forth.

Poincare examined the proposition of the equality of the speed of light from A to B and the speed from B to A, and this proposition in particular became the principal postulate of Einstein's 1905 work [2], although it was not presented in the form of a postulate, but rather in the form of a "definition", which preceded two Einsteinian principals that are often called postulates. Later Einstein called this "definition" an assumption, during which he noted that it pertains not only to the speed of light, but also to velocity in general.

It is often said that the equality of the speeds back and forth is obvious, since space is isotropic, and that inequality is unobvious. This is not the case. The fact that light requires more time to move from point A to point B than to move from B to A is also obvious if, for example, point A is located in the stern and point B in the bow of a spacecraft that is moving relative to us and we track the process of light movement from A to B and back not from within, but rather from without. In principle, both the equality and the inequality of this craft's light propagation times from point A

to point B and back can be found from a host of other reference systems that are in motion relative to this craft, even if the clocks of these systems have been synchronized using Einstein's method. In this vein, what is the basis on which the clock inside the craft is synchronized without allowance for the objective results of the observation of light behavior inside the craft obtained from different reference systems outside the craft?

During the 1960s and 1970s, references were often encountered in abstract journals to foreign works in which versions of the special theory of relativity based on the proposition of the inequality of the speeds of light in opposite directions were examined. These versions were called ε-STR and consistently described everything that the STR describes. In truth, most of them were more "ponderous" and less convenient than Einstein's version, since they violated the requirement of the immutability of the mathematical form of notation of laws in different reference systems. Most of the works of these authors were not opposed to Einstein's version, but rather demonstrated the consistency of an untraditional approach. The authors of these works attempted, by disrupting the mathematical beauty of the STR, to uncover its physical content and to clear up the enigma of the speed of light in one direction. Why nature does not permit us to measure the speed of light in one direction without arbitrary assumptions! Is this randomness or something deeper? The developers of the alternative theories did not answer this question.

2. ONE WAY SPEED OF LIGHT. DEVICE AND METHOD FOR MEASURING IT

And yet, a method does exist for measuring the speed of light in a single direction without arbitrary assumptions. This method was proposed by S. Marinov and implemented by S. Marinov himself and his followers [3–5]. Here we consider a method similar to the Marinov's method and a device for measuring the speed of light in one direction and analyze the features associated with this measurement.

The essence of this method and the means for implementing it consist of the following.

Imagine a long cylindrical elastic rod, S, to the edge, A, of the cylindrical surface of which a great number of strokes evenly arranged around the periphery is applied. At a certain moment in time, the rod is set into rotation around the axis of the cylindrical surface, for which purpose torque is applied to end A of the rod. After an angular spin rate of equaling ω_0 is achieved, the predetermined angular velocity of end A is rigorously maintained.

Let's assume a sensor is located alongside rod end A that records the passage of the strokes near it and simultaneously generates pulses that proceed to a counter. The pulse counter transmits data concerning the number of pulses reaching it to a device that performs the function of a clock after the constancy of the angular velocity of rod end A is established, converting the number of pulses received by the counter into a time reading.

Let us further assume that precisely the same instruments as near end A, including a pulse counter and a clock, are installed at the other end of rod S — end B, and that precisely the same strokes as on end A are located on the cylindrical surface of end B. During the initial period of time, when the rod is rotating at an increasing rate, the angular velocity of end B is less than that of end A due to a delay in torque transmission. If a straight guide line is applied along the generatrix of the rod's cylindrical surface over its entire length before the rod is set into a state of rotation, the guide line on the cylindrical surface of the rod takes on a helical shape during this period of time. When the angular acceleration of end A is sufficiently low, only a poorly expressed helicity (a quite large helix pitch) that does not lead to extreme rod deformation can be achieved. After a certain amount of time, the angular velocity of end B becomes constant and equals ω_0. Under steady-state conditions, it cannot be otherwise, since the difference in the angular velocities of the ends would lead to gradual "twisting" and to rod breakage. We will assume that there are no residual strains in the freely rotating rod and that no external braking forces act on it (the rod is rotating in a vacuum, or in the ideal case, in a state of weightlessness). Under these conditions, the clocks on the ends of the freely rotating rod with a straightened guide line run synchronously.

In confirming this, we proceed on the basis of the fact that if the pulse counters installed on both ends of the rods are zeroed out before end A starts to spin, both ends must then make an identical number of revolutions by the time the helix disappears. For this reason, the counter guide lines must transfer identical numbers to the clocks when helicity is absent, and the clocks must provide identical readings.

Clocks synchronized in this way can be used to measure the speed of light in a single direction — from end A to end B of a rod or vice versa. Clock synchronicity does not require arbitrary assumptions concerning the nature of the speeds of light in opposite directions.

If the postulate concerning the equality of the speeds of light in opposite directions proposed in the special theory of relativity is true in the physical sense, the result of the measurement of the one-way speed of light by the clocks must then be the acquisition of a velocity value that equals the constant c. Due to the equality of inertial frames of reference, such an experimental result must not be dependent upon the selection of the inertial frame of reference within which an experiment is conducted.

In the Lorentz ether theory, physical ether time and physical ether simultaneity are absolute. If the device described above is at rest in the ether, then the straight guide line on the cylindrical surface of a rod after it is set into a state of free rotation must remain straight due to ether space anisotropy and due to rod symmetry. On the other hand, since physical simultaneity in the ether theory is absolute, a straight guide line on a rotating rod that is simultaneously recorded in one inertial frame of reference must also remain straight in another inertial frame of reference. Furthermore, guide line straightness on all similar rods at rest or in motion in the ether at different velocities must be retained in all inertial frames of reference. But absolute ether simultaneity leads to the inequality of the speeds of light in opposite directions in inertial systems that are in motion in the ether. For this reason, the speeds of light measured by the aforementioned clocks located on the ends of a rotating rod in opposite directions must be different if the rotating shaft is moving through the ether in the axial direction.

3. WHY NOTHING CAN BE FASTER THAN LIGHT

We will presume to postulate a condition during the satisfaction of which the fact of the finiteness of velocity becomes obvious and stops contradicting everyday common sense, while the possibility of a boundless increase in the velocity of tangible objects fully emerges beyond the framework of everyday common sense.

This condition is as follows: "*Massles signals and particles that are always present in material objects are propagated at a velocity, V, that is unattainable for physical objects and particles that do have mass, continuously initiate interactions and processes in these bodies*".

The condition does not contain a limitation of the velocity of tangible objects, but also does not contradict it. As we will demonstrate further on, this limitation proves to be a consequence, not a requirement of the condition. However, while observing the condition and temporarily skirting the prohibitions of the special theory of relativity, let us *a priori* assume the existence of velocities of solid physical bodies and particles that equal any prescribed values. Here, in order to satisfy the requirement of the unattainability of the velocity of massless interaction signals and carrier particles by these bodies and particles that is contained in the condition, we will presume that any prescribed postulated velocity, v, in all our speculations is negligible as compared to the postulated velocity, V.

Can we, by satisfying the condition cited above, conceptually dispatch a free-moving signal or solid body to point A, located a distance of L from a certain material body at rest (in our reference system), at a predetermined velocity and bring it back in such a way that they almost instantaneously fly to and fro, traversing a distance of $2L$ in this instance?

At first glance, we can — after all, we are able to assign the body any v velocity, and according to the condition we formulated, the V velocity of a signal is much greater. But before we rush to judgment, can we pause to ponder the content of the concept of "instantaneously"?

What does "instantaneously" mean?

In the metrological sense, "instantaneously" means a zero variation in the readings of arbitrarily accurately running clock between the times when a body or signal is dispatched and it returns. In the physical sense, "instantaneously" means that no processes and variations occurred between these times — even at the microlevel. The dispatch time and the return time must merge together in this instance. After all, if any processes and variations occurred in a body between these times, then by occurring in time, the processes and variations required a specific amount of time. This means that the times are separated by a time interval to which the arbitrarily accurately running clock must react by a change in their readings.

We now wonder is it possible for an arbitrarily fast-moving body or signal to traverse a distance of $2L$ while no variations occur in a body at rest?

No, this is not possible if the condition we formulated is valid, and there are interaction signals and carrier particles in the body at rest that are propagated at a velocity of V and that initiate events.

Let us remember that everything changes at the microlevel in material bodies, without stopping for even the tiniest period of time. Interaction signals and carrier particles that exchange the elements of material bodies are responsible for many processes and events in these bodies.

Being found in material bodies in a state of motion at a velocity of V according to the condition we formulated, interaction signals and carrier particles initiate the accomplishment of events. If the average distance, λ, between material body elements interacting in a certain way is considerably less than the entire $2L$ path, then when a (massless) signal moving to point A and back covers a total of a small part of the path it is traversing, which equals λ, each of the event-initiating interaction signals and carrier particles of a specific type present in a body at rest produces an interaction in the mean statistical sense. However, during the time of travel of a signal to point A and back, and its traversal of a distance of $2L$, $2L/\lambda$ times more events of a given type are accomplished in a body at rest than when traversing a short distance equaling λ. But if there are interactions in a body, the body then changes in time, and arbitrarily accurately running clock must react to these changes by way of a variation in readings.

4. CONCLUSION

A method for measuring the speed of light in a single direction without arbitrary assumptions is discussed. Such a method was implemented in Marinov's experiment and is considered by his followers.

Clock, synchronized by the proposed method can be used to measure the speed of light in one direction. If the postulate concerning the equality of the speeds of light in opposite directions proposed in the special theory of relativity is true in the physical sense, the result of the measurement of the one-way speed of light by the clocks must then be the acquisition of a velocity value that equals the constant c. If ether exists, then the speeds of light measured by the clocks located on the ends of a rotating rod in opposite directions must be different if the rotating shaft is moving through the ether in the axial direction.

We initially examined the conditions under which the velocity of material bodies has a limited nature based on the example of the model (the simulation of the special theory of relativity) described in references [6–8]. We later departed from this model and made the transition to the examination of the question independent of it. However, the considerations set forth in the aforementioned works in particular impelled us toward the logical solution of the problem of the finiteness of velocity and made it possible to answer the questions arising during the resolution of this problem.

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