WHY THE VELOCITIES OF MATERIAL BODIES CANNOT ACHIEVE THE SPEED OF LIGHT IN A VACUUM

Vadim N. Matveev[1], Oleg V. Matvejev[2]

A possible cause of the finiteness of the velocity of tangible 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 tangible objects at any prescribed velocities proves to be self-contradictory in instances when the prescribed velocities of the objects exceed a certain value. This condition consists of the presence of interaction signals and carrier particles in material bodies that are propagated at a velocity greater than any prescribed velocity of the material bodies.

Introduction

It is generally known that the velocities of material bodies not only cannot exceed, but cannot even achieve the speed of light in a vacuum, and this is assuming that the speed of light, *c*, itself is not so great, at least for elementary particles, many of which move at velocities only slightly lower than the speed of light. The inability of tangible objects to achieve the speed of light and the impossibility of any tangible objects moving at superluminal velocities fall within the framework of everyday "common" sense and are generally explained by the prohibitions against this movement that are contained in the special theory of relativity. However, such explanations only make it possible to state the fact of the finiteness of

[1] matwad@mail.ru

[2] oleg@tdd.lt

the velocity of tangible objects and do little toward making its underlying causes comprehensible.

Why are material bodies fated to move at a velocity lower than the speed of light? What is the reason that a material body, no matter how and how long it is being accelerated, never achieves the speed of light in a vacuum? Why does the speed of light, being finite, behave as if it is infinite and is therefore unattainable for materials bodies?

None of these questions would exist if the speed of light were infinite. Then it would also be impossible for a beam to catch up, the speed of light in reference systems moving relative to one another would be identical, and physical bodies could not achieve the speed of light precisely because its infinity. But, alas. The speed of light is finite, and this is an indisputable experimental fact.

Will the reason for the impassability of the light barrier by physical objects ever be found or will one always have to settle for the statement of fact and to explain it by way of the prohibitions of the special theory of relativity and the ostensibility of mathematical expressions in the superluminal velocity regions?

1. Inconsistency of the Assumption Concerning the Boundless Velocity of Tangible Objects

Many people believe the statement of the question of the cause of the finiteness of the velocity of tangible objects is incorrect. In the opinion of proponents of this point of view, the fact of the finiteness of velocity should be taken as a certain given without the question “why”. Yet, we will still 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: *“Interaction signals and carrier particles that have no mass (at rest) are always present in material bodies, which,* *being propagated at a velocity, V, that is unattainable for physical bodies and particles that do have mass (at rest), 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_p, in all our speculations is negligible as compared to the postulated velocity, V_p (the subscript "*p*" in the v_p and V_p notations symbolizes the conceptual, postulative nature of these velocities).

We can justify the transgression of the fact of the limitation of a velocity with a constant of *c* that we committed during these assumptions by way of the fact that we are not solving a physical problem, but rather are attempting to logically prove the inconsistency of the assumption of the movement of tangible objects at a boundless velocity. Acting in a purely formal manner, we will use the trivial logical method of proof by contradiction, all the more so in that logically and mathematically boundless velocities are possible. Only the superluminal velocities of tangible physical objects capable of transferring energy and information from one point in space to another are prohibited in the special theory of relativity. For this reason, the limited nature of the velocity of tangible objects is often referred to as the inability to transfer information, a signal, or an interaction at a speed that exceeds a velocity with a constant of *c*. But the velocity of nonphysical objects that do not carry information and energy can exceed the limiting velocity of signals. Such objects include, for example, the point of intersection of shearing blades approaching one another or a light spot from a rotated beam "running" over a surface.

In line with the question posed, 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 2*L* in this instance?

At first glance, we can – after all, we are able to assign the body any v_p velocity, and according to the condition we formulated, the V_p 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 2*L* 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_p 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_p 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.

If the event accomplishment frequency is proportional to the V_p velocity, then the number of events of a given type, $\Delta\eta$, in a body at rest that occur between the time that a free-moving signal is dispatched from the body at rest to point *A* and the time that it comes back, is not dependent upon the V_p velocity we have conceptually given the interaction signals and carrier particles. The higher the conceptual V_p velocity, the faster (in our minds) the signal traverses the path from the body at rest to point *A* and back, but the more often events are accomplished in the body in our imaginary time when all other conditions are equal.

Thus, at any conceptual V_p velocity, the number of events of a given type, $\Delta\eta$, in a body at rest that are accomplished between the times of dispatch and return of a signal remains unchanged; i.e., the extent to which the body changes, if this is estimated via the number of events of a given type, will be dependent upon the distance that the signal traversed and will not be dependent upon our conceptual V_p velocity. The greater the distance the signal traverses, the larger the number of events accomplished in the body at rest. It is not possible to ensure the absolute immutability of a body at rest in the presence of an *L* distance that exceeds the λ distance. Being guided by everyday common sense and introducing the assumption of an arbitrarily high velocity, we will create conditions for the boundedness of this velocity and will arrive at the inconsistency of the assumption introduced, if we just introduce this velocity not only into an empty space, but also into the space of material bodies. This is the principal result of our speculations.

2. Simulation of the Finiteness of the Velocity of Tangible Objects

We will now simulate the finiteness of velocity based on the example of the following unpretentious imaginary model. It consists of a set of constructs (a world of constructs), each of which has imaginary elements (spheres) at rest, while signal particles fly between the sphere elements at an enormous imaginary V_p velocity. The V_p velocity at which the fast-moving particles travel in the imaginary "world" of constructs and the V_p velocity we examined in the previous section at which signals move in material bodies are the same velocity, which exceeds any prescribed v_p velocity of any solid body. When the fast-moving particles (signal particles) enter the elements, they initiate the accomplishment of events within a construct. The fast-moving particles do not have a mass (at rest) and are never in a state of rest.

We will presume that each event caused by a fast-moving particle entering an element of a given construct leads to the variation of this construct.

Let's say the average path (the mean free path) that a fast-moving particle traverses between the elements of any construct without colliding with them equals λ. We will hazard a guess that n fast-moving particles are continuously present between the elements in any part of the mass, m, of a given construct. We will assume that the number of events, η, accomplished in a part of a construct with a mass of m over a time of t, reckoned from a certain zero time, as a result of the collision of the fast-moving particles with the construct elements, is directly proportional to the mass of the allotted part of the construct and the t time value.

Once again, as in the previous case, we will imagine that the v_p velocity of solid bodies located outside constructs can equal any prescribed value. We will then again assume that the imaginary V_p velocity of a fast-moving particle is so great that it far exceeds any prescribed imaginary v_p velocity of a solid body. Is it possible in this instance, albeit conceptually, to accelerate a solid body located outside the confines of a construct at rest (in our reference system) to a velocity such that it flies from this concept's location to point *A* a distance of *L* away and returns to the original point almost instantaneously; i.e., so that nothing occurs within the construct at rest in this instance?

No! This is impossible.

It is not possible because even if not a solid body, but a free one is dispatched on the flight to point *A* and back – i.e., a fast-moving particle that is located outside the confines of a construct, which under our assumption moves at a velocity of V_p more quickly than any solid body, then it, too, cannot instantaneously fly there and back. Actually, even over the time during which a free fast-moving particle traverses just a small part of a path, numerically equal to λ, each of the particles moving within the construct at the same V_p velocity gives rises to the accomplishment of an average of one event, while altogether as many events occur in the construct as there are fast-moving particles within it. However, over the time of travel of a free fast-moving particle to point *A* and back, and its traversal of a distance of $2L$, $2L/\lambda$ times more events are accomplished in the construct than when a distance equaling λ is traversed. Altogether over the travel time of a fast-moving particle to point *A* and back, $2Ln/\lambda$ events are accomplished in a part of a construct that contains *n* fast-moving particles; i.e.

$$\Delta\eta = 2Ln/\lambda. \qquad (1)$$

Here, $\Delta\eta$ is the number of events accomplished in a part of a construct that contains *n* fast-moving particles between the times of dispatch and return of a fast-moving free particle. However, if it is not a signal, but a solid body that flies to point *A* and back, the v_p velocity of which is lower than the V_p velocity of a signal, then more than $2Ln/\lambda$ events are accomplished over the particle flight time.

Thus, even over the time of flight of a fast-moving particle there and back at a velocity that is greater than any velocity of a solid body, a construct at rest changes; i.e., some amount of time is required for the flight. How much? How is time measured using the tools of our imaginary world of constructs?

If the number of events, η, accomplished in any part of a given construct over a time of t, reckoned from a certain moment (or from a certain specific event), is directly proportional to the t time value, then using any such parts, a hypothetical clock can be conceptually linked to it that makes it possible to directly or indirectly compute the number of events, η, in this part of the construct and to depict it on the clock's dial. Mind you, hypothetical clocks of this type have a shortcoming in that their readings are dependent upon the size of the part of the construct that performs the function of a "clock". If the number of events accomplished in any part of a construct over a time of t is proportional to the mass, m, of this part, then the set of "clocks" with different masses would be different, because the greater the mass of a "clock", the more events occurring therein over a time of t. In order for this dependence not to exist, instead of the number of events, η, we will conceptually depict the ratio of this number to mass, m, on the dial; i.e., the η/m value, which we will designate with the symbol η_m.

Assuming that any processes in the world of constructs consist of a set of events initiated by fast-moving particles and occur at a rate that is determined by the event accomplishment rate, we can call the η_m value the simulated time of the "world" of constructs. Unlike the η value, the simulated time of constructs, η_m, flows identically in all constructs and in all their parts. In turn, all the simulated processes in the constructs occur in the universal time of the world of constructs. The dimensionality of time in our case is expressed by reciprocal mass $[M^{-1}]$; however, it is not essential and can always be converted to the units of measurement to which we are accustomed in the necessary instances by introducing a dimension factor.

Introducing the concept of the mass concentration, n_m, of fast-moving particles, which consists of the ratio of the number of fast-moving particles, n, in a part of a construct with a mass of m to the m mass, and dividing the left-hand and right-hand sides of equation (1) by m, we obtain

$$\Delta\eta_m = 2Ln_m/\lambda. \qquad (2)$$

Knowing that, according to formula (2), $\Delta\eta_m = 2Ln_m/\lambda$ events are accomplished over the time that it takes a signal to traverse a distance of $2L$ in a section of a body or a construct of unit mass (a time of $\Delta\eta_m$ passes), we can divide the distance of $2L$ by a simulated time interval $2Ln_m/\lambda$ and obtain the velocity value V_{imit}, which equals λ/n_m in simulated time; i.e.

$$V_{imit} = \lambda/n_m \qquad (3)$$

According to formula (3), the V_{imit} velocity of a signal in simulated time will only be dependent upon the internal λ and n_m parameters of the constructs. The simulated velocity, V_{imit}, is the highest velocity of the objects examined in the model and they cannot exceed it.

The t time value to which we are accustomed can be formally linked to the simulated time, η_m, of the "world" of constructs by the correlation

$$t = \alpha\eta_m ,$$

where α is a dimensional proportionality factor, while t and η_m – the readings of a conventional clock and a hypothetical clock of the world of constructs, respectively.

Accordingly, the Δt time interval to which we are accustomed is linked to the $\Delta\eta_m$ simulated time interval of the "world" of constructs by the equation

$$\Delta t = \alpha\Delta\eta_m , \qquad (4)$$

Dividing the $2L$ distance by the Δt time, we obtain the velocity, V, in the units to which we are accustomed. Using equations (2) and (4), this velocity can be written in the form

$$V = \lambda/\alpha n_m.$$

It is clear that the V velocity here is the c velocity in a vacuum. Of course, we cannot calculate the c constant using the formula derived based on the example of a primitive model. The λ, α, and n_m values in the latter formula have nothing to do with actual objects, and their use is only invoked to demonstrate the inconsistency of the assumption of the boundless velocity of objects.

Conclusion

The speculations presented in this article can be tied to any inertial reference system by virtue of the formal equality of these systems. 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 [1-2]. 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. The results of our work may be useful when discussing the subject of superluminal velocities, which recently again captured the attention of specialists in the wake of questionable publications [3-5] concerning experimental observations of these velocities.

References

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