

Proof that Earth Does Not Revolve around the Sun and Consequences for Special Relativity Theory

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In 1971, Hafele and Keating performed the experiment in which they proved the time dilation effect with the use of macroscopic clocks. By consistently applying their reasoning we come to the absurd conclusion that the Earth is not rotating around the Sun. Such a paradox is the result of the fact that Hafele and Keating performed their reasoning applying the SRT, while the correct solution of this problem is possible only on the basis of GRT. In fact, Hafele and Keating proved GRT while their intention was proving SRT. If we take a closer look at other experiments confirming SRT we can see that all the experiments are the repetition of the mistake made by Hafele and Keating; however only their experiment allows for deriving such a spectacular conclusion. Therefore one may question if it is possible to perform any experiments proving Special Relativity Theory at all.

Some part of experimental proofs of the Special Relativity Theory consist of measuring of time dilation of various relativistic objects. The common feature of these experiments is the fact that the examined object always had to change its velocity. However, the change of velocity lasts for a very short time and the relativistic effects resulting from the change of the velocity, predicted by the GRT, were much lower than the change of time resulting from velocity itself. Therefore, the results of the experiments were assumed to be the proof that the motion with the constant velocity is the source of the time dilation—in other words, the proof of the SRT.

In 1971 Hafele and Keating performed their well-known experiment proving the SRT with the help of macroscopic clocks carried eastward and westward around the world. The indications of the clocks were compared with the indications of the clock remaining on the Earth's surface. The difference between the indications of the clocks was assumed to be the proof of SRT.

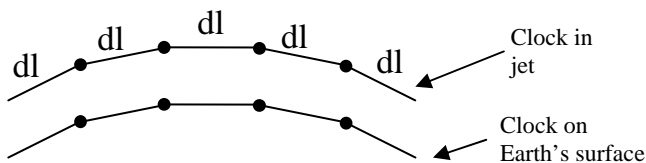


Fig. 1: If the motion of jets was to be treated as inertial, the path of the jets should be treated as if it consisted of segments of straight lines.

Solving any problem from the point of view of SRT requires choosing the inertial reference system in which the motions are considered. Hafele and Keating assumed that in case of the rotational motion of the clocks—they were all rotating around the axis of the Earth—the inertial coordinate system should be bound with the Earth's axis. If the motion was to be treated as inertial, the path of the clocks around the world should be treated as if it consisted of segments of straight lines—see Fig. 1. Computations of the flow of times for all the segments gives the correct result for the predicted time dilation. This result has been confirmed

many times during the computations of time dilation for the GPS system.

In my paper published in *Phys. Essays* [1], I asked the following question: if, for the problem solved by the Hafele and Keating, the inertial reference system could be bound with the Earth's axis, then could the reference system be bound with the axis of the Sun too? It is even a "more inertial" system than the one bound with the axis of the Earth. By binding the inertial coordinate system with the Sun's axis, we are adding the velocity of the motion of the Earth around the Sun to the velocities of all the clocks taking part in the experiment. The velocities of the clocks are added to or subtracted from the velocity of the Earth depending on the time of the day. Eventually we should obtain a very strong dependence of the difference between the indications of the clocks and the time of the day, which should change the achieved results by several hundred percent. The difference did not occur, and therefore the conclusion was that the Earth is not rotating around the Sun. By binding the inertial system with the center of our galaxy we come to conclusion that the galaxy is not rotating, etc., etc.

The source of the paradox is that the problem of rotational motion **must** be solved with the help of GRT. The mistake made by Hafele and Keating was treating this problem using SRT which, on the other hand, required some false assumptions which led to this paradox. Eventually, Hafele and Keating proved the GRT but were convinced that they proved the SRT.

The mistake made by Hafele and Keating is commonly repeated in publications considering the rotational motion of Earth, GPS satellites, and so on [4]. The mistake can still be repeated because the approximate GRT solutions describing the time dilation in rotational systems for satellites and the Earth are identical with the exact solutions derived with the help of SRT with some false assumptions. An example of such false assumptions can be computations, based on the SRT, of the time dilation of the Earth in the coordinate system bound with the Sun, and then computation of the time dilations of the satellites' clocks, in the coordinate system bound not with the Sun, but with the Earth. Such approach can be possible using the GRT, but not using the SRT where, in case of the coordinate systems bound with the Sun, the

velocities of the Earth's satellites are changing depending on the time of a day—similarly to the clocks in the Hafele and Keating paradox. However, the final formulas obtained using the SRT and false assumptions mentioned above are correct, and the way of deriving the formulas using the SRT is much simpler than when applying the GRT; therefore, the method based on SRT is commonly used and the results obtained in such a way are in accordance with the experiment. The only difference between the two methods is that by solving the problem with the use of the SRT, we are convinced that the origin of the time dilation is the SRT, while in fact the GRT is responsible for the time dilation phenomena. Finally, the time dilation which is assumed to be the result of the velocity—the result of SRT—is, in fact, the result of GRT, namely the combination of the velocity and the centrifugal acceleration.

Let us come back to Fig.1. The approach based on the SRT was to omit the change of the velocity at the edges of the segments of the trajectory of the clocks. This gave us the correct results, but it gave us the false conclusion that only the velocity and nothing else is the origin of the time dilation, while in fact the source of the time dilation was both the velocity and the change of the velocity. Ignoring the changes of the velocity only affects the interpretation of the results—not the results themselves. If we consider other experiments proving the time dilation phenomena, we will see that in all these experiments we make the same mistake as the one Hafele and Keating made; however, only the Hafele and Keating experiment allowed to derive such a spectacularly absurd conclusion. It can be shown with the example of meson π . The creation of the meson causes its rapid acceleration and the decay causes its rapid slowing. However, both moments are omitted during the analysis of the problem of the time dilation in the reference system of the meson. The time dilation of the meson is assumed to be only the effect of the velocity, the same assumption made in case of rotational motion during the Hafele and Keating experiment. In the case of the Hafele and Keating experiment, the final time dilation formula suggested that the time dilation was an effect of the velocity while there was also another significant factor, i.e., centrifugal acceleration, so the influence of the velocity for the time dilation phenomena was different from the one predicted by SRT. However, together with the time dilation, the effect resulting from the centrifugal acceleration, it yielded the final formula which seemed to be derived from the SRT. A similar situation likely takes place in the case of meson π and similar experiments where the final formula only suggests the dependence on the velocity as well. Moreover, as soon as the motion of the meson is inertial, the problem of the time dilation between the clock bound with the meson and the clock bound with the Earth are fully symmetrical. Just the change in the velocity of meson results in the fact that the mutually observed time change turns

into the real time dilation in the coordinate system that changed its velocity.

Therefore, apart from the formulas suggesting the dependence of the time dilation from the velocity, when considering the mechanism of the time dilation we cannot neglect the processes taking place during the velocity change, because these processes, however enigmatic, must play a certain role in turning the mutually observed time dilation into a real one which takes place in only one of the coordinates systems taking part in the experiment.

Such mechanism explaining how and why the observed time dilation becomes the actual one had been described with the use of a new model of Euclidean reality. The detailed description of this mechanism can be found on my website [5] and the proceedings of PIRT conference in Budapest 2009 [6].

Returning to SRT: on the basis of the hitherto experiments confirming the SRT, we are unable to univocally state that the time dilation is the result of nothing but velocity. We can only say that the measurement of the time dilation shows the dependence between the time dilation and the velocity, while we cannot say that only the velocity is responsible for the time dilation effect. We can only say that there are certainly two factors which can be responsible for the time dilation effect, either the velocity and the change of velocity or only one of them, but we cannot find out which. The hitherto experiments in which one of the objects had to change its velocity are not a convincing proof that the time dilation changes during uniform motion and they cannot serve as a proof for SRT.

Therefore, I will conclude this paper with the following:

Can SRT be experimentally proven, or are all the effects predicted by SRT in fact approximations of GRT? Does pure SRT describe actual physics, or is it only a set of simple computational tools approximating GRT?

References

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