THE „EXPERIMENTUM CRUCIS”

J. BAJNOK

The present study seeks to demonstrate that the true change in the frequency of atomic clocks depending on their velocity leads to conclusive evidence that the principle of relativity and relativity theory can no longer be accepted.

Introduction

The experimental setting presented here applies the results of the transverse Doppler effect, in four steps The aim of the experiment is to show that the velocity-dependent, true frequency change of atomic clocks contradicts the theory of relativity.

1^{st} STEP

Ives and Stilwell [1], while exploiting the transverse Doppler effect, were the first to show that actual changes can be observed in the frequency of atomic clocks moving with different velocities *(v)*.[1] In our frame of reference the relationship between the frequency of a stationary clock *(f_0)* and a moving clock *(f)* is $f = f_0\sqrt{1 - v^2/c^2}$, where c is the speed of light in vacuo.

In this case, the frequency of an atomic clock can vary depending on its velocity.

The frequency of the clock can be influenced by other external factors as well. The Pound–Rebka experiments [2] demonstrated the gravitation potential effect of this variable. Therefore the conditions of the present experiment were chosen in such a way that except for the velocity, all other factors affecting the frequency of the clocks remained constant.

Inertial atomic clocks moving with different velocities have constant frequencies as long as external factors remain constant. While the direction and velocity of a moving atomic clock *(„B”)* in the inertial system K corresponds to the direction and velocity of the clock *(„A”)* examined in the Ives–Stilwell experiment, the frequency of the former clock is definable without taking any additional measurements, assuming that the clocks are of the same type (Fig. 1).

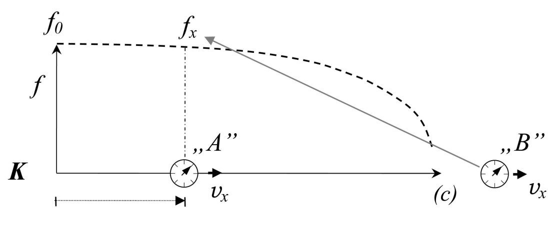

FIGURE 1. Determining the frequency of atomic clock „B” based on the Ives–Stilwell experiment

[1] During the measurement of transversal Doppler shift - apart from the phenomenon of aberration - there is no apparent shift in frequency arising from the difference in speed between the source and the observer.

2[nd] STEP

In the following experiment two atomic clocks are first accelerated to constant v_x velocity in a railway carriage, then in this new inertial system of the carriage, clocks are accelerated to constant velocities in opposite directions $-v$ and $+v$ along the horizontal x-axis. The absolute values of velocities $-v$ and $+v$ are the same, i.e. $|-v| = |+v|$ (Fig. 2).

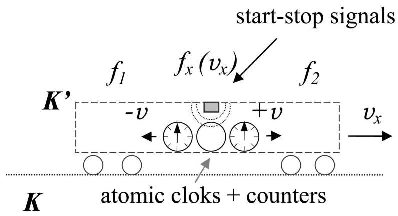

FIGURE 2. Experiment with atomic clocks and counters in the closed system K'

Inside the inertial system K we set up a closed system, called K', corresponding to the railway carriage moving with constant velocity v_x. Counters are attached to the clocks that record the number of oscillations while traversing the same distance (start-stop signals).[2]

3[rd] STEP

Let us relate the diagram with the horizontal x-axis defined like that in the Ives–Stilwell experiment to the railway carriage representing the closed system K' moving with velocity v_x (Fig.3).

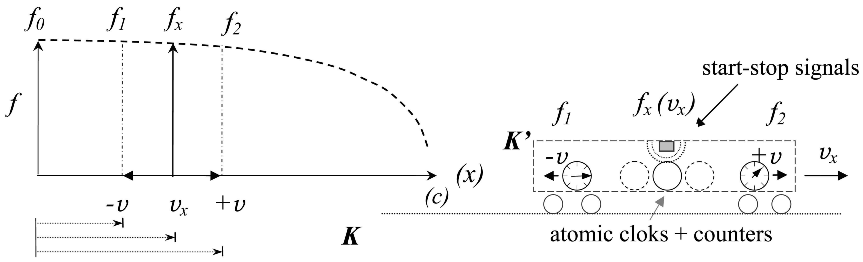

FIGURE 3. The connection between the Ives–Stilwell measurements and the clocks in the closed system K'

It is not necessary to measure the frequencies on the railway carriage, since the frequencies of the clocks $f_1(-v)$, $f_2(+v)$ are already known from the measurements made by Ives–Stilwell in the inertial system K, assuming the atomic clocks are of the same type. Here, it is clear that the frequencies of the clocks moving with velocities $-v$ and $+v$ change asymmetrically, so $f_1 > f_2$.

[2]In this experiment the counters record the number of oscillations while the times and distances measured are the same. The use of counters for the clocks allows the observer to assess the phenomenon independently of the effect of his position and motion. Hence there is no difficulty in reading the moving clocks and the inclusion of acceleration processes in measurement results is avoidable -as a result „pure states” of inertial motion can be analyzed.

The frequency of the clock approaching light speed is lower than the frequency of the clock moving in the opposite direction.[3]

Accordingly, there is an "experimentum crucis" showing that in a closed system the motion of a system and the direction of the motion is demonstrable.

4th STEP

From the conclusions reached above, the following question emerges: does a restricted theory of relativity apply under these conditions or might the rejected notion of absolute motion be correct after all?

It should be noted that *asymmetry appears in two aspects* here, since the frequency difference $|f_1 - f_x| < |f_x - f_2|$ is also asymmetric.

As can be seen in the diagram, the difference between the frequencies $|f_1 - f_x|$ and $|f_x - f_2|$ gradually increases in a decreasing manner, and asymmetry gradually decreases with the gradual decrease in the velocity of the railway carriage in the inertial system K (Fig. 4.).

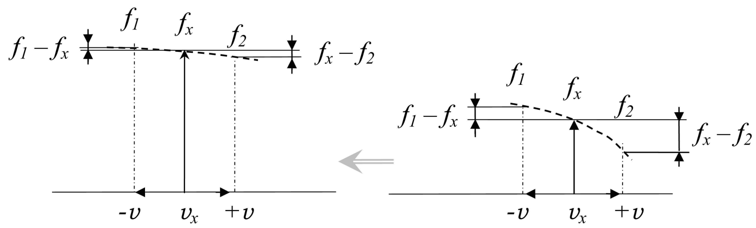

FIGURE 4. Asymmetric change in $|f_1 - f_x| < |f_x - f_2|$

The decreasing difference between the frequencies $|f_1 - f_x| < |f_x - f_2|$ implies that if there were a system with lower velocity than that of the system K with unknown velocity, then in that system the frequencies of the atomic clocks at rest (v_x) would be higher than in the system K.[4]

If motion exists at a lower speed than the unknown velocity of the motion in the system of Ives-Stilwell, a system undergoing inertial motion has to be assumed where the frequency of the clock at rest is higher. This is true as long as we can have a system in which the frequency of the clock at rest has a maximum value. If there were no such system, the clock would approach the speed of light while its frequency would increase continuously. However, this would contradict to results of the Ives–Stilwell experiment and other observations which suggest that approaching the speed of light leads to a decrease in the frequencies of the clocks.

In the railway carriage, the phenomenon can be verified when changing velocities since the difference $|f_1 - f_x| < |f_x - f_2|$ will decrease in a system moving with lower velocity compared to the unknown velocity of the system K.

Consequently, there must be a state of motion for the clocks (v_x), where the increase in their frequencies stops and starts to decrease, i.e. a frequency maximum appears. This maximal value

[3] This view is corroborated by the results of measurements made with atomic clocks in the Hafele-Keating experiment. [3]

[4] The Ives-Stilwell experiment assumes a symmetric frequency change relative to the clock at rest in the system. However, in the experiment with the current settings, the frequency change is asymmetric relative to the clock at rest in the system K'. With this measurement procedure, their results can be extrapolated to any inertial system.

corresponds to a state where no advancing motion appears. (From the dynamic perspective, the clock gives its kinetic energy to the surroundings, hence loses all its kinetic energy.) This means that the clocks are in the state of absolute rest, a phenomenon that is currently rejected. In this benchmark state the differences between frequencies become symmetric, $|f_1 - f_x| = |f_x - f_2|$.

In the experiment described above, the examination was restricted to clocks moving along a horizontal axis for easier comprehension. To determine the state of motion without advancing, the experiment should be extrapolated to all directions of space and by reaching the upper limit the clock will attain a state of absolute rest.

Let the frequency corresponding to absolute rest be f_{A0}, and f_A the frequency corresponding to the absolute velocity v_A, (the „$_A$” index stands for absolute values) and c be the speed of light in vacuo. In the case of absolute motion, the relationship between frequency and absolute motion is described by $f_A = f_{A0}\sqrt{1 - v_A^2/c^2}$, (Fig. 5.).

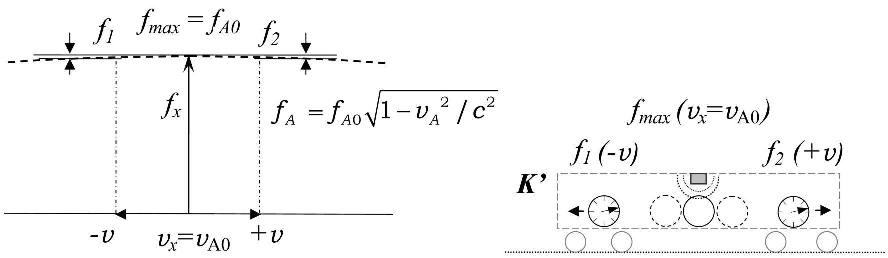

FIGURE 5. The frequency difference $|f_1 - f_x| = |f_x - f_2|$ becomes symmetric

An atomic clock (a body) attaining a state of absolute rest can be defined with radiation frequency as follows: An atomic clock (a body) comes to absolute standstill, that is, its straight-line motion ceases if its radiation frequency reaches a maximum (upper limit), and if all other factors affecting the frequency of the clocks remain constant.[5] [4,5,6].

CONCLUSIONS

In the experiment described here, only already established physical phenomena were applied. Based on the results of the experiment, in a closed system, the motion of a system and the direction of its motion both appear demonstrable. It also allows us to devise an experiment that is actually capable of determining the numeric rate of absolute velocity.

[5]a/ The absolute rest state of the clock is not a requirement for determining the absolute velocity. Knowing the formula the absolute velocity can be calculated from the frequencies measured at different relative velocities.

b/ The lack of knowledge of the absolute velocity impeded the application of a single (absolute) time in systems moving with different velocities. All the correlations of absolute velocity are known, which in an arbitrary moving system help arbitrary determine the real difference between local clocks and the clocks in the state of absolute rest.

c/ Clocks in the state of absolute rest allow a new understanding of absolute space.

References

[1] H. E. Ives, G. R. J. Stilwell, An experimental study of the rate of a moving atomic clock, Opt. Soc. Amer., 2, 215 (1938)

[2] R. V. Pound, G. A. Rebka Jr., Gravitational Red-Shift in Nuclear Resonance, Physical Review Letters 3 (9): 439 441 (1959)

[3] J. C. Hafele and R. E. Keating, Around the world atomic clocks: predicted relativistic time gains, Science, 177, 166 (1972)

[4] J. Bajnok: Az abszolút mozgás elve. Budapest, Published by the Author, ISBN 963 650 136 x, 69 (1995)

[5] J. Bajnok: Absolute motion as the physical state of objects, Budapest, Published by the Author, ISBN 963 440 638 6, 24 (2002)

[6] J. Bajnok: Absolute motion as the physical state of bodies, http://vixra.org/pdf/1112.0076v2.pdf