THE SPEED OF LIGHT IN ONE DIRECTION RELATIVE TO THE EARTH SURFACE

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The speed of light relative to the Earth surface is shown as depending on the direction of its propagation. Clock synchronization.

Einstein's theory of clock synchronization is based on an arbitrary, as noted by Einstein [1], assumption of the equality of the speed of light in opposite directions and on experimental data on the "constancy" of the average speed of light on the way "there and back".

All earlier experiments to measure the speed of light were conducted by measuring it with just one clock, doubling the distance between a transmitter/receiver and a reflector and calculating the time of signal propagation on the way to the reflector and back.

Poincare, Reichenbach, Tyapkin, Brillouin [2-5] and many others noted that only measuring the speed of light by using a pair of clocks that have been pre-synchronized at points A and B in space could yield the speed of light in one direction – from point A to point B. All other methods, even including, as shown by Karlov [4], the method of astronomical observations used by Roemer, yield an average value of the speed of light in opposite directions.

However, to synchronize two spatially separated clocks one needs to know precisely the speed of light in the direction from point *A* to point *B,* which is to be measured.

While examining Einstein's method of synchronization, Brillouin [5] wrote: "This rule is arbitrary and even metaphysical. One cannot prove or disprove it experimentally; the rule says that signals propagating from east to west and from west to east have the same speeds, whereas Michelson's experiment only allows measuring the simple average of these two speeds. It is apparent that here we deal with an unexpected and unverifiable hypothesis."

The fact that this hypothesis is unverifiable within strictly inertial reference frames appears to be true. It is similarly true that having stationed one clock in the west of Moscow and another clock in the east of that city, one cannot measure the speed of light from the west to the east of Moscow without prior clock synchronization.

Does it mean that the speed of light from west to east or reverse cannot be measured at all?

The fact that such measurement is possible and that it does not require prior synchronization of two spatially separated clocks may be deduced from the following:

Let us imagine that a short-wave radar is stationed close to the city of Quito, sending a narrow-angle signal in the east direction. Let us also imagine that all over the equator line a great number of reflectors are stationed in such a way that any of the adjacent reflectors is within the field of vision from another. Let the reflectors deflect the radar signal emitted in Quito in such a way that it, propagating zigzag-wise near the Earth's surface, circles the Earth along the equator, coming back to the radar in Quito from the west.

Knowing the length of the zigzag line along which the radar signal propagates and the time needed for signal to circle the Earth, an operator of a radio relay station can calculate the propagation speed of the signal circling the Earth from east to west or reverse. That these speeds will not be identical to and differ from the constant *C* can be upheld by the following:

Let us ideally place a non-rotating detached onlooker at a distant from the Earth point of the imaginary Earth rotation axis. Let this onlooker be immobile in relation to the centre of the Earth's mass and be watching the northern hemisphere rotating counter clockwise below us, mentally following the signal propagation.

Within the reference frame of the detached onlooker the speed of light propagating in space zigzag-wise is equal to the fundamental constant *C*. If the Earth were not rotating, then the signal in order to circle the hypothetically non-rotating Earth would need the time equal to the length of the zigzag line encompassing the Earth along the equator, divided by the constant *C*.

However, the Earth does rotate!

When the signal arrives at the initial point in the space of the detached onlooker, the radar of Quito will move approximately 62 meters east, and the signal arriving from the west would need extra time equal to 0.2 microseconds to return to the radar.

If the operator turned the antenna 180 degrees and directed the signal westward, the signal would need two microseconds less to circle the Earth and return to the radar because during the signal's travel around the Earth the radar would move 62 meters eastward and the signal coming from the east would have no need to cover these 62 meters. The signal delay is a first order effect in relation to the value of v/C, where v is the linear speed of the rotating Earth's surface, and this delay is large enough compared to relativistic effects of the second order of smallness.

In case simultaneous impulses are emitted by the radar in opposite directions – eastward and westward, the impulses that have circled the Earth and returned to the radar will need different times to do so and return to the radar at different times. The difference of impulse return times will equal about 0.4 microseconds. This effect actually represents the Sagnac effect [6] used in optical gyroscopes [7]. If an operator sent the signal eastward and enabled the signal coming from the west to be reflected from the radar's auxiliary reflector in the reverse direction, and after making the reverse flight return to the radar from the east, the time needed for a double "round the world flight" of the signal first from west to east and then, having been reflected, from east to west will practically not differ from the time the signal would need to make a similar flight around the hypothetically not-rotating Earth. In this case, the measurement of the speed of light on the way there and back would give at least a second order accurate value, equal to the fundamental constant *C*.

Considering the Lorentz contraction of the equator and the slowdown of the rate of the clock moving together with the surface of the rotating Earth, the average speed of light on the way there and back would have been precisely equal to the constant *C*.

Knowing the equatorial speed of light from west to east or/and in the reverse direction, one may synchronize any pair or multitude of clocks stationed on the equator.

In this case, the clocks appear synchronized in such a way that the mentioned detached onlooker "sees" the same readings of the different clocks stationed at different points of the equator. If experimenters on the Earth's surface attempted to synchronise any pair of equator-stationed clocks by Einstein's method, believing that the speed of light from west to east is precisely equal to the constant *C*, they would encounter serious problems.

Firstly, the clocks synchronised in such a way and found in absolutely equal conditions would at any moment in time show different readings to a detached onlooker at the above mentioned point on the Earth axis. Secondly, having, for instance, chosen the reading of the Quito clock as a reference time, and successively synchronizing each pair of the adjacent clocks, the observers on the Earth's surface, passing from one pair of clocks to another, would return to the initial point at the reference clock in Quito, finding that the reference clock in Quito is going asynchronously to itself, with each "asynchrony" represented by those 0.2 microseconds.

The clock synchronization considering the inequality of the speeds of light from west to east and from east to west will indeed give the same result as the clock synchronization through a synchronizing signal transmitted by a detached onlooker from a point on the imaginary Earth's axis of rotation to all point on the equator. The readings of the clocks synchronized with regard to the inequality of the speeds there and back are conceived by a detached onlooker as the same.

The synchronization of the clocks on the Earth's surface using the above method supports the absence of the conventional component of the speed of light, as, for instance, mentioned in [8-9]. The speed of light in relation to the surface of an object that is non-rotating in the outer space is the same in all directions, though the speed of light on rotating globular objects depends on the direction of light propagation, this fact related not to a convention, but to physics.

The issue of synchronization becomes even more entertaining, if we ideally replace the Earth with a giant ring of an arbitrarily large diameter, accommodating a transmitter/receiver and a system of reflectors there. In this case, at a given linear speed *v* of the ring and an arbitrarily small angular speed of the ring rotation, the deviation of the signal propagation speed in one of the directions from the constant *C* will, as a first approximation, equal *v*.

If we imagine that an inertial laboratory is tangentially flying to the ring at a speed equal to the linear speed of this ring, and that this laboratory, given an arbitrarily large diameter of the ring, during an arbitrarily long period of time finds itself beside a nearby sector of the ring, then during this period of time this sector of the ring and the laboratory will find themselves practically immobile one to another. If the speed of signal propagation in one direction in relation to a sector of the ring is different from *C*, then why the speed of that same signal (in the same direction) in relation to the inertial laboratory should unquestionably be thought of as equal to constant *C*?

LITERATURE

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