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The absolute meaning of motion to the optical path

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ABSTRACT

The present manuscript aims to lay the groundwork for a research proposal to open the gateway for novel signal precision technology.

Introduction

When I walk away from a signal, the signal takes longer to reach me. This fact is at work in fiber optic gyroscopes. In 1919, Sagnac won the Pierson-Perrin prize for the detection of the luminiferous ether via the detection of this effect, which was since called the Sagnac effect [1,2]. Paul Langevin's explanation of the same effect in the sense of special relativity as reviewed by Gianni Pascoli [3] has its opponents including Wolfgang Engelhardt [4]. In 2003, Ruyong Wang and colleagues proved a linear version of this effect [5,6].

Let us identify two axioms to examine this problem depicted in Fig. 1.

When an observer moves away from a signal, the signal takes longer to reach the observer. To understand the fundamental truth of this statement, imagine that the moment just before the signal would otherwise reach the observer, the observer takes a step back. It is self-evident that a signal traveling at any finite speed, takes a longer time to cover an additional distance. We can therefore safely raise our first axiom.

Fig. 1. Observer, Signal and Source: The velocity of a source does not influence the speed of a signal – but only the motion of the observer relative to the signal influences its time of flight.

Axiom 1: The observer motion relative to a signal influences its time of flight.

We did not talk about a source in the first problem, as the source was irrelevant to the question. Whilst the effect of the observer motion can be logically proven as the nature of the signal is irrelevant to our first question, it is due to the physical nature of light as a wave, that the source motion does not influence the signal speed. This also is a well experimentally verified fact. We therefore raise our second axiom to be:

Axiom 2: The source motion does not influence the signal time of flight.

When we now combine both axioms, we see that the observer- but not the source motion relative to the signal influences its time of flight. The situation is asymmetrical. The effect does not depend on the relative motion between source and observer, but on the motion of the observer relative to the emitted signal.

Axiom 1 and 2 foretell the results of Ryong Wang's [5,6], Torr and Kolen's [7] and De Witte's [8] experiments. Let us investigate the essence of these two types of experiments:

Type 1

Around 2003, Ruyong Wang and his team developed fiber optic conveyors to investigate the Sagnac effect along linear fiber segments. The team constructed 24 different arrangements which are schematically represented in Fig. 2. Comparison of two travel-time differences with a different length of the straight fiber segment (c), revealed that the counter-directional travel-time difference Δt existed in linear fiber

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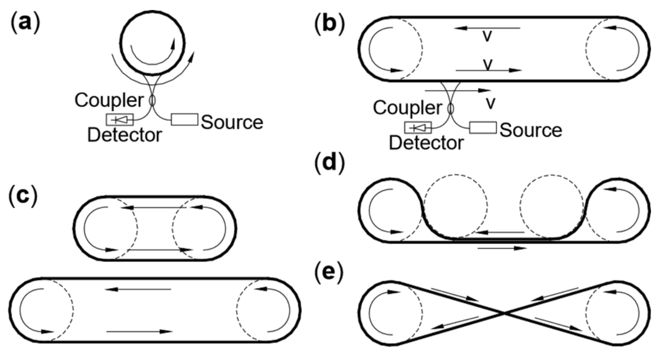

Fig. 2. Fiber Optic Gyroscope constellations by Wang et al. 2003*. *The image is a reproduction from the openly accessible pre-print version of Wang et al. 2003.

segments to the same extend as in the rotational segments – likewise described by the formula

$$\Delta t = \frac{2vl}{c^2} \tag{1}$$

But therefore the effect must in a physically meaningful way occur in the linear fiber segments in isolation. But then it cannot be explained with rotating references frames. The finding that the magnitude of the effect was linearly proportional to the linear fiber length l and the velocity v, further strengthens this conclusion. Other constellations depicted in Fig. 2 including d) and e), further strengthened this point.

Concluding that the effect is independent of the type of motion as also suggested by Engelhardt's theoretical revision [4], the team set to perform further experiments. They added proof by showing that it is the effective length of the fiber into the direction of motion, rather than the actual length of the fiber, which calculates the size of the effect. Mathematically, the length "l" in equation (1) therefore needs replacing by its projection into the direction of motion at angel θ to yield

$$\Delta t = \frac{2vlcos\theta}{c^2} \tag{2}$$

As importantly, the team devised an experiment depicted in Fig. 3, to prove the above stated claim, that a linear segment in isolation experiences the measured effect. In fact, in the experiment depicted in Fig. 3, only linear motion accounted for the measured effect which still obeyed the same formula. Please see the original publications [5,6] for experimental details.

Type 2

In 1982 Douglas Torr and Paul Kolen conducted an experiment on the one way velocity of light, which is schematically represented in Fig. 4. Avoiding the need for synchronicity, a frequency source called

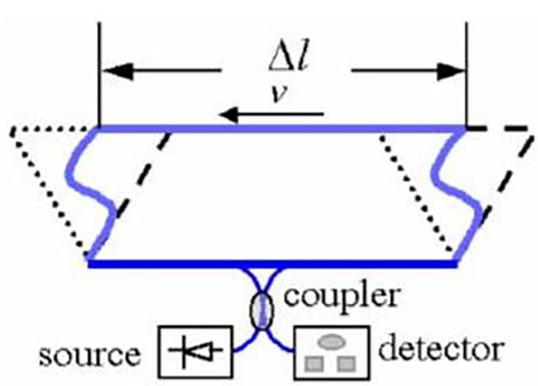

Fig. 3. Linear Fiber Optic Experiment by Wang et al. 2004* aimed at measuring the optical pathlength on a linear fiber segment of length Δl. *The image is a reproduction from the openly accessible pre-print version of Wang et al. 2004.

Clock A fed a frequency into an adjacent interval counter, whilst a second frequency source called Clock B fed in a frequency along a longer axis which describes the meaningful distance in the experiment. The aim was the detection of a fringe shift equivalence which was expected to oscillate with the sidereal day, if the one way velocity of light along the axis varied with the orientation in- and hence motion through space. In personal communication, Paul Kolen explained: "Even though this experiment was done in the time domain, it is exactly equivilant to being done via a phase detector, in the frequency domain. " – "These start/stop events are defined as when the 5 Mhz sinewave goes thru "zero-crossing", which has the highest dV/dt, or rate of change. If both clocks were perfect, i.e. no linear drift and phase noise, the time interval, defined as the time between when the local clock passes thru zero (start) and the remote clock passes thru zero (stop), would remain constant over the sidereal period IF the one way velocity is constant, as per SR."

Whilst Torr and Kolen's experiment showed promising results, it lacked in technical precision. In 1991, the same experiment, albeit with more accurate clocks and a longer distance was conducted by Roland De Witte in a triplicate version employing six clocks along 3 axes. The results of the experiment were not made public at the time, but published by Reg Cahill in 2006, as presented in Fig. 5. The results demonstrate variations in the one-way velocity of light along an axis with the orientation of this axis in space - which gets shifted periodically by the rotation of earth.

Hypothesis

We move at an absolute speed of approximately 369,000 m/s through a fabric of space into direction Leo.

Electromagnetic waves are a travelling disturbance in this fabric - allowing us to detect this motion by their time of flight in the laboratory.

Aim

To detect the hypothesised motion by a type 2 experiment described in the below experimental proposal.

Theory

At this stage, axioms 1 and 2 alone are enough to model the physical facts essential to our problem.

Let us start by examining stationary and moving sources and observers, as depicted in Fig. 6 with the letters S and O. A source and observer which are at absolute rest, are separated by

$$\Delta x = x - x_o \tag{3}$$

meters, which is equals the distance the signal bridges from when it leaves the source to when it reaches the observer. At time t_o the source sends out light, which will reach the observer after

$$\Delta t = t - t_o = \frac{\Delta x}{c} \tag{4}$$

seconds at time t. Therefore by

$$t_o = t - \frac{\Delta x}{c} \tag{5}$$

the observer must conclude t_o at which the source sent out the photon. Hence the observer perceives the event shifted in time, because the signal takes a finite time to reach him.

If the observer and source are only at relative rest, the absolute motion of the observer relative to the approaching information needs to be considered. Let us define a positive velocity of either signal or observer to describe motion into the negative x-direction of diagram 1. If the observer moves into the negative x‾direction, the distance the

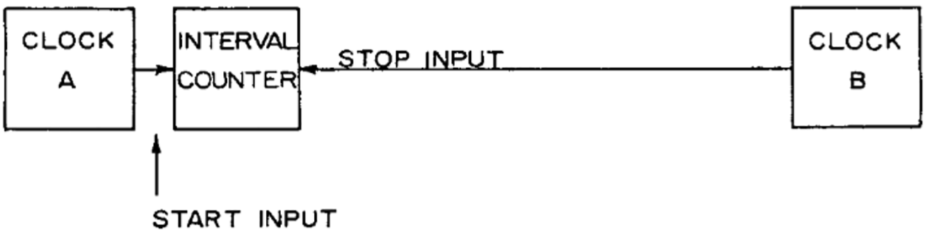

Fig. 4. Schematic illustration of Torr and Kolen's one way experiment* to observe a phase offset between two signals over time. *The image is a reproduction from Torr and Kolen 1984.

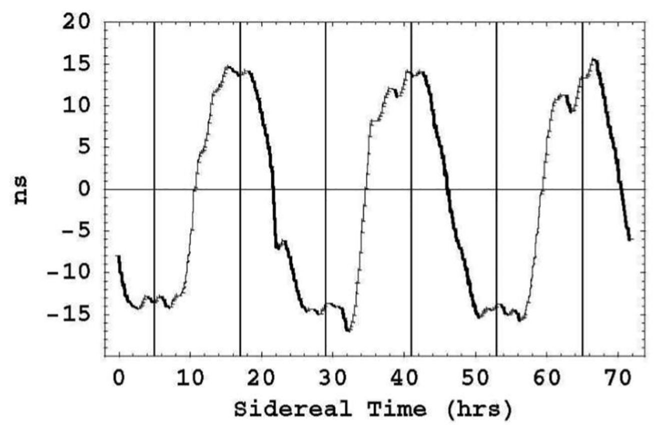

Fig. 5. Result of the 1991 De Witte experiment* which demonstrates variations in the one-way velocity of light along an axis over time. *The image is a reproduction from the openly accessible pre-print version of Cahill 2006.

information has to travel changes to

$$x - x_o^{'} = \Delta x + \Delta x' \tag{6}$$

where $\Delta x^{'}$ denotes the distance that the observer moves away from the signal with velocity v_x during $\Delta t'$ which is the time the signal takes to reach him. So

$$\Delta x^{'} = v_x * \Delta t' \tag{7}$$

where v_x is the absolute velocity of the observer, and where

$$\Delta t^{'} = t' - t_o = \frac{\Delta x + \Delta x'}{c} \tag{8}$$

When substituting (7) into (8) it now holds that

$$t' - t_o = \Delta t' = \frac{\frac{\Delta x}{c}}{1 - \frac{v_x}{c}} \tag{9}$$

Through (4) and (9) we recognize a factor by which the optical path length and thus the time interval the signal takes to reach the observer changes due to the absolute motion of the observer. If we call this factor α, we find that

$$\Delta t^{'} = \Delta t * \alpha \tag{10}$$

where

$$\alpha = \frac{1}{1 - \frac{v_x}{c}} \tag{11}$$

Following from this, the observer needs to conclude the time at which the signal was emitted as

$$t_o = t^{'} - \alpha * \frac{\Delta x}{c} \tag{12}$$

It holds that

$$\Delta t' = \frac{\Delta x}{c - v_x} \tag{13}$$

Consideringα and remembering that v_x is a vectorial quantity defined into the same direction as the velocity of the signal, we realize that if the observer moves towards the signal at the same speed as the signal, the signal only has to bridge half the distances to reach him – but if the observer moves away from the signal at the same speed as the signal, the signal cannot reach him. This implies a possible relative velocity v' between two signals in the range of

$$-2c < v' < 2c \tag{14}$$

Axiom 2 describes a signal as a propagating disturbance in a medium which recently found its way back into physics as the happening stage of a quantum world. But if this is the case, then motion

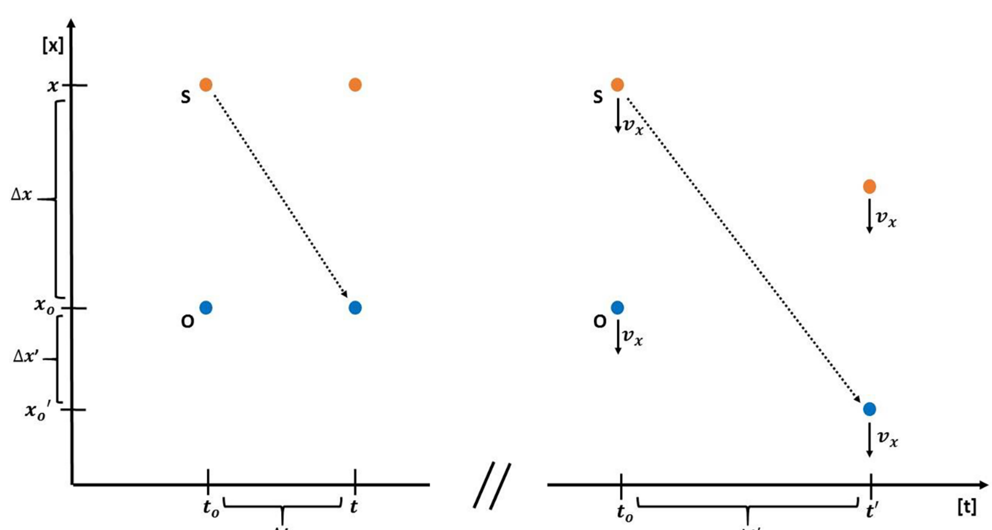

Fig. 6. Stationary and Moving Sources and Observers.

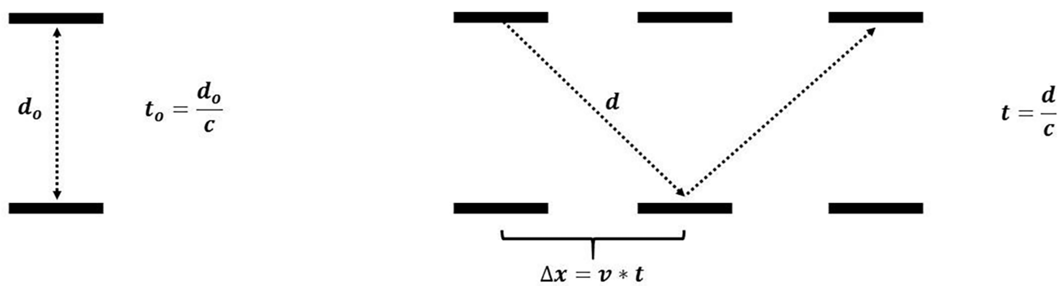

Fig. 7. A Lightclock at Rest and Absolute Motion.

through the medium will affect any other oscillation, including standing disturbances. Whilst De Broglie ascribed a hypothetical wave nature to matter, the physical wave nature of elementary matter has found prove with numerous famous quantum experiments today. There of course do not exist any solid pointparticles in nothingness, but it is rather that there exists a fabric of change, which throws waves.

Matter in motion ages slower in an absolute comparable sense as proven by numerous experiments [9–16] – please see the discussion. Let us examine this phenomenon with the help of a lightclock.

We already realized that absolute motion can be defined as motion relative to a signal. But therefore, lightclocks are an indicator of absolute motion. In a resting lightclock, a signal bridges a distance d_o in t_o seconds. Following earlier logic, when as depicted in Fig. 7, the same lightclock moves with absolute speed v into a given direction, and the signal travels within the clock perpendicular to this direction, then the signal needs to cover a larger distance by

$$d = \frac{d_o}{\sqrt{1 - \frac{v^2}{c^2}}} \tag{15}$$

One cycle thus takes longer to complete by

$$t = \frac{t_o}{\sqrt{1 - \frac{v^2}{c^2}}} \tag{16}$$

such that the clock will encounter a frequencyshift by

$$f = f_o * \sqrt{1 - \frac{v^2}{c^2}} \tag{17}$$

The formula implies a maximum absolute velocity c for any matter and hence a possible relative velocity in the range of $-2c < v' < 2c$, which we also found in Eq. (14). If the velocity of an object relative to a laboratory is v_O' and that of the laboratory v_L, then the velocity of the object v is given by

$$-c < v = v_L + v_O' < c \tag{18}$$

The model of our lightclock, describes rest matter to in a meaningful way oscillate at speed c perpendicular to the direction of its motion, whilst its lifetime is decided by how many cycles it can last. This agrees with experimental results of the lifespan of high speed particles being increased by the above factor known as gamma [11–13] – however must be understood as an untested assertion, born from observational agreement with experiment.

If matter and therefore clocks experience an absolute frequencyshift, described by the above model of a lightclock, then if we compare two clocks against each other, the times that it takes for a cycle to complete in either clock will however relate according to

$$t_2 = \frac{t_1 * \sqrt{1 - \frac{v_1{}^2}{c^2}}}{\sqrt{1 - \frac{v_2{}^2}{c^2}}} \tag{19}$$

The clocks relative motion to each other does not matter, but v_1 and v_2 describe their absolute velocities, as each clock relates to a clock at rest in space by a cycle taking

$$t_1 = \frac{t_o}{\sqrt{1 - \frac{v_1{}^2}{c^2}}} and t_2 = \frac{t_o}{\sqrt{1 - \frac{v_2{}^2}{c^2}}} \tag{20}$$

We can define a rest clock if we know our own (laboratory L) velocity v_L through space. The frequency $f_o$of this rest clock can hence be determined from the frequency f_L of our own clock via

$$f_o = f_L * \frac{1}{\sqrt{1 - \frac{v_L{}^2}{c^2}}} \tag{21}$$

Thus we can define a universal time (as measured by the universal clock in Fig. 8), which will be an essential tool to derive the absolute picture of reality in a meaningful comparable way.

Now we are ready to appreciate the slowing of clocks and incorporate it into equation (12) which we will express in the form of

$$t_o = t - \left(\frac{d/c}{1 - \frac{v}{c}}\right) \tag{22}$$

where t_o indicates the time the signal is sent, t the time the signal is received, d the distance between source and observer at the moment the signal was sent, v the observer's absolute velocity and c the speed of light.

Until now, we failed to consider that motion slows down the ageing of matter. The term, let us call it β, by which the observer needs to correct for, depends on the frequencyshift the observer experience and the duration he experiences it for.

$$\beta = \Delta f * \Delta t \tag{23}$$

where Δf is the frequencyshift of the observer's clock as compared to the universal clock, and Δt the duration of the experiment as measured by the universal clock. We remember that the observer's frequency f as compared to the frequency f_o of the universal clock, reduces by

$$f = f_o * \sqrt{1 - \frac{v^2}{c^2}} \tag{24}$$

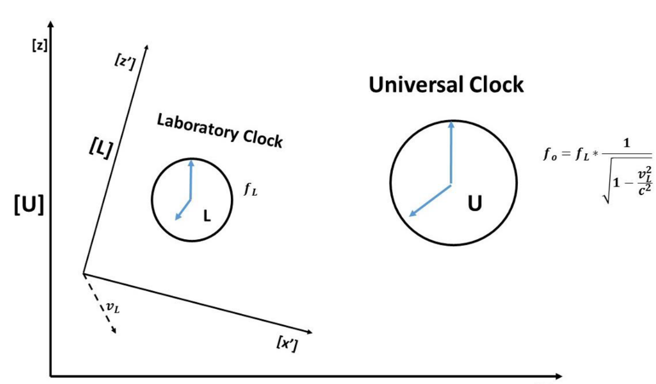

Fig. 8. Defining the Rest Clock.

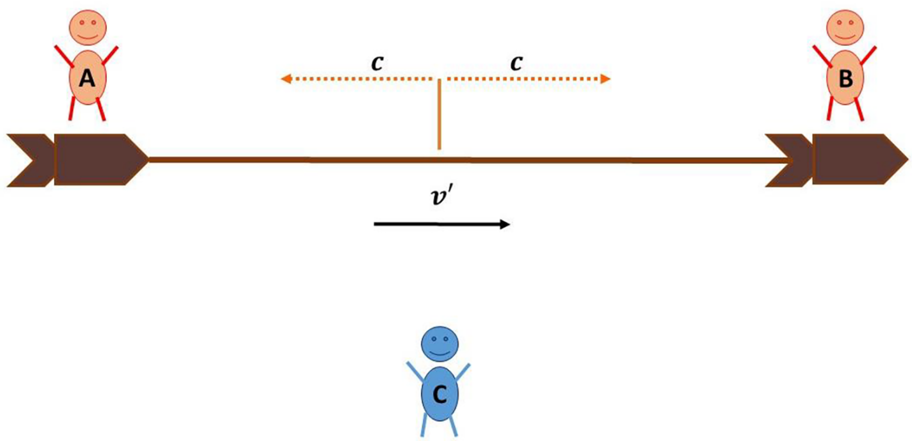

Fig. 9. Two spaceships on a rod.

Thus the frequency difference Δf will be

$$\Delta f = f_o - f_o * \sqrt{1-\frac{v^2}{c^2}} = f_o\left(1-\sqrt{1-\frac{v^2}{c^2}}\right) \tag{25}$$

Let all clocks be synchronised at t_o. Whatever time or amount of cycles the observer loses by his clock being slowed down through his motion during the duration of the experiment as compared to the universal clock, will need to be added to the right site of Eq. (22) in form of β

$$t_o = t - \frac{d/c}{1-\frac{v}{c}} + \beta \tag{26}$$

such that the universal Δt which it took for the signal to reach the observer according to the rest clock is

$$\Delta t = \frac{d/c}{1-\frac{v}{c}} = t + \beta - t_o \tag{27}$$

In this equation, t_o is the universal time when the signal was sent and t is the time on the observer's slowed down clock when the signal was received. It still holds that

$$\frac{d}{1-\frac{v}{c}} \tag{28}$$

is the optical path length whilst d was the distance between source and observer the moment the signal was sent, and

$$\frac{d/c}{1-\frac{v}{c}} \tag{29}$$

the time interval a signal takes to cover its path which is of universal nature.

To calculate t_o in cycles, an observer will have to solve

$$t_o = t - \frac{d/c}{1-\frac{v}{c}} + f_o\left(1-\sqrt{1-\frac{v^2}{c^2}}\right) * \Delta t \tag{30}$$

As the universal Δt equals $\frac{d/c}{1-\frac{v}{c}}$, we can rearrange the above Eq. (30) to derive expressions for t_o and Δt.

$$t_o = t - \frac{d/c}{1-\frac{v}{c}}\left(1 + f_o\left(1-\sqrt{1-\frac{v^2}{c^2}}\right)\right) \tag{31}$$

describes a t_o, which every observer, independent on how their clock is slowed down would agree upon.

$$\Delta t = \frac{t - t_o}{1 - f_o\left(1-\sqrt{1-\frac{v^2}{c^2}}\right)} \tag{32}$$

describes a universal Δt which likewise every observer would agree upon. We need to define

$$f_o = 1 \tag{33}$$

and talk about units and definitions. Frequency is commonly measured in cycles per second. But what even is a second? It may in future be sensible to let time be measured by cycles of the universal clock, let frequency be a unitless measure expressing the amount of cycles a clock describes during one cycle of the universal clock the frequency of which is 1, let a distance unit be defined through the distance light covers during a cycle of the universal clock and let the speed of light be given in units of distance per cycle. Therewith, the understanding of the meaning of rest in the fabric of reality leads to consistent definitions and applications in physics.

Experiments reviewed in the discussion demonstrated that unaccelerated motion through the fabric of space causes absolute changes to matter. Thus, if slower ageing is due to motion rather than acceleration, we can calculate how much longer an accelerated particle will live by calculating its average velocity. This understanding is in accordance with the work and calculations by Chou et al. [16].

The presented theory can be applied to solve every problem that today falls in the subject of special relativity. Whilst such can easily been seen for the lifetime of atmospheric muons (see discussion) and for signal precision (see introduction), a more complex example involving particle collision can be supplied by the author on demand, calculating a realistic collision in the sense of special relativity and the sense of the presented theory to yield "almost" identical results.

More importantly, the presented theory can solve problems which special relativity cannot solve. One such unsolved question is depicted in Fig. 9:

Two spaceships are connected by a rod which snaps if the back engine starts before the front engine. The engines are started by a signal sent from the center of the rod.

The assumption that motion only has relative meaning implies the absence of a rest frame and the equivalence of individual inertial reference frames, concluding the rod to hold in the reference frame of the spaceships, but to snap in the reference frame of an external observer who moves relative to the spaceships at a relative velocity v'.

But after the signal has been sent, all observers will either see a broken or an intact rod. Hence, this technical problem which is tied to the question of synchronicity and coordinate precision, cannot be answered under the assumption that motion only has relative meaning, but demands there to be an observer independent rest frame in which this problem can be solved, which is neither the frame of the spaceships, nor that of the external observer.

The rod either snaps or it doesn't depending on which engine 'really' starts first – a concept which special relativity denies to have meaning – because reality does not care what different observers conclude in their respective reference frames. But if this one true picture of reality exists, which of course it does as a rod cannot both survive and not survive an event, then we can work it out. To work out its essence was the scope of this theoretical work. But to realise it, we need technology to determine our absolute velocity through space. This is the scope of the following research proposal.

Proposal

The proposed experiment is based on the 1982 experimental design by Kolen (Fig. 4). The experimental setup will physically look like the one depicted in Fig. 4, whilst being mounted on a turntable or axis. We will however employ 2 caesium standards, which will connect to an interferometer via optical cables. Once the experiment is running, we will record some initial phase offset between the clocks at a time we define as t-zero. According to our hypothesis, this phase offset will oscillate periodically as the rotation of earth shifts the direction of our experimental axis in space.

When employing the earth rotation to turn the setup 360 degree, we expect to detect the total velocity vector V (see Fig. 10) into direction Leo, deduced from changes in its east-west component C (see Fig. 10), by measuring the amplitude of signal-oscillation. This is best achieved when aligning our axis into an east-west direction for an initial experiment along the vector C in Fig. 10.

We expect this experiment to return positive results as it is a repetition of the experiments stated in the introduction. Having mounted our experiment onto a turn table or turn-able axis, we are however able to reproduce the change in orientation of our axis in space as caused by the earth rotation, in the laboratory, albeit at a higher frequency. We can manually rotate the experimental axis to do so. If our hypothesis is true, the sets of data should match. If we obtain matching sets of data (i.e. same amplitude for same degree of rotation) this puts constraints on alternative interpretations and strengthens our hypothesis. Being able to manually change the orientation of our experiment, we are also able to align it directly into direction Leo and then turn it manually such that after a 180 degree turn it points out of direction Leo, (see Fig. 11), which should produce a different set of data with a higher amplitude than turning the experiment in the east-west plane. Being able to do so helps us to identify the magnitude and orientation of the absolute motion vector, as such coincides with the greatest signal amplitude. Having identified the exact declination of this vector, the data set obtained employing the rotation of earth should calculate the same vector magnitude. It is unlikely that the here envisioned results could be explained by an alternative explanation to our hypothesis.

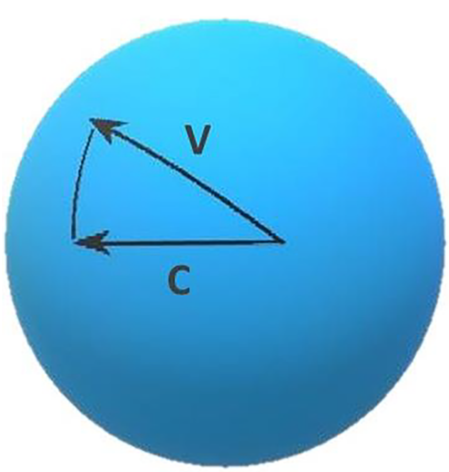

Fig. 10. The absolute velocity vector V and its component C in the east-west plane along which the experiment will be aligned.

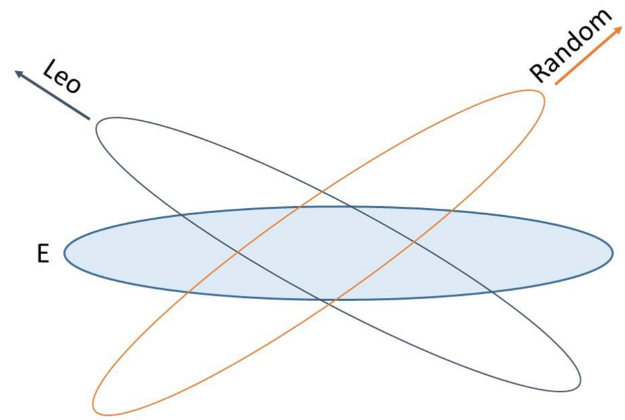

Fig. 11. Planes of rotation in the laboratory for the proposed experiment being turned manually.

Note, that whilst there is one east-waste plane, there is an infinite amount of possible planes to rotate our axis in and out of direction Leo, which when obtaining matching sets of data will further strengthen our hypothesis. However choosing a different random plane of rotation alike the orange plane depicted in Fig. 11, a reduced amplitude will add final proof to our hypothesis by ruling out alternative explanations which also should predict positive results here.

We can further combine a type 1 into our type 2 experiment by additionally driving our table in the laboratory in or out of the direction of our axis.

To prove our hypothesis we need to make a prediction. For this, we need to derive an expression for a vector which calculates our total velocity at any given time for some location on earth to an approximation precise enough to base our predictions upon. The observed vector constitutes from its different astronomically observed components including the rotation of earth, the revolution of the solar system, the revolution of the galaxy, the galactic motion and the group velocity. As we are expecting to detect a total velocity vector in the order of 369,000 m/s, the component contributed by the rotation of earth with 500 m/s is negligible for our purpose. Remember that we do not aim to detect this component, but that we merely employ the rotation of earth to turn our experimental axis in the fabric of space, such that when our optical signal travels maximally into direction LEO at one instant, after a 180 degree rotation it will travel maximally out of direction LEO. The revolution of our laboratory around the sun with 30,000 m/s, however causes a more significant variation to our total vector.

To allow us to specify our laboratory motion through space, we will adhere to the standard celestial reference frame. It suffices to choose the sun as the center of our coordinate system. The primary direction is defined from the center of the coordinate system, into the direction of the vernal equinox. Based on this coordinate system, in spherical coordinates, Leo is located at a right ascension α, and declination δ, of approximately

$$\begin{aligned} \alpha &= 165^\circ \\ \delta &= 15^\circ \end{aligned} \tag{34}$$

Based on the motion of our solar system relative to the CMB, our entire celestial sphere moves into this direction with approximately 369,000 m/s [17]. This velocity summarizes the vector components contributed by the motion of our galactic group, our galaxy within and the rotation of our galaxy.

To define a vector, let us describe its magnitude in its first entry in meters per second, its ascension in degrees as a second entry and its declination in degrees as a third entry.

The contribution $\boldsymbol{V_S}$ from the motion of our galactic group, our galaxy within and the rotation of our galaxy as defined by the motion of our solar system, describes a constant vector of

$$\boldsymbol{V_S} = [369,000; 165; 15] \quad (35)$$

Our remaining question is how the velocity of earth around the sun of magnitude $V_R = 30,000 m/s$ adds to the first entry of $\boldsymbol{V_S}$, whilst we assume the other components constant. Let us call V_R's component into direction LEO $V_E \approx 29,000$ m/s. As the year has approximately as many days as the circle has degrees, 165 days after the vernal equinox, we have advanced approximately 165° and are rotating into a direction perpendicular to our motion into direction LEO. Hence, a quarter year earlier or 75 days after the vernal equinox we are rotating into direction LEO, and after 255 days out of direction LEO. Based on our coordinate system, our revolution around the sun at angle α causes a fluctuation in $V_E$by $\sin(165° - \alpha)$. The celestial equator and ecliptic describe and angle of 23. 5°, with the tilt however being along the equinoxial axis which points out of direction LEO to a very close approximation. Thus V_S approximately becomes

$$\boldsymbol{V_S} = [369,000 + 29,000 * sin(165° - \alpha); 165; 15] \quad (36)$$

Whilst not being exact, this expression is sufficient for our purpose. 75 and 255 degrees after the vernal equinox, the vector magnitudes respectively become approximately 398,000 and 340,000 m/s.

Thus, conducting our experiment around day 75, we expect to move into direction LEO with 398,000 m/s take or give less than 500 m/s. If we align the axis for our one way experiment in an east–west direction, then at one moment, light will maximally travel into direction LEO, and half a sidereal day later, maximally out of direction LEO. If our axis has length d then the maximal time of flight difference of our signal at one time during the day versus the other calculates as

$$\Delta t = t_{in} - t_{out} \quad (37)$$

$$t_{in} = \frac{d}{c - |v|} \quad (38)$$

$$t_{out} = \frac{d}{c + |v|} \quad (39)$$

As nothing adds to the speed of light, for a physical derivation of the above formulas please see the theoretical chapter. To state some example, let us assume it is day 75 and our distance is 100 m. Remember that our expected velocity of 398,000 m/s, is diminished by $cos15°$. Then we obtain

$$\Delta t = 3.337616608e - 7sec - 3.329061038e - 7sec = 8.56 * 10^{-10}sec \quad (40)$$

We expect oscillations of this magnitude to occur with a period of the sidereal day.

Half a year later in comparison we would receive a

$$\Delta t = 3.336981767e - 7sec - 3.329692869e - 7sec = 7.29 * 10^{-10}sec \quad (41)$$

We should be able to distinguish this and observe a larger envelope over our daily oscillations, itself oscillating with the astronomical year.

Modern instruments allow resolution beyond this figure which should allow us to build a smaller turn-able experiment.

As there is no relative motion between the source and the observer, Doppler shift will not affect our results. To understand why this physically is the case, let us start by acknowledging the definition

$$\lambda = c * T = c * 1/f \quad (42)$$

which is nothing but the definition

$$s = v * t \quad (43)$$

Applied to the distance λ covered at a speed of propagation c during one period T. Let us first consider what changes absolute motion of the source will cause to λ as depicted in Fig. 12.

Let us consider the most simple of all sources of EM radiation, namely a charge moving up and down a cycle of distance d at speed v_d, in period T. When the charge moves up and down, the electric field that surrounds it moves up and down with it. But the information of this motion only propagates outwards at speed c, causing the appearance of the wave. When the source containing the charge is at absolute rest, it hence emits a wave according to the relation

$$\lambda_o = c * T_o \quad (44)$$

Into all directions perpendicular to the charge's direction of motion.

But if the same source moves along the positive x-axis, the speed $c$of propagation of the information that the field moves, does not change. Yet, the distance towards a given x-coordinate for the completion of a cycle is either increased or decreased, leading to a shift of the apparent wave.

At rest, the amount of time it takes to induce a given x-coordinate is

$$\Delta T_o = \frac{\Delta x}{c} \quad (45)$$

Out of the direction of the motion of the source, the amount to induce the same location is

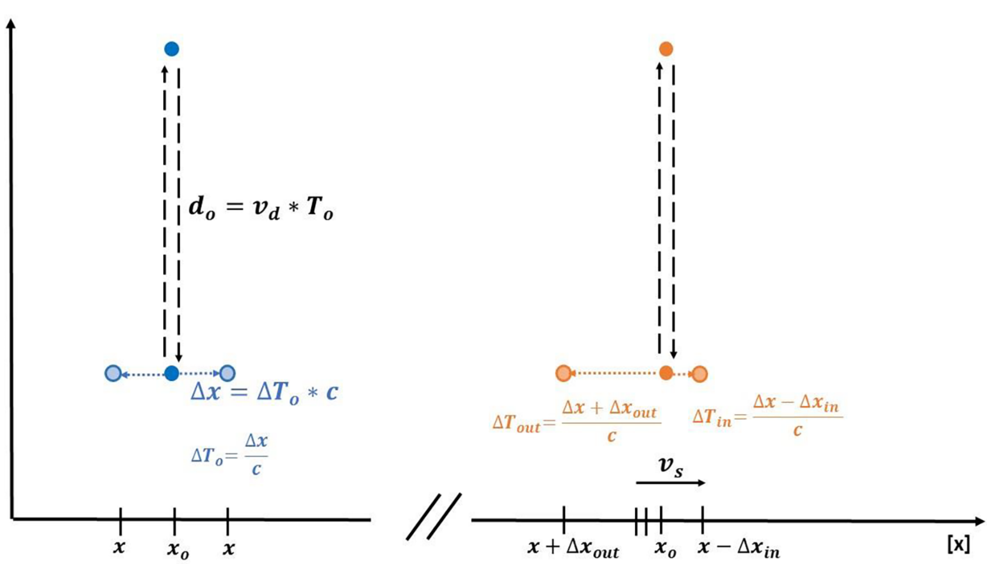

Fig. 12. EM-wavesource at Absolute Rest and in Motion.

$$\Delta T_{out} = \frac{\Delta x + \Delta x_{out}}{c} \tag{46}$$

$$\Delta T_{out} = \frac{\Delta x + |v_s|\ \Delta T_o}{c} \tag{47}$$

$$\Delta T_{out} = \Delta T_o * \left(1 + \left|\frac{v_s}{c}\right|\right) \tag{48}$$

where $\Delta x_{out} = |v_s|\ \Delta T_o$ describes the distance that the source moved at speed v_s during the time ΔT_o that it takes to induce a given x-coordinate from a given instantaneous location. What is physically happening to demand this model, is that a next starting point x_o from which our given x-coordinate is induced, is shifted by the motion of the source. As wavelength and period are proportional, the wave would get stretched by

$$\Delta\lambda_{out} = \Delta\lambda_o * \left(1 + \left|\frac{v_s}{c}\right|\right) \tag{49}$$

Into the direction of the motion of the source, with similar reasoning we derive that the apparent wave would get pushed by

$$\Delta\lambda_{in} = \Delta\lambda_o * \left(1 - \left|\frac{v_s}{c}\right|\right) \tag{50}$$

The motion of the source hence shifts the wavelength of the emitted EM wave in an absolute sense, by the above relations.

If however the observer moves with velocity v_O along the x-direction, he moves towards or away from the him approaching signal to perceive a field value to drop or rise later (direction out) or sooner (direction in). However his motion is affecting the final wavelength that the observer will measure in a different way than the motion of the source. Let us first consider the observer moving away from the signal. At rest, the amount of time it takes for an induced signal to reach him is

$$\Delta T_o = \frac{\Delta x}{c} \tag{51}$$

If he moves away from this signal he increases the distance this signal has to travel by

$$\Delta T_{out} = \frac{\Delta x + \Delta x_{out}}{c} \tag{52}$$

where however

$$\Delta T_{out} = \frac{\Delta x + |v_o|\ \Delta T_{out}}{c} \tag{53}$$

such that

$$\Delta T_{out} = \Delta T_o * \frac{1}{1 - \left|\frac{v_o}{c}\right|} \tag{54}$$

because $|v_o|\ \Delta T_{out}$ describes how far he traveled in the time ΔT_{out} the signal took to reach him. As the wavelength and period are proportional we get

$$\Delta\lambda_{out} = \Delta\lambda_o * \frac{1}{1 - \left|\frac{v_o}{c}\right|} \tag{55}$$

Likewise if the observer moves towards the signal we get

$$\Delta\lambda_{in} = \Delta\lambda_o * \frac{1}{1 + \left|\frac{v_o}{c}\right|} \tag{56}$$

Taken together, we can state the following 4 equations: If the source moves away from the observer at absolute rest, and the observer now moves away from the approaching signal, he will record a wavelength shift of

$$\lambda_{out/out} = \lambda_o * \frac{1 + \left|\frac{v_s}{c}\right|}{1 - \left|\frac{v_o}{c}\right|} \tag{57}$$

If the source moves away from the observer at absolute rest, and the observer now moves towards the approaching signal, he will record a wavelength shift of

$$\lambda_{out/in} = \lambda_o * \frac{1 + \left|\frac{v_s}{c}\right|}{1 + \left|\frac{v_o}{c}\right|} \tag{58}$$

If the source moves towards the observer at absolute rest, and the observer now moves away from the approaching signal, he will record a wavelength shift of

$$\lambda_{in/out} = \lambda_o * \frac{1 - \left|\frac{v_s}{c}\right|}{1 - \left|\frac{v_o}{c}\right|} \tag{59}$$

If the source moves towards the observer at absolute rest, and the observer now moves towards the approaching signal, he will record a wavelength shift of

$$\lambda_{in/in} = \lambda_o * \frac{1 - \left|\frac{v_s}{c}\right|}{1 + \left|\frac{v_o}{c}\right|} \tag{60}$$

Whilst the first contribution to the shift of the measured wavelength is absolute, and the second is relative, this has the same effect onto our measurement. Regarding Eqs. (58) and (59), the effects of Doppler shift in our experiment cancel when our experimental axis is aligned along our direction of absolute motion. Therefore, there is no influence onto the amplitude (nor frequency) of our signal which we expect to resemble a graph as shown in Fig. 5.

Whilst transverse Doppler shift physically exists, it likewise cancels if source and observer move transverse to the signal into the same direction at the same speed. This can easily be seen from Fig. 13 which demonstrates how the absolute transverse blueshift caused by the source cancels the redshift on the observer's front. If the observer moves transverse to a signal, a given wavefront will take longer to reach him, always leading to a redshift as depicted in Fig. 13. If the source however moves transverse to the direction observer, into its direction of motion it causes an absolute blueshift as depicted in Fig. 13. At like speeds, Fig. 13 shows why they cancel. A total transverse red-shift is recorded only then when observer and source move in opposite transverse directions.

The apparent cancellation of Doppler shifts in the absence of relative motion between source and observer, leaves the failure of the Michelson-Morley experiment a mystery, suggesting there are factors at play we have not understood yet. Data obtained from the proposed experiment may help to give insight into this question, as the proposed experiment constitutes a more detailed Michelson-Morley experiment,

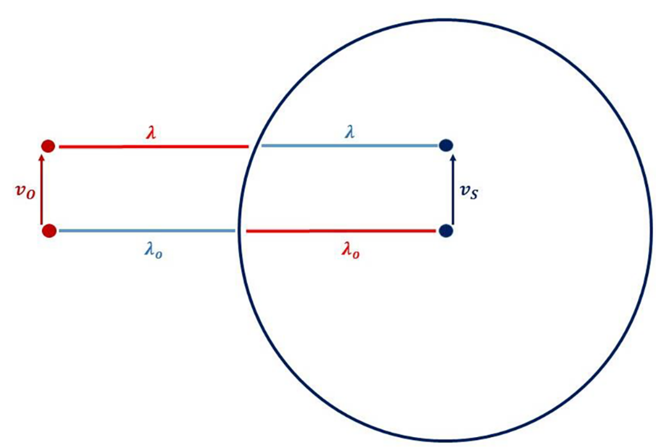

Fig. 13. Wavesource and Observer in unidirectional transverse motion.

measuring the path along each leg in isolation (i.e. 4 one way paths instead of 2 return paths).

Discussion

What is different to previous one-way experiments, is that we will obtain different sets of data by comparing a set of data obtained with the locked in axis in E-W alignment employing the rotation of earth, to experimental data resulting from various rotations in the laboratory, in the east-west pane and in numerous other planes. Successful results will make a distinguishing statement about the underlying physical cause of our results in favour of the stated hypothesis.

On the other hand the experimental design serves as a prototype for ultra-precise motion sensing technology as relevant to space travel, absolute signal precision and synchronicity – applications which were symbolised by the two spaceships on a rod problem. Experimental results by Marinov [18], give hope that a bench topped sized linear experiment could be employed to devise the envisioned motion sensing technology. Whilst Marinov's experiment tested a linear effect, in contrast to a type 2 experiment which detects a first order effect, it measured a second order effect as it employed reflected counter-propagating signals. We will detect a first order effect.

With the help of the theory chapter, it is possible for observers to agree on the question of simultaneity, the duration and length a signal travelled and a universal time at which it was sent. The knowledge of their own velocity through the fabric of space is the essential ingredient. Therefore the here presented experimental proposal will serve an essential prototype for this upcoming capability and technology together with the theory. But where are we already seeing its implication?

The question whether motion causes matter to age slower in a comparable sense, resulting in one twin dying before the other, has been answered positively in numerous experiments involving space-stations, satellites and particle accelerators [9,10].

Atmospheric particles travelling towards earth at almost the speed of light, live longer than their twins at rest on earth [11,12]. The average muon in our laboratory has a lifespan of $2.21 \mp .003\mu sec$ [13]. However incoming muons are observed to live longer by a factor of $8.8 \mp .8$ [13] to explain the detected quantity. These results coincide with the time dilation factor from special relativity (SR), with the factor calculated being 8.4 after averaging [13,19]. The time dilation effect described in SR to generally be a real comparable effect, would imply one inertial reference frame special over the other, contradicting the premise of SR [19*, p. 1 and 7*]. Experimental results are commonly explained by considering the time dilation effect of SR from the perspective of the twin muon at rest on earth only, and the length contraction effect of SR from the perspective of the incoming muon only. To do so however contradicts the premise of SR, which states the equivalence of both frames of reference, if this problem is considered in the sense of SR which applies to inertial frames of reference only, whilst our twin muon resting on earth is under the influence of gravity. General relativity (GR) even predicts that the muon on the ground should age slower than the one in free fall, as those in free fall according to GR are not affected by any forces during the relevant duration of the experiment unlike those resting on earth [20]. In reality, when the incoming muons arrive well alive, they find their twin muons long dead.

Let us therefore discuss relativistic effects and then apply our own theory to atmospheric muons: If there is a clock at rest in space and an observer moves past the clock, he would measure the signal to bridge a longer distance inside his own reference frame, by the same amount as if the lightclock moved past him instead, if it were not for the effect of whose clock is really or absolutely slowed down.

Fig. 14 shows the reference frame of a hypothetical observer moving to the left or a lightclock moving to the right. v_p stands for the perceived velocity of the observed object as measured in the reference frame of the observer, d_p for the perceived distance a signal bridges as measured in the reference frame of the observer, and t_p for how long he miscalculates the signal to take. If either a lightclock moved to the right, or we moved to the left, and it was not for the effect that clocks in absolute motion are really slowed down, in our own frame we would measure the light to have covered a larger distance than the rest-distance d_o, namely

$$d_p = \frac{d_o}{\sqrt{1 - \frac{v_p^2}{c^2}}} \tag{61}$$

for which we miscalculate the tick of a clock to take longer by

$$t_p = \frac{t_o}{\sqrt{1 - \frac{v_p^2}{c^2}}} \tag{62}$$

These formulas resemble Eqs. (16) and (17) of our own theory, however are of a hypothetical nature with no characteristics of appearance attached to them. Starting with the assertion of SR that motion only has relative meaning [19], the first observer sees the clock of the second observer tick slower, alike the second observer sees the clock of the first observer tick slower as stated in our above example. Hence SR, if it applies, states that muons traveling at almost the speed of light, should see muons at rest on earth age slower by

$$f_{other} = f_{own} * \sqrt{1 - \frac{v^2}{c^2}} \tag{63}$$

However muons traveling at almost the speed of light age slower in an absolute, comparable sense to find their twin dead, when they arrive nice and alive. Hence, as a matter of fact, the traveling muons experience their twins to age faster, not slower. The reason for this is that the clock of the fast muons is absolutely slowed down, so that all events appear faster to them. But if this is so, SR neither describes these

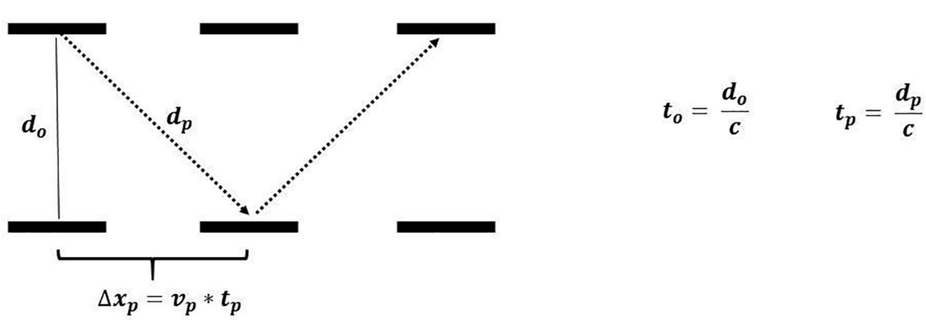

Fig. 14. Inside the Reference Frame of a hypothetical Observer moving Relative to a Lightclock.

absolute comparable effects, nor even the associated perceptive effects.

According to presented theory, the frequency of the traveling muons is slowed down in an absolute sense by

$$f_{traveler} = f_o * \sqrt{1 - \frac{v^2}{c^2}} \tag{64}$$

in comparison to a clock at rest with frequency f_o – as described in the theoretical part. According to the understanding of this manuscript, the frequencies of both muon's relate by

$$f_{earth} = \frac{f_{traveler} * \sqrt{1 - \frac{v_{earth}^2}{c^2}}}{\sqrt{1 - \frac{v_{traveler}^2}{c^2}}} \approx \frac{f_{traveler}}{\sqrt{1 - \frac{v_{traveler}^2}{c^2}}} \tag{65}$$

seconds. As muons live their life away by the frequency of their biological clock, this matches experimental results and delivers a physical and consistent explanation.

What has been presented in this manuscript thus far, allows us to understand a famous experiment in a new light. In the introduction to their paper from 1972, Hafele and Keating write that flying clocks around the world, should lose cycles during the eastward trip and gain cycles during the westward trip in a comparable fashion, as predicted by Einstein's equations. The calculation of the gain and loss of cycles [14 – Eq. (1)] demonstrates, that what was considered to differ on either trip was the velocities of the clocks. A westward trip counteracts the earth rotation, and thus Hafele and Keating predicted an absolute gain of cycles of $275 \mp 21 nsec$ as compared to a clock stationary on earth, whereas an eastward trip is going along the earth rotation and thus a loss of cycles was predicted at $40 \mp 23 nsec$ [14]. A gain of $273 \mp 7 nsec$ during the westward- and loss of $59 \mp 10 nsec$ during the eastward trip was recorded [15]. The clock stationary on earth can be removed from the experiment, when we realize that the two clocks flown into different directions around earth, had gained a different amount of cycles when compared next to each other after the experiment. Direction can only then matter if motion has absolute meaning. A hypothetical reference frame does not offer a physical explanation, but the presented theory does.

We in fact can use clocks as an indicator for absolute motion. In a recent experiment by Chou et al., [16], two atomic clocks were located in different laboratories. One at rest, and the other in harmonic motion. In personal communication Dr. Chou confirmed: "You are correct that with the 75-m fiber link and the way it is done in the experiment, it is equivalent to have the clocks next to each other. " Acceleration was integrated to find the average speed to be used in equations of SR [16 – Eq. (1)]. The two clocks showed absolute differences in frequency, coinciding with calculations from SR as shown in Fig. 2 of Chou's paper, with the clock that exhibited motion in the laboratory, recording less cycles. Dr. Chou ensured: "When we compared the clocks at different height and/or in relative motion, we found that the two clocks produced different frequencies. So you are correct in saying that "during the duration of the experiment one clock recorded 'absolutely' more cycles than the other." ". But in an otherwise empty space, being one of these two clocks, direct comparison would allow us to understand whom of us moved and who not.

Clocks ticking at different rates during an experiment begets us to detach our understanding of time from what is measured by clocks and adhere to a universal time and associated definitions as suggested in the theoretical part.

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References

[1] Sagnac G. The luminiferous ether demonstrated by the effect of the relative motion of the ether in an interferometer in uniform rotation. Comptes Rendus de l'Academie des Sciences 1913;157:708–10.
[2] Sagnac G. Regarding the proof for the existence of a luminiferous ether using a rotating interferometer experiment. Comptes Rendus de l'Academie des Sciences 1913;157:1410–3.
[3] Pascoli G. The Sagnac effect and its interpretation by Paul Langevin. C. R. Physique 2017;18:563–9.
[4] Engelhardt W. Classical and relativistic derivation of the sagnac effect. Annales de la Foundation Louis de Broglie 2015;40:149–56.
[5] Wang R, Zheng Y, Yao A, Langley D. Modified Sagnac experiment for measuring travel-time difference between counter-propagating light beams in a uniformly moving fiber. Phys Lett A 2003;312:7–10.
[6] Wang R, Zheng Y, Yao A. Generalized sagnac effect. Phys Rev Lett 2004;93:143901.
[7] Torr DG, Kolen P. An experiment to measure relative variations in the one-way velocity of light. Precision Measure Fund Constants 1984;2(617):675–9.
[8] Cahill RT. The Roland De Witte 1991 detection of absolute motion and gravitational waves. Prog Phys 2006;3:60–5.
[9] Ashby N. Relativity in the global positioning system (PDF). Living Rev Relativ 2003;6:16.
[10] Bailey J, Borer K, Combley F, Drumm H, Eck C, Farley FJM, et al. Final report on the CERN muon storage ring including the anomalous magnetic moment and the electric dipole moment of the muon, and a direct test of relativistic time dilation. Nucl Phys B 1979;150(1979):1–75.
[11] Rossi Bruno, Hall David B. Variation of the rate of decay of mesotrons with momentum. Phys Rev 1941;59:223.
[12] Rossi B, Greisen K, Stearns JC, Froman DK, Koontz PG. Further Measurements of the Mesotron Lifetime. Phys Rev 1942;61(11–12):675–9.
[13] Frisch DH, Smith JH. Measurement of the relativistic time dilation using μ-mesons. Am J Phys 1963;31(5):342–55.
[14] Hafele, Keating. Around-the-world atomic clocks: predicted relativistic time gains. Science, New Series 1972;177(4044):166–8.
[15] Hafele, Keating. Around-the-world atomic clocks: observed relativistic time gains. Science, New Series 1972;177(4044):168–70.
[16] Chou CW, Hume DB, Rosenband T, Wineland DJ. Optical clocks and relativity. Science 2010;329:1630.
[17] Lineweaver, CH, The CMB dipole: the Most Recent Measurement and some History" arxiv: astro-ph/9609034, 1996.
[18] Marinov S. Measurement of the Laboratory's Absolute Velocity. Gen Relativ Gravit 1980;12(1):57–66.
[19] Einstein A. Zur Elektrodynamik bewegter Koerper. Ann Phys 1905;4(17):891–921.
[20] Einstein A. Die Grundlage der allgemeinen Relativitaetstheorie. Ann Phys 1916;354(7):769–822.