Laurențiu Mihăescu

Space and Time

Three articles on the physics of our universe

PREMIUS

Premius Publishing House, First Edition, September 2021

Prime Theory series Book 5

Author's website: www.1theory.com

ISBN: 978-606-94562-4-8

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1. Relative or Absolute?

1.1. Introduction

Does the relativity of motion represent the most defining feature of our Universe? Or is it only a facet, a partial interpretation of a reality that hides different rules and a totally new fundamental mechanism?

Wherever we would gaze into the vastness of space, a lot of cosmic bodies (stars, galaxies, planets) can be seen moving continuously, each one relative to all the others. We cannot pinpoint one of these bodies and say that we found a truly fixed point in space; therefore, it is easy to state that the relativity of motion must be a given of our universe. Consequently, the Theory of Relativity (special) should be able to decipher all the mysteries of motion and to formalize all the laws of physics related to this subject.

However, based on the current model of our universe's birth, the Theory of the Absolute [2] has identified an absolute "point" within this vast expanse of space and tries to harmonize the two interpretations of the cosmic symphony. It starts from the same simple premise, namely the speed of light is a universal constant. As it was previously stated in my Prime Theory series, the intergalactic space (the regions of space that are far away from any cosmic object) provides an ideal, uniform framework in which the movement of a body or a simpler granular structure can have any absolute speed - up to the maximum value **c**. This limitation also applies to fields and photons of any kind, being determined by the intrinsic characteristics of the spatial granular fluid.

But things are more complex than that, check out Chapter 11 of [3] - "A unique reality". The presence of a body with significant mass (planet, moon, star) produces an important perturbation (sub-quantum fluctuations) to all the gravitational fluxes in the neighborhood and changes the characteristics of space within a large radius around. Practically, this creates a new granularization (on a larger scale) of the spatial fluid from the big sphere circumscribed to the cosmic object, imprinting this whole region with a special feature of *local absolute*. If a certain cosmic area is populated by several cosmic bodies, there will be the same number of regions (separate or overlapping) with absolute features and each region will follow the trajectory of its source and will inherit its rotational movements.

Once we come very close to a cosmic object and a certain limit is passed, the absolute feature of its surrounding space becomes dominant and will determine all the movements inside this region. The photons, for example, will move at the speed limit **c** relative to this absolute framework. Consequently, a laboratory placed on the Earth's surface is lying inside its region of absolute space (for now, we will ignore the direct effects of gravitation and planetary rotation). It will rotate in sync with the planet - therefore, with the local absolute - and, for any experience made with light, it may be considered a perfect Absolute Frame of Reference (AFR). This also represents the minimal frame in which we can study the relative motion, considering that one or several Inertial Frames of Reference (IFR) are moving uniformly in regard to it.

In all my previous articles it was clearly assumed that photons are the only granular structures that can constitute a global indicator of the absolute in our universe and which can help us reveal the relative movement of any cosmic body against this spatial "background". Now, once we have theoretically identified the regions of absolute space around any object with significant mass, photons will be included in some experiments designed to confirm my new idea and to make a few necessary additions to the initial version of the "Theory of the Absolute".

1.2. The General Postulates of TA

First of all, we must say that the major theoretical support is provided by the Fundamental Laws of the Universe (TP) and by their consequences. All the features of the spatial granular fluid are currently known, also the way in which it facilitates the movement of any granular structure, simple or complex.

The Theory of Relativity (TR), as it was shown in The Universe [2], is contradictory in several respects and does not provide a complete framework for our analysis on motion, neither at quantum nor macroscopic levels. As the relative motion is present all over the universe, TR should provide a complete descriptive mechanism of the moving frames in the absence of an absolute point. The whole foundation of TR consists of two simple postulates whose apparent correctness is, however, based on numerous experimental results (invariance and equivalence):

- The speed of light is a universal physical constant, a maximum speed of propagation of interactions; it is invariant with respect to any IFR (the direction of its motion does not matter).
- The laws of physics are identical in different inertial frames, all the IFRs are equivalent (Lorentz symmetry).

At the first sight, these two postulates seem to be perfectly logical, also intuitive, depicting coherently and completely an "elegant" and uniform universe; in this type of universe, all the movements have an upper limit of speed and the uniform motion does not change the laws of physics. Moreover, the Lorentz transformations can connect the space-time coordinates from various IFRs and the famous formulae of TR will come up immediately; they show the dependence of some fundamental physical quantities, like time and space, on the relative speed. However, the PT's perspective on these things differs significantly; the movement of a material structure through space automatically produces some changes at the quantum level, and these state changes are depending only on its absolute speed. Therefore, the two postulates above must be rephrased to correctly reflect the new paradigm, to add them *realism*. Thus, we may start from the original TA premises:

- The speed of light is invariant in relation to any absolute frame of reference (local or universal) and, at the same time, it represents an upper limit for the speed of any granular structures;
- The laws of physics are identical in all frames of reference, but their parameters depend on the value and direction of the IFR's absolute velocity (relative to its *parent** AFR).

A series of observations and classifications can be made at this time:

- The speed of light in a vacuum, as a maximum value, is characteristic to the local absolute (it only depends on the local granular density). There are different maxima in different absolute regions; however, at the scale of our universe, all of these values are lower than the well-known speed threshold ***C*** (***C* > 1.4 c**, as it was previously shown in TP).
- The trajectory of all photons follows the local absolute, they are copying its global movement (and its eventual curvature, but this aspect will not be considered here).
- The speed of light (observed from the AFR) gets now an **apparent** character; its value is no longer the same in the *child* IFRs, as it now depends on the absolute velocity's magnitude and direction. Therefore, we must evaluate the **directionality** of physics in a certain IFR, the potential asymmetry that might exist in its direction of travel.
- Various child IFRs of a certain AFR are **equivalent** if they have identical absolute velocities (direction and value); we may apply the Lorentz transformations to these frames, and their rates of time are all identical. The child IFRs can be called **twins** if only their absolute speeds are identical.
- As time is in fact a reflection and a consequence of the quantum level movements, its rate in an IFR must be lower than the *background* value of the parent AFR. But all the uniform movements we see in mobile frames are having a directional character; therefore, their rate of time might also depend on direction.

* The attribute *parent* for an AFR means it has one or more attached *child* IFRs.

1.3. Famous experiments and their new interpretations

The outcome of some trials may confirm a theory or a specific formula, may reject it, or may be inconclusive. Let's take a look at a few famous experiments and at their conclusions, then check if some different explanations can be found for those results in the new context given by the model of absolute space (which is somehow similar to the concept of aether from the 1900s).

1.3.1. Michelson-Morley experiment

Essentially, the MM experiment has tried to confirm the existence of some kind of ether, in fact an ether wind that would change its direction as the Earth is moving through space. They used a simple device named interferometer; it contains a light source **L**, two mirrors **M1** and **M2**, a beam-splitting mirror **M3**, and a screen **S** on which the interference pattern can be seen (as shown in Figure 1). Mirror **M1** is precisely adjusted to set the same distance **D** between the normal mirrors and beam splitter. The half-silvered mirror splits the light beam into two perpendicular beams which are reflected back by the two mirrors and finally interfere on the screen.

The interference pattern displayed on screen **S** will depend on the path difference between the two beams, and this difference can be easily calculated. If we assume that the ether moves from left to right with the speed **u**, the total time it takes light to cover the horizontal and vertical distances would be:

$$t_{12} = t_1 + t_2 = \frac{D}{c-u} + \frac{D}{c+u} = \frac{2D}{c}\frac{1}{1-u^2/c^2}$$

$$t_{34} = t_3 + t_4 = \frac{D}{\sqrt{c^2-v^2}} + \frac{D}{\sqrt{c^2-v^2}} = \frac{2D}{c}\frac{1}{\sqrt{1-u^2/c^2}}$$

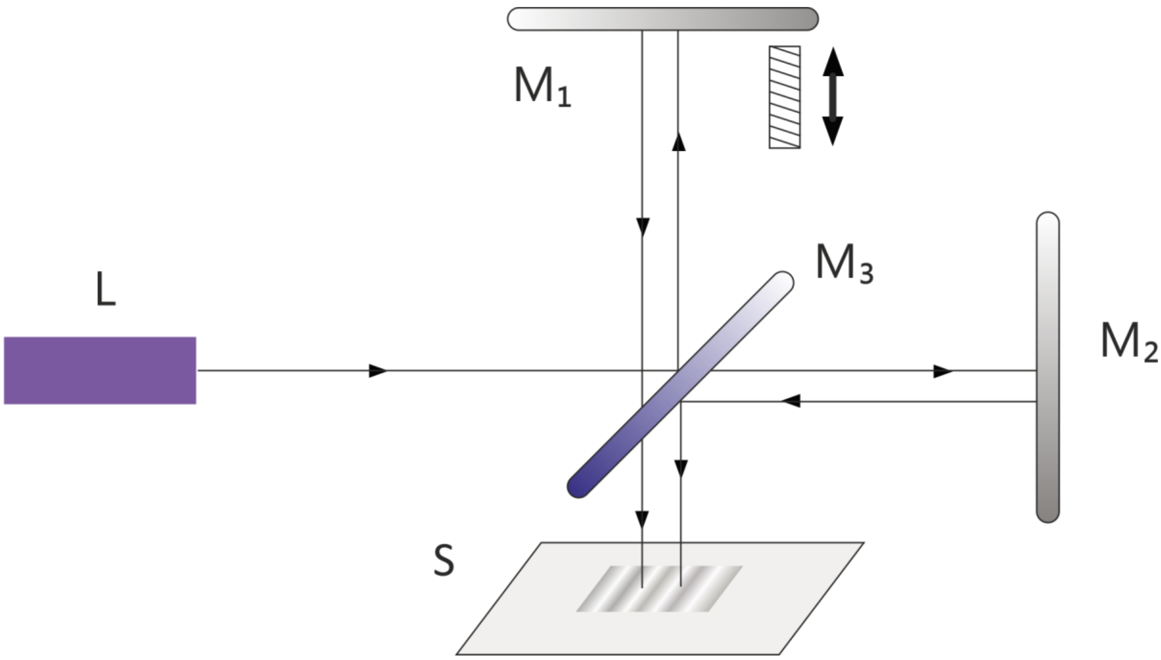

Figure 1 - *The Michelson-Morley interferometer*

The interference pattern shows a fringe shift equal to one fringe when the time difference is equal to the period of the wave, i.e. an interval **T = λ / c**. Moreover, the difference between these time intervals will double if the apparatus is rotated by 90 degrees. Therefore, the total fringe shift **N** of the interference pattern will be:

$$N = \frac{4D}{\lambda}\left(\frac{1}{1-\frac{u^2}{c^2}} - \frac{1}{\sqrt{1-\frac{u^2}{c^2}}}\right)$$

This concrete result, the number of fringes, was virtually zero; no fringe shift was noticed during one or more days. Therefore, this implies that a normal addition of velocities (Galilean transformations) is not applicable in this case. Moreover, the general conclusion of the experiment was: the ether is undetectable and the speed of light is independent of the inertial frame of reference. Consequently, Einstein abandoned the concept of ether and, implicitly, the notion of absolute universal time [4][5].

But let's take one more look at the MM experiment, as the logical conclusion we can draw from its results seems to be more nuanced. Namely, if the ether really exists, it does not flow relative to the device - it moves at the same speed as the device moves (dragging effect). Ignoring the low accuracy of the instrument, the phase shift of reflected light, and other experimental errors, a fringe shift **N = 0.44** was expected for equal-length arms of **D = 11m** and a wavelength of **λ = 500 nm**. The idea of an ether that is "fixed" in the reference frame of the laboratory (of the Earth) now makes perfect sense. A beam of light would then have an absolute path and a constant speed, independent of direction. However, we cannot conclude yet that the speed of light does not depend on the speed of the source. Other experiments and other devices, as the one imagined in Chapter 3.3 of "The Universe" [2] (which would detect any deviation in the trajectory of light), or a simpler version of the MM interferometer (as the *mobile* one shown in Figure 2, oriented along its velocity vector) would be able to detect the movement in regard to the "fixed" frame of the Earth.

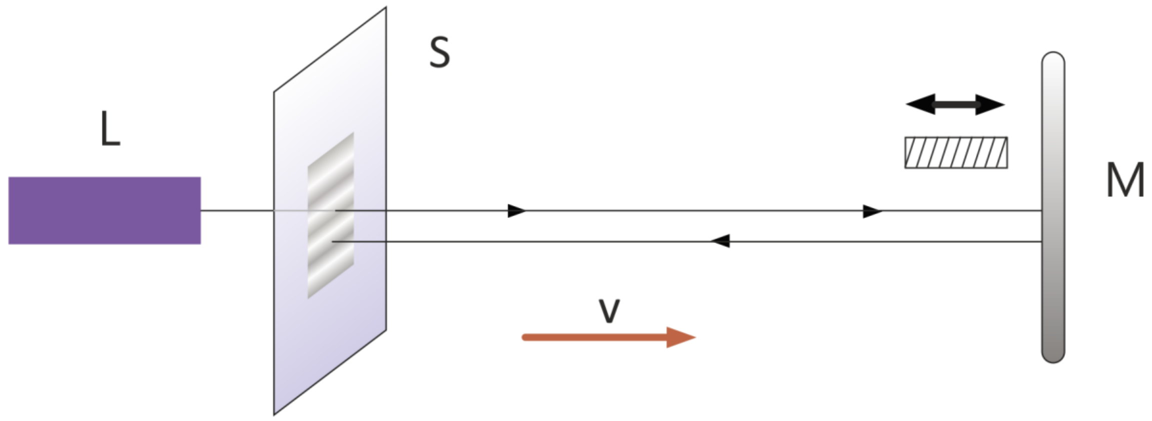

Figure 2 - *The mobile interferometer*

Simplified calculations, for a **3m** arm length and red light (**λ = 600Nm**), would give us the results from Table 1 (similar to those of a *fixed, normal MM interferometer*).

Significant variations in the fringe shift practically occur after 30km/s and the fringes become countable after 100km/s. If such a mobile device would revolve on a high orbit around the planet, having a tangential speed in this range, it might permanently elucidate the mystery of the ether - or of a local absolute, as in the TA perspective.

Note 1. We have presumed that the movement of the ether relative to our laboratory and the movement of an apparatus through a fixed ether are equivalent things, both theoretically and practically. Therefore, the null result given by the fixed interferometer and a positive result from the mobile one do not exclude each other, even more, this would represent the proof for the existence of the local absolute.

Note 2. It is hard to discriminate between a source-related speed of photons and an absolute one, given by the local absolute - as long as the results of the experiments are identical or inconclusive in this respect. It seems that any experiment you would perform using something "fixed" and something "mobile", a possible point of absolute and its absolute reference frame cannot be revealed (due to the intrinsic relativism). Anyway, when speeds are very low in comparison with **c**. A variable light speed means a variable propagation speed of all fields, implying that the entire "mechanics" of interactions in an IFR must have a "relative" character. In this case, we may not detect easily in which frame (at source or receptor) the speed changes in fact, or where the Doppler effect of visible light is actually produced, for example.

v	N
1 m/s	10^{-10}
10 m/s	10^{-8}
100 m/s	10^{-6}
1000 m/s	10^{-4}
10 km/s	0.01
20 km/s	0.04
30 km/s	0.1
50 km/s	0.3
70 km/s	0.5
100 km/s	1.1
1000 km/s	110

Table 1

1.3.2. The stellar aberration

Stellar aberration is an astronomical phenomenon that produces an apparent change in direction to the light coming from the stars; this is due to the relative movement of the observer about the source of light and due to the finite speed of light. Aberration causes sources of light to appear to be displaced towards the direction of motion (see Figure 3). Thus, if **S** is a star and **E** is the Earth which revolves with the speed **v** around the Sun, the direction of the stellar light should form the angle **θ** with the horizontal axis; instead, the star is observed at the angle $\boldsymbol{\varphi}$, $\boldsymbol{\varphi < \theta}$.

In a classical approach, by adding the axial components of the light coming from a fixed star and of velocity **v**, we can easily find the angle of the light beam in Earth's frame of reference:

$$\tan \varphi = \frac{\sin \theta}{{}^{v}/_{c} + \cos \theta}$$

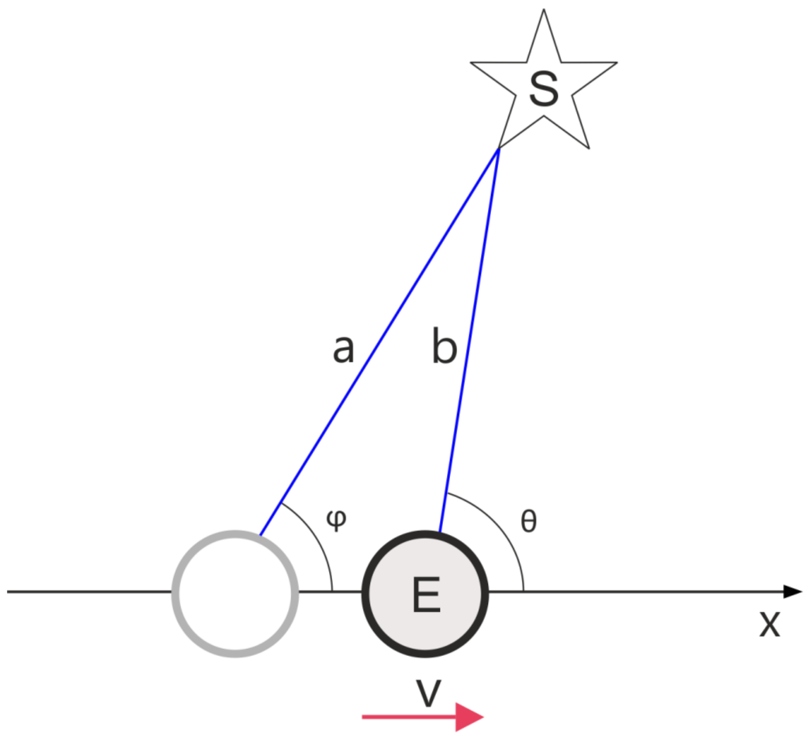

Figure 3 - *The aberration of light coming from stars*

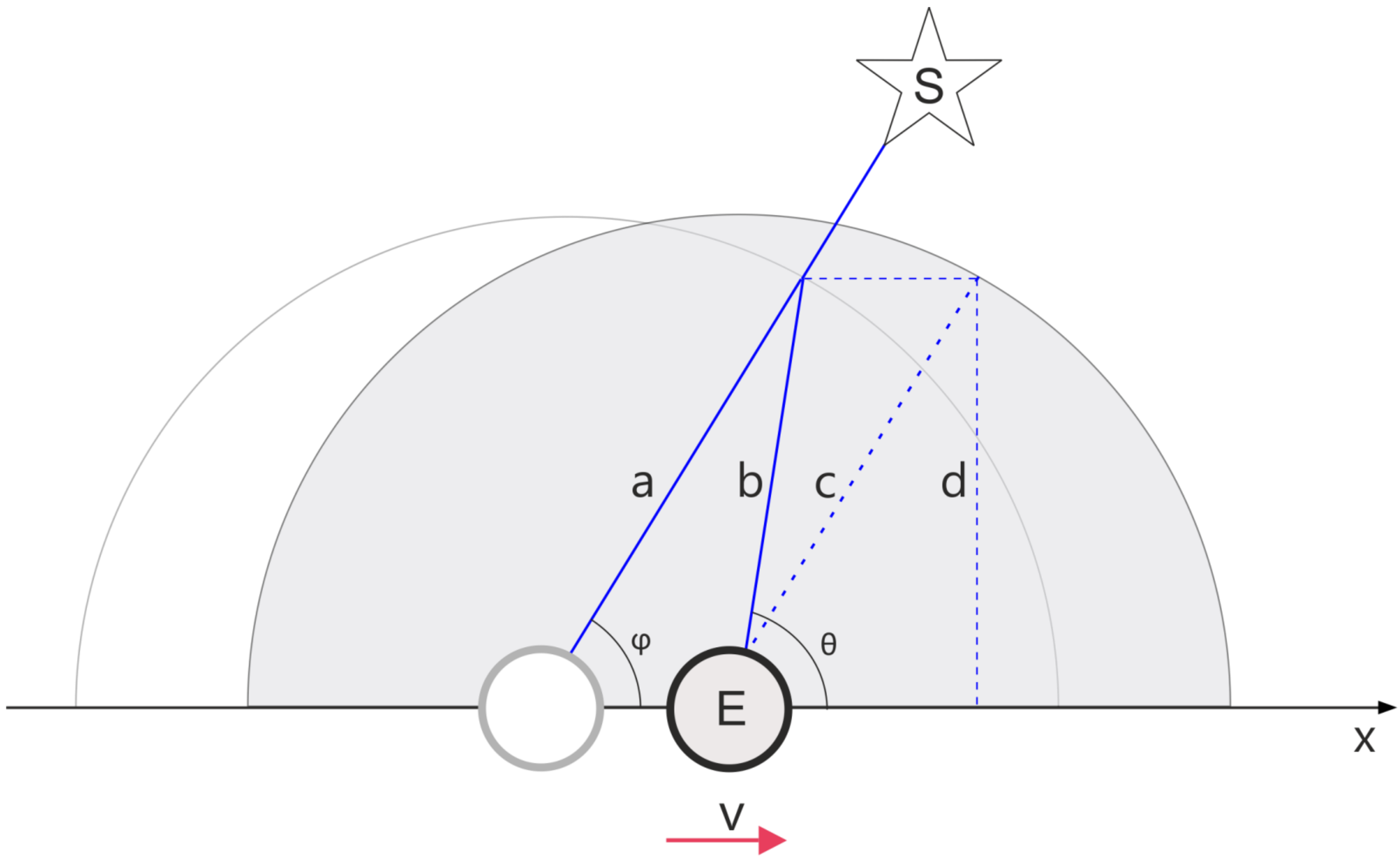

Figure 4 - *The aberration of light in absolute terms*

In relativistic terms, considering that light has the same speed **c** in the observer's frame (i.e. on the path (**b**)), the previous formula becomes (using the relativistic addition of velocities):

$$\tan\varphi = \frac{\sin\theta}{\gamma\,(^{v}/_{c} + \cos\theta)}$$

Where γ = $\mathbf{1/\sqrt{1 - v^2/c^2}}$. For v << c and $\theta = 90°$, we find that $\boldsymbol{\theta - \varphi = v/c}$ in both cases.

In absolute terms, starting from the main principles of TA, we identify at first the Earth and its surrounding space as a spherical region of absolute. At a given moment, the light from star **S** reaches this zone, as shown in Figure 4.

If our planet wouldn't move through space, the light beam would normally follow the path (**a**) toward the Earth-based observer, having the inclination angle $\boldsymbol{\varphi}$ to the horizontal axis. But the planet moves with speed **v** along the horizontal axis and reaches a new position while the beam of light travels at speed **c** toward the observer on the absolute path (**a**). As the planet moves, the whole adjacent region of absolute moves too, and the star will be seen in a different direction, (**c**), which is parallel to (**a**). Light is practically "dragged" by the absolute frame of the Earth, and its apparent trajectory (**b**) will form a greater angle to the horizontal axis, $\boldsymbol{\theta}$.

There are two right triangles formed by the paths (**a,b**), the horizontal axis and the perpendicular direction (**d**); we can write the cotangent of the angles $\boldsymbol{\varphi}$ and $\boldsymbol{\theta}$ and then eliminate the distance **d**, getting to this equation:

$$\cot\varphi = \cot\theta + \frac{v}{c}\frac{1}{\sqrt{1 - v^2/c^2}} = \cot\theta + \gamma\,\frac{v}{c}$$

The formula above is similar to the relativistic formula, rewritten using cotangents:

$$\cot\varphi = \gamma\left(\cot\theta + \frac{v}{c}\frac{1}{\sin\theta}\right)$$

Taking into account that the average speed of Earth on its solar orbit is only 29.28 km/s, all three cases (considering $\boldsymbol{\theta = 90°}$) lead to the same result, namely a deviation of 20.489 arcseconds.

Remark. This deviation does not depend on the diameter of the absolute sphere.

The analysis made under the TA terms holds for all collateral experiments (the observation of stellar aberration using a telescope immersed in water, for example, in which case the speed of light is lower).

1.3.3. Interpretations

The experiments described above (Chapters 3.1 and 3.2) and their different variants proved to be *inconclusive* in regard to the presumed existence of the ether and to the constancy of the speed of light in any inertial frame. However, they were used to formulate the postulates of special relativity and the final form of the theory was based on them, leading to a wrong approach and a partial understanding of the nature of reality. With all that, TR has a great success in physics, as it does provide accurate results in most cases. Why this paradox? In general, the absolute speed of the inertial frames of reference involved was small and the final results were not significantly influenced. All experiments have been performed on the planet's surface and in the vicinity at relative speeds under 10 km/s.

Normally, we should regard our planet and its surrounding region as an absolute system, which, along with other equivalent systems, moves throughout the Universe and bears the same laws of physics. These distinct or overlapped systems have dynamic configurations, moving and rotating together with the stars and galaxies about the global absolute that is a characteristic of our universe. When photons (or other particles) cross these regions, their motion and their trajectories are changed by the local absolute, being "imprinted" in this way by the respective region. As the relative speeds of these regions are small, the deviations will be also small (compared with the values from Chapter 3.2), but measurable. If a cosmic-level analysis is performed, we must identify first all the absolute systems (stars, planets, galaxies) crossed by the beam of light, their topology, and their speed, and then we may calculate the deviations. If a planetary-level analysis is performed, we must identify first the child IFRs and then find their parameters relative to the local absolute.

If we apply TA to all inertial frames of reference, the analysis becomes uniform and all phenomena have a clear meaning. Moreover, if the time would be absolute, we would observe that all processes and interactions will slow down when the absolute speed increases; this will imply more difficult calculations, but in this way, the nature of reality will be correctly represented.

1.4. Models and calculations

1.4.1. Observers and processes

As reality and its physical laws might depend on the concrete FR, we have to make a clear distinction between the observers of the various processes and movements that take place in nature. Now we can define several types of observers (they may be humans or apparatuses, but this separation will not be made here):

- *Absolute observer*. This observer is at rest in AFR and the time reference he uses is the absolute time - which has the maximum rate in this frame. His observations are *real, uniform, absolute,* and they correctly reflect the laws of physics of this AFR. At the same time, this observer has a virtual character: he can turn into a mobile observer and all the observations he makes in an IFR will have the *apparent* attribute.

- *Local observer*. This observer is at rest in an IFR, being an integral part of that inertial frame; the time reference he uses is the local time (its rate of passage is specific to this frame). His observations, based on his own temporal reference, may depend on the absolute velocity of its frame (both magnitude and direction).

Note 1. The association between time and a certain reference frame is kind of artificial, serving only theoretical purposes. Time is in fact a reflection of some concrete processes that undergo in concrete material objects.

Note 2. The local observer is potentially affected by movement in the same way the observed processes are. If the local physics changes, the internal mechanisms by which he quantifies the observations will also change. We can infer from this a *relative* character of all his observations, an intrinsic limitation they have in the local "universe" of an IFR.

Note 3. The internal clock (reference time) of an observer is based on a process that normally has the maximum possible rate; anyway, the fastest process in that frame has the speed of light in that context.

Uniform processes or bodies in uniform motion can be categorized, depending on their absolute speed, as follows:

- *Luminal processes*, running at the speed of light.

- *Subluminal processes*, running at a speed less than light.

For that the absolute speed of light cannot be exceeded by any particle, field, or body, the behavior of these two types of processes differs when the absolute speed of their IFRs increases. The respective differences are related to the manner in which they are slowing down, and the analysis must be made considering the distinction between the observational and the real nature of these changes.

1.4.2. Parent AFR and child IFR

Let be the absolute frame of reference **XOY**, as shown in Figure 5. At time zero, omnidirectional light is emitted from the origin **O**; at time **t,** the wavefront will have the circular distribution **C** (in a two-dimensional projection). The trajectory of a certain photon emitted from point **O** forms the angle **α** to the horizontal axis; this photon reaches point **A** after the time interval **t**, traveling the distance **ct**.

Now let be the child IFR **X'O'Y'**, which overlaps the parent AFR at time zero (their origins coincide); if it moves along the OX-axis with speed **v**, the wavefront of light will appear different to an absolute observer from this frame (Figure 6). The shape of this wavefront is still circular, but the entire front is shifted to the left by distance **vt**, that exact distance traveled by the IFR in the time interval **t**. That observer will see a shorter distance traveled by the photon to point **A**, and this new trajectory (**d**) forms a different angle, **α'**, to the horizontal axis. From his absolute perspective, our photon has traveled the distance **ct** in **t** seconds; from his local perspective, our photon has traveled a shorter distance in the same interval. Therefore, we might say that the apparent speed of light in an IFR is lower than **c** in the frame's direction of travel.

Note. If we consider that the source of omnidirectional light is in the origin **O'** of the mobile frame **X'O'Y'**, the final distribution of the wavefront at time **t** will be no different from the current one (first postulate of the Theory of the Absolute).

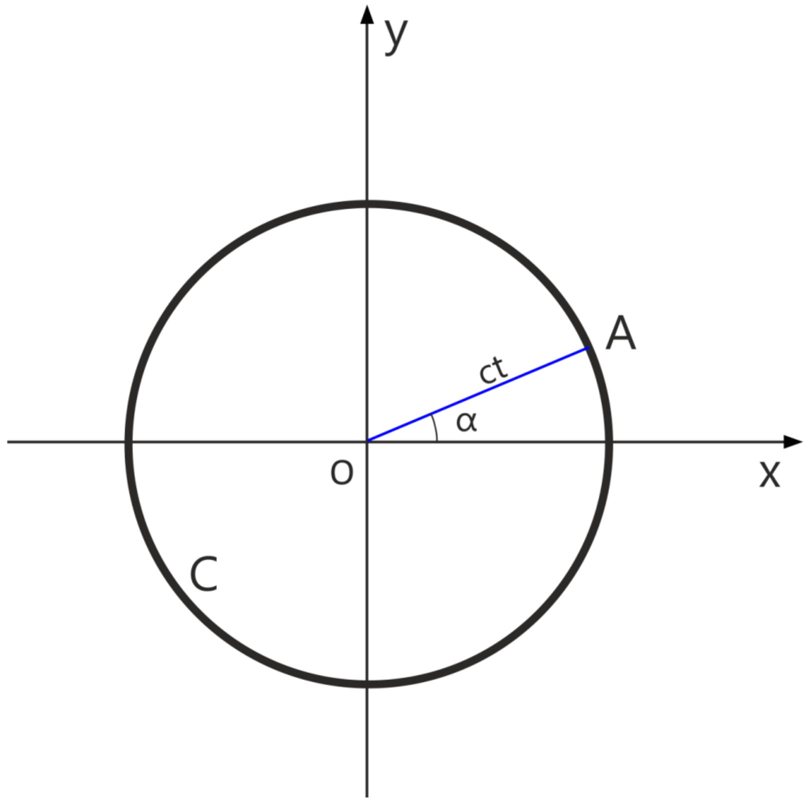

Figure 5 - *The absolute distribution of light*

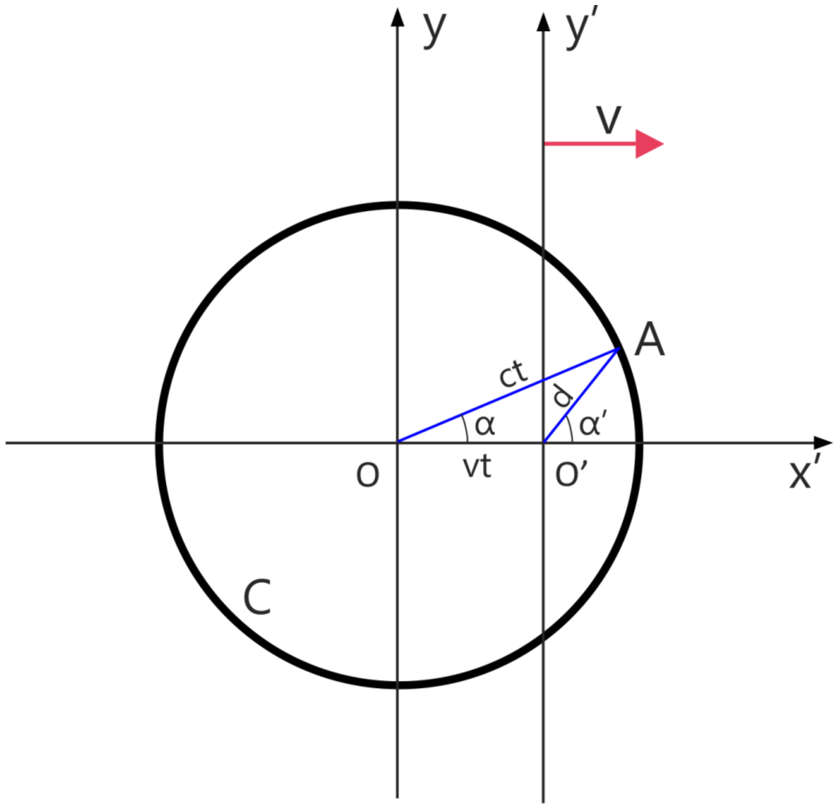

Figure 6 - *The distribution of light in an IFR*

It is easy to observe that the distribution of light in an IFR is no longer uniform, and therefore we can say that light has different speeds in there. A local observer (we can call him a mobile observer), whose time reference has a constant rate, still cannot measure and calculate a constant speed of light (no matter where its source is located).

Be the apparent velocity of light in **X'O'Y'** denoted by **u**; we now can simply write the formulae for the value of this vector and its angle to the horizontal axis:

$$u = \sqrt{c^2 - 2cv\cos\alpha + v^2}$$

$$\sin\alpha' = \frac{c\sin\alpha}{\sqrt{c^2 - 2cv\cos\alpha + v^2}}$$

Here are a few special values of this speed and angles (negative angles are also accepted due to symmetry):

α	**u**	**α'**
0°	c - v	0°
arccos (v/c)	$\sqrt{c^2 - v^2}$	90°
90°	$\sqrt{c^2 + v^2}$	90°+arctan (v/c)
180°	c + v	180°

Table 2

Note 1: Speed **u** is an apparent speed, a relative speed of light in regard to certain IFR. Therefore, its value can exceed the absolute limit **c** (may be up to **2c**). In general, regardless of their concrete FR, two objects may have relative speeds in this range: **0..2c** (when they are seen by an absolute observer).

Note 2: If the local observer (of absolute type) would be able to measure this speed, he would get different values, depending on the orientation: minimum speed in the direction of **v** and maximum in the opposite direction. Therefore, this observer would know at least the direction in which its own IFR moves, i.e. the direction of velocity **v**. Could he find out the exact value of **v**? The answer is yes, and the reason for this hides in Table 2 - the ratio between the maximum and minimum speed does not depend on the rate of local time.

Parenthesis

The single-arm MM interferometer (Figure 2) could be used for this purpose, by analyzing the fringe shift when it is mounted in a certain direction and then perpendicularly to it.

Note 3: Can this local observer synchronize his local clock with a clock ticking in the AFR? But to calibrate it? Theoretically speaking, the answer is yes to each question. Both clocks may start at the same moment, when the origins of the two frames, **O** and **O'**, coincide. For calibration, let us consider that short pulses of light are emitted from point **O** at the time interval **$\tau = 1$** (one second). The observer knows this thing, but he perceives a longer pause between pulses, namely the absolute interval **$\tau' = c\,\tau/(c-v)$**. As he knows the value of velocity **v**, the calibration of its "local" second is perfectly possible.

Note 4: This local observer of absolute type will perceive the things around him slightly deformed, all of them being "pulled" back along the direction of velocity **v** (due to the finite speed of light and due to the motion of the IFR). Also, the color of things will change due to the different apparent values of the speed of light.

1.4.3. Time in AFR and IFRs

What is the rate of local time in the above IFR, or the rate of the observer's reference time? And are they local constants, depending only on the absolute speed of the reference frame? TA stated that the rate of time in a parent AFR has a maximum value and all processes are slowing down in any child IFR. Moreover, we have already seen that the apparent speed of light is not uniform in an IFR, it depends on the frame's absolute velocity. If we were to see these things in a relativistic manner, we could establish that the speed of light is constant in any IFR (TR postulate) and, consequently, their local time will have different rates. If we were to see these things in an absolute manner, we have two alternatives:

1. We keep the AFR's rate of time in all child IFRs. All processes and local movements will change with the absolute velocity **v**, and these changes should be described by new equations of motion.

2. We try to set a certain local time in each IFR that its rate does not change the equations of motion. However, Chapter 4.1 shows us how the apparent speed of light depends on the direction in an IFR, and we could infer from it that time - as a reflection of things' velocity - also depends on direction!

Obviously, the second alternative seems more natural, closer to the well-known relativistic style; anyway, is this alternative really possible, and moreover, does it reflect properly the reality? To find the answers to these questions and to choose the best approach, we should now remember the definition of time (Chapters 8 and 12 of [3]); also, we need to know if all types of clocks (especially the light clock and the atomic clock) are measuring correctly the flowing of time and how exactly this special quantity is connected to different observers. In absolute terms, time is a derived physical quantity that is linked to the movement of concrete material bodies. It reflects the speed at which they move, vibrate, oscillate, it shows how the rate of these processes is limited due to the material nature of the structures involved, due to their intrinsic characteristics at quantum and granular levels. The maximum rate of time can only be found in the luminal processes that run in absolute frames (being at rest relative to an AFR). Once an object from this frame starts to move with a certain absolute speed, a part of its internal energy is "reallocated" for this and, consequently, it can no longer move or oscillate at the same speed in its proper (comoving) IFR - therefore, we can assume that its local time slows down. This phenomenon must be used in conjunction with the observational changes that happen in an IFR, which means we have to take into consideration the new apparent speed of things and light.

Let us identify the exact time in an AFR, see how much it slows down in a certain IFR and if this new rate is correctly reflected by the local clocks. According to TA, this slowdown may be quantified by applying TR in IFR relative to AFR - and the constant value that resulted could be seen in the context as an averaged value over all directions. But is this relativistic approach compatible with the normal equations of motion in IFRs?

1.4.3.1. Time measurement

In order to identify the source of absolute time at the quantum level, our analysis must start from the granular time. The quantum time (Chapter 12 of [3]) is in fact a reflection of how the speed of all movements is limited by the fundamental constants at the granular level - in principle, it is about the absolute granular speed ***C***, which limits the speed of all granular structures to **c**. If a particle undergoes a repetitive process in which the absolute speed **c** is reached, it can be used as a good example in our quest to find the rate of quantum time. The period of that process may be considered as a proportional constant, as a base for quantum time - and, implicitly, for the passage of time at a macroscopic level.

For this purpose, let us imagine now a system that consists of two hypothetical particles **A** and **B**, firmly joined together, which are rotating with the speed of light **c** in the plane **YOZ**, as shown in Figure 7. As long as their AFR is an isotropic space, the trajectories of these particles are perfect circles of radius **r**. Consequently, the rotation period **T** is given by this simple formula:

$$T = \frac{2\pi\, r}{c}$$

This system, in the given circumstances, can be characterized as *maximal* if we consider the speed of its internal process. If an external force pushes on the x-axis, the system will accelerate, reaching the speed **v** after a while. The internal process (the rotational motion of particles) will slow down in the system's comoving frame - as shown in Figure 8. As the value of each particle's absolute velocity is still **c** and its direction changes (this vector's plane is no longer YOZ), the tangential speed of both particles will automatically decrease. The new rotation period can be written as:

$$T' = \frac{2\pi\, r}{u} \qquad\qquad T' = \frac{2\pi\, r}{\sqrt{c^2 - v^2}}$$

and the ratio of the two periods results immediately:

$$\frac{T'}{T} = \frac{1}{\sqrt{1 - {v^2}/{c^2}}}$$

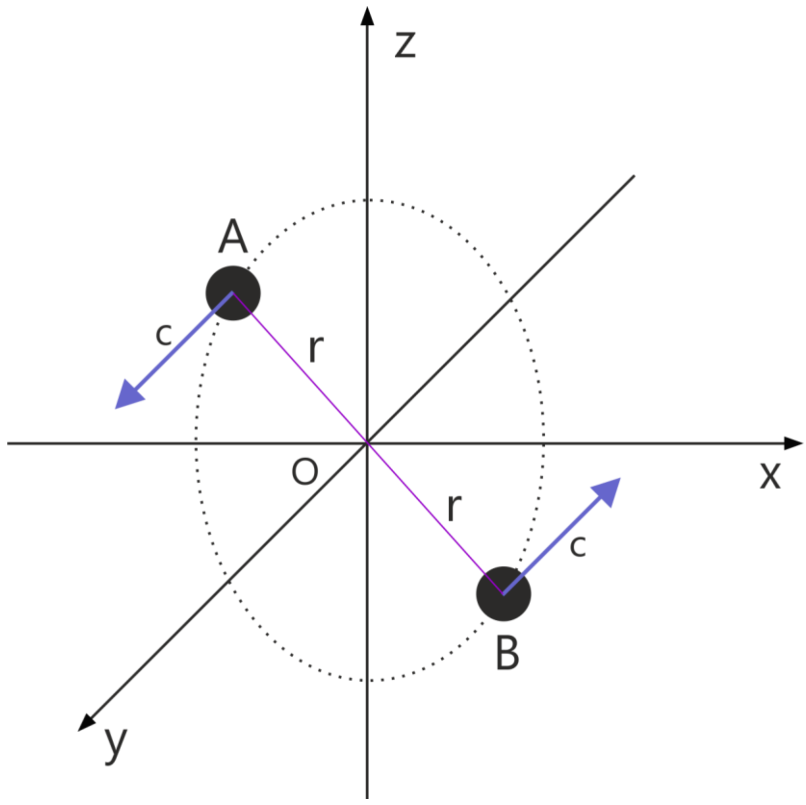

Figure 7 - *A system of two particles in AFR*

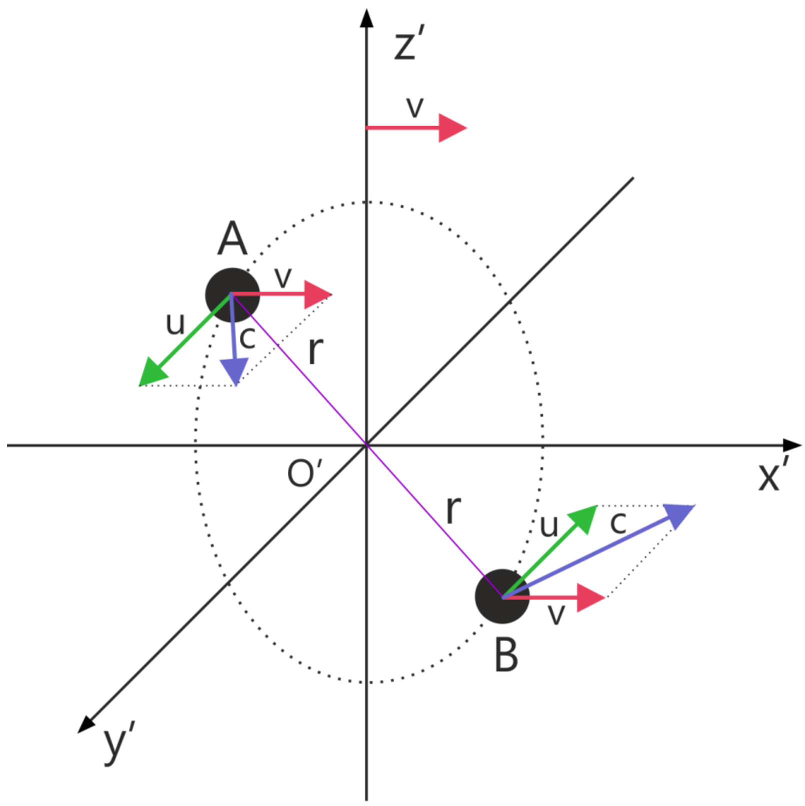

Figure 8 - *A system of two particles in IFR*