



Advanced Relativity: Reintroduction of Absolute Frame of Reference

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ABSTRACT

In Relativity theory, 'space' is empty and has no physical properties. Motion of a given physical object in such an empty space can be related only to the other objects which exist in space. In Advanced Relativity, space has Planck energy density which is diminished by the presence of a given physical object. The motion of physical objects causes 'The Dragging effect' with space, which opens the possibility for the reintroduction of space as the absolute frame of reference.

Key Words: Relativistic Motion, Space, Absolute Reference Frame, Relativity Theory, dynamic symmetry

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Introduction

Alice and Bob are travelling in the vastness of universal space by the two ships. The spaceships are coming closer and Alice informs Bob that the speedometer in his spaceship does not work. Bob informed Alice that the speedometer is also damaged. Both Alice and Bob want to know which spaceship has higher speed. Both of them are experts in General Relativity and they decide to calibrate their clocks when driving one by the other and drive a circle with radius of 1000 kilometres. They read their clocks at a reunion. The clock of Alice is ticking slower than Bob's clock. This according to the Relativity Theory means that Alice's spaceship is moving faster than Bob's spaceship. The rate of clocks in both Alice and Bob's spaceships are defined by the speed of their spaceships, in the same way as the clocks of GPS system have different rate on the satellite and Earth surface. The rate of clock on the satellite is slower because of its motion (Special Relativity effect) than on the Earth surface by 7 microseconds per day (Sorli, 2018).

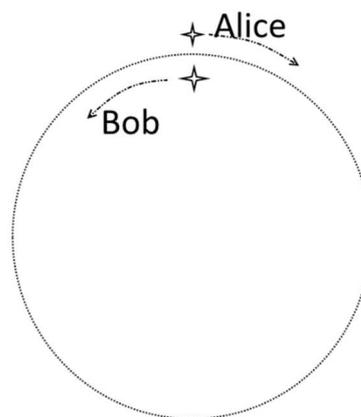


Figure 1. Alice and Bob defining which spaceship is faster

Alice's spaceship diminishes energy density of space more than Bob spaceship because of its higher speed. Higher is the value of diminished energy density of space, slower is the rate of clocks. This means that energy density of space defines the rate of clocks. Clocks are devices with which we can indirectly measure the values of space energy density in a given

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point of universal space. In intergalactic space where there are no stellar objects, rate of the clock is at the maximum and energy density of space is at the maximum, which is of Planck energy density ρ_{PE} . On the surface of stellar objects rate of the clock will diminish because energy density of space there is diminishing too. Energy density of space is diminishing also in the centre of spaceship (ρ_{SE}) which is moving with velocity v for the following value:

$$\rho_{SE} = \rho_{PE} - \left(\frac{m \cdot c^2}{V} \right) - \left(\frac{m \cdot v^2}{2V} \right) \quad (1),$$

where m is the mass of the spaceship and V is the volume of the spaceship. Kinetic energy of the spaceship $m \cdot v^2 / 2$ is the energy of space which is concentrated inside the atoms which build materials of the spaceship. This concentration of the space energy in the atoms due to their motion in space causes the additional diminishing of space energy density in the centre of spaceship or GPS satellite.

The same is valid also on micro scale, for example relativistic proton vortex when accelerated in cyclotron is because of its high speed getting energy from the space which additionally diminishes energy density if space ρ_{SE} in the centre of the proton vortex:

$$\rho_{SE} = \rho_{PE} - \left(\frac{m_0 \cdot c^2}{V} \right) - \left(\frac{\gamma \cdot m_0 \cdot c^2}{V} \right) \quad (2),$$

where m_0 is mass of the proton at rest, γ is Lorentz factor.

Photon is moving in real physical space

In this perspective, space is the absolute frame of reference for moving of the physical objects. In a given physical object, the rate of clock is at maximum, when object is at rest, regarding the space in which physical object exists. The rate of clock diminishes with the increasing of object velocity. Theoretically, the velocity of a given spaceship can be defined by the rate of clock placed in the spaceship, which is far away from the stellar objects. When spaceship is at rest regarding the space, rate of clock is at

the maximum and is diminishing by the increased velocity of the spaceship.

Historically it's seen that abolishing of the absolute frame of reference has happened with the abolishing of ether in the beginning of 20th century. Einstein has managed to describe the constancy of light speed in all inertial systems by introducing space-time of Minkowski with Lorentz transformation. But in Advanced Relativity, the photon is the vortex of space (Sorli, 2018) and has the same velocity in all the inertial systems. In this view, the Special Relativity can be described in a 3D Euclidean space with Galilean transformation for spatial coordinates X, Y and Z and Selleri transformation for time t (Fiscaletti, Sorli, 2013; Sorli *et al.*, 2011). In this description there is no need for introducing the "proper time", "coordinate time", and "length contraction. Relative velocity of clocks in all inertial systems in Advanced Relativity valid for all observers, which is proved by GPS system and can be expressed by Selleri's formula, in which there is no spatial coordinates. Below is the Lorentz formula for time dilation, where X is spatial coordinate of inertial system with time t :

$$t' = \frac{t - \frac{v \cdot X}{c^2}}{1 - \sqrt{\frac{v^2}{c^2}}} \quad (3),$$

Lorentz formula for time dilation was further developed by Selleri as follows below:

$$t' = t \cdot \sqrt{1 - \frac{v^2}{c^2}} \quad (4),$$

where we can see that time t' and so rate of clock in inertial system X', Y', Z' depends only on the velocity v of moving inertial system X', Y', Z' .

In Advanced Relativity, the space is not filled with ether. It's well known that the space itself has physical property, namely 'variable energy density'. Photon is the vortex of space and moves with the velocity of light speed C . In all different inertial systems with all different velocities, the light satisfies the law of Doppler effect. The first postulate of Special Relativity (constancy of light speed) has physical origin in photon as the vortex of space in which all inertial systems move. The second postulate of Special Relativity (physical laws are the same in all inertial systems) has physical origin in the fact



that all inertial systems move in the same space which energy density is defines physical laws. The Relativity of time has origin in variability of space energy density and is valid for all observers.

In text books of physics you can read that the rate of the moving photon clock is slower for the stationary observer which sees that in a moving clock photon is moving “zig-zag”. Because of this optical illusion, the moving photon clock will not have slower rate; the stationary observer has no ‘magic powers’ to change the rate of the moving clock with its observation.

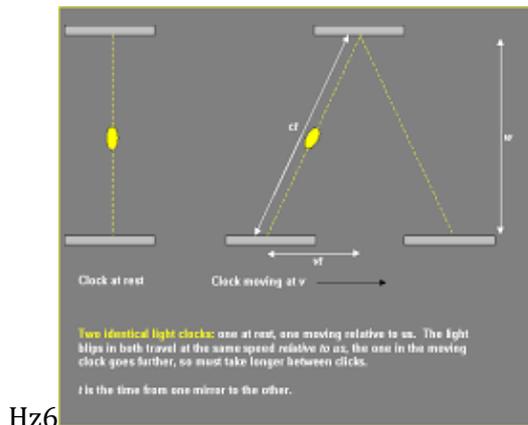


Figure 2: Moving photon clock has slower rate because of optical illusion of stationary observer

Photon clock had the same rate for the stationary observer and for the observer which is moving with the clock. The rate of the photon clock depends exclusively on the energy density of space and is valid for all observers.

In Advanced Relativity, both the inertia and gravity are the result of dynamic symmetry between given massive object and the space. The massive object is diminishing energy density of space accordingly to the amount of its energy, which creates both the inertial mass and gravitational mass, as below:

$$E = mc^2 = (\rho_{PE} - \rho_{SE}) \cdot V \quad (5)$$

where E is energy of space, m is mass of the object, V is volume of the object, and $(\rho_{PE} - \rho_{SE})$ is the difference between Planck energy density of outer space ρ_{PE} and energy density of space in the centre of physical object ρ_{SE} . Difference $(\rho_{PE} - \rho_{SE})$ is the origin of inertia and gravity (Sorli, 2018). So that we have

$$E = (\rho_{PE} - \rho_{SE}) \cdot V \quad (6)$$

which clearly shows that the energy of a given massive physical object has origin and corresponds to both the ‘difference of energy density of space outside’ and the ‘centre of the massive physical object’. Equations (5) and (6) are expressing fundamental symmetry in the universe between a given material object and space in which this object exists. We have to understand that the space does not end on the surface of material object; rather it continues inside. Elementary particles are the different vortexes of space energy (Sorli, 2018). Space and particles are in the final stage “the same stuff” as was already said by Ervin Schrödinger: “What we observe as material bodies and forces are nothing but shapes and variations in the structure of space” (Sorli et al., 2018a).

Rate of clocks depends on the variable energy density of space

In General Relativity the gravitational time dilation is calculated by the following formula:

$$t = \frac{t_0}{\sqrt{1 - \frac{2GM}{rc^2}}} \quad (7)$$

where t_0 is rate of the clock on the surface of stellar object surface, m is the mass of stellar object, G is gravitational constant, r is radius of the stellar object, and t is the rate of the clock at the point T which is infinitely away in empty cosmic space. For example, when one second has passed at point T in infinity, only 0.9999999993 seconds has passed on the Earth clock. So that we can calculate the rate of clock at the point T_1 , situated on the distance h above the surface of stellar object with following formula:

$$t = t_0 \cdot \sqrt{\frac{1 - \frac{2GM}{(r+h) \cdot c^2}}{1 - \frac{2GM}{rc^2}}} \quad (8)$$

Let’s calculate time t at the point 20 km above Earth surface comparing with the 1 day elapsed time on the Earth surface:

$$t = 86400s \cdot \sqrt{\frac{1 - \frac{2(5.97219 \times 10^{24}kg)(6.67408 \times 10^{-11}m^3kg^{-1}s^{-2})}{(6371000m + 20000m)(8.99 \times 10^{16}m^2s^{-2})}}{1 - \frac{2(5.97219 \times 10^{24}kg)(6.67408 \times 10^{-11}m^3kg^{-1}s^{-2})}{(6371000m)(8.99 \times 10^{16}m^2s^{-2})}}}$$



$$t = 86400s \cdot \sqrt{\frac{1 - \frac{7.9717748 \times 10^{14} m^3 s^{-2}}{(6391000m)(8.99 \times 10^{16} m^2 s^{-2})}}{1 - \frac{7.9717748 \times 10^{14} m^3 s^{-2}}{(6371000m)(8.99 \times 10^{16} m^2 s^{-2})}}}$$

$$t = 86400s \cdot \sqrt{\frac{1 - 0.00000000138747}{1 - 0.00000000139183}}$$

$$t = 8.640000000188352 \times 10^4 s \quad (20 \text{ km above surface})$$

Let's calculate time t at the point 40 km above Earth surface comparing with the 1 day elapsed time on the Earth surface:

$$t = 86400s \cdot \sqrt{\frac{1 - \frac{7.9717748 \times 10^{14} m^3 s^{-2}}{(6411000m)(8.99 \times 10^{16} m^2 s^{-2})}}{1 - \frac{7.9717748 \times 10^{14} m^3 s^{-2}}{(6371000m)(8.99 \times 10^{16} m^2 s^{-2})}}}$$

$$t = 86400s \cdot \sqrt{\frac{1 - 0.00000000138315}{1 - 0.00000000139183}}$$

$$\Delta_{space.energy.density} = \rho_{PE} - \rho_{SE} = 6,138 \cdot 10^{19} J/m^3$$

$$t = 8.6400000000374967 \times 10^4 s \quad (40 \text{ km above surface})$$

Let's calculate time t at the point 60 km above Earth surface comparing with the 1 day elapsed time on the Earth surface:

$$t = 86400s \cdot \sqrt{\frac{1 - \frac{7.9717748 \times 10^{14} m^3 s^{-2}}{(6431000m)(8.99 \times 10^{16} m^2 s^{-2})}}{1 - \frac{7.9717748 \times 10^{14} m^3 s^{-2}}{(6371000m)(8.99 \times 10^{16} m^2 s^{-2})}}}$$

$$t = 86400s \cdot \sqrt{\frac{1 - 0.00000000137884}{1 - 0.00000000139183}}$$

$$t = 8.6400000000561158 \times 10^4 s \quad (60 \text{ km above surface})$$

Let's calculate time t at the point 80 km above Earth surface comparing with the 1 day elapsed time on the Earth surface:

$$t = 86400s \cdot \sqrt{\frac{1 - \frac{7.9717748 \times 10^{14} m^3 s^{-2}}{(6451000m)(8.99 \times 10^{16} m^2 s^{-2})}}{1 - \frac{7.9717748 \times 10^{14} m^3 s^{-2}}{(6371000m)(8.99 \times 10^{16} m^2 s^{-2})}}}$$

$$t = 86400s \cdot \sqrt{\frac{1 - 0.00000000137457}{1 - 0.00000000139183}}$$

$$t = 8.6400000000745632 \times 10^4 s \quad (80 \text{ km above surface})$$

In Advanced Relativity, we can calculate the energy density of the space at the point T by the following formula:

$$\rho_{SE} = \rho_{PE} - \frac{3M \cdot c^2}{4\pi \cdot (r+d)^3} \quad (9),$$

where ρ_{SE} is energy density at the point T , ρ_{PE} is Planck energy density, r is diameter of the stellar object, and d is the distance between the centre of the stellar object and point T . Calculation below shows that the diminishing of the energy density of space on the Earth surface regarding Planck energy density ρ_{PE} . It's noted that when $d = r$, one gets energy density of space ρ_{SE} in the centre of the stellar object as follows in formula below:

$$\rho_{SE} = 4.633 \times 10^{113} J/m^3 - \frac{3(5.97219 \times 10^{24} kg)(299792458 m s^{-1})^2}{4\pi \cdot (1.2742 \times 10^7 m)^3}$$

$$\rho_{SE} = 4.633 \times 10^{113} J/m^3 - \frac{(1.791657 \cdot 10^{25} kg)(8.99 \times 10^{16} m^2 s^{-2})}{4\pi(2.66877 \times 10^{21} m^3)}$$

$$\rho_{SE} = 4.633 \times 10^{113} J/m^3 - \frac{1.6107 \times 10^{42} m^2 s^{-2}}{2.6 \times 10^{22} m^3}$$

$$\rho_{SE} = 4.633 \times 10^{113} J/m^3 - 6.1949 \times 10^{19} J/m^3$$

$$\Delta_{space.energy.density} = \rho_{PE} - \rho_{SE} = 6.1949 \times 10^{19} J/m^3.$$

Again, calculation below also shows that the diminishing of the energy density of space 20 km above the Earth surface regarding Planck energy density:



$$\rho_{SE} = \frac{4.633 \times 10^{113} \text{J/m}^3}{3(5.97219 \times 10^{24} \text{kg})(299792458 \text{ms}^{-1})^2} - \frac{4\pi \cdot (6371000 \text{m} + 6391000 \text{m})^3}$$

$$\rho_{SE} = \frac{4.633 \times 10^{113} \text{J/m}^3}{(1.791657 \times 10^{25} \text{kg})(8.99 \times 10^{16} \text{m}^2 \text{s}^{-2})} - \frac{4\pi(2,0785296 \times 10^{21} \text{m}^3)}$$

$$\rho_{SE} = 4.633 \times 10^{113} \text{J/m}^3 - \frac{1.6107 \times 10^{42} \text{m}^2 \text{s}^{-2}}{2.6119574 \times 10^{22} \text{m}^3}$$

$$\rho_{SE} = 4.633 \times 10^{113} \text{J/m}^3 - 6.166 \times 10^{19} \text{J/m}^3$$

$$\Delta_{\text{space.energy.density}} = \rho_{PE} - \rho_{SE} = 6.166 \times 10^{19} \text{J/m}^3.$$

The calculation below shows that the diminishing of the energy density of space 40 km above the Earth surface regarding Planck energy density:

$$\rho_{SE} = \frac{4.633 \times 10^{113} \text{J/m}^3}{3(5.97219 \times 10^{24} \text{kg})(299792458 \text{ms}^{-1})^2} - \frac{4\pi \cdot (6371000 \text{m} + 6411000 \text{m})^3}$$

$$\rho_{SE} = 4.633 \times 10^{113} \text{J/m}^3 - \frac{1.6107 \times 10^{42} \text{m}^2 \text{s}^{-2}}{2.6242566 \times 10^{22} \text{m}^3}$$

$$\rho_{SE} = 4.633 \times 10^{113} \text{J/m}^3 - 6.138 \times 10^{19} \text{J/m}^3$$

$$\Delta_{\text{space.energy.density}} = \rho_{PE} - \rho_{SE} = 6.138 \times 10^{19} \text{J/m}^3.$$

Similarly, calculation below shows that the diminishing of the energy density of space 60 km above the Earth surface regarding Planck energy density:

$$\rho_{SE} = \frac{4.633 \times 10^{113} \text{J/m}^3}{3(5.97219 \times 10^{24} \text{kg})(299792458 \text{ms}^{-1})^2} - \frac{4\pi \cdot (6371000 \text{m} + 6431000 \text{m})^3}$$

$$\Delta_{\text{space.energy.density}} = \rho_{PE} - \rho_{SE} = 6.109 \times 10^{19} \text{J/m}^3.$$

Calculation below shows the diminishing of the energy density of space 80 km above the Earth surface regarding Planck energy density:

$$\rho_{SE} = \frac{4.633 \times 10^{113} \text{J/m}^3}{3(5.97219 \times 10^{24} \text{kg})(299792458 \text{ms}^{-1})^2} - \frac{4\pi \cdot (6371000 \text{m} + 6451000 \text{m})^3}$$

$$\rho_{SE} = 4.633 \times 10^{113} \text{J/m}^3 - \frac{1.6107 \times 10^{42} \text{m}^2 \text{s}^{-2}}{2.6242566 \times 10^{22} \text{m}^3}$$

$$\rho_{SE} = 4.633 \times 10^{113} \text{J/m}^3 - 6.080 \times 10^{19} \text{J/m}^3$$

$$\Delta_{\text{space.energy.density}} = \rho_{PE} - \rho_{SE} = 6.080 \times 10^{19} \text{J/m}^3.$$

We can see in figure 3 below that by increasing the distance from the Earth surface time dilation is increasing, and the energy density of space is also increasing. On the basis of these calculations we can draw the following result (figure 4). For time dilation, we apply the last numbers 188, 374, 561, 745. For energy density increasing we apply decimal differences between space energy at Earth surface and 20km which is 26, 40km which is 54, 60km which is 83, 80 km which is 112.

	4,633x10E113	
Earth surface	- 6,192x10E19	86400 s
20 km above	- 6,166x10E19 26	+ 0,000000 188352 s
40 km above	- 6,138x10E19 54	+ 0,000000 374967 s
60 km above	- 6,109x10E19 83	+ 0,000000 561158 s
80 km above	- 6,080x10E19 112	+ 0,000000 745632 s

Figure 3. Calculations of gravitational time dilation and of increasing of energy density of space

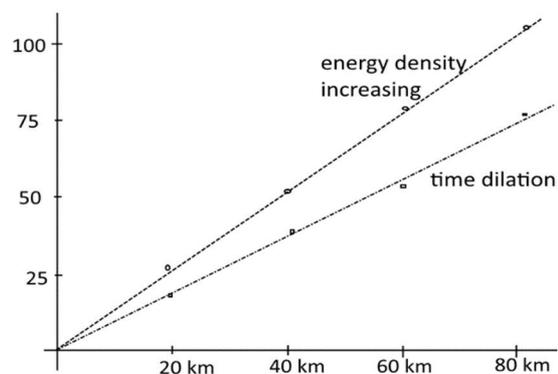


Figure 4. Diagrams of gravitational time dilation and space energy density



We can see that diagram of time dilation and diagram of increasing energy density of space have similar linear shape and direction which confirms that the actual physical circumstance which determines the rate of the clock is energy density of space in which is always NOW. It's well known that motion happens and clocks run in space only; not in time. Time is merely a numerical sequential order of events running in timeless space. When we measure numerical order time as duration appears. Duration of a given observed phenomenon enters the existence when measured from the side of the observer (Sorli *et al.*, 2018b).

Space and time "luckily separated"

In Advanced Relativity, space and time are finally "luckily separated" again after more than 100 years. Space is fundamental energy of the universe and time is only a mathematical parameter of motion in space. Motion does not happen in time and space, motion happens only in space and time is just its numerical sequence. Space and a given physical object are not separable elements of the universe. A given physical object is diminishing energy density of space. Rotation of physical object or stellar object causes also minimal rotation of surrounding space, which we call "dragging effect". Sun is rotating space around it and this rotation of space causes precession of the planets. We develop a model of precession of planets which is based on dragging effect. Our model also explains 'Sagnac effect' which can't be explained by the classical Relativity with empty space. When we measure the signal, which moves from A to B on the Earth surface in the direction of Earth motion, the elapsed time will be shorter than when we measure the time of signal moving from B to A. This happens because the space around the Earth is rotating with the Earth. As signal is a vibration of space, it needs lesser time, while moving from A to B.

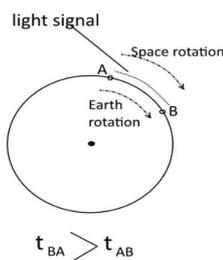


Figure 5. Sagnac effect in Advanced Relativity

Michelson-Morley experiment has given the null result which means that light is not the vibration of ether. In 1905 Einstein idea of the photon moving in an empty space was fully accepted. The model of empty space deprived of physical properties does not pass bijective analysis. In Advanced Relativity, space is not only a concept, but space is also "real", space is physical, space has its variable energy density. Advanced Relativity (AR) is not "resurrecting" ether model; AR is developing Einstein's Relativity which is marvellous "mathematical theory" where physical space has only geometrical properties in "physical theory" where space gains concrete physical properties, namely, energy density which gives origin to the relative rate of clocks, inertia, and gravity.

In physical space which is the absolute frame of reference we distinguish relative and absolute velocity. You imagine you drive a car with the velocity of 110 km per hour. 500 meters in front of you is a car moving with the velocity of 120 km per hour. Accident happens and the car in front of you crash in the wall along the street. Driver luckily survives but the car is totally destroyed. This simple example proves that your "relative velocity" of 10 km per hour of the car in front of you was not "real". The real velocity of the car is the velocity regarding the highway which is 120 km per hour.

The same is valid per light speed which "real" velocity is the velocity of the light in the physical space and is valid for all observers. If you move towards the source of light with the velocity of 1000 km per hour it make no sense to say that for you light has velocity of $v = c + 1000$ km/h. The first postulate of Special Relativity is taking in account that absolute velocity of light is valid for all observers which is right.

Towards unified field theory

In the leading paradigm of today mainstream physics we have in space three different fundamental fields: electromagnetic fields, Higgs field and gravitational field. These three fields are not unified yet. In Advanced Relativity the functions of these three fundamental fields are carried by the space itself: photon is the vortex of space composed out of magnetic and electric component, inertia and gravity have both origin in the difference $\rho_{PE} - \rho_{SE}$ between Planck energy density of outer space ρ_{PE} and energy density of space in the centre of physical object ρ_{PE} . Introduction of energy



density of space in physics is necessary for the development of unified field theory.

Conclusions

The idea of empty space is one the biggest misunderstandings of 20th century physics. Space has energy density which is in dynamic symmetry with physical entities from the micro to the macro scale.

For the motion of every physical object, space is the absolute reference frame. When a clock in space is at rest and far away from stellar objects, it has a maximum speed. When the clock in space as the absolute frame of reference starts moving, its rate is diminishing. GPS system is working on the basis of different rates of clocks on the Earth surface and on the satellites, which are determined by the variable energy density of space.

The kinetic energy of the moving physical object is the energy of space, which is concentrated in the protons vortexes which build

matter. Higher is the velocity of the moving object more energy of space is involved in proton vortex.

Finally, every elementary particle is the vortex of space energy. This view is the basis for unified field theory.

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