# The flow of time

## A new perspective on the passage of time

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#time, #relative, #absolute, #granular, #relativity

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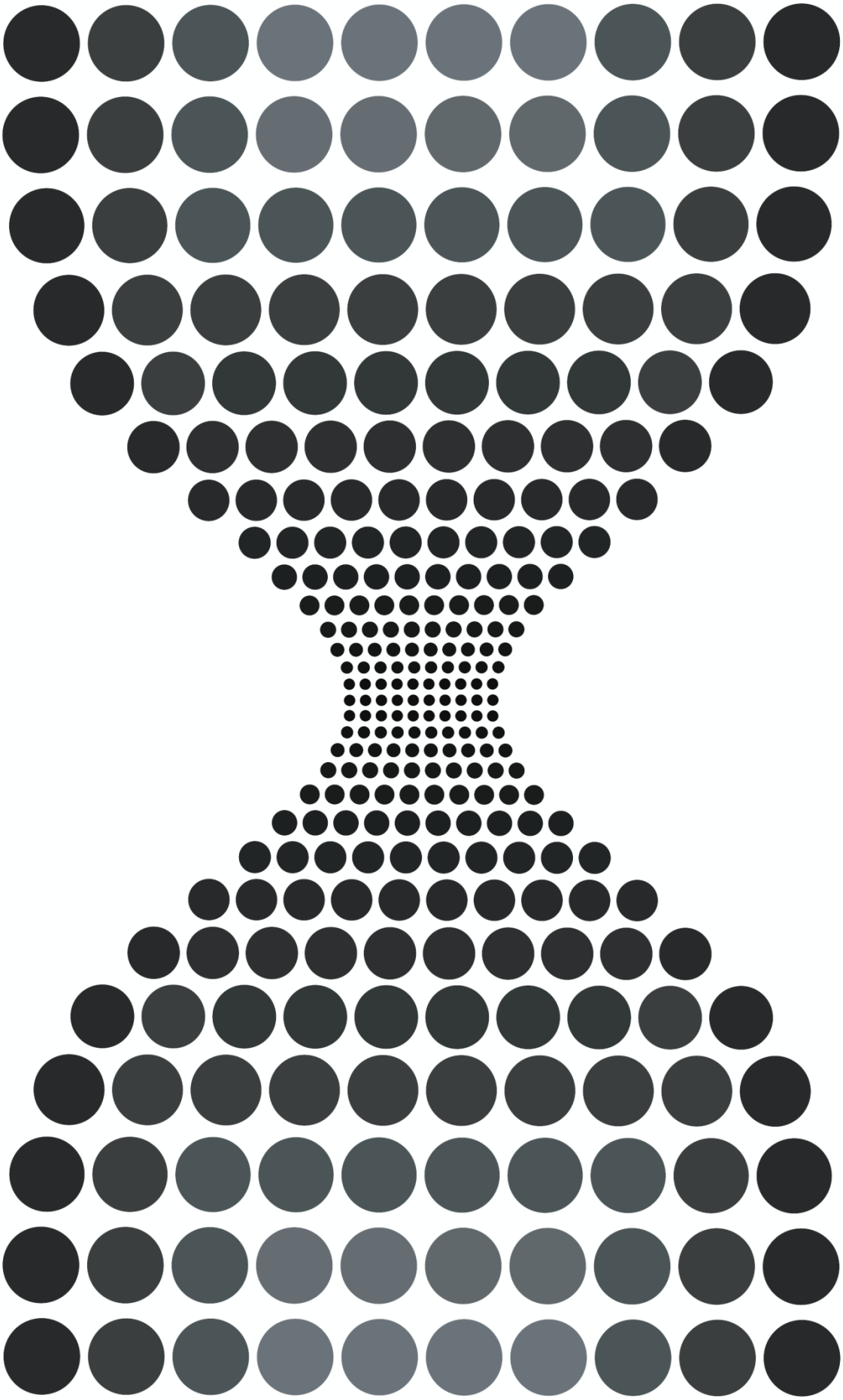

## 1. Definition

To understand what the time really means is equivalent to the understanding of the mechanism that runs the whole Universe, of all processes that move, change and transform its matter. Equally important are, in this perspective, those changes the space itself (i.e. that particular medium in which all these things are happening) is continuously undergoing. We could never talk about time if there hadn't been the matter and its structures, or if it would have been in a perfect stillness. The global model created by the current physics to explain the nature of reality has a certain degree of compatibility with the experimental observations, but it is at least incomplete; it is fragmented on several dimensional intervals and, more important, it does not define the fundamental elements that made up the space and ordinary matter. The laws of transformation and conservation of various quantities that characterize the physical phenomena, from quantum level up to the cosmic one, try to theoretically reflect more and more aspects of an extremely complex and dynamic reality. However, none of the latest theories does provide a full and rational explanation for the underlying mechanisms behind space and matter, although these two fundamental components of the surrounding reality should be very *simple* and easy to define. We have to better use our imagination in order to develop an abstract model of the nature, to fill in the blanks where the experiments can no longer give us significant data. We may observe the whole reality around, but there are *objective* limitations reaching to its biggest and lowest dimensions; therefore, any unitary model of reality will automatically lack two big parts, namely the extremes of the dimensional spectrum, which both should be completed by using the logic and the scientific argument.

Regardless of this global model to be formulated, one thing is certain: the matter of our universe is transforming continuously, being driven by various fields. Their energy is transferred to matter, and more complex structures are created all the time. Some new interactions occur between these structures, changing their states, while the cosmic objects they form start moving through space. These sequences of changes (state, position and energy variations) would be better described mathematically if we introduce a special physical quantity named *time*. It helps us to correctly describe the movement of matter, the speed of its transformation processes. We may therefore identify in these changes a particular moment, when a certain event takes place, and accurately quantify it. An equation that describes the state of a physical system may help us identifying the exact moment of an event, showing its "position" in time. Relative to the current moment called "now", we may declare something new about that event: it has happened in the past,

it is happening now or it will happen in the future. It is very easy to associate now the quantity *time* with a certain dimensional axis that is oriented from the past toward the future. We've practically created a new physical dimension (beside the other three of the three-dimensional space), which may help us to better describe the movements of matter.

The modern physics still uses a dual definition of *time*, a classical one (Newtonian time) and another one - of relativistic nature (as in Einstein's Theory of General Relativity):

- Time is a fundamental physical quantity (scalar, absolute, linear) that characterizes the duration of the movements, phenomena or of a succession of events; time flows uniformly in any physical system, regardless of the external phenomena.
- It is also a fundamental physical quantity (scalar) that characterizes durations - which depends on the reference system (its speed) and on the local *gravitational field intensity* (or, in accordance with the equivalence principle, on the *acceleration* of a system); the time dimension represents a coordinate in the four-dimensional continuum known as *spacetime*.

In my opinion, however, time is no longer a fundamental physical quantity! It is a derived scalar quantity, of a variable rate, which results directly from the inherent nature of reality - from the fact all matter (in any form) may move through the three-dimensional space. This special quantity depends on the absolute feature of motion at granular scale (the abstract absolute of our universe or the local absolute, determined by the nonuniformity of gravitational fluxes and by the quantum gravitational fluctuations). The motion of granular matter, from elementary particles and photons up to the complex cosmic structures, is limited by the absolute speed; this restriction reflects itself in the rate of proper movements - which in fact determine the rate of local time. Generally speaking, all matter is subjected to a speed limit, as it moves simultaneously through space and time (Gravity [3], Chapter 5.3: "The simultaneous movements of particles through space and time are therefore limited to the global maximum speed, as it was described by the principles of relativity, and this happens because the *same* entity may travel through space and also fix its local time's rate *by the same internal granular motion*"). Although space is granular, the movement of any body through it may be considered continuous - as it does occupy all the intermediate positions on its trajectory; therefore, the movement through time may also be considered as continuous, with all its variable speed.

Seen globally, time becomes in fact a more complex quantity; it is no longer an abstract concept, which may describe - for example - a virtual reference frame, but a physical quantity that has always to be associated with *concrete* matter (structures) *and* with its movement (as there are its real origin). Therefore, time may have different meanings at different scales (as shown in detail in [3], Chapter 10.2.1). The rate of passage can be either constant or variable, depending on the scale and on the actual physical system.

## 2. My vision of time

There were several kinds of time introduced in my previous works, but only the most important three of them are shown here, in order of the dimensional scale we are taking into consideration:

A. **The primary (granular) time** derives from the granular motion that takes place within the spatial fluid (all granules move at the absolute speed ***C***). It is associated with the speed of this uniform motion and, consequently, it has a constant rate of passage; this kind of time is in fact a virtual quantity that comes directly from the fundamental constants of the granular level (Gravity [3])

B. **The quantum time** flows in the quantum realm and it is associated with the movement of all granular structures. This kind of time cannot only be seen as the proper time of a specific particle, but also as a descriptive element of its interactions with other particles through various fields. As a local time, it derives from the fundamental constants of space and thus, indirectly, from the primary time. The source of this time is the specific, dual-type movement of elementary particles, which simultaneously execute their intrinsic precession and the global translation (having the absolute speed limited to **c**). It should be noted that the entire dynamics of a particle depends on its absolute mass, which depends on the absolute speed and on the distribution of granular fluxes - known as the intensity of gravity. If this type of time is associated to a single (isolated) elementary particle, then it would have only a theoretical abstract nature and it will not describe the actually mechanics from the quantum level; this mechanics imply several particles to interact, a system of particles.

C. **The macroscopic time** can be assigned to the structures of elementary particles, atoms and to the physical bodies they form. The quantum

time, as well as the macroscopic one, features an *absolute character* (not in the classic sense, but as connection to the real nature of our universe) - when a stationary granular structure is considered - or a *relative character* - when the structure is in motion. As all of the atoms and molecules that are making up the physical bodies have their own movements (beside the global one), we may see the macroscopic time of a particular body as a resultant, a mean of all its internal quantum times.

The quantum time and the macroscopic one are considered by the modern physics as a unitary, continuous quantity, of relativistic nature; they both will be called in short *time*. As we have already seen, the local time of a particle or of a more complex material structure is dependent on the absolute speed, its rate of passage being lower close to the speed value **c**; therefore, if that particle travels at this exact speed, the local time becomes infinite - it practically came to a full stop. Inversely, if that particle or all the particles of a system are at absolute rest, their local time reaches the maximum possible rate of passage.

Considering this absolute component of the time, we might introduce a global time, of maximum rate, to use for the entire universe. Even if the granular density is not the same in all regions of space, even if we ignore the massive stars and all the galaxies, this time cannot have a constant rate of passage. Paradoxically, even the rate of time changes over time! And this is due to the variable granular density of the universe - which varied significantly since the Big Bang and which continues to decrease. This phenomenon induces a global relativism to our universe, even in case the fundamental constants we previously postulated (Gravity [3], Chapter 9) are truly *absolute constants*. If granular density varies over time, some other quantities will also change, such the mass of elementary particles and their maximum speed (speed of light) - and this entails variations of the internal parameters for all of our time measurement devices. What can we do to ensure uniformity in our observations directed to distant cosmic objects? As previously proposed, we can agree on a unique rate of time - resulting from a repetitive quantum phenomenon - which could be used for all observations of the cosmic objects,

and then extrapolate the other quantities in accordance with the estimated variation of the granular density.

Two other c*onclusions* (Gravity [3], Chapter 8) have to be mentioned here, as they both are related to time measurement (with atomic clocks and light clocks) in relativistic conditions:

- "... only the quantum processes should be used to measure time; at macroscopic level, time it just a reflection, a sum of the relativistic changes that are happening at atomic level and below."

- "The primary time emerges from the first level of matter, being connected with its granular constants (kinetical and dimensional); it embeds itself in all granular structures (elementary and composite particles, atoms etc.) and their quantum interactions."

## 3. Entropy and time

Why disorder wins in our Universe? Why entropy always tends to increase, is that really a universal law?

First of all, let us take a look at the granular level: space here may be assimilated to a perfect fluid, evenly distributed, whose entropy-like property does not vary on short intervals (ignoring now the volume increase of space).

At quantum level, where lies the structured matter (elementary particles and atoms bound together by different fields), space loses its uniformity and may directly interact with the granular structures. Be a certain region in the proximity of a star, where the gravitational field is significant. In addition to the quantum gravitational fluctuations (described in [3], Chapter 11), that area is continuously crossed by the star's radiations and particles; we may also consider the incomplete photons and the granular remains produced by the annihilation of some particles. In these specific conditions, any material structure would exist there will be subjected to *random transfers of energy*. We may conclude that space itself, over time, could increase the entropy of all quantum structures - no matter how isolated they seem to be.

However, we cannot declare that any transformation of matter from one state to another, as essence or in granular form, has increased the degree of disorder (if this concept can be applied in that place and time) - giving in this way a direction to the *arrow of time*. There were two special moments in the early universe when matter has spontaneously organized itself; first, the simplest granular formations have appeared and, later on, their composite structures. The continuous action of the granular fluxes on the structured matter, over billions of years, had two seemingly opposed effects:

- These fluxes transferred energy to matter, allowing the creation of heavier atoms (maintaining the fusion reaction in the cores of stars).
- They increased the entropy of the complex structures these atoms have built eventually, breaking them and thus giving them the chance to recombine in other forms; this is in fact the natural process behind the very complex, highly organized structures (see the living cells and life in general) - apparently dominated by order.

The space itself, by its own granular energy, have shaped and built complex material things, proving to be very creative over time! We must not forget two important facts, the emergence of a *huge* number of granular structures in the early universe and their *stability* over time, which allowed all this mechanics to work continuously and to generate the great diversity of particles, atoms and molecules. All "bricks" of matter, the Hydrogen and Helium atoms, have clumped together and formed distinct systems - stars and their formations - which continued to concentrate the primordial energies in billions of cosmic laboratories named galaxies. This process may repeat itself: stars are born, burn a relatively long period and then have quite different destines - depending on their mass and composition - for example they could explode (went novas), become red dwarfs, neutron stars or black holes. The matter spread in case of explosions may constitute the fuel for new stars, and the process may be repeated.

Seen at any scale, all material systems are continuously evolving, changing, passing through different states. As specified in my previous work (Prime Theory [1], Chapter 10), their mechanics is always causal and deterministic: **"Clearly, the current state of a system determines in a causal way its future states; this happens at any level, it is the *true nature* of things, which will always set up the direction of the arrow of time".** The perpetual motion of spatial granules - at the constant speed ***C*** - causes the movement of the material structures of any kind, allowing them to move at any absolute speed between values **0** and **c**. Time, as physical quantity that has a variable rate, reflects how all of these structures travel through space and, simultaneously, interact.

## 4. Temporal symmetry

It is well known the symmetry of physical laws under the simultaneous change of the electric charge, parity and time reversal. However, if we consider the above statements regarding the "arrow" of time, it would seem unreasonable for all the laws of physics to be perfectly symmetrical when time changes its sign. The universe, i.e. all forms of structured and unstructured matter, is continuously transforming; if we speak of a closed system and fixed dimensions, we may have a large-scale conservation of *all* quantities related to motion. However, this system is not fixed; space undergoes a continuous expansion process, which automatically imposes an asymmetry to the movement of matter. This thing has caused a few big changes of the granular entropy over time and has led to the emergence of structured matter - which is another significant asymmetry at cosmic scale (see The Universe [2], Chapter 2). The future evolution of normal matter's entropy, which will remain constant or will increase - in accordance with the second **law** of thermodynamics - is just a consequence of the special consistency of matter. In other words, our universe came out of its initial "frozen" state of stability and order at a certain moment (let us use the term Big Bang), and then built a virtually infinite number of small stable "islands" - the elementary particles and their structures. Without going into the details, we may notice that the matter structuring (in a mature and quasi-stable universe), powered by the force of the granular fluxes, still continues as an irreversible process. The dynamics of this process is based on a fundamental asymmetric phenomenon (which is also reflected by the arrow of time): the spatial fluxes have only a *constructive effect*, compressing and condensing the matter. If our closed and causal universe is expanding, and if the intensity of the spatial fluxes is proportional with the granular density, the global constructive effect of these fluxes will decrease continuously over time. *This is where the real source of the arrow of time hides in fact, as fundamental asymmetry; it is the global ratio between the granular material and the structured matter, which in our universe is constantly growing* (this can be seen in the number of black holes and in their increasing mass). If the future will hold a state of equilibrium between the expansion of space and the concentration of matter, it is difficult to say now. With all the current data, a never-ending expansion and an oscillating universe seem to be now two equiprobable speculations...

## 5. Time and relativity

We may notice that the rate at which the local time passes (as quantity depending on the absolute speed - of the local absolute, if there are gravitational fluctuations - and on the local gravitational field intensity) varies from one body to another, even if we take into account averaged values. A precise clock that lies near a certain body does not measure in fact its local time... There are some small differences caused by several phenomena, but mainly by their different positions in the gravitational field. And things are more different for the individual atoms and molecules, as their current time changes with the thermal agitation and with the random directions of their movement. However, we may use a standard clock and assume a constant rate of time for all of macroscopic objects around (with nonrelativistic speeds). Important adjustments should be made only if the gravitational field has significant variations (as in the case of the global positioning system GPS) or in the relativistic speed range. Two important conclusions are formulated in The Universe [2], Chapter 3.2:

**1.** The local time of a body depends on its absolute speed; the rate of passage decreases when it accelerates in regard to the ASR and reaches a relativistic speed, according to the TR formula we may apply in this context.

**2.** The local time also depends on the absolute direction of travel; a regular clock that would be using oscillations on opposite directions will not have significant errors. However, the quantum scale particles will experience bigger time variations with their direction of travel.

The well-known formulas of time dilation are:

$$t_0 = t_f \sqrt{1 - v^2/c^2}$$

$$t_0 = t_f \sqrt{1 - 2GM/rc^2}$$

where

$\mathbf{t_0}$ is the proper time between events A and B for a slow-ticking observer,

$\mathbf{t_f}$ is the coordinate time between events A and B for a fast-ticking observer (at rest or respectively, at a large distance from the massive object),

**G** is the Gravitational constant,

**M** is the mass of the object creating the gravitational field,

**r** is the radial coordinate of the observer,

**c** is the speed of light,

**v** is the velocity.

## 6. The mechanics of time

There should be some special attributes of time, depending on "how much" a body moves, or if its internal state changes significantly. It was previously postulated a *continuous* movement of matter, at any scale, which simply means that the flow of time must have the same characteristic. Therefore, beyond the units of measurement and the actual measurements, we may identify several concepts connected to the time "dynamics":

- *Time intervals* are finite time durations that are measured between two distinct events, or between the physical changes (state, position) of a generic body.
- *Time rate* is the rate at which the local time actually flows, and it may be established in relation to a fixed rate that is measured in another system, considered as reference. This measure of time could be given by a repetitive phenomenon of constant frequency that takes place in both systems. As value, it may be arbitrarily selected (anyway, it is linked with some fundamental constants), but it will tend to zero in systems travelling close to the speed of light.
- *The moment of time* - is an exact position in the time continuum, an infinitely short period at which a certain event does happen. We may also use the term "now" for a specific point in this chain.
- *Time*, regarded as a physical quantity related to our universe, can only exist if there is structured matter and it interacts. This *time*

"passes" because the matter from our universe is dynamic, it moves, transforms and its state changes continuously. If these processes would stop, or if all matter would be destructured to its granular state (condensed in amorphous forms like black holes) in a distant future, then this macroscopic time will no longer have any meaning, it will also come to a stop.

- As time is an "elastic" quantity, it may be compared with a rubber band that extends itself under certain conditions of speed and gravity; however, this band can revert back to its normal form if those special conditions cease to exist.

The granular mechanics describes the perpetual motion of all spatial granules, being centered on the idea that these phenomena conserve the granular kinetic energy; therefore, at higher scales, the spatial fluid will automatically induce other conservation laws to the mechanical quantities. All these laws will have a logical and causal connection with the *time* quantity, which is in fact an image of the elementary kinetic energy. In conclusion, we can say that the properties of time depend on the fundamental constants of motion; moreover, if this mechanical energy would not have existed - as continuous movement of matter through space - we could not talk about the concept of time! The causal link described here is extremely important, it reveals in fact the true nature of time. As the granular movement conserves the total granular energy (the state of motion at granular scale), so the granular time - as indirect source of the quantum time - should conserve its flowing state. Therefore, the absolute macroscopic time *can never be stopped*, and, moreover, *its rate of passage cannot be changed* (it is determined by the fundamental constants). Consequently, the inner relativism of the local time in physical systems is also caused by the granular movement (whose elementary energy is also conserved in bigger structures).

## 7. Time travel

As time is not something reversible, we cannot directly act on it, neither consider it *an independent entity*, apart from the organized matter. The local time of a body in motion at relativistic speed or of a body in a strong

gravitational field slows down in comparison with the absolute time. Let us say that the structured components - all matter and fields throughout the universe - have a certain global state S1 at T1 moment, which includes all of their movement characteristics. As a result of the interactions, at a later moment T2 there will be the global state S2, different from the first one. The distribution of energy (in any form) changed between the two moments, whatever close they might be. However, the total amount of energy did not change, the energy has been *redistributed*. Locally, a certain amount of energy might have been consumed, but this exact quantity was absorbed somewhere else, in another form. The global process that took place between T1 and T2 is irreversible and continuous; the transformations of matter, starting at granular scale, may be neither stopped and nor reversed - they simply happen, and this is a "mechanical given" of our universe.

At the quantum scale, however, there could be atoms having the same state and position between two moments of time; this does not mean that a certain atom could "freeze" time or that it has gone back in time! It surely had some interactions in this period, and the electrons continuously moved inside their orbitals - so its local time has passed in a normal manner. Extrapolating these things, we will reach the same conclusions for the macroscopic realm. A certain body continuously changes the internal state, and its local time may only slow down under some special conditions. At the limit, near the speed of light or in a gravitational field of infinite intensity, time would simply stop - and the whole body would turn into an amorphous granular mass, for which time no longer has any meaning!

As movement is the cause for the flow of time and it is present at any scale, anywhere in the universe, we may conclude that the rate of absolute time (its mean value) cannot change significantly and perceptibly (we are considering here the intrinsic relativism of a closed universe). A certain physical system X may have the same state at two different moments, but time has passed anyway - even if there are no traces - and it also passed for all the other systems around!

*System X cannot "travel" into the past*, for example, because the universe as a whole cannot stop moving, neither make a global "jump" into a previous state.

*System X cannot "travel" into the future either*, as the universe cannot "jump" into a future state without passing through all intermediate states. At fundamental level, all matter has a speed limit and, consequently, *nothing can happen instantaneously*! All events are lining up on a time axis, and they cannot be moved or changed once the "now" moment passed by their current position. Any current event cannot have an effect on the past events, and any kind of influence might exist between certain events - it cannot propagate faster than the speed of light **c** (we have to include here the quantum entanglement, which is in fact a pre-configuration of two different quantum states - spin, polarization - whose future observation will not affect them in any way).

Let us now compare two different systems. System X is at absolute rest, while system Y is moving away at relativistic speed. As the Y's local time flows slower, the events produced in these two systems may be added on two axes that "increase" with different speeds. A certain event "now" may happen simultaneously in those systems, but all of the subsequent events will happen at different time rates. This phenomenon is known as "the twin paradox" (The Universe [2], Annex 2, its traditional variant and my explanation based on the absolute motion), but time having different rates of passage is not exactly the same thing as the time travel. If we are to exploit this phenomenon using some relativistic speed rockets, humans would travel faster this way into the global "future" - passing more slowly through the time continuum. These astronauts would experience a different passage of time, slower than the absolute time rate; all their biological processes would be changed, and they will age less than the other people on Earth.

However, time would not flow differently in two identical galaxies, on identical planets. Even if these galaxies would have a big relative speed, their local absolute - which is imposed by the level of granular fluctuations - should not differ and thus the local time rate will have the same value.

A time machine, or the time travel as a jump into the past or into the future, are just utopian ideas in my opinion, good subjects for the SF movies - which are allowed to elude the laws of physics for "artistic reasons".

## 8. Perception

We are aware that human, a conscious being, have an inner capacity to realize the passage of time - as a result of his biological processes and of the adaptation to the environment. The biological processes help us perceive the external environment through our senses and, consequently, they play an important role in setting their data rates. For example, the sense of sight has the largest informational flow, giving us images from the exterior at the maximum speed of 10..20 frames per second; our brain can easily process this string of data in real time, analyzing and comparing them with stored images and patterns. Therefore, there is a speed limitation of perception right inside our eyes (the sensors in retina), and some faster events could be lost from sight (or they are not consciously perceived). However, the human adaptation to the environment and various conditions is almost perfect; we depend entirely on the major changes in nature, we have a circadian rhythm, a lunar one, the seasons etc. As intelligent beings we fully perceive and understand the changes caused by the passage of time in all living organisms. "Now" is deeply embedded in our conscience, and we almost perfectly realize the passage of time as a continuous line of moments in a sequence: past - present - future. All of the biological processes, as results of the laws of physics and chemistry, have a specific pace (of relatively constant value) that can even dictate the speed of our thoughts. But there are other physical limitations to consider, such as the speed of the electrical impulses through neurons and the complexity of their connections.

Therefore, all people have a nearly identical perception on the rate at which time passes. There are some variations of subjective nature, which mainly depend on our current activity, on our mental condition and on the social pace of life. The technology advancements play an important role as well; also the human age may alter or enhance the accuracy of time *perception*. On the other hand, the changes people are facing continuously lead to a clear mental representation of the *arrow* of time. Moreover, as we all realize the finite duration of our existence, time gets the highest possible value for each of us. In conclusion, due to the human power to perceive and understand the most complex things, the illusion of time (as Einstein formulated) may be turned into a major factor of social and personal progress.

## 9. References

**[1]** Laurentiu Mihaescu, 2014. *Prime Theory*, Premius Publishing House

**[2]** Laurentiu Mihaescu, 2015. *The Universe*, Premius Publishing House

**[3]** Laurentiu Mihaescu, 2018. G*ravity*, Premius Publishing House

## Acronyms and conventions

**AFR** - Absolute Frame of Reference

**FR** - Frame of Reference

**SR** - System of Reference

**TR** - Theory of Relativity

**GTR** - General Theory of Relativity

**TA** - Theory of the Absolute

**PT** - Prime Theory

**"Abc"** - Figurative language

**Big Bang** - A theory on the Universe's birth