Time and relativity

- The mystery of time, explanation and conclusion -

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This article is a short analysis of the methods used to measure time, of the principles of physics involved in this and of the various equipments specially designed for this purpose. It will also highlight the behavior of these devices while moving at relativistic speed in inertial FRs.

What is the basis of time measurement?

Normally, a periodical phenomenon is required to this end, a cyclic event that repeats at a constant interval; this period should be adjustable, a fine tuning being required to compensate for the action of various environmental factors. As each period T passes, a certain impulse (may be of mechanical, electrical or optical nature) is sent to a special "counting" device, which will turn it into a human-readable format, into a numerical value. Most of these time measuring devices (clocks) feature some restart or synchronisation mechanisms; they allow a clock to start at certain moments or to show the same time as another, distant clock.

Note: Although the term "relativistic mass" is no longer used by the current physics, the variation of a mass-like physical quantity [9] with speed still is certain.

1. The hourglass

This device can operate with either water or sand, and the measured time interval begins on the inverting moment - when the upper bulb is full - and stops once it is empty. This interval is proportional, in principle, to the volume of the flowing "fluid" and inversely proportional to the neck width (there are more parameters):

$$T \sim V / D^n$$

Remark 1: We may presume that the weight of the fluid increases if the hourglass moves at relativistic speeds (while being in a uniform gravitational field); however, this clock will not be able to reflect the time dilation stated by TR.

Remark 2: Similarly, it will not be able to reveal any gravitational time dilation (GTR).

2. The gravity pendulum

This is probably the first mechanical device used to measure the time. Obviously, it was not a very accurate timekeeper and, even worse, it is affected by the global movement. In brief, the potential energy of a certain weight is periodically transformed into kinetic energy and vice versa, and the whole process takes a certain amount of time, for example one second. Its period of oscillation does not depend on mass:

$$T \sim 2\pi \sqrt{(L/g)}$$

Remark 1: This clock will indicate the time passing at constant rate, regardless of the relativistic speed the whole device might have (in a uniform gravitational field), and therefore it cannot show the relativistic dilation of time (TR).
Remark 2: As the gravitational acceleration gets higher, the period of this clock becomes smaller, and this behavior does not comply with the predictions of GTR.

3. The mechanical watch

Its central system is an assembly consisting of a balance spring and a balance wheel. Such a mechanism oscillates at a certain resonant frequency, and that period is:

$$T \sim 2\pi \sqrt{(I/k)}$$

where **I** is the moment of inertia of the balance wheel, directly dependent on its mass.

Remark 1: Although the period depends on mass, the dependency is not linear and therefore the displayed time cannot be accurate in case of relativistic speeds.
Remark 2: Its period does not depend on gravitational acceleration, so it is not consistent with TRG.

4. The electronic clock

In spite of the *electronic* part in its name, this type of clock is based on the mechanical oscillation produced by a quartz crystal. This oscillator has the period:

$$T \sim 2\pi\, l^2/a \sqrt{(12\, \rho / E)}$$

a formula where ρ is the density of the material, whose value depends on mass. The remarks are thus identical to those of the above-mentioned case (3).

5. The atomic clock

This type of clock uses as reference the electron transition frequency from certain atoms (Hydrogen, Caesium, Rubidium), which may be in the microwave, optical or UV region of the electromagnetic spectrum. SI has defined the second as the duration of 9,192,631,770 oscillations produced of the caesium-133 element, which thus becomes the standard in time measurement. But a frequency standard can also be obtained from the atom of hydrogen (the 21 cm line, given by the spin of the electron), about 1420 Ghz, using masers.

Anyway, the formula for this frequency is (Rydberg):

$$f = \pi^2 m_0 e^4/h^3 (1/n^2 - 1/m^2)$$

It may be easily seen that the period is inversely proportional to the rest mass of the electron; if we were to speculate, a relativistic increase of this mass would lead to a "contracted" time (assuming that the other physical quantities involved remain constant).

Remark 1: All caesium-based clocks that were used in kinetic tests have shown correct deviations, almost identical with those resulting from TR. We may come now to a conclusion regarding the quantum phenomena that occur at global relativistic speeds: they are influencing the transitions of the orbiting electrons in more complex ways, and many other physical quantities are also varying.

Remark 2: This formula does not depend on the gravitational acceleration; however, the emitted photons will exhibit a gravitational redshift. Therefore, this atomic clock may measure the time in accordance with the GTR calculations.

6. The light clock

Under TR conditions, a clock based on a light pulse that reflects on a mirror and then comes back on the same path might show the passage of time in a certain inertial FR - as the speed of light is constant (this is a common example). If this frame is considered fixed, we may measure the value of that period of time, for example **Δt**. If the same light clock is put in a mobile frame (speed **v**), it should measure a larger time interval, **Δt'**, as the light rays have to travel a greater distance until they reach the mirror and back (the well-known formula of time dilation).

This way to see these things is wrong, as it was previously stated in [2], and a correct view has to be based on the new definition of space, of elementary particles and of the absolute nature of motion. Therefore, under TA conditions [2], we consider an AFR called A (Figure 1) and an inertial frame B that moves with the absolute velocity **v** along the OX axis. The light rays are represented by blue arrows, vectors symbolizing the relative velocity of the light in regard to the O points.

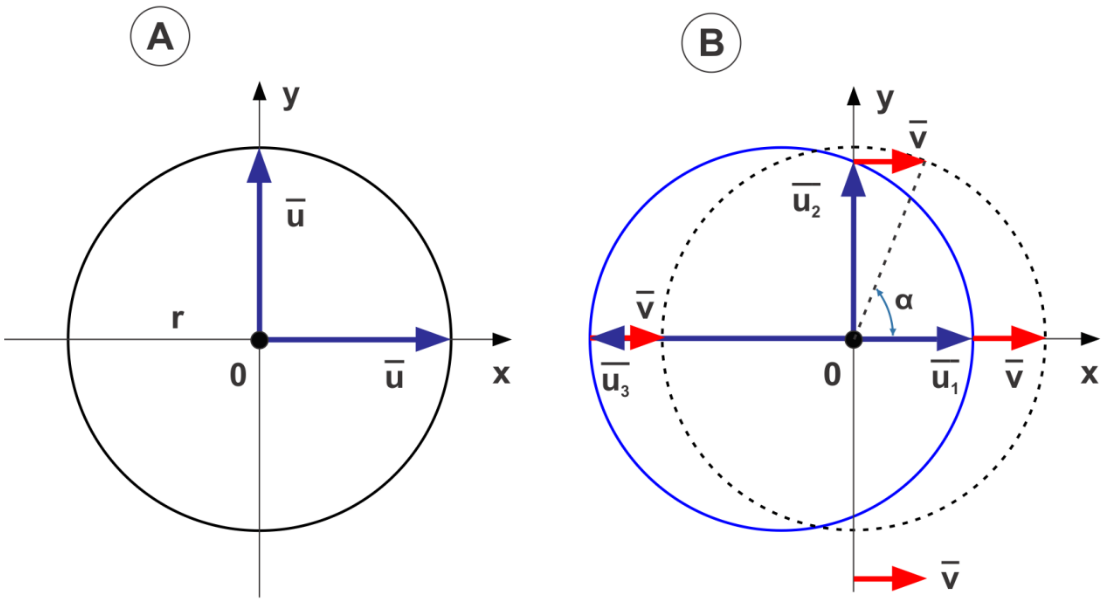

Figure 1 - *Inertial frames of reference*

We may easily write the formulas for all relative speeds in both frames of reference:

$$\mathbf{u = c}$$

$$\mathbf{u_1 = c - v}$$

$$\mathbf{u_2 = \surd\ (c^2 - v^2)}$$

$$\mathbf{u_3 = c + v}$$

If **α** would be the angle of the light pulses (relative to the OX axis), the general formula is:

$$\mathbf{u = \surd\ (c^2 - 2\ c\ v\ \cos \alpha + v^2)}$$

Even if we would use both directions of the ray (reflected by a mirror), the time indicated by this device (of radius **r**) would have a significant dependence of the angle **α**. We may write:

On OX and OY: $\mathbf{\Delta t = 2\ r / c}$

On OX: $\mathbf{\Delta t' = 2\ r / (c - v)}$

On OY: $\mathbf{\Delta t' = 2\ r / \surd\ (c^2 - v^2)}$

Taking into consideration only the OY axis, we will find the classic formula of time dilation:

$$\mathbf{\Delta t' = \Delta t / \surd\ (1 - v^2 / c^2)}$$

Remark 1: This clock (operating in vacuum) can measure the time in accordance with the TR.

Remark 2: It can measure the time in accordance with GTR, if using the Doppler Effect.

7. Conclusion

A general conclusion may be drawn at this point: the time cannot be accurately measured at macroscopic level - as its flowing rate is set at a different scale, namely at quantum level (it was explained in the *Mass-energy equivalence* article [9], starting from the genesis of granular time). Therefore, only the quantum processes should be used to measure time; at macroscopic level, time is just a reflection, a sum of the relativistic changes that are happening at atomic level and below. The clocks of type 1..4 do not actually measure the real time, they use some physical characteristics of the macroscopic objects to obtain different delays or oscillations that are not directly linked with the "source" of time.

The primary time emerges from the first level of matter, being connected with the granular kinetical and dimensional constants, and embeds itself in any elementary structure (particle or field) that acts and moves at quantum level and beyond.

8. References

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

[2] Laurentiu Mihaescu, 2016. *The Universe*, Premius Publishing House

[3] Laurentiu Mihaescu, 2016. *The theory of granular gravitation*, article

[4] Application "*Particle Simulation*", Microsys Com, 2015,

http://www.1theory.com/software.htm

[5] Laurentiu Mihaescu, 2016, *The First Bangs*, article

[6] Application "*Elementary Particles*", Microsys Com, 2017

http://www.1theory.com/software.htm#2

[7] Laurentiu Mihaescu, 2017, *The formation of elementary particles*, article

[8] Laurentiu Mihaescu, 2017, *The shape of elementary particles*, article

[9] Laurentiu Mihaescu, 2017, *Mass-energy equivalence*, article

9. Acronyms and conventions

AFR - Absolute Frame of Reference

FR - Frame of Reference

TR - Theory of Relativity

GTR - General Theory of Relativity

TA - Theory of the Absolute

PT - Prime Theory

"Abc" - Figurative language