Relativity ρ

Energy Link of the Universe

Beyond Einstein's geometry

Based on a peer-reviewed article

$$\frac{t_A}{t_B} = \sqrt{\frac{C^2 - {V_A}^2}{C^2 - {V_B}^2} \; \frac{\rho_B}{\rho_A}}$$

"I regret that we didn't meet 10 or 15 years ago,

we could have changed the world together. Hang in there

and continue your research."

— Miroslav Sukenik

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Preface

Throughout the history of science, every decisive advance has been born from the courage to question established foundations. The classical theory of relativity, conceived by Einstein, was one of those moments of rupture, replacing absolute space with a dynamic geometry of spacetime. However, more than a century later, it becomes evident that the elegance of the model rests on abstractions that do not translate the real energy density of the universe.

It is in this context that ρ Relativity emerges, proposed by José Luís Pereira Rebelo Fernandes. This new paradigm is not limited to adjusting equations or introducing marginal corrections: it shifts the axis of scientific understanding, returning to matter and energy the leading role as the fundamental variables. The quantity ρ, understood as the density of universal potential energy, ceases to be an auxiliary parameter and becomes the key that structures time, gravity, and the properties of the vacuum.

The reader will find in this work not only a technical formulation, but an epistemological vision that rejects geometric abstractionism and assumes the universe as a coherent energy system. In doing so, ρ-Relativity offers answers to observational phenomena that have remained enigmatic—such as the Moon's recession from the Earth—and provides tools for determining the age of the universe based on measurable quantities.

This preface is, therefore, an invitation: to explore a science that is more transparent, more comprehensive, and more faithful to physical reality. A science that integrates theory and experience into a coherent synthesis, paving the way for new interpretations and universal applications.

Prologue

Everything has a beginning, and this is the beginning of my dedication to understanding relativity and its physical foundations.

In physics, such a beginning is rarely an answer; it is almost always a persistent difficulty in accepting an explanation that, although elegant, does not appear to be physically complete.

From time contraction to the increase in rotational velocity and temperature of celestialbodies, many phenomena have been described with great success by relativity theory. Even so, for many years I sought to fully understand the conceptual method that led Einstein to introduce spatial contraction in the direction of motion.

I have often tried to recall when I first became interested in relativity and when everything began to make sense to me. I remember acquiring, on May 26, 1983, a book written by Albert Einstein and Leopold Infeld entitled *The Evolution of Physics: From Newton to Quantum Theory*. From reading that work arose my personal commitment to properly study the subject, although conceptual difficulties remained that I was never able to ignore.

At the time, I was beginning my professional activity in civil engineering, and my duty was to pursue continuity and success in my career. Nevertheless, I never ceased to carry a very clear image in my mind: walking down Rua dos Bragas, in Porto, where the Faculty of Engineering was located, and wishing to understand relativity theory more deeply—an aspiration that later led me to acquire the aforementioned book.

Later, in 2005, after visiting the exhibition commemorating one hundred years of relativity theory, at the suggestion of my daughter, in Coimbra, I decided to devote part of my time to the systematic analysis of the principles of Einstein's relativity.

It was within this context that, upon learning that the Moon was systematically receding from the Earth, a simple yet persistent idea arose—one that would ultimately lead to the development presented in this book.

Beyond Geometry

Classical relativity theory was revolutionary in replacing absolute space with a curved space–time. However, it remains grounded in abstractions that do not reflect the real energetic density of the universe. Relativity ρ emerges to address this limitation by placing matter and energy at the center of physical description.

Within this new paradigm, the quantity ρ measures the universal density of potential energy, which structures time and determines the Universal Gravitic Variable. Geometry ceases to be the point of departure; instead, we adopt measurable physical quantities capable of explaining local phenomena and cosmological dynamics without resorting to hypothetical concepts such as “dark matter” or “dark energy.”

Fundamental Principles

- Time: varies inversely with the square root of the universal density of potential energy at a given location or traversed by a reference frame.
- The Universal Gravitic Variable (UGV): arises directly from the density of potential energy, reflecting its variations across all scales.
- Variable permeability of the vacuum: varies inversely with the universal density of potential energy, reflecting the expansion of the cosmos.

These relations make it possible to explain observational phenomena such as the apparent value of the Moon’s recession from the Earth and the apparent accelerated expansion of the universe, while also providing precise tools for determining the age of the universe.

Relativity ρ thus proposes a clearer and more comprehensive science, capable of uniting theory and observation into a coherent synthesis, opening the way to new interpretations and universal applications.

1 – The Relativity of Time with the Universal Density of Potential Energy

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In this chapter, the relativity of time in different stationary reference frames is analysed, starting from the expressions currently used in satellite navigation systems. The analysis of these expressions makes it possible to reinterpret time dilation not as a direct effect of local gravity, but as a consequence of an energetic differential between reference frames.

1.1- Stationary Reference Frames and the Classical Formulation

Let us consider the expression currently used to assist in the calculation of time in satellites. The expression based on the Schwarzschild metric, which according to the prevailing view corrects satellite time as a function of terrestrial gravity, began to be applied practically from the very beginning of the GPS system, that is, in the 1970s, with the first tests and theoretical validations.

However, its full operational adoption occurred with the launch of the GPS NAVSTAR system, developed by the United States Department of Defense from 1978 onward, and consolidated throughout the 1980s and 1990s.

The metric formulated by Karl Schwarzschild in 1916 was the first exact solution of Einstein's field equations. It describes the external gravitational field of a spherical, non-rotating body—such as the Earth, to a first approximation—and is used to calculate the gravitational time dilation affecting satellite clocks relative to those on the Earth's surface.

From the analysis of Einstein's relativity, derived from the Schwarzschild metric, the change in time between a reference frame A, located on the surface of the mass generating the gravitational field of mass M (in our case, the Earth), and another reference frame B, located at the limit of the gravitational field, is given by:

- G – Universal gravitational constant
- M – Mass of the Earth
- R – Radius of the Earth
- C – Speed of light
- t(A) – Time in reference frame A (Earth's surface)
- t(B) – Time in reference frame B (point located at the limit of the gravitational field generated by M)

$$\frac{t_A}{t_B} = \sqrt{1 - \frac{2GM}{RC^2}}$$

We adopt this expression because it leads to values consistent with observed reality. However, it is important to emphasise that nothing in it indicates a direct dependence on terrestrial gravity itself, but only on an energetic differential between two stationary reference frames. Since this expression accurately reflects the values found in satellites, it most likely hides the universal solution, so let's take a closer look.

Given by:

$$\frac{t_A}{t_B} = \sqrt{1 - \frac{2GM}{RC^2}}$$

That is:

$$\frac{t_A}{t_B} = \sqrt{\frac{C^2 - \frac{2GM}{R}}{C^2}}$$

or equivalently:

$$\frac{t_A}{t_B} = \sqrt{\frac{\frac{C^2}{2G} - \frac{M}{R}}{\frac{C^2}{2G}}}$$

On the Earth's surface we have a higher energy density, $\frac{C^2}{2G}$. At the boundary of its field we have a lower density. Time slows down where the density is higher and speeds up where it is lower, $\frac{C^2}{2G} - \frac{M}{R}$.

If you look to calculate the density at the boundary of the Earth's field, we remove the influence of the Earth's mass $\frac{M}{R}$, which means that $\frac{C^2}{2G}$ can only be the influence of all universal-masses, including the Earth itself.

The relativity of time ceases to be a geometric effect. It becomes an energetic Effect

1.2- Definition of the Local Density of Potential Energy

The term potential energy density at a location does not correspond to a volumetric density in the classical sense, but to a linear structural density, expressed by the ratio $\frac{M}{R}$, resulting from a spherical surface distribution, which characterizes the contribution of each mass to the energy state of space.

The potential energy density that a celestial body generates on its surface is given by the ratio of its mass M to its radius R. This ratio characterizes the intensity of the contribution of this body to the energy state of space on its surface.

We can designate this quantity as a local density of potential energy, defined by:

$$\rho_l = \frac{M}{R}$$

$$\rho_l = \frac{MC^2}{C^2R} = \frac{E}{C^2R}$$

The escape potential—that is, the minimum velocity required for a particle to leave the gravitational field of a body—is classically expressed as:

$$V_f^{\,2} = 2G\frac{M}{R}$$

Substituting the previous expression, we obtain:

$$V_f^{\,2} = 2G\,\rho_l$$

This relation reveals that the escape velocity is directly determined by the local density of potential energy.

1.3 – The Universal Escape Potential. The Universal density of potential energy at local.

If we consider the limiting regime in which matter is no longer confined by any gravitational field—a regime corresponding to the manifestation of radiation—it becomes necessary to admit the existence of a universal value of the density of potential energy.

This value defines the universal escape potential of matter, that is, the energetic threshold beyond which radiation propagates freely throughout the universe. We designate this quantity as the universal density of potential energy, ρu\rho_uρu, and write:

Being:

M_u – Quantity of universal mass intervening at the location

R_u – Average radius of the universal mass

$$C^2 = 2G\frac{M_u}{R_u}$$

$$\rho_u = \frac{M_u}{R_u}$$

In this formulation, the constant C acquires a deeper physical meaning. It ceases to be merely a kinematic constant and becomes a fundamental energetic parameter associated with the transition between material confinement and radiative freedom:

$$C^2 = 2G\,\rho_u$$

In this formulation, the constant C acquires a deeper physical meaning. It ceases to be merely a kinematic constant and comes to represent a fundamental energy parameter, associated with the transition between material confinement and the freedom of radiation:

$$\rho_u = \frac{C^2}{2G}$$

Where ρ_u represents the universal density of potential energy at the Earth's surface.

The quantity ρ_u should be called the universal potential energy density, since it represents the global structural energy density of the universe, from which all local dynamical effects emerge.

$$\rho_u = \frac{C^2}{2G}$$

Unidade: kg/m (linear).

$$G = \frac{C^2}{2\,\rho_u}$$

Physical interpretation: ρu is not the local volumetric energy density, but the universal structural potential that defines the maximum limit within which normal matter can exist.

When local energy exceeds this potential, normal matter transforms into radiation (light), that is, light is the maximum manifestation of matter under ρu.

This density is universal and primary, as it structures time, the propagation of light, and all emergent energy processes in the universe.

Interestingly, we can define the potential for local leakage as:

$$V_f{}^2 = 2G\frac{M}{R}$$

$$V_f{}^2 = 2\frac{C^2}{2\,\rho_u}\;\rho_l$$

$$V_f{}^2 = \frac{\rho_l}{\rho_u}C^2$$

The local gravitational potential is a perturbation in the universal gravitational potential.

When $\rho_l \rightarrow \rho_u$, the system reaches the limiting regime in which the escape velocity coincides with the speed of light, characterizing the transition to radiative behavior.

1.4 - Reinterpretation of Time Dilation

Reintroducing this definition into the relativistic expression for time, we obtain:

$$\frac{t_A}{t_B} = \sqrt{\frac{\rho_u - \frac{M}{R}}{\rho_u}}$$

Considering the Earth as reference frame A, since it is in this frame that the value of ρu is known, we generally have:

$$\rho_A = \rho_U$$

Thus:

$$\frac{t_A}{t_B} = \sqrt{\frac{\rho_A - \frac{M}{R}}{\rho_A}}$$

The term $(\rho_A - \frac{M}{R})$ corresponde simplesmente a remover a influência da massa M de ρA, ou seja, a calcular a densidade universal de energia potencial no limite do campo gerado pela massa M, que denotamos como ρB:

$$\rho_B = \rho_A - \frac{M}{R}$$

It is only possible to remove the potential energy density generated by the Earth and still have energy density if ρ_A is generated by the entire universe.

Thus:

$$\frac{t_A}{t_B} = \sqrt{\frac{\rho_B}{\rho_A}}$$

1.5- Fundamental Consequence

Time in each stationary reference frame is therefore inversely proportional to the square root of the local universal density of potential energy.

This implies that we live immersed in a universal energetic medium, characterised by a density of potential energy ρu\rho_uρu that is not constant throughout space. Variations of this density from place to place directly determine the local rhythm of time.

If the universal density of potential energy were constant, as implicitly assumed since Einstein, then time would be the same in all stationary reference frames—something that contradicts the empirical evidence observed in satellite systems.

Here a new paradigm emerges: Relativity ρ, in which the relativity of time results from the spatial variability of the universal density of potential energy.

1.6- Time at Different Points Within the Gravitational Field

Up to this point, we have analysed the relativity of time between the surface of a massive body and the limit of its gravitational field. However, time dilation is not a discrete phenomenon, but rather a continuous one. Time varies gradually as we move within the gravitational field.

We may imagine this field as an invisible energetic sphere surrounding the Earth. As we move away from its centre, the density of potential energy surrounding us decreases, and with it the local rate of time changes.

Let us consider:

Reference frame A, on the Earth's surface, at a distance R from the centre of the Earth.

Reference frame D, farther away, at a distance D from the centre of the Earth.

The universal density of potential energy at D will differ from that at A. To calculate this difference, we subtract the influence of the mass at the surface and add the influence of the same mass at a greater distance (D):

$$\rho_{UD} = \rho_{UA} \; \frac{M}{R} + \frac{M}{D}$$

$$\frac{t_A}{t_D} = \sqrt{\frac{\rho_{UA} - \frac{M}{R} + \frac{M}{D}}{\rho_{UA}}}$$

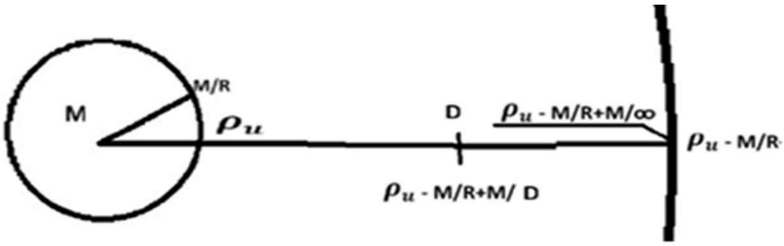

Figure 1 – Earth's gravitational field

$$\frac{t_A}{t_D} = \sqrt{\frac{\rho_{UD}}{\rho_{UA}}}$$

Time in each reference frame is therefore inversely proportional to the square root of the universal density of potential energy at each location.

1.7 - The Density Is Not Constant — and That Changes Everything

As we have seen, the universal density of potential energy, ρ_U, is not constant everywhere; if it were, time in all stationary reference frames would be the same.

Since Einstein, the universal density of potential energy has implicitly been considered constant. If that were the case, time measured on satellites would be the same as that measured on Earth.

$$\rho_{UA} \neq \rho_{UC} \neq \rho_{UB}$$

1.8 - Fundamental Result

Time in each stationary reference frame is therefore inversely proportional to the square root of the local universal density of potential energy.