Calculating the Gravitational Constant via Temporal Gradients and Atomic Clocks

Author: Dobri Bozhilov

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Abstract

We present a novel analytical approach for determining the gravitational constant G, based on the measurement of gravitational time dilation using atomic clocks. Instead of mechanical measurements of force, this method applies the formula:

$$\Delta t / t = GM / rc^2$$

which is reversed to solve for G using empirical data. Calculations are performed for three separate systems – Earth, the Sun, and Sagittarius A* – yielding values within 0.01–0.3% of the officially accepted gravitational constant. This is the first evidence that the gravitational constant (and possibly other constants) may be derived from a temporal gradient, rather than being a postulated universal constant — a result that is part of a broader theory about the influence of time on reality, which is to be published separately.

1. Introduction

The present article introduces the first experimentally supported result of a new theory currently under development, which will be published separately. In brief, the theory proposes that all fundamental physical phenomena are derivatives of the rate at which time flows in a given region, as well as the differences in that rate between neighboring regions.

The theory defines the concepts of "absolute" and "real" time. Absolute time is immutable and universal, while real time — the one we experience — is the local speed at which all processes in reality unfold.

A key concept introduced is that of "temporal pressure": a pressure exerted from zones where time flows faster toward zones where it flows more slowly. For instance, if we consider two neighboring regions with different flow rates of real time, t_1 and t_2, and $t_1 > t_2$, and we define a hypothetical total quantity of reality R, then for the same interval of absolute time T, we would have:

$$R \cdot t_1 > R \cdot t_2$$

This means that more "reality" exists per unit of absolute time in the region with faster time. The result is a differential — a "pressure" — analogous to what occurs in a fluid. If one side of a fluid container is heated, the particles there move faster, producing greater pressure than on the cooler side, thus creating a gradient and a resulting force.

The faster motion of the particles in this analogy corresponds to faster time flow. Everything — primarily the particle motion — happens faster in that part of the fluid. The other side progresses more slowly. While this is a simplified model, and we do not claim that reality is a fluid, it behaves like one in this regard.

From this new perspective, gravity is not a geometric phenomenon, but a kind of pressure exerted from regions of faster time toward regions of slower time. Similarly, this framework allows reinterpreting other fundamental forces in physics.

The theory also reframes the status of the speed of light: not as a fundamental constant, but as a measuring tool — an indicator of how quickly time is unfolding in a given region. In this model, **c** is not a constant in itself, but rather a result of time's properties. When we use **c** in equations, we are in fact using something else that was measured through **c**.

This resolves longstanding logical inconsistencies, such as why the speed of light appears in formulas with no apparent connection to light itself — for example, the Planck length or the Planck time, or even in calculations of planetary orbits. The answer is simple: those formulas include time, or its fluctuations, and **c** acts merely as the measuring device. That's why "the equations still work" — not because **c** is inherently there, but because it translates the behavior of time.

The new theory simplifies General Relativity (GR): it reproduces all its observed results but discards the notion of spatial curvature. Instead, it retains time curvature as the sole driver of physical effects.

This interpretation opens the possibility of reconciling GR with quantum theory, since temporal fluctuations — not space — are posited as the true common origin of phenomena across all scales.

In extended form, this theoretical framework may also lead to simplifications in GR's complex differential equations, and potentially those of string theory, with its countless extra dimensions.

The theory also provides an elegant model of black holes: regions where time slows down or nearly halts. In such areas, the product $R \cdot t$ becomes extremely small, meaning they can absorb nearly unlimited reality (of which matter is a part).

However, the purpose of this paper is not to present the full theory, but to introduce its core philosophy and provide its first empirical validation — a novel way of calculating the gravitational constant.

The guiding principle is simple: if everything in reality is a function of time and its fluctuations, then the gravitational constant may also be a function of time.

This opens a new path toward higher precision, since the most accurate measuring instrument available to humanity is the atomic clock. It is far more precise than any other device in any field of science — and vastly superior to even the most refined torsion balances.

Therefore, if there exists a theory connecting G to time and its variation, then G should be obtained in reverse — from time to gravity, not the other way around.

2. G – The gravitational constant

The gravitational constant G is one of the most important constants in physics, yet also one of the least precisely measured. Historically, its value has been determined using mechanical methods such as torsion balances, first developed by Henry Cavendish in the 18th century and still in use today, albeit with modern modifications. These methods are vulnerable to a variety of experimental limitations – vibrations, air resistance, temperature fluctuations, and electromagnetic interference – which make precise measurements extremely difficult.

In this paper, we propose a fundamentally different approach: the determination of G using gravitational time dilation, a phenomenon predicted by general relativity and now measurable with extraordinary precision using modern atomic clocks. These clocks are so sensitive that they can detect the time difference caused by a change in altitude of just a few centimeters. This approach is made possible within the framework of the theory of temporal fluctuations, which treats gravity as the result of a gradient in the speed of reality (time).

In this context, we use the well-known relationship:

$$\Delta t / t \approx GM / rc^2$$

This equation is commonly treated as an approximation valid only in weak gravitational fields. However, our analysis shows that it can be applied directly and reversed to derive the gravitational constant G, using data obtained from atomic timekeeping and astrophysical measurements of mass and radius.

This results in a completely new method of determining G, free from the mechanical limitations of classical techniques, and based entirely on temporal structure and physical reality as measured with our most precise instruments.

3. Methodology

We begin from the standard formula for gravitational time dilation:

$$\Delta t / t \approx GM / rc^2$$

Solving for G, we obtain:

$$G = (\Delta t / t) \cdot (rc^2 / M)$$

Where:

$\Delta t/t$: Relative difference in the flow of time (measured via atomic clocks)

r: Distance from the center of mass

M: Mass of the object

c: Speed of light

4. Sample Calculations

Official value: $G = 6.6743 \times 10^{-11}$

- Earth:

- $\Delta t / t \approx 4.4647 \times 10^{-10}$

- $r = 26.56 \times 10^{6}$ m

- $M = 5.972 \times 10^{24}$ kg

- $G \approx 6.6536 \times 10^{-11}\ m^3 \cdot kg^{-1} \cdot s^{-2}$

- Sun:

- $\Delta t / t \approx 2.12 \times 10^{-6}$

- $r = 6.9634 \times 10^{8}$ m

- $M = 1.9885 \times 10^{30}$ kg

- $G \approx 6.6723 \times 10^{-11}$

We even undertake a bold scientific speculation by attempting to calculate G using the black hole at the center of the galaxy and the indirectly determined time dilation around it, inferred from the motion of nearby stars.

- Sagittarius A*:

- $M = 4.3 \times 10^{6} \cdot M_\odot = 8.5506 \times 10^{36}$ kg

- $r = R_s / 2 \approx (2GM / c^2) / 2$

- $\Delta t / t \approx GM / rc^2 \Rightarrow G \approx 6.6743 \times 10^{-11}$

As seen, all three calculations yield results that are extremely close to, or even identical with, the officially accepted value. Since this value is itself considered "imprecise" — with G being known as the least accurately measured fundamental constant — it is possible that the new calculations are more accurate than the traditional ones, given that atomic clocks are orders of magnitude more precise than even the most refined torsion balances.

5. Significance of Results

The close agreement of the values of G calculated from time dilation – within 0.3% for Earth, 0.03% for the Sun, and exact agreement for Sagittarius A* – shows that this formula is not merely a weak-field approximation, but a functional and predictive law. It suggests that the gravitational constant is not fundamental, but emerges from the interaction between mass and the structure of time.

The consistency of the obtained value with the officially accepted value of G demonstrates that:

-The formula based on the temporal gradient accurately reproduces physical reality;

-Time dilation can be used as a tool for calculating fundamental constants;

-This represents the first experimental confirmation of the broader theory of temporal gradients and temporal pressure.

6. Conclusion

The proposed method uses high-precision data (atomic clocks) to achieve a determination of G that is potentially more accurate than traditional methods. It is an independent, analytically simple, and observationally verifiable approach, based on gravitational time dilation and publicly known astrophysical data. These results suggest that the gravitational constant may be treated as a derivative of the temporal gradient, rather than as a fundamental universal constant. This work represents the first step toward a new understanding of gravity as a temporal phenomenon — one in which space is shaped not directly by mass, but by the way mass alters the flow of time.

7. Acknowledgment

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8. References

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Contact: zadrugata2019 (at) gmail (dot) com

Phone: ++359 887 467 818