Time, Spacetime Expansion, and the Question of Infinity within Pawan Upadhyay's Pressure–Curvature Law of Gravity (PPC Gravity)

Author: Pawan Upadhyay
Affiliation: Independent Researcher
Email: pawanupadhyay28@hotmail.com
Framework: Pawan Upadhyay's Pressure–Curvature Law of Gravity (PPC Law)

Abstract

The nature of time, spacetime expansion, and the possible infiniteness of the universe remain central open questions in fundamental physics. In this paper, these issues are examined within Pawan Upadhyay's Pressure–Curvature Law of Gravity (PPC Law), where gravity is interpreted as a pressure-driven phenomenon arising from mass–energy density. Extreme gravitational pressure near compact objects leads to strong time dilation, while weak-pressure regions correspond to nearly flat spacetime. The unification of space and time as spacetime is emphasized, and the implications of spacetime expansion for cosmic structure and possible multiverse scenarios are discussed. The paper carefully distinguishes experimentally established results from theoretical interpretations and hypotheses, providing a pressure-based perspective on time, infinity, and cosmic evolution.

1. Introduction

Modern physics has revealed that space and time are not independent entities but components of a single geometric structure known as spacetime. General Relativity successfully describes how spacetime curvature governs motion and time dilation, yet it leaves open fundamental interpretive questions concerning the origin of curvature, the ultimate nature of time, and the global structure of the universe.

The Pressure–Curvature Law of Gravity (PPC Law) proposes that gravitational pressure generated by mass–energy density is the physical cause of spacetime curvature. This paper applies the PPC framework to examine time dilation, spacetime expansion, and the question of whether the universe—or a multiverse—may be infinite.

2. Time and Gravitational Pressure

Mass density ρ corresponds to energy density:

$$E_d = \rho c^2$$

Gravitational pressure is defined as:

$$P_g = wE_d$$

where w characterizes the physical regime of matter–energy.

Time dilation is interpreted as a **pressure-dependent phenomenon**:

- Higher gravitational pressure → stronger curvature → slower passage of time
- Lower gravitational pressure → weaker curvature → faster passage of time

This interpretation reproduces all experimentally verified gravitational time dilation effects without modifying Einstein's equations.

3. Extreme Time Dilation Near Black Holes

Near compact objects such as black holes, gravitational pressure becomes extremely large. For distant observers, clocks near the event horizon appear to slow dramatically, approaching zero rate asymptotically.

Within PPC gravity:

- This extreme time dilation is a consequence of maximum gravitational pressure and curvature.

- Time does not become infinite in an absolute sense; rather, time dilation becomes arbitrarily large relative to distant reference frames.

Thus, black holes represent regions of extreme pressure-controlled time distortion, not a literal halt of time for all observers.

4. Unity of Space and Time

Special and General Relativity establish that space and time form a unified four-dimensional spacetime. PPC gravity fully adopts this principle.

In the PPC interpretation:

- Pressure acts on spacetime as a whole.
- Changes in spatial curvature are inseparably linked to changes in temporal rates.
- Space and time cannot be treated as independent physical entities.

This unity implies that any discussion of cosmic expansion or time evolution must be framed in terms of spacetime dynamics rather than space or time alone.

5. Spacetime Expansion and Pressure Gradients

Observations indicate that spacetime is expanding on cosmological scales. In PPC gravity, this expansion can be interpreted as the large-scale evolution of gravitational pressure and curvature.

- High-pressure regions dominate early cosmic evolution.
- As pressure redistributes, curvature weakens locally.
- Weak-pressure regions approach near-flat spacetime.

Expansion, therefore, reflects the global dynamics of pressure and curvature, not merely geometric stretching.

6. Universe, Infinity, and Physical Limits

The question of whether the universe is finite or infinite remains unresolved in modern cosmology.

Within PPC gravity:

- Expansion does not imply infinity.
- Weak curvature does not guarantee infinite extent.
- Observational data constrain local geometry but not global topology.

Thus, claims of an infinite universe cannot be established solely from time dilation, black holes, or cosmic expansion.

7. Multiverse as a Theoretical Possibility

Some cosmological models suggest the existence of multiple causally disconnected regions of spacetime. In PPC terms, such regions could arise where:

- Gravitational pressure becomes sufficiently weak,
- Curvature flattens,
- Causal interaction with other regions ceases.

However, these ideas remain theoretical hypotheses, not experimentally verified conclusions. PPC gravity allows such scenarios conceptually but does not assert them as established facts.

8. Finite Spacetime vs Infinite Universe

It is logically possible that:

- Spacetime has a finite causal structure,
- The universe appears unbounded within observational limits.

PPC gravity neither proves nor disproves this possibility. Instead, it reframes the question in terms of pressure distribution and curvature limits, which may ultimately determine cosmic boundaries.

9. Discussion

The PPC framework provides a physically intuitive interpretation of time dilation and spacetime evolution through gravitational pressure. It clarifies why time slows near massive objects and how spacetime expansion may reflect pressure redistribution. At the same time, it emphasizes the distinction between experimentally supported physics and speculative cosmological extensions.

10. Conclusion

This paper has examined time, spacetime expansion, and the question of infinity within Pawan Upadhyay's Pressure–Curvature Law of Gravity. Extreme gravitational pressure explains strong time dilation near compact objects, while spacetime expansion reflects large-scale pressure dynamics. The unity of space and time is preserved, but conclusions regarding an infinite universe or multiverse remain open questions rather than established results. PPC gravity thus offers a coherent interpretive framework while maintaining strict consistency with observational evidence.

Key Statement:

In PPC gravity, gravitational pressure governs time dilation and spacetime dynamics, while the global finiteness or infiniteness of the universe remains an open physical question.

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