‘Dark Matter and Dark Energy’ in Pawan Upadhyay’s Pressure–Curvature Law of Gravity

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Abstract

Dark matter and dark energy are central components of modern cosmology, introduced to explain excess gravitational binding and accelerated cosmic expansion, respectively. Despite their success in fitting observational data, their physical nature remains unknown. In this paper, Pawan Upadhyay’s Pressure–Curvature Law of Gravity (PPC Law) is applied to reinterpret dark matter and dark energy phenomena as emergent effects of gravitational pressure and pressure–curvature waves. Within this framework, dark matter effects arise from extended pressure–curvature wave fields generated by visible mass, while dark energy effects emerge from large-scale pressure dilution and curvature flattening during cosmic expansion. This pressure-based interpretation offers a physically intuitive alternative without invoking unknown forms of matter or energy.

1. Introduction

The ΛCDM model explains a wide range of cosmological observations by postulating two dominant but unseen components: dark matter and dark energy. Dark matter accounts for approximately 27% of the cosmic energy budget and is required to explain galaxy rotation curves and gravitational lensing, while dark energy accounts for about 68% and is responsible for the observed accelerated expansion of the universe.

However, despite decades of experimental effort, the fundamental nature of both components remains unresolved. This motivates the exploration of alternative interpretations grounded in known physical principles.

Pawan Upadhyay’s Pressure–Curvature Law of Gravity (PPC Law) proposes that gravity originates from pressure generated by mass–energy, with spacetime curvature emerging as its geometric response. This paper explores how dark matter and dark energy phenomena can be understood within this pressure–curvature framework.

2. Overview of the PPC Law of Gravity

The PPC Law is based on the causal chain:

$$\text{Mass–Energy} \rightarrow \text{Pressure} \rightarrow \text{Curvature} \rightarrow \text{Motion}$$

Gravitational pressure P_g is related to energy density E_d through an equation of state:

$$P_g = \omega E_d$$

where ω characterizes the pressure response of spacetime to energy density.

Gravitational interaction is mediated by **pressure–curvature waves**, which carry pressure gradients across spacetime and produce effective forces.

3. Forces in PPC Gravity

Two complementary forces arise from gravitational pressure:

3.1 Field Force

$$\mathbf{F}_{\text{field}} = -\nabla P_g$$

This force arises from spatial gradients in gravitational pressure and governs acceleration, orbital motion, and large-scale binding.

3.2 Surface Force

$$F_p = P_g A$$

This force represents the direct action of gravitational pressure on extended bodies and plays an important role in binding low-mass, low-curvature objects.

Together, these forces fully describe gravitational interaction within the PPC framework.

4. Dark Matter as an Emergent Pressure–Curvature Effect

4.1 Galactic Rotation Curves

In spiral galaxies, observed rotation curves remain flat at large radii, contradicting Newtonian expectations based on visible matter alone. In PPC gravity:

- Visible mass generates gravitational pressure
- Pressure–curvature waves extend well beyond luminous matter
- Pressure gradients remain significant at large distances

Thus, the field force provides additional binding without invoking unseen mass.

4.2 Gravitational Lensing

Gravitational lensing effects attributed to dark matter halos are interpreted as curvature produced by extended pressure–curvature wave fields surrounding visible matter distributions.

4.3 Galaxy Clusters

In clusters, overlapping pressure–curvature wave fields from many galaxies combine to produce strong binding and lensing effects, mimicking the presence of dark matter.

In PPC gravity, dark matter effects arise from the extended reach of pressure–curvature waves generated by ordinary matter.

5. Dark Energy as Pressure Dilution

5.1 Cosmic Expansion

As the universe expands, energy density decreases. In PPC gravity, this leads to:

- Decreasing gravitational pressure
- Weakening pressure–curvature waves
- Flattening of spacetime curvature

The reduction in binding force at large scales naturally results in accelerated expansion.

5.2 No Repulsive Force Required

Unlike dark energy models that introduce a repulsive vacuum energy, PPC gravity explains acceleration as a loss of attractive pressure binding, not as an additional force.

Dark energy effects emerge as a consequence of global pressure dilution rather than a fundamental repulsive component.

7. Comparison with ΛCDM (Conceptual)

- **ΛCDM Dark Matter:** Unknown non-baryonic particles
- **PPC Interpretation:** Extended pressure–curvature wave fields
- **ΛCDM Dark Energy:** Cosmological constant or vacuum energy
- **PPC Interpretation:** Pressure dilution and curvature flattening

The PPC framework reinterprets observed phenomena without adding new entities.

8. Scientific Positioning and Limitations

This work is conceptual and interpretive in nature. While PPC gravity offers a physically intuitive explanation, it does not yet replace ΛCDM. Future work must:

- Quantify pressure–curvature wave profiles
- Match precision cosmological data
- Identify testable deviations from standard models

Careful experimental and observational verification is essential.

9. Implications

- Provides a unified physical interpretation of dark matter and dark energy
- Avoids invoking unknown substances
- Links galactic dynamics, cosmic expansion, and multiverse formation
- Restores a causal role to pressure in gravitational physics

10. Conclusion

Within Pawan Upadhyay's Pressure–Curvature Law of Gravity, dark matter and dark energy are interpreted as emergent gravitational-pressure phenomena. Dark matter effects arise from extended pressure–curvature wave fields generated by visible mass, while dark energy effects emerge from large-scale pressure dilution and curvature flattening during cosmic expansion. This framework provides a unified and physically intuitive interpretation of cosmic observations while remaining open to future quantitative development and experimental testing.

Final PPC Statement

Dark matter and dark energy phenomena can be understood as manifestations of gravitational pressure and its propagation, rather than as evidence for unknown forms of matter or energy.

11. Testable Predictions of PPC Gravity

The scientific validity of **Pawan Upadhyay's Pressure–Curvature Law of Gravity (PPC Law)** ultimately depends on experimental and observational verification. The PPC framework leads to a set of **clear, falsifiable, and testable predictions** that distinguish it from particle-based dark matter models and vacuum-energy-based dark energy models.

11.1 Galactic Rotation Curves Without Dark Matter Particles

PPC gravity predicts that galaxy rotation curves arise from **extended pressure–curvature wave fields** generated by visible matter.

Prediction:
Observed flat rotation curves should correlate with pressure–curvature wave profiles derived from baryonic mass distributions rather than requiring non-baryonic dark matter halos.

Test:
Construct gravitational pressure profiles from observed luminous matter and compare predicted orbital velocities from

$$\mathbf{F} = -\nabla P_g$$

11.2 Surface Force Effects on Small Bodies

PPC gravity predicts that **surface force** plays a measurable role in binding small planets and moons.

Prediction:
Bodies with similar masses but different surface areas should show subtle differences in orbital stability due to

$$F_p = P_g A$$

Test:
Analyze orbital behavior of moons and small planets embedded in strong gravitational pressure environments.

11.3 Pressure–Curvature Wave Signatures in Gravitational Lensing

PPC gravity predicts that gravitational lensing effects extend beyond luminous matter due to pressure–curvature wave propagation.

Prediction:
Lensing profiles should follow smooth pressure-field extensions rather than sharply bounded dark matter halos.

Test:
Compare lensing data with curvature models derived from pressure–curvature wave propagation.

11.4 Cosmic Acceleration from Pressure Dilution

PPC gravity predicts that cosmic acceleration results from **global weakening of gravitational pressure**, not from a repulsive dark energy component.

Prediction:
There exists a cosmic scale at which pressure dilution causes large-scale binding forces to weaken significantly.

Test:
Compare supernova and baryon acoustic oscillation data with pressure-based expansion models.

11.5 Time Dilation Governed by Gravitational Pressure

PPC gravity predicts that gravitational time dilation correlates directly with gravitational pressure.

Prediction:
Regions of higher P_g should exhibit stronger time dilation than regions of lower pressure.

Test:
Re-express atomic clock experiments and relativistic timing data in terms of local pressure distributions.

11.6 Weakening of Forces at Cosmic Boundaries

PPC gravity predicts that at extreme cosmic scales both gravitational forces vanish:

$$\nabla P_g \to 0, \quad P_g \to 0$$

Prediction:
Large-scale causal disconnection occurs when both field force and surface force become negligible.

Test:
Search for horizon-scale anomalies consistent with pressure-force breakdown.

11.7 Absence of Exotic Gravitational Particles

PPC gravity predicts that no new gravitational particles are required.

Prediction:
Continued null results in direct dark matter detection experiments are consistent with PPC gravity.

Test:
Compare observational fits using pressure–curvature models against particle-based dark matter models.

11.8 Unified Scaling Across Cosmic Structures

PPC gravity predicts a **single pressure-based mechanism** governing gravity from planetary to cosmological scales.

Prediction:
The same pressure–curvature equations should apply to planets, galaxies, clusters, and cosmic expansion without scale-dependent modifications.

Test:
Apply identical PPC formulations across multiple astronomical scales and compare consistency.

Summary

If gravity arises from pressure–curvature waves, then gravitational binding, time dilation, galactic dynamics, and cosmic expansion must correlate with measurable pressure distributions rather than unseen matter or repulsive energy.

References

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