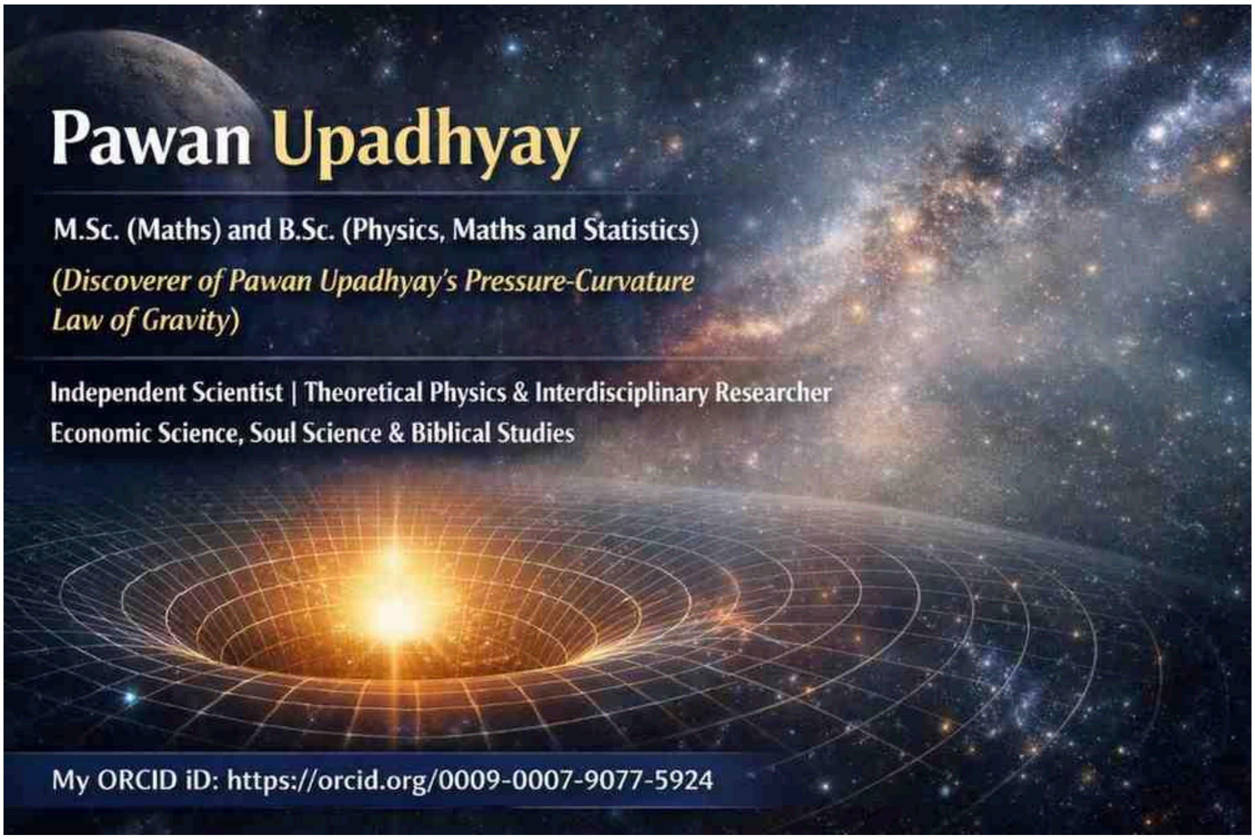
Weightlessness, Free Fall, and the Nature of Gravity:
A Comparative Interpretation Between Einstein's General Relativity and Pawan Upadhyay's Pressure–Curvature Law of Gravity

Author: Pawan Upadhyay
Affiliation: Independent Researcher
Email: pawanupadhyay28@hotmail.com
Frameworks Compared: General Relativity (Einstein) and Pawan Upadhyay's Pressure–Curvature Law of Gravity (PPC)



Abstract

Einstein's General Relativity explains gravity as spacetime curvature and identifies free fall as inertial motion along geodesics, leading to the phenomenon of weightlessness. Pawan Upadhyay's Pressure–Curvature Law of Gravity (PPC Law) retains all equations of General Relativity while offering a pressure-based physical interpretation of curvature and motion. This paper compares Einstein's original statements on free fall and weightlessness with PPC interpretations, showing that both frameworks describe the same physical reality but differ in explanatory emphasis. The comparison clarifies why a person falling through air does not feel weight, despite gravity acting continuously.

1. Einstein's Statement on Weightlessness

In General Relativity, Albert Einstein established that:

- Gravity is not a force but the manifestation of spacetime curvature
- A freely falling body follows a geodesic
- A freely falling observer experiences no proper acceleration
- Therefore, a freely falling observer feels weightless

Einstein famously illustrated this using the elevator thought experiment, concluding:

- A person in free fall cannot distinguish gravity from inertial motion.

Thus, in Einstein's view:

- Gravity exists during free fall
- Weight is not gravity
- Weight arises from support forces, not from spacetime curvature itself

2. PPC Law Statement on Weightlessness

In Pawan Upadhyay's Pressure–Curvature Law of Gravity, the same physical situation is interpreted as follows:

- Earth's mass–energy density generates gravitational pressure
- Pressure gradients curve spacetime
- Curved spacetime determines geodesic motion
- A freely falling person follows a pressure-induced geodesic

In PPC terms:

A person in free fall does not feel weight because no opposing pressure or support force acts on the body, even though Earth's gravitational pressure field is present.

Thus:

- Gravity is present as pressure-induced curvature
- The absence of weight arises from absence of resisting pressure
- Air resistance may exist but does not produce weight

3. Comparison of Key Statements

Einstein (General Relativity)

- Gravity = spacetime curvature
- Free fall = inertial motion
- Weightlessness = zero proper acceleration
- Cause of motion = geometry

PPC Law (Interpretive Framework)

- Gravity = pressure-induced curvature
- Free fall = inertial motion along pressure-shaped geometry
- Weightlessness = absence of opposing pressure/support
- Cause of curvature = mass–energy pressure

Both frameworks agree on motion, equations, and observations; they differ only in physical interpretation.

4. Falling Through Air: Clarifying the Confusion

Einstein's view:

- Air resistance causes drag
- Drag modifies motion but does not cause gravity
- Weightlessness persists until a supporting force appears

PPC interpretation:

- The falling body compresses air
- This creates fluid pressure drag
- Drag resists motion but does not cancel gravitational pressure
- Therefore, the person still feels weightless until the impact of supportive force.

Conclusion:
Air pressure modifies motion, not gravity.

5. Unified Interpretation

The two perspectives can be unified as:

- Einstein explains how bodies move (geodesics)
- PPC explains why spacetime is curved (pressure from energy density)

Mathematically identical descriptions receive different conceptual explanations.

6. Key Insight

"Weightlessness does not mean absence of gravity; it means absence of resistance."

This statement is fully consistent with both Einstein's General Relativity and the PPC interpretive framework.

7. Conclusion

Einstein’s General Relativity and Pawan Upadhyay’s Pressure–Curvature Law of Gravity describe the same gravitational phenomena using the same equations.

Einstein emphasized geometry, while PPC emphasizes pressure as the physical origin of that geometry.

The phenomenon of a falling person not feeling weight is naturally explained in both frameworks as inertial motion along curved spacetime, with PPC adding a pressure-based causal narrative.

Acknowledgment

The author acknowledges and honors Albert Einstein, whose General Relativity provides the mathematical foundation upon which this interpretive framework is constructed.

One-line takeaway:

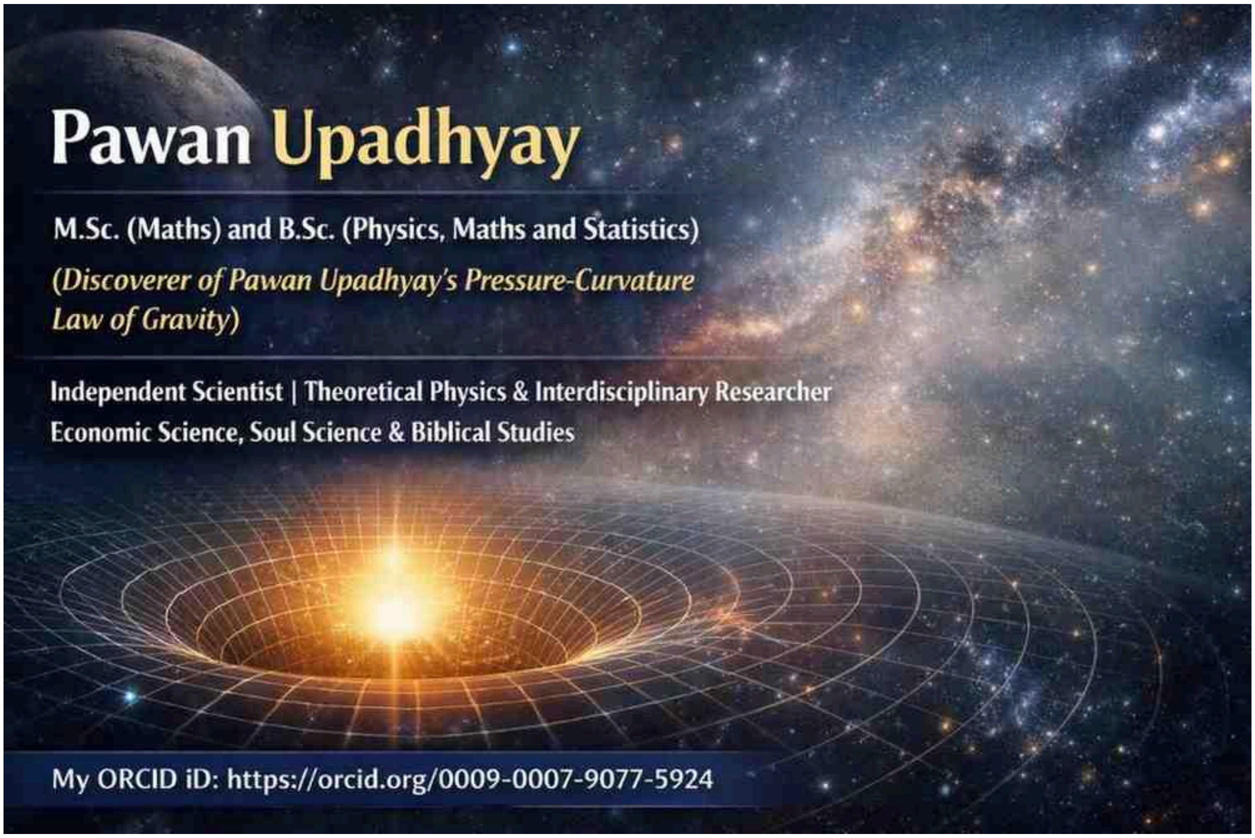
Einstein showed that free fall is inertial; PPC explains that this inertia arises because gravitational pressure creates curvature without resistance.

Although all fundamental equations of Einstein are retained unchanged, they are systematically re-expressed and interpreted in the PPC framework in terms of energy density and pressure.

[Research Paper 2]

Interstellar Objects in the Universe on the Scale of
P_g=ωE_d :
An Interpretation within Pawan Upadhyay’s Pressure–Curvature Law of Gravity

Author and Researcher : Pawan Upadhyay
Theory: Pawan Upadhyay's Pressure–Curvature Law of Gravity (PPC Law)
Email: pawanupadhyay28@hotmail.com
Date: 10 January 2026


Pawan Upadhyay
M.Sc. (Maths) and B.Sc. (Physics, Maths and Statistics)
(Discoverer of Pawan Upadhyay's Pressure-Curvature Law of Gravity)
Independent Scientist | Theoretical Physics & Interdisciplinary Researcher
Economic Science, Soul Science & Biblical Studies
My ORCID iD: https://orcid.org/0009-0007-9077-5924

Abstract

Interstellar objects, including free-floating asteroids, comets, and rogue planets, travel through regions of extremely low mass density and weak gravitational influence. In this paper, their motion is analyzed within **Pawan Upadhyay's Pressure–Curvature Law of Gravity (PPC Law)** using the relation $P_g = wE_d$, where gravitational pressure is proportional to energy density through an equation-of-state parameter w. It is shown that interstellar space corresponds to a low-pressure regime ($w \ll 1$), leading to weak spacetime curvature and near-inertial geodesic motion. Pressure–curvature waves are discussed as dynamical perturbations whose amplitude depends on pressure but whose propagation speed remains universal. Interstellar objects are thus interpreted as natural probes of the large-scale pressure structure of the universe.

1. Introduction

Observations of interstellar objects—such as 1I/‘Oumuamua and 2I/Borisov—have demonstrated that solid bodies can travel between stellar systems. Traditional gravitational theories describe their motion using Newtonian dynamics or geodesic motion in General Relativity. However, these approaches do not explicitly emphasize the physical role of pressure in shaping spacetime and motion.

Pawan Upadhyay's Pressure–Curvature Law of Gravity (PPC Law) provides a physically intuitive framework in which gravity arises from pressure generated by mass density. This paper applies the PPC framework to interstellar objects, focusing on their behavior in low-pressure environments characterized by the relation:

$$P_g = \omega E_d$$

2. Gravitational Pressure in PPC Gravity

In PPC gravity, gravitational pressure P_g is related to energy density E_d by

$$P_g = wE_d, \quad \text{where} \quad E_d = \rho c^2.$$

Here:

- ρ is mass density,
- c is the speed of light,
- w is the equation-of-state parameter defining the physical regime.

This relation allows gravitational environments to be classified according to pressure scale rather than mass alone.

3. Interstellar Space as a Low-Pressure Regime

Interstellar space is characterized by extremely low mass density:

$$\rho \to \text{very small} \quad \Rightarrow \quad E_d \to \text{very small}.$$

For ordinary matter in weak gravitational fields,

$$\boxed{w \ll 1}.$$

Thus,

$$P_g = wE_d \ll 1.$$

This places interstellar space firmly in the **low-pressure, weak-curvature regime** of PPC gravity.

4. Spacetime Curvature and Motion of Interstellar Objects

In the low-pressure regime:

- pressure gradients are minimal,
- spacetime curvature is nearly flat,
- the pressure-gradient field force $-\nabla P_g$ is very weak.

As a result, interstellar objects follow **nearly straight geodesics** over vast distances. Significant deflections occur only when such objects pass through localized regions of higher pressure, such as near stars, planetary systems, or dense molecular clouds.

This explains how interstellar objects can traverse the galaxy while remaining only weakly influenced by gravitational fields for most of their journey.

5. Pressure–Curvature Waves in Interstellar Space

Pressure–curvature waves arise from time-dependent variations in gravitational pressure and spacetime curvature produced by accelerated mass–energy. In PPC gravity:

- pressure waves propagate at the universal speed c,
- wave speed is independent of source mass,
- wave **amplitude** depends on the pressure scale P_g.

In interstellar space, where $P_g \ll 1$, pressure waves are extremely weak. Nevertheless, they may induce small, transient perturbations in nearby low-mass bodies through **surface force**, particularly for dust, small asteroids, or loosely bound material.

6. Interaction with Nearby Gravitational Systems

When interstellar objects encounter regions of higher wE_d, such as stellar environments:

- gravitational pressure increases,
- curvature becomes stronger,
- trajectories may bend significantly.

Temporary capture, hyperbolic flybys, or orbital insertion can occur depending on the pressure gradient encountered. Thus, interstellar motion is interpreted as **movement through a pressure-structured spacetime landscape**.

7. Hierarchy of PPC Gravitational Regimes

The PPC framework naturally orders gravitational environments:

- **Interstellar space:** $w \ll 1$, very low pressure, nearly flat spacetime
- **Planetary systems:** $w \ll 1$, low to moderate pressure
- **Compact objects:** $w \sim 1$, high pressure, strong curvature
- **Black hole vicinity:** $w = 1$, maximum pressure and curvature

Interstellar objects occupy the lowest end of this hierarchy.

8. Physical Interpretation

Within PPC gravity, interstellar objects are not merely passive travelers but **test bodies revealing the pressure structure of spacetime**. Their near-inertial motion reflects the extremely low gravitational pressure of interstellar space, while their rare deflections reveal localized pressure enhancements.

9. Conclusion

This paper has shown that interstellar objects naturally fit within the low-pressure regime of Pawan Upadhyay's Pressure–Curvature Law of Gravity. Using the relation that gravitational pressure is equal to the equation-of-state parameter omega multiplied by the energy density ($P_g = \omega E_d$), interstellar space is characterized by weak curvature and minimal pressure gradients, allowing nearly free geodesic motion across the universe. Pressure–curvature waves exist in principle but are extremely weak in such environments. Interstellar objects thus serve as natural probes of the large-scale gravitational pressure distribution of the cosmos.

Key Statement

> *In PPC gravity, interstellar objects move through low-pressure, weak-curvature regions of spacetime defined by $P_g = wE_d$ with $w \ll 1$, resulting in near-inertial geodesic motion across the universe.*