

## [1st Research Paper]

### (1) Time Dilation in Pawan Upadhyay's Pressure–Curvature Law of Gravity

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#### **Abstract**

Gravitational time dilation is one of the most well-tested predictions of General Relativity, traditionally explained through spacetime curvature. In this paper, time dilation is reinterpreted within Pawan Upadhyay's Pressure–Curvature Law of Gravity (PPC Law) as a direct consequence of gravitational pressure generated by mass–energy density. It is shown that variations in gravitational pressure control the rate of time, with higher pressure leading to slower clock rates and lower pressure leading to faster clock rates. This interpretation preserves all experimental confirmations while providing a clear physical mechanism underlying gravitational time dilation.

#### **1. Introduction**

Gravitational time dilation has been experimentally verified through clock experiments near Earth, in satellites, and in strong gravitational fields. While General Relativity attributes this phenomenon to curved spacetime, it does not explicitly identify the physical cause behind the curvature.

The PPC Law identifies gravitational pressure as the physical origin of spacetime curvature. This paper applies the PPC framework to gravitational time dilation.

## 2. Gravitational Pressure in PPC Gravity

Mass density  $\rho$  corresponds to energy density:

$$E_d = \rho c^2$$

Gravitational pressure is defined as:

$$P_g = w E_d$$

where  $w$  characterizes the physical regime of matter–energy.

### 3. Pressure-Controlled Time Dilation

In PPC gravity:

Higher pressure produces stronger curvature.  
Stronger curvature slows the passage of time.  
Thus:

$P_g \uparrow \Rightarrow$  Time slows

$P_g \downarrow \Rightarrow$  Time speeds up

This relation reproduces gravitational redshift and relativistic clock effects.

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## 4. Weak and Strong Pressure Regimes

- **Planetary environments:** small  $P_g$ , weak time dilation
  - **Compact stars:** large  $P_g$ , strong time dilation
  - **Black hole vicinity:**  $P_g \approx E_d$ , extreme time dilation
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## 5. Consistency with Experiments

All classic experiments (Pound–Rebka, GPS time dilation, gravitational redshift) are consistent with the PPC interpretation.

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## 6. Conclusion

Gravitational time dilation emerges naturally in PPC gravity as a pressure-controlled phenomenon, providing a physical explanation for relativistic time effects without modifying Einstein's equations.

## (2) 'Entropy and Arrow of Time' in Pawan Upadhyay's Pressure-curvature law of Gravity

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### Abstract

Entropy and the arrow of time remain deep conceptual challenges in gravitational physics. In this paper, entropy is examined within the PPC Law as a manifestation of pressure-driven energy and information redistribution in curved spacetime. It is shown that gravitational pressure gradients naturally lead to irreversible processes, providing a gravitational contribution to entropy increase and time's arrow.

### 1. Introduction

Traditional thermodynamics treats entropy independently of gravity, while black hole physics reveals a strong connection between gravity and entropy. PPC gravity provides a framework to unify these ideas through gravitational pressure.

### 2. Pressure, Curvature, and Information

High gravitational pressure corresponds to high energy density and strong curvature. Curvature constrains information flow, while pressure gradients drive irreversible redistribution of energy.

### 3. Entropy as Pressure Redistribution

#### In PPC gravity:

- Entropy increases as systems evolve toward pressure equilibrium.
- Pressure waves transport energy irreversibly.
- Curvature introduces directionality in energy flow.

### 4. Arrow of Time

The arrow of time emerges because:

- pressure gradients decay irreversibly,

- pressure waves propagate outward,
- equilibrium cannot be spontaneously reversed.

## 5. Black Holes and Maximum Entropy

Near black holes, gravitational pressure approaches its maximum. This naturally explains why black holes represent states of maximal entropy in PPC gravity.

## 6. Conclusion

Entropy in PPC gravity arises from gravitational pressure dynamics, linking thermodynamics, curvature, and time's arrow within a single physical framework.

### [3rd Research Paper]

#### (3) Wormholes in Pawan Upadhyay's Pressure-curvature law of Gravity

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### Abstract

Wormholes are traditionally described as exotic solutions of Einstein's equations requiring unusual matter conditions. In this paper, wormholes are reinterpreted within PPC gravity as extreme gravitational pressure-gradient structures. This approach provides a physical interpretation of wormhole geometry and clarifies stability conditions using pressure balance.

### 1. Introduction

Wormholes connect distant regions of spacetime through non-trivial topology. While mathematically valid in General Relativity, their physical interpretation remains unclear.

### 2. Pressure–Curvature Interpretation

In PPC gravity, curvature arises from pressure. A wormhole corresponds to:

- a localized pressure saddle or maximum,
- balanced pressure gradients on either side.

### **3. Wormhole Throat as Pressure Balance**

**The throat of a wormhole exists where:**

- inward and outward pressure forces balance,
- curvature remains finite but extreme.

### **4. Stability Conditions**

**Wormhole stability requires:**

- sustained pressure gradients,
- controlled pressure wave emission,
- avoidance of runaway collapse.

Exotic matter in GR corresponds to non-standard pressure regimes in PPC gravity.

### **5. Dynamical Effects and Pressure Waves**

Pressure waves can:

- destabilize weak wormholes,
- transmit information through wormhole structures,
- couple to matter via surface force.

### **6. Conclusion**

Within PPC gravity, wormholes are interpretable as extreme pressure–curvature configurations, providing a physically intuitive explanation consistent with relativistic geometry.

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# References (for all three papers)

1. Misner, Thorne, Wheeler – *Gravitation*, 1973
  2. Wald – *General Relativity*, 1984
  3. Carroll – *Spacetime and Geometry*, 2004
  4. Hawking – *A Brief History of Time*, 1988
  5. Morris & Thorne – *Wormholes in Spacetime*, 1988
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## One-line Summary:

PPC gravity unifies time dilation, entropy, and wormholes under a single physical cause—gravitational pressure—while preserving all verified predictions of General Relativity.

[Extended Research Paper]

Time Dilation, Wormholes, and Entropy in the PPC Law of Gravity

The PPC Law of Gravity identifies gravitational pressure—generated by energy density—as the primary cause of curvature. Because curvature controls time flow, motion, geometry, and information structure, PPC offers a natural and physically intuitive way to understand:

1. Time Dilation
2. Wormholes
3. Entropy and information flow

Each phenomenon emerges directly from the behavior of gravitational pressure fields.

## **1. Time Dilation in PPC Gravity**

### **1.1 Cause of Time Dilation in PPC**

In General Relativity, time dilation arises from spacetime curvature.  
In PPC, curvature arises from pressure.

Thus:

Time slows down where gravitational pressure is higher.

Higher energy density → higher pressure → stronger curvature → slower local time.

This provides a physical mechanism, not just a geometric statement.

### **1.2 Types of Time Dilation in PPC**

#### **A. Gravitational Time Dilation**

Occurs because pressure alters spacetime curvature:

$$P_g = E_d$$

A higher pressure field slows the flow of proper time.

Thus:

- Near neutron stars (high pressure): time moves significantly slower.

- Near black holes (extreme pressure): time nearly stops.
- In empty space (low pressure): time moves fastest.

## **B. Velocity Time Dilation (Special Relativity within PPC)**

Motion through a pressure-defined curvature modifies proper time.

PPC interpretation:

Moving objects experience time dilation because they interact differently with the pressure-defined geometry.

## **C. Rotational Time Dilation**

Inside rotating systems (planets, stars):

- inward pressure forces
- outward inertial effects
- affect time asymmetrically.

Thus:

Equatorial regions (higher rotational inertia) experience slightly altered time compared to poles.

### **1.3 Key PPC Prediction**

Two systems with equal mass but different internal pressures should produce different gravitational time dilation signatures.

This is unique to PPC.

## **2. Wormholes in the PPC Law of Gravity**

Wormholes are shortcuts created by extreme curvature of spacetime.

In PPC, curvature is caused by pressure, so the existence and stability of wormholes depend on pressure fields, not exotic negative energy.

### **2.1 What Creates a Wormhole in PPC?**

A wormhole requires:

- 1. A region of extremely high gravitational pressure**
- 2. A pressure gradient configuration that bends spacetime into two connected sheets**

Wormholes form when:

- pressure is extremely concentrated,
- curvature becomes multi-valued,
- geodesics reconnect into tunnels.

Thus PPC provides the first physical mechanism that explains what bends spacetime enough to create a wormhole:

Wormholes are pressure-induced curvature tunnels formed by extreme compression of spacetime.

## **2.2 Do Wormholes Require Negative Energy? (PPC answer: No)**

Standard GR requires exotic negative energy to stabilize wormholes.

But PPC offers a new interpretation:

If pressure can curve spacetime positively or negatively depending on distribution,

Then stability can arise from pressure gradients, not exotic matter.

PPC Prediction:

High-pressure curvature configurations can mimic the effect of negative energy without violating physical laws.

This offers a path to physically viable wormholes.

## **2.3 Pressure Waves and Wormhole Stability**

PPC predicts:

- pressure waves inside a wormhole could destabilize or strengthen the connection
- high-frequency gravitational pressure waves may “open” or “close” throat regions

This provides a new theoretical basis for wormhole dynamics.

### 3. Entropy in PPC Gravity

Entropy in PPC is not purely statistical.

It is directly tied to pressure information structure.

Because pressure determines curvature, PPC redefines entropy in gravitational systems as:

Entropy is the measure of information and complexity stored in the pressure configuration of spacetime.

#### 3.1 Entropy–Pressure Relationship

High-pressure systems (stars, black holes):

- contain more curvature
- encode more gravitational information
- have higher entropy

Low-pressure systems (empty space):

- contain less curvature
- have lower entropy

This is consistent with Bekenstein–Hawking entropy, but PPC provides the physical reason:

**Black holes have maximal entropy because they have maximal pressure curvature.**

#### 3.2 Entropy and Cosmic Expansion

As the universe expands:

- gravitational pressure drops
- curvature weakens
- entropy spreads but becomes less concentrated

### **PPC interpretation:**

Cosmic expansion is the redistribution of pressure information, causing entropy to increase overall.

This connects thermodynamics and gravity through pressure fields.

### **3.3 Entropy Flow Through Wormholes**

If wormholes are pressure tunnels:

- entropy can flow through them
- pressure differences drive “information transfer”
- wormholes act as entropy equalizers

This predicts that wormholes must have entropy gradients depending on pressure structure.

## **4. Unified View: Pressure Controls Time, Space, and Entropy**

PPC connects three major concepts:

1. Time dilation → controlled by pressure
2. Wormholes → created by extreme pressure curvature
3. Entropy → encoded in pressure information

Therefore:

Pressure is the fundamental physical quantity that shapes time, curvature, wormholes, motion, and entropy.

This gives gravity a unified physical interpretation, unlike standard GR which treats these as unrelated phenomena.

## **5. PPC Predictions Involving Time, Wormholes, and Entropy**

- ✓ High-pressure stars should show stronger time dilation than GR predicts.
- ✓ Wormhole-like curvature may appear in extreme pressure regions (supernova cores, neutron star mergers).
- ✓ Entropy in black holes is proportional to pressure-induced curvature, not only area.
- ✓ Time dilation anomalies should correlate with pressure—not mass—distributions.
- ✓ Pressure waves could modulate wormhole stability or structure.

These predictions can be used for future observational or theoretical tests.

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