

Speed of Light in PPC Gravity

Author: Pawan Upadhyay

Independent Researcher

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Email: pawanupadhyay28@hotmail.com

Abstract

The Pawan Upadhyay's Pressure–Curvature (PPC) Law of Gravity introduces gravitational pressure as the physical mechanism responsible for spacetime curvature and the resulting geodesic motion of matter and radiation. In this paper, the behavior of the speed of light is analyzed within the PPC framework. While the numerical value of c remains identical to that in General Relativity, PPC provides a deeper physical interpretation: the speed of light is the fundamental propagation speed of curvature and gravitational pressure waves in spacetime. Light moves independently of mass, pressure, and inertia, following curvature created by gravitational pressure fields. This paper clarifies why the speed of light is the fastest possible speed, how gravitational pressure affects light propagation, why the coordinate speed changes in curved spacetime while local speed remains constant, and how PPC explains bending, redshift, time delay, and horizon behavior. The PPC interpretation unifies light propagation, curvature physics, and pressure mechanics into a coherent physical model.

1. Introduction

The PPC Law of Gravity states:

$$P_g = \omega E_d$$

where P_g is gravitational pressure, E_d is energy density, and ω is the equation-of-state parameter. In PPC gravity, curvature arises not directly from mass-energy, but from the pressure generated by mass-energy. Light, having zero mass and zero inertia, interacts with spacetime solely through curvature.

The speed of light c is preserved as the invariant local speed, but PPC adds a new physical explanation:

The speed of light is the propagation speed of curvature itself, and therefore the fastest possible speed in the universe.

This research paper presents a complete PPC-based interpretation of light propagation, speed constancy, gravitational effects, and cosmic implications.

2. Light as a Curvature-Propagating Entity

In PPC gravity, light is not slowed by matter, pressure, or inertia because photons have:

- no rest mass
- no internal pressure
- no resistance to acceleration

Thus, light travels freely on the curvature created by pressure fields:

Light path = Geodesics determined by P_g .

The speed is not determined by matter but by the structure of spacetime itself.

3. Local Constancy of the Speed of Light

PPC follows Einstein's principle:

$$c = 299,792,458 \text{ m/s}$$

The local speed of light is invariant because:

1. The local gravitational pressure is uniform over infinitesimal distances.
2. Spacetime curvature does not change locally.
3. Light always propagates at the fundamental curvature-update speed.

Thus, PPC preserves all classical relativistic results while providing a physical mechanism behind them.

4. Coordinate Speed of Light in Pressure-Generated Curvature

In curved spacetime created by gravitational pressure, the coordinate speed of light may appear slower, while local speed remains constant.

This is because:

- gravitational pressure slows the flow of coordinate time

- curvature modifies radial distances
- pressure gradients produce observable delays

Mathematically, PPC states:

$$F = \nabla P_g$$

Stronger pressure gradients → stronger curvature → greater coordinate deviations.

Thus:

- Near massive bodies, light appears to slow down.
- On lunar or deep-space environments, coordinate speeds are nearly flat.
- Near event horizons, coordinate speed approaches zero.

5. Light Bending in PPC Gravity

Traditional GR explains bending via curvature.

PPC explains the cause of curvature:

$$\theta \propto \nabla P_g$$

Thus, light bends because pressure gradients distort curvature geometry.

This provides a mechanical explanation for:

- gravitational lensing
- Shapiro delay
- solar bending of starlight
- photon orbits near black holes

Bending is not due to a “force,” but due to pressure-generated curvature.

6. Gravitational Redshift in PPC

Redshift arises because pressure slows time:

$$\Delta t \propto P_g.$$

Higher pressure \rightarrow slower clock \rightarrow lower observed frequency.

Thus:

- photons climbing out of a pressure well lose energy (redshift)
- photons falling into a pressure well gain energy (blueshift)

This ties frequency shift directly to the pressure field.

7. Speed of Light Near Black Holes

PPC describes black holes as maximum-pressure curvature states.

At the event horizon:

$$P_g \rightarrow \infty \text{ (in the PPC sense)}$$

- coordinate time stops
- coordinate speed of light approaches zero
- light is trapped along curvature contours

Local speed remains c , but global propagation is blocked.

Thus PPC gives a mechanical understanding:

A black hole is a region where pressure bends spacetime so steeply that outward curvature becomes impossible.

8. Light and Pressure Waves

In PPC, gravitational waves are pressure waves. They travel at c , the same speed as light, because they represent oscillations in the curvature itself.

Thus:

c = speed of curvature propagation.

This unifies gravitational waves and electromagnetic waves under one physical interpretation.

9. Why Light is the Fastest Possible Speed

In PPC, no entity can exceed the speed of light because:

1. Light has no inertia
2. Matter experiences infinite pressure resistance near c
3. Spacetime curvature updates at rate c
4. Information transmission occurs through curvature

Thus:

c = maximum possible propagation speed allowed by pressure-curvature dynamics

Anything faster would require updating the geometry faster than spacetime can respond, which is impossible.

10. Differences from Sound Speed (PPC Distinction)

Sound is a mechanical pressure wave in matter.

Light is a curvature wave in spacetime.

() for Feature.

[] for Light.

{ } for Sound.

(Feature)	[Light]	{Sound}
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(Medium)	[Spacetime]	{Matter}
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(Type) [EM + curvature] {Mechanical
Pressure wave}

(Speed) [Constant c] {Varies with
Pressure&density}

(Limit) [Upper limit] {No-fixed-upper-limit}

(Affected [Yes(Curvature)] {Not
by gravity?) {fundamentally}}

This demonstrates why light is far faster.

11. Summary and Conclusion

In PPC gravity:

Light moves at the constant speed c because it propagates through spacetime curvature without inertia or pressure resistance.

- The curvature that guides light is created by gravitational pressure fields.
- Coordinate deviations in speed arise from pressure-induced time dilation and curvature geometry.
- Black holes represent maximum-pressure curvature where light cannot escape.
- Gravitational waves and light waves are unified as curvature-propagation modes.

The PPC Law therefore provides a physical, mechanical, and intuitive explanation for why light is the fastest possible speed and how it interacts with gravity.

References

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