Paper 036
Retarded Gravity-Cogravity as a Conserved Linear Field Theory

A Jefimenko-compatible foundation note for source causality, continuity, and negative field-energy accounting

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Abstract

Jefimenko-style gravity/cogravity is treated here as a linear retarded mass-current field theory, not as a replacement for general relativity. The paper restates the gravity and cogravity equations, derives the Lorenz-gauge potentials, writes the retarded source integrals, proves the continuity constraint, and gives a Poynting-like energy ledger with negative gravitational field energy. The result is a foundation proposal: any later speculative application must preserve Newtonian recovery, source conservation, retarded boundary conditions, and energy-power closure.

Status. Draft manuscript for review and revision. This paper is not an empirical claim of new physics or field-ready technology. It is a structured proposal, theory note, protocol, or application architecture intended to be auditable, falsifiable, and publishable with source.

Contents

1 Problem

Jefimenko-style gravity/cogravity is useful only if it is handled as a constrained mathematical model rather than as a slogan. The immediate problem is to write a minimal field theory whose source terms are retarded, whose mass current is conserved, whose Newtonian limit is explicit, and whose bookkeeping makes it hard to smuggle in free energy or unsupported propulsion claims.

The scope of this paper is deliberately narrow. We use a flat-background, linear, Maxwell-like system for a mass density ρ and a mass-current density $\mathbf{J} = \rho\mathbf{v}$. We do not claim that this system replaces general relativity. We ask instead whether the equations form a coherent source-to-field calculus suitable for JMP0X1B proposal papers, solvers, null experiments, and observational bounds.

2 Model

Let $\mathbf{g}(\mathbf{x}, t)$ be the gravitational field and let $\mathbf{K}(\mathbf{x}, t)$ be the cogravitational field. The source pair is $(\rho, \mathbf{J})$ with

$$\partial_t \rho + \nabla \cdot \mathbf{J} = 0. \tag{1}$$

The field equations are

$$\nabla \cdot \mathbf{g} = -4\pi G\rho, \tag{2}$$
$$\nabla \cdot \mathbf{K} = 0, \tag{3}$$
$$\nabla \times \mathbf{g} = -\partial_t \mathbf{K}, \tag{4}$$
$$\nabla \times \mathbf{K} = -\frac{4\pi G}{c^2}\mathbf{J} + \frac{1}{c^2}\partial_t \mathbf{g}. \tag{5}$$

A test particle of mass m and velocity $\mathbf{v}$ is assigned the Lorentz-analogue force

$$\mathbf{F} = m(\mathbf{g} + \mathbf{v} \times \mathbf{K}). \tag{6}$$

The cogravity term performs no instantaneous mechanical work because $\mathbf{v} \cdot (\mathbf{v} \times \mathbf{K}) = 0$.

A potential representation is

$$\mathbf{g} = -\nabla\Phi - \partial_t \mathbf{A}, \qquad \mathbf{K} = \nabla \times \mathbf{A}, \tag{7}$$

with Lorenz-type gauge

$$\nabla \cdot \mathbf{A} + \frac{1}{c^2}\partial_t \Phi = 0. \tag{8}$$

The potentials then satisfy

$$\nabla^2\Phi - \frac{1}{c^2}\partial_t^2\Phi = 4\pi G\rho, \tag{9}$$
$$\nabla^2\mathbf{A} - \frac{1}{c^2}\partial_t^2\mathbf{A} = \frac{4\pi G}{c^2}\mathbf{J}. \tag{10}$$

The retarded solutions are

$$\Phi(\mathbf{x}, t) = -G \int \frac{[\rho]}{R}\, \mathrm{d}^3x', \tag{11}$$
$$\mathbf{A}(\mathbf{x}, t) = -\frac{G}{c^2} \int \frac{[\mathbf{J}]}{R}\, \mathrm{d}^3x', \tag{12}$$

where $\mathbf{R} = \mathbf{x} - \mathbf{x}'$, $R = |\mathbf{R}|$, and brackets mean evaluation at $t_\mathrm{r} = t - R/c$.

Taking derivatives of the potentials yields the Jefimenko-type source formulas

$$\mathbf{g}(\mathbf{x}, t) = -G \int \left(\frac{[\rho]\mathbf{R}}{R^3} + \frac{[\partial_t \rho]\mathbf{R}}{cR^2} \right) \mathrm{d}^3x' + \frac{G}{c^2} \int \frac{[\partial_t \mathbf{J}]}{R} \mathrm{d}^3x', \tag{13}$$

$$\mathbf{K}(\mathbf{x}, t) = -\frac{G}{c^2} \int \left(\frac{[\mathbf{J}]}{R^3} + \frac{[\partial_t \mathbf{J}]}{cR^2} \right) \times \mathbf{R} \, \mathrm{d}^3x'. \tag{14}$$

The static limit of Eq. (13) is Newtonian gravity, and the static mass-current limit of Eq. (14) is the cogravitational analogue of magnetostatics.

3 Claims

Claim 1 (Continuity is not optional). *Equations* (2)–(5) *imply local mass-current conservation. Taking the divergence of Eq.* (5) *gives*

$$0 = -\frac{4\pi G}{c^2} \nabla \cdot \mathbf{J} + \frac{1}{c^2} \partial_t (\nabla \cdot \mathbf{g}) = -\frac{4\pi G}{c^2} (\nabla \cdot \mathbf{J} + \partial_t \rho). \tag{15}$$

Any speculative source extension must therefore preserve $\partial_t \rho + \nabla \cdot \mathbf{J} = 0$ or explicitly state where the model is being abandoned.

Claim 2 (The retarded potentials are the clean causal surface). *The potential equations produce Eqs.* (13) *and* (14) *with no simultaneous field-to-field causation assumption. The source history is the causal input;* $\mathbf{g}$ *and* $\mathbf{K}$ *are jointly computed outputs.*

Claim 3 (Energy bookkeeping has a negative field-energy convention). *Multiplying Eq.* (5) *by* $\mathbf{g}$, *Eq.* (4) *by* $\mathbf{K}$, *and using* $\nabla \cdot (\mathbf{g} \times \mathbf{K}) = \mathbf{K} \cdot (\nabla \times \mathbf{g}) - \mathbf{g} \cdot (\nabla \times \mathbf{K})$ *gives*

$$\partial_t u_G + \nabla \cdot \mathbf{S}_G + \mathbf{J} \cdot \mathbf{g} = 0, \tag{16}$$

with

$$u_G = -\frac{|\mathbf{g}|^2 + c^2 |\mathbf{K}|^2}{8\pi G}, \qquad \mathbf{S}_G = -\frac{c^2}{4\pi G} \mathbf{g} \times \mathbf{K}. \tag{17}$$

This sign convention is the natural attractive-field analogue of Poynting bookkeeping.

Claim 4 (The model has four hard consistency gates). *A gravity/cogravity proposal should pass four gates before experiment is discussed: Newtonian limit, continuity, retarded boundary condition, and energy-power closure. Failing any gate makes the proposal a different theory rather than a Jefimenko-compatible extension.*

4 Evidence Plan

The evidence in this foundation paper is mathematical and computational. The first release should include derivations for the divergence constraint, retarded potentials, Jefimenko integrals, and Poynting-like theorem. A reference notebook should verify the static point-mass field, a compact rotating source, a time-varying mass-current pulse, and a source that intentionally violates continuity to show how the residuals fail.

A useful manufactured-solution test is to prescribe compact ρ and $\mathbf{J}$ satisfying continuity, compute Φ and $\mathbf{A}$ by retarded convolution, and then measure the four residuals

$$\epsilon_1 = \|\nabla \cdot \mathbf{g} + 4\pi G\rho\|\,, \qquad \epsilon_2 = \|\nabla \cdot \mathbf{K}\|\,, \tag{18}$$

$$\epsilon_3 = \|\nabla \times \mathbf{g} + \partial_t \mathbf{K}\|\,, \qquad \epsilon_4 = \left\|\nabla \times \mathbf{K} + \frac{4\pi G}{c^2}\mathbf{J} - \frac{1}{c^2}\partial_t \mathbf{g}\right\|. \tag{19}$$

The release should state mesh size, time step, interpolation rule, boundary truncation, and convergence rate.

5 JMP0X1B Implementation Surface

The implementation surface is a small typed kernel for mass-current field models. A minimal schema is

```
record MassCurrentSource { rho, J, support, continuity_residual }
record GcoPotential      { Phi, A, gauge_residual, retarded_kernel }
record GcoField          { g, K, residuals, energy_ledger }
fn verify(source, field) -> AuditReport
```

This kernel becomes shared infrastructure for the solver paper, the laboratory null-test paper, and the observational-bounds paper.

6 Release and Review Plan

Release the LaTeX source, PDF, derivation notes, symbolic checks, and a small numerical test suite. The review checklist should ask: Does the source conserve mass? Does the static field reduce to Newton? Are all field quantities retarded? Does the proposed force law preserve the no-work property of the cogravity term? Does the energy ledger close?

7 Open Questions

- What is the cleanest map between this vector field model and convention-dependent weak-field general relativity?
- Can a covariant stress-energy formulation be written without changing the empirical content of the proposal?
- Which speculative extensions preserve continuity automatically?
- What observations already bound the cogravity term so tightly that laboratory searches become only artifact studies?

8 Conclusion

This paper turns one part of the gravity/cogravity idea into a named, reviewable work package. Its value does not depend on treating the framework as established physics. The value is the disciplined reduction of a speculative field analogy into equations, invariants, bounds, null tests, and release artifacts that can be audited and either extended or killed.

References

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