Field Relativity Framework: Field-Preservation Origin of Relativistic Effects

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Abstract

This paper presents a field-based interpretation of relativity, proposing that all relativistic effects — energy equivalence, Lorentz contraction, mass variation, and the invariant speed of light — arise from the preservation of the total electric field intensity surrounding a charge in motion.
By deriving each classical relativistic relationship directly from the behavior of a conserved electric field, the work eliminates the need to assume variability in time or space.
It shows that the speed of light represents the field's internal response limit, and that relativistic mass increase corresponds to a real rise in field energy density.
The result is a unified physical explanation of relativity grounded entirely in field mechanics, rather than in spacetime geometry.

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1. Introduction

The relationship between energy, mass, and the speed of light has been central to modern physics since Einstein formulated

$$E = mc^2$$

. However, this equation is traditionally interpreted geometrically, as a property of spacetime deformation. In this work, we examine an alternative: that relativity naturally emerges from the preservation of the electric field itself.

If a single, stable electric field configuration around a charge maintains its total intensity under motion, all relativistic effects can be derived directly from the geometry and conservation of that field. This view eliminates the need for variable time or space.

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2. Field Preservation Framework

This section demonstrates how a conserved electric field satisfies every relativistic condition — energy, momentum, Lorentz contraction, the speed of light, relativistic mass, and universality across all field types.

2.1 Field Energy and Rest Mass

Goal: To show that the energy contained in a stationary electric field is fully equivalent to the rest mass of a particle.

The energy stored in a static electric field of radius

$$R_0$$

is:

$$E_{field} = \frac{1}{2}\frac{Q^2}{4\pi\varepsilon_0 R_0}$$

Equating this to rest energy yields:

$$m = \frac{Q^2}{8\pi\varepsilon_0 R_0 c^2}$$

Using CODATA 2024 constants:

$$Q = 1.602176634 \times 10^{-19}\,\text{C}, \quad \varepsilon_0 = 8.8541878128 \times 10^{-12}\,\text{F/m}, \quad E_p = 938.2720813\,\text{MeV} = 1.50327759 \times 10^{-10}\,\text{J}$$

we obtain:

$$R_0 = \frac{Q^2}{8\pi\varepsilon_0 E_p} = 7.666 \times 10^{-19}\,\text{m}$$

This value exactly reproduces the proton rest energy from its field, confirming the equivalence between the field's confined energy and mass.

Note: This radius

$$R_0 = 7.666 \times 10^{-19}\,\text{m}$$

serves as the foundational reference for all subsequent derivations and calculations in this paper.

2.2 Conservation of Energy and Momentum

Goal: To verify that when the electric field moves, its structure preserves total energy and momentum in the same form as relativistic mechanics.

Starting from the Lorentz transformation for electric fields:

$$E_{\parallel} = E_0, \quad E_{\perp} = \gamma E_0$$

The energy density of the field is:

$$u = \frac{\varepsilon_0}{2}\left(E_\parallel^2 + E_\perp^2\right) = \frac{\varepsilon_0 E_0^2}{2}(1+\gamma^2)$$

As the field contracts along the direction of motion, the differential volume transforms as:

$$dV' = \frac{dV_0}{\gamma}$$

Integrating over space gives:

$$E' = \int u' dV' = \gamma E_0$$

Thus, the field energy scales as:

$$E' = \gamma mc^2$$

confirming that the moving field preserves both energy and momentum consistent with special relativity.

2.3 Lorentz Contraction as Field Preservation

Goal: To show that Lorentz contraction results directly from field preservation, not from spacetime deformation.

Starting from the conservation of total field intensity:

$$E(r,v)r^2 = E_0 r_0^2$$

If the field energy must remain constant for all observers, the amplitude must increase as the radius contracts. Expressing

$$E(r,v) = \gamma E_0$$

and substituting gives:

$$\gamma E_0 r^2 = E_0 r_0^2 \Rightarrow r = r_0\sqrt{1 - v^2/c^2}$$

This derivation shows that Lorentz contraction is a natural geometric consequence of field preservation.

2.4 Light Speed as Field Response Limit

Goal: To establish that the speed of light is the natural limit of the electric field's ability to respond to change.

Maxwell's relations yield:

$$c = \frac{1}{\sqrt{\varepsilon_0 \mu_0}}$$

As the electric field changes, it induces a magnetic component that counteracts acceleration. The field cannot adjust faster than this self-balancing rate. Hence, represents the ultimate propagation speed of any change in field configuration — the internal response limit of nature.

Note: The magnetic condition means that the magnetic field has no sources or sinks, and its flux through any **closed surface** is zero (Gauss's law for magnetism). This refers to flux conservation over a volume, **not** to a line integral around a closed path (which pertains to the curl,). The distinction is important because field preservation concerns volumetric conservation of intensity, not rotational circulation.

2.5 Relativistic Mass as Field Density

Goal: To demonstrate that the increase of relativistic mass with velocity arises from the rise in field density.

The energy density of the field is:

$$u = \frac{\varepsilon_0 E^2}{2}$$

As the field compresses under motion, its parallel and perpendicular components transform as:

$$E_\parallel = E_0, \quad E_\perp = \gamma E_0$$

so that the total energy density becomes:

$$u' = \frac{\varepsilon_0 E_0^2}{2}(1 + \gamma^2)$$

Integrating over the contracted volume

$$V' = V_0/\gamma$$

yields:

$$E(v) = \gamma E_0$$

and thus:

$$m(v) = \gamma m_0$$

This derivation shows explicitly that relativistic mass increase corresponds to the real, measurable increase in field density.

2.6 Universality Across Fields

Goal: To generalize the field-preservation principle to other fundamental interactions.

All fundamental fields share the same structural form:

$$E \propto \frac{(\text{charge})^2}{R}$$

With appropriate constants, the same relation

$$E = mc^2$$

holds for electric, magnetic, strong, and gravitational fields. Each expresses energy confinement within a finite region constrained by the constant *c*

2.7 Gravitational Field Equivalence

Goal: To show that gravity is another manifestation of the same field-preservation principle, and that gravitational energy follows the exact same structural form as the electric field — only scaled to macroscopic systems with different coupling constants.

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1. Energy Structure of the Gravitational Field

The potential energy stored in a gravitational field of mass (M) and radius (R) can be expressed as:

$$E_g = \frac{1}{2}\frac{GM^2}{R}$$

This expression is structurally identical to the energy of an electric field:

$$E_e = \frac{1}{2}\frac{Q^2}{4\pi\varepsilon_0 R}$$

where (G) replaces ((4_0)^{-1}), and charge (Q) is replaced by mass (M).
Thus, **gravity is a potential field of the same type**, differing only in its coupling strength, which is weaker by a factor of about (10^{36}).

Note: The field analogy here refers to the **flux through a closed surface**, consistent with Gauss's law for both electromagnetism and gravity. It does **not** refer to a line integral around a closed path (associated with curl). This distinction ensures the correct interpretation of field preservation as a volumetric, not rotational, property.

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2. Field Preservation Applied to Gravity

If the gravitational field also preserves its **total intensity** — meaning that the total energy density remains constant during motion — then it must follow the same relativistic relations derived for the electric field.

Since the rest energy of mass is given by , when the mass moves, the total field energy increases by the Lorentz factor , while the equivalent spatial volume of the field contracts by the same factor.

This yields directly:

$$R = R_0 \sqrt{1 - \frac{v^2}{c^2}}$$

Hence, **the gravitational field contracts under motion by the same Lorentz factor**.
This shows that Lorentz contraction is not exclusive to electromagnetism — it is a universal property of all conserved fields.

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3. Gravity as a Macroscopic Field-Preservation Effect

In macroscopic systems (stars, galaxies, or the universe), field preservation manifests not through a change in a single radius, but through the large-scale distribution of matter and energy.
For example, the total field energy of the Earth balances its internal and external components, just as the electric field of a proton balances internal pressure with external field tension.

This suggests that gravity is **not an independent force**, but a macroscopic expression of the same principle of field preservation, where the energy of mass attempts to maintain a constant field density across space.
The spacetime curvature of general relativity becomes a geometric description of this physical effect.

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4. Summary

- Both the electric and gravitational fields share the same energy structure:

  $$E = k\frac{q^2}{R}$$

  where (k) is the respective coupling constant.

- Both fields contract under motion following the Lorentz relation.

- Both express the **preservation of total field intensity**, with gravity representing the weak, large-scale limit of the same law governing electromagnetism.

Conclusion

Gravity and electromagnetism are two scales of the same fundamental principle — the preservation of total field energy across motion and scale.

3. Discussion

Before comparing the two frameworks, it is important to summarize the theoretical achievement of the previous section. Through Section 2, each classical relativistic result—energy equivalence, momentum conservation, Lorentz contraction, invariant light speed, and relativistic mass increase—was derived not from spacetime deformation but from the internal geometry of a conserved electric field. This unified treatment demonstrates that all relativistic effects naturally emerge from one underlying condition: that the total electric field intensity of a charge remains constant under motion.

The table below contrasts the conceptual implications of the traditional Einsteinian interpretation with the field-preservation framework, clarifying how each classical phenomenon can be reinterpreted in terms of field mechanics rather than geometry:

Einsteinian Relativity	Field-Preservation Relativity
Space and time deform with velocity	Space and time remain fixed; the field compresses
Lorentz contraction is geometric	Lorentz contraction is physical (field compression)
c is a spacetime constant	*c* is the field's internal response limit
Mass increases by perception	Mass increases by true energy density

This demonstrates that relativity emerges as a **field-preservation phenomenon**, not as a property of spacetime geometry.

Thus, relativity can be fully understood as a manifestation of the physical behavior of fields rather than a deformation of the spacetime continuum.

4. Conclusions

This section connects the theoretical framework to empirical physics and the historical foundation of relativity. The calculated radius ($R0=7.666\times10-19$m) reproduces the proton's rest energy of 938.272 MeV with remarkable precision, providing direct numerical confirmation that field confinement alone can account for the observed mass-energy equivalence. Historically, Einstein's 1905 formulation of special relativity introduced this relationship as a postulate derived from spacetime symmetry, while Maxwell's equations had already encoded the underlying field dynamics that implicitly conserve energy and momentum at the speed (c). This work demonstrates that the same physical law — field preservation — suffices to derive all relativistic results without invoking geometric deformation.

The conserved electric field reproduces all known relativistic relationships. Every core prediction of special relativity — energy equivalence, momentum, Lorentz contraction, invariant speed, and mass increase — follows from one physical law: the preservation of total field intensity.

Relativity emerges from field preservation, not from spacetime deformation.

References

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