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}).

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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 (E = mc^2), when the mass moves, the total field energy increases by ( ), 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.

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.**