Fundamental theory of mass
(Mass-electromagnetic energy relation)

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1. Abstract

This theory proposes that mass is not a fundamental quantity, but rather emerges from localized, self-sustaining configurations of electromagnetic (EM) energy. All known particle properties — mass, charge, inertia, spin, and even gravitational interaction — arise as manifestations of the geometry and dynamics of these EM fields. The aim is to build a unified field-based framework connecting electrodynamics, quantum mechanics, and general relativity.

2. Core Hypothesis

Mass = Confined Electromagnetic Energy.

Particles are stable EM field knots named solitons.

Each property (mass, charge, spin, etc.) arises from a specific topological or geometric configuration of the EM field.

3. *Mathematical Foundation*

Energy Density of Electromagnetic Field

$$\rho = (1/2) \times (\varepsilon_0 \times E^2 + B^2 / \mu_0)$$

Total Energy in a Volume

$$E = \int [(1/2) \times \varepsilon_0 \times E^2 + (1/2\mu_0) \times B^2] \, dV$$

Relating to Mass via Einstein's Equation

$$E = mc^2$$
$$\Rightarrow m = E/c^2$$
$$\Rightarrow m = (1/c^2) \times \int [(1/2) \times \varepsilon_0 \times E^2 + (1/2\mu_0) B^2] \, dV$$

Thus, mass is equivalent to the confined EM field energy.

Extended Maxwell's Equation (Nonlinear Correction)

$\partial\mu\ F^\wedge\mu\nu + \alpha * (F^\wedge\mu\nu * F\_\mu\nu) * F^\wedge\mu\nu = J^\wedge\nu$

This enables topological stability of the field (soliton solutions).

4. <u>Electromagnetic Intensity Fall-off</u>

This theory also predicts that the intensity of the EM field decreases with distance from the center of a particle:

$I(r) = I_0 / r^2$

This explains why electromagnetic interactions become weaker with distance and contributes to the spatial boundary of the mass.

5. <u>Mass definition according to this theory:-</u>

Mass and energy are equivalent, but here:

Energy is not abstract — it is the real, confined energy of EM fields.

Mass is a label for this confined energy.

Thus,

- **Therefore , Mass is the measurable effect of spatially confined EM energy**.

6. <u>Relation with Other Theories</u>

Quantum Mechanics:-

I)Wavefunction describes the shape of the field configuration.

II)Spin is a topological twist in the field (e.g., toroidal or helical).

III)Uncertainty emerges from trade-offs in localizing EM field energy.

General Relativity

I)Energy-momentum tensor of the EM field curves spacetime:

$T\_\mu v = (1/\mu_0) * [F\_\mu\alpha * F\_v^\alpha - (1/4) *g\_\mu v * F\_\alpha\beta *F^\alpha\beta]$

Used in Einstein equation:
$G\_\mu v = (8\pi G / c^4) * T\_\mu v$

Standard Model

I)The Higgs field is not needed. Mass arises from intrinsic EM structures.

II)Charge quantization is explained via topological constraints in EM field configurations.

7. *Particle Interpretations*

Particle-   EM Field Interpretation

Electrons- Toroidal EM soliton

Proton-   Triply knotted EM field

Neutrons- Neutral nested EM configuration

Photon   -   Free-propagating EM wave

Neutrinos-   Twisted EM wave with near   zero energy

Quark-   Partial field structures with fractional charge

8. Predictions and Experimental Tests

1) Mass variability in high-EM-density environments.

2) Gravity from EM field curvature detectable via precision instruments.

3) Dark matter as undiscovered stable EM field knots.

4) Fractional charges from divided EM structures (explaining quarks).

5) Use of laser-plasma or resonant cavities to detect new field states.

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9. Final Statement

Mass is electromagnetic .
Matter, energy, inertia, and gravity are unified by the geometry of light itself.
The wall separating classical physics, quantum mechanics, and relativity collapses into a single field-based explanation, revealing the electromagnetic field as the true building block of reality.

•Equations to prove and relate the theory are as follows:

1. Energy Density of Electromagnetic Field

The total energy density (ρ) in an electromagnetic field is given by:

$$\rho = (1/2) * (\varepsilon_0 * E^2 + B^2 / \mu_0)$$

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2. *Total Electromagnetic Energy in a Region*

To get the total energy stored in a region of space with volume :
$$E = \int \left[(1/2) * \varepsilon_0 * E^2 + (1/2\mu_0) * B^2 \right] dV$$

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3. *Mass-Energy Equivalence (Einstein's Relation)*

According to Einstein's famous formula:

$$E = mc^2$$
$$=> m = E/c^2$$

Substitute the expression for energy from above equation
$$m = (1/c^2) * \int \left[(1/2) * \varepsilon_0 * E^2 + (1/2\mu_0) * B^2 \right] dV$$

This shows that mass is a direct result of the integrated electromagnetic energy density.

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4. *Electromagnetic Field Intensity Fall-Off*

Assuming the electromagnetic intensity decreases with distance from a point-like center of a particle:

$$I(r) = I_0 / r^2$$

This is consistent with the inverse square law for field strength (like electric field or light intensity in space).

You can integrate over a finite radius to find the mass contained within that region.

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5. *Nonlinear Generalization of Maxwell's Equations*

To describe stable, localized EM field configurations (solitons), a nonlinear correction can be added to Maxwell's equations:
$\partial\mu\, F^{\mu v} + \alpha * (F^{\mu v} * F\_\mu v) * F^{\mu v} = J^v$

This nonlinear term may allow for self-trapping of EM fields — potentially forming particles.

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6. *Energy-Momentum Tensor and Curvature of Spacetime*

In General Relativity, the energy-momentum tensor for the electromagnetic field is:
$T\_\mu v = (1/\mu_0) * [F\_\mu\alpha * F\_v^\alpha - (1/4) * g\_\mu v * F\_\alpha\beta * F^{\alpha\beta}]$

This enters Einstein's field equation:

$G\_\mu v = (8\pi G / c^4) * T\_\mu v$

This shows how electromagnetic energy density contributes to spacetime curvature — hinting at a unification with gravity.