Electromagnetic Model of Standing Wave Energy Flows

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Abstract

We model energy as a self-attracting electromagnetic flow confined to a toroidal standing wave. This structure leads to energy quantization purely from geometric and coherence constraints, without invoking mass, charge, quantum postulates, or spacetime curvature. We show that energy attracts energy, forming self-sustaining configurations that resist deformation. These toroidal flows exhibit quantized sizes, corresponding to discrete energy levels. Degeneracy and inertial mass emerge naturally from internal flow patterns. Momentum-wavelength relations are reinterpreted as topological phenomena. We provide a classical electromagnetic framework that reproduces atomic spectra, quantization, and inertial structures.

1. Introduction

Modern physics assumes particles, mass, charge, and quantum mechanics as foundational. We show these are not necessary. Maxwell's equations in vacuum admit self-organizing, non-divergent energy configurations. When constrained by topology and coherence, these energy flows form stable structures with quantized properties.

This model does not rely on point particles or probabilistic collapse. Instead, energy flows into closed, self-stabilizing standing wave loops—toroidal in topology—forming the foundation of atomic, inertial, and interactive phenomena.

2. Maxwell’s Equations in Vacuum

Maxwell's field equations in free space are:

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divE = 0
divB = 0
curlE = −∂B/∂t
curlB = μ₀ε₀ ∂E/∂t
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These deterministic and continuous equations support wave solutions and coherent flows. Energy is not discretized or probabilistic, but flows and interacts according to geometry and boundary conditions.

3. Toroidal Standing Waves

We model energy as confined to a torus, with two angular modes:

- Toroidal loop with winding number n_1
- Poloidal loop with winding number n_2

These loops define periodic boundary conditions:

$$\lambda_1 = (2\pi R) / n_1$$
$$\lambda_2 = (2\pi r) / n_2$$

where R and r are major and minor radii. Only wavelengths that fit exactly on both loops produce stable standing waves. This constraint leads to quantization.

4. Energy Quantization

4.1 Discrete Modes

The fundamental mode is $n_1 = n_2 = 1$, defining the lowest energy. Higher modes:

$$E_{n1,n2} \propto E_0 / (n_1 \times n_2)$$

Assuming symmetric flows ($n_1 = n_2 = n$):

$$E_n \propto E_0 / n^2$$

This reproduces the Rydberg series using only classical field structure.

4.2 Flow Degeneracy

Each angular mode allows bidirectional circulation. Degeneracy arises naturally as $2 \times n^2$ possible flow configurations for each energy level.

5. Energy Self-Attraction

From prior work, we know that energy attracts energy:

> Standing-wave modes between localized energy flows result in a net $-1/r^2$ attractive force. This arises from the 1/r spatial decay of mode amplitude and total energy conservation.
> [2]

Thus, energy naturally forms localized, coherent structures. The resulting flows gain an effective viscosity, resembling smoke rings in behavior. Toroidal confinement arises from dynamic balance: attraction and field tension create a stable radius.

6. Emergence of Inertial Mass

Mass is not fundamental, but emergent. Internal momentum circulation in the toroidal flow resists acceleration. Inertia results from the conservation of circulating field momentum. A change in direction or velocity requires energy input to deform or redirect the internal field pattern.

7. Momentum-Wavelength Reinterpretation

The de Broglie relation is not fundamental. In this model:

$$p \propto 1 / \lambda$$

Planck's constant h is not an axiom, but reflects the geometry and coherence scale of the fundamental toroidal configuration. It sets the unit of phase-energy per spatial cycle.

8. On Measurement and Collapse

No wavefunction collapse occurs. Measurement corresponds to phase realignment within the energy flow. Detection processes shift the internal structure or coherence of a standing wave, not collapse an abstract state.[1]

9. Cosmological Note

The self-attraction of energy can be perceived as cosmological expansion if the speed of light is assumed constant. This illusion is detailed in another work.
[3]

10. Conclusion

We present a model where all observed physical structure emerges from standing wave energy flows described by Maxwell's equations. Toroidal topologies, coherence, and internal circulation explain atomic quantization, inertial mass, degeneracy, and interaction—without invoking particles, quantum collapse, or curved spacetime.

This framework is purely classical, deterministic, and geometric.

References

1. Maxwell, J.C. *A Treatise on Electricity and Magnetism*, 1873.
2. A. Rodriguez, *Emergent $-1/r^2$ Interaction Force in a Pure Maxwell Universe*, Feb 2025.
   DOI: 10.13140/RG.2.2.16128.14085
3. A. Rodriguez, *The Illusion of an Expanding Universe from a Purely Classical Maxwellian Perspective*, Feb 2025.
   DOI: 10.13140/RG.2.2.17235.69922

[1] Note on Contributions: An does not fully understand the phase realignment idea for measurements. It seems to An as a non-contradictory idea.