An Exact Calculation, a Radical Hypothesis: Toward a New Physical Paradigm from Lockyer's Model

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Abstract

Lockyer's model calculates the proton-to-electron mass ratio with astonishing precision: the first seven significant digits are exact. This result, derived from fundamental constants and a geometry of nested photons, is verifiable through a previously published JavaScript program. This paper poses a question: is this a coincidence, or does this calculation reveal a profound physical truth? Exploring the latter hypothesis, we propose that the propagation of electromagnetic waves in a space deformed by energy itself accounts for the confinement of energy within matter. This emerging paradigm, where spacetime acts as a dynamic optical medium, opens perspectives for rethinking the nature of matter.

Keywords: proton-to-electron mass ratio, Lockyer's model, optical spacetime, electromagnetic wave confinement, energy density gradients, total internal reflection, fine-structure constant, nested photonic structures, proton structure.

1 Introduction

The proton-to-electron mass ratio, $\frac{m_p}{m_e} \approx 1836.1526734\ldots$, is a fundamental constant that still defies a complete theoretical explanation. Why this precise value? Standard models, such as quantum chromodynamics for the proton or quantum electrodynamics for the electron, successfully describe these particles, but the ratio $\frac{m_p}{m_e}$ remains a theoretical mystery. Lockyer's model, unconventional yet strikingly precise, calls for reflection. It posits that the proton is the sum of photons confined in nested geometric structures. This model calculates the ratio $\frac{m_p}{m_e}$ with an accuracy of seven significant digits, without any adjusted parameters.

Details of Lockyer's model can be found in a previous publication [1], which outlines the calculation and provides a JavaScript program to perform it. Here, we do not focus on the specific structure proposed by Lockyer but broaden the discussion to any structure capable of yielding an identical result.

This paper explores the implications of such a model, proposing a paradigm where spacetime, deformed by energy, acts as an optical medium that confines electromagnetic waves.

2 Lockyer's Model: A Photonic Geometry

Lockyer's model rests on a radical yet simple idea: fundamental particles are structures of electromagnetic waves confined in nested geometries. Each level, or "layer," contains photons with energy higher than the previous layer by a constant factor, determined by the confinement geometry (a detailed analysis of this factor will be published separately). The positron serves as the initial "template," with each subsequent layer nesting within the previous one, like photonic Russian dolls.

THE PROTON AS A TESSERACT
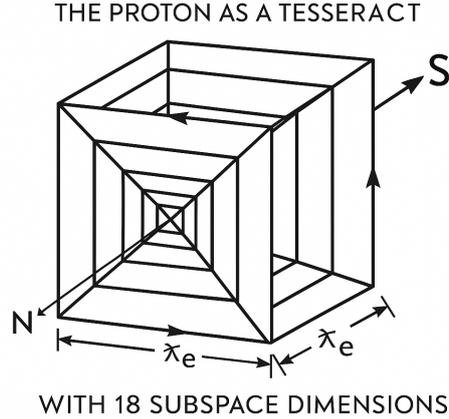

WITH 18 SUBSPACE DIMENSIONS

Figure 1: Schematic of nested photonic layers in Lockyer's model, illustrating the hierarchical structure of confined electromagnetic waves (adapted from [2]).

Remarkably, the cumulative energy calculation of these layers reproduces the ratio $\frac{m_p}{m_e} \approx 1836.1526734$ with seven correct significant digits. This result, detailed in [1], relies solely on fundamental constants and rigorous geometry, without ad hoc adjustments. The model exhibits two key properties:

- A discrete fractal structure, where each level confines photons in an identical geometry.

- A constant scaling factor between each energy level, related to the magnetic moment and the fine-structure constant.

This constant scaling factor across all levels suggests that confinement does not depend on the absolute energy of the level but on a constant geometric ratio:

$$\frac{\lambda}{R} = k,$$

where λ is the photon's wavelength and R is the radius of curvature of its trajectory. We propose that this constant ratio results from an effective refractive index, induced by the local deformation of the metric by energy. This principle, central to our hypothesis, transforms spacetime into a dynamic optical medium.

3 Central Hypothesis: An Optical Spacetime

If Lockyer's calculation is not fortuitous, it unveils a universal property of electromagnetic wave propagation. We posit that the confinement of photons in nested structures arises from a variation in energy density between levels, acting as a dynamic optical medium.

Consider electromagnetic waves organized in nested levels, each level n possessing higher energy than level $n-1$. This energy increase implies a growing energy density as one progresses toward inner levels. A wave at level n, attempting to escape to level $n-1$, transitions from a high-energy-density medium to a lower-energy-density medium. This density gradient induces an effective refractive index n_{eff}, defined qualitatively as:

$$n_{\text{eff}}(n) = f(E_n),$$

where E_n is the energy density at level n. Analogous to light passing from a dense medium (e.g., glass) to a less dense one (e.g., air), there exists a critical angle θ_c beyond which the wave undergoes total internal reflection [3]. Any trajectory imposing an incidence angle below θ_c confines the wave, preventing its escape to outer levels.

This principle, akin to total internal reflection in optics, applies to any nested structure, independent of the specific geometry proposed by Lockyer (detailed in [1]). Mathematically, the condition for total internal reflection is expressed as:

$$\sin \theta_c = \frac{n_{\text{eff}}(n-1)}{n_{\text{eff}}(n)},$$

where $n_{\text{eff}}(n) > n_{\text{eff}}(n-1)$ due to the increasing energy density. Trajectories satisfying this condition form stationary closed loops, stabilizing the wave within its level.

Notably, the proton's charge radius, measured experimentally, remains relatively constant, yet deep inelastic scattering experiments suggest a smaller size. This apparent contradiction aligns with Lockyer's model: the charge, concentrated in the initial layer (the positron), dominates the charge radius, while the mass, localized in the high-energy-density inner layers, reduces the perceived size in deep inelastic scattering. This consistency strengthens the notion that our paradigm captures fundamental aspects of the proton's structure.

Consequently, this mechanism explains:

- The stable confinement of waves, forming structures such as protons, neutrons, or electrons.

- The absolute stability of the proton, ensured by an impassable energy gradient.

- The emergence of spin and magnetic moment, via closed-loop trajectories induced by total internal reflection (in these cases, not purely stationary waves but pseudo-stationary waves resulting from the superposition of waves traveling in opposite directions along the same trajectory, with one having a slightly higher frequency and thus a slightly higher number of wavelengths than the other).

To formalize, we assume that the energy density E_n locally deforms the metric, altering wave propagation. Speculatively, the metric takes the form:

$$ds^2 = g_{\mu\nu}(E_n)dx^\mu dx^\nu,$$

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where $g_{\mu\nu}(E_n)$ depends on the energy density at level n. This deformation induces the effective refractive index, confining waves via total internal reflection.

For instance, the effective refractive index may scale with the energy density as $n_{\text{eff}}(n) \propto \sqrt{E_n}$, reflecting the increased curvature of spacetime in denser regions, analogous to gravitational lensing effects.

A rigorous derivation of this relationship, linking n_{eff} to the metric, is under development and will be presented in future work.

4 Implications: Toward a Unifying Paradigm

This model lays the foundation for a novel vision: spacetime is a dynamic optical medium, and matter is a manifestation of electromagnetic waves confined by energy density gradients. This approach offers prospects for elucidating the nature of the fine-structure constant, as it is implicated in Lockyer's model.

This paradigm must be reconciled with general relativity and quantum mechanics, whose experimental successes are indisputable. We envision that the deformation of the metric by energy gradients could serve as a bridge between these theories.

5 Discussion and Perspectives

Lockyer's model, though speculative, rests on a numerical result of unsettling precision. If this calculation reflects physical reality, it compels us to rethink space and matter. The concept of an optical spacetime, where energy density gradients confine waves via total internal reflection, resonates with modern ideas such as emergent gravity or holographic approaches, yet stands out for its universality. Unlike specific geometric models, this principle applies to any nested structure, offering theoretical flexibility. Future work will explore:

- A complete mathematical derivation of the effective refractive index and the condition for total internal reflection.

- The implications of energy density gradients on particle structure.

- A correspondence between the fine-structure constant and the refractive index of these structures.

This is merely a beginning, but a vast exploratory field lies ahead. Perhaps this new paradigm will prove non-contradictory with our current theories.

References

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