Photon Soul Continuity:
An Unobserved Extension of Maxwell's Equations

Peter De Ceuster

August 1, 2025

Abstract

We propose a minimal extension of Maxwell's equations to encode a hidden "soul" current J_s, arising from a higher-dimensional Higgs–photon coupling. In ordinary four-dimensional spacetime this additional current vanishes identically, recovering classical electromagnetism. In a bulk of dimension $4+k$, however, it induces a conserved "soul-charge" whose topological effects could manifest as tiny deviations in photon interference. We formulate the law, derive its consequences, and outline experimental signatures.

1 Introduction

Classical Maxwell theory in four dimensions is governed by

$$dF = 0, \qquad d{*}F = 0,$$

where $F = dA$ is the electromagnetic field-strength 2-form. These equations guarantee massless, Higgs-decoupled photons. We hypothesize an "unobserved" extension valid in a higher-dimensional bulk Y (real dimension $4+k$), which reduces to ordinary Maxwell in 4D but encodes a hidden soul current from a Higgs–photon coupling.

2 Modified Maxwell "Soul" Equations

Let

- $\pi : Y \to X$ be the projection from the full bulk Y to our 4D spacetime X.

- P denote the photon sheaf on Y pulled back from X.

- H denote the Higgs sheaf on Y.

- $\eta : \pi^*P \otimes H \to \mathcal{O}_Y[\ell]$ be a nontrivial morphism in the derived category.

Define the *soul current* on X by

$$J_s \;=\; R^{\bullet}\pi_*\big[\eta(\pi^*P \otimes H)\big] \;\in\; \Omega^3(X).$$

We propose the extended Maxwell equations:

$$\boxed{\begin{aligned} dF &= 0, \\ d\big({*}F \;-\; J_s\big) &= 0. \end{aligned}} \tag{}$$

3 Consistency and Reduction to 4D

- In ordinary 4D ($k = 0$), the bulk sheaf H has no support off Y, so $\pi_* \eta(\pi^* P \otimes H) = 0$. Hence $J_s = 0$ and () reduces to $dF = 0$, $d*F = 0$.

- In the full $(4 + k)$-dimensional theory, J_s need not vanish. Equation () then implies conservation of a *soul-charge*

$$Q_{\text{soul}} = \int_{\Sigma^3} \left(*F - J_s \right) \implies d \left(*F - J_s \right) = 0.$$

4 Physical Interpretation

The current J_s encodes the obstruction class $\omega(\eta)$ in cohomology, reinterpreted as a 3-form. A nonzero $\omega(\eta)$ leads to a slight violation of perfect interference visibility:

$$1 - V \sim \|\omega(\eta)\|^2 \, \Lambda^{-2k},$$

where Λ is the compactification scale. Precision quantum-optical experiments could in principle bound or detect this effect.

5 Conclusion

We have formulated a single-pair modification of Maxwell's equations that

1. Reduces exactly to classical electromagnetism in four dimensions.

2. Encodes a novel, conserved soul-charge arising from a higher-dimensional Higgs–photon coupling.

3. Makes concrete, testable predictions for deviations in interference experiments.

This "Photon Soul Continuity" law opens a new theoretical pathway to probe hidden aspects of spacetime topology and Higgs interactions. Future work will explore anomaly cancellation, coupling to gravity, and potential embeddings in string theory.

References

[1] D.S. Freed, *Dirac charge quantization and generalized differential cohomology*, Surveys in Differential Geometry **7**, 129–194 (2000).

[2] M.E. Peskin, D.V. Schroeder, *An Introduction to Quantum Field Theory*, Addison-Wesley (1995).

[3] E. Witten, *Geometric Langlands and the equations of Nahm and Bogomolny*, arXiv:1602.09021 [hep-th] (2016).