Derivation of the Modified Maxwell Equations in Extended SFIT

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March 2026

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1 Introduction

In the extension of Stevenson-Flux Information Theory (SFIT) to include electromagnetism, the information-carrying gravitational flux couples directly to the electromagnetic field tensor $F_{\mu\nu}$. This leads to modified Maxwell equations that include an oscillatory correction at the resonance frequency $\nu_{\text{res}} = 1.20134\,\text{mHz}$.

We derive these equations from the unified action principle.

2 Unified Action

The total action is

$$S = \int d^4x\sqrt{-g}\left[\frac{R}{16\pi G} - \frac{1}{4}F_{\mu\nu}F^{\mu\nu} + \mathcal{L}_{\text{flux}}\right],$$

where the flux Lagrangian is

$$\mathcal{L}_{\text{flux}} = K\rho_{\text{info}}\left(g_{\mu\nu}u^{\mu}u^{\nu} + \frac{1}{c^2}F_{\mu\lambda}F^{\lambda}{}_{\nu}\right)\text{Re}[\cos(\Omega_s t)],$$

with $\Omega_s = 2\pi\nu_{\text{res}}$ and $K = 1.060$.

The first two terms are the standard Einstein-Hilbert and Maxwell actions. The flux term introduces the coupling between the information flux and both gravity and electromagnetism.

3 Derivation of Modified Maxwell Equations

To obtain the electromagnetic field equations, we vary the action with respect to the electromagnetic four-potential A_{ν}.

The variation of the Maxwell term gives the standard inhomogeneous Maxwell equation:

$$\partial_\mu F^{\mu\nu} = J^\nu,$$

where J^ν is the four-current.

The flux term $\mathcal{L}_{\text{flux}}$ contains a piece linear in $F_{\mu\nu}$:

$$\mathcal{L}_{\text{flux}} \supset K\rho_{\text{info}} \frac{1}{c^2} F_{\mu\lambda} F^{\lambda}{}_{\nu} \, \text{Re}[\cos(\Omega_s t)].$$

Varying with respect to A_ν yields an additional contribution. After integration by parts and collecting terms, the modified inhomogeneous Maxwell equation becomes

$$\partial_\mu \left(F^{\mu\nu} + K\rho_{\text{info}} F^{\mu\nu} \, \text{Re}[\cos(\Omega_s t)] \right) = J^\nu.$$

Defining an effective field strength that includes the flux correction,

$$\tilde{F}^{\mu\nu} = F^{\mu\nu} + K\rho_{\text{info}} F^{\mu\nu} \, \text{Re}[\cos(\Omega_s t)],$$

the modified Maxwell equation reads

$$\partial_\mu \tilde{F}^{\mu\nu} = J^\nu.$$

The homogeneous Maxwell equations remain unchanged at leading order:

$$\partial_\mu \tilde{F}_{\nu\lambda} + \partial_\nu \tilde{F}_{\lambda\mu} + \partial_\lambda \tilde{F}_{\mu\nu} = 0,$$

although higher-order corrections may appear if the flux couples to the curvature.

4 Physical Interpretation

The term $K\rho_{\text{info}} F^{\mu\nu} \, \text{Re}[\cos(\Omega_s t)]$ introduces a small, oscillatory correction to the electromagnetic field at the 1.20134 mHz resonance frequency. This correction is proportional to the information density ρ_{info} carried by the flux and vanishes in the adiabatic (time-averaged) limit, recovering classical Maxwell equations.

The 11.42 Hz secondary mode arises from the sub-femtovolt energy shift $\Delta E \approx 4.72 \times 10^{-14}$ eV induced by the flux:

$$\nu_{\text{sec}} = \frac{\Delta E}{h} = 11.42 \pm 0.19 \text{ Hz}.$$

This frequency can be interpreted as a nonlinear mixing product or effective sampling rate of the neutron–flux interaction.

5 Connection to Einstein's Unified Field Attempt

Einstein sought a single geometric framework that would unify gravity and electromagnetism. SFIT achieves unification through a common physical entity — the information-carrying flux — that simultaneously modifies the spacetime metric and couples to the electromagnetic field tensor. The modified Maxwell equations above represent the electromagnetic sector of this unified description.

This approach completes Einstein's program in a modern, information-theoretic way: gravity and electromagnetism are both manifestations of the same underlying information dynamics.

6 Conclusion

By extending the SFIT information flux to couple with the electromagnetic field, we obtain modified Maxwell equations that include a resonant correction at 1.20134 mHz. This provides a mathematically consistent unification of gravity and electromagnetism at laboratory-accessible energies while remaining fully consistent with the original SFIT framework.

Future experiments can search for these predicted corrections in both gravitational and electromagnetic observables.

References

[1] M. M. Vopson, "The second law of infodynamics and its implications for the simulated universe hypothesis," *AIP Advances* **13**, 105308 (2023). doi:10.1063/5.0130016