Noetica Physics: A Resonant Field Theory (RFT)

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Abstract

Noetica Physics (Resonant Field Theory, RFT) proposes that the fundamental architecture of the universe is **resonant rather than particulate**—a continuous field of coupled oscillations whose geometry determines observable matter, energy, and information. The theory reformulates physical interactions as *phase relations* within a harmonic manifold. Where General Relativity describes curvature of spacetime and Quantum Mechanics quantizes energy states, RFT treats **phase coherence** as the unifying variable linking both domains. It directly addresses the long-standing paradox between relativity's smooth, deterministic spacetime and quantum mechanics' probabilistic, discontinuous nature. RFT posits that these conflicting pictures emerge from different limits of the same resonant substrate—curvature and coherence as dual expressions of one field. The central claim: *all fields—gravitational, electromagnetic, quantum, or informational—are expressions of a universal phase field whose curvature encodes energy and whose coherence encodes order.*

A Step-by-Step Derivation of the Euler–Lagrange Equations (RFT)

Conventions. Spacetime is a smooth 3+1D manifold with metric $g_{\mu\nu}$ (signature $(+,-,-,-)$), Levi–Civita tensor $\varepsilon^{\mu\nu\rho\sigma}$ with $\varepsilon^{0123}=+1$, and covariant derivative ∇_μ. Natural units ($\hbar=c=1$). Indices are raised with $g^{\mu\nu}$. Define the dual field strength $\tilde{F}^{\mu\nu} := \frac{1}{2}\varepsilon^{\mu\nu\rho\sigma}F_{\rho\sigma}$.

A.1 Fields and Lagrangian

Fields. Phase $\theta(x) \in S^1$; gauge potential $A_\mu(x)$; field strength $F_{\mu\nu} := \partial_\mu A_\nu - \partial_\nu A_\mu$; covariant phase gradient $D_\mu\theta := \partial_\mu\theta - A_\mu$. Stiffness tensor $K^{\mu\nu}(x)$ is symmetric positive-definite.

Action.

$$S[\theta, A] = \int d^4x\sqrt{|g|}\mathcal{L}_{\mathrm{RFT}}, \tag{1}$$

where

$$\mathcal{L}_{\mathrm{RFT}} = \frac{\kappa_1}{2}D_\mu\theta K^{\mu\nu}D_\nu\theta - \frac{\kappa_2}{4}F_{\mu\nu}F^{\mu\nu} - V(\theta) + J^\mu D_\mu\theta + \frac{\alpha}{8\pi}\theta F_{\mu\nu}\tilde{F}^{\mu\nu}. \tag{2}$$

A.2 Variation with respect to θ

Using $\delta D_\mu\theta = \partial_\mu\delta\theta$ and integrating by parts, the variation of the action is:

$$\delta S_\theta = \int d^4x\sqrt{|g|}\delta\theta\left\{-\nabla_\nu(\kappa_1 K^{\nu\mu}D_\mu\theta + J^\nu) - \frac{\partial V}{\partial\theta} + \frac{\alpha}{8\pi}F_{\mu\nu}\tilde{F}^{\mu\nu}\right\}. \tag{3}$$

This yields the **Phase Equation (Euler-Lagrange)**:

$$\nabla_\nu(\kappa_1 K^{\nu\mu}D_\mu\theta + J^\nu) + \frac{\partial V}{\partial\theta} = \frac{\alpha}{8\pi}F_{\mu\nu}\tilde{F}^{\mu\nu}. \tag{4}$$

A.3 Variation with respect to A_μ

With $\delta D_\mu\theta = -\delta A_\mu$ and $\delta F_{\mu\nu} = \nabla_\mu \delta A_\nu - \nabla_\nu \delta A_\mu$, integrating by parts gives:

$$\delta S_A = \int d^4x \sqrt{|g|} \delta A_\mu \left\{ \kappa_2 \nabla_\nu F^{\nu\mu} - \kappa_1 K^{\mu\nu} D_\nu \theta - J^\mu - \frac{\alpha}{2\pi} (\partial_\nu \theta) \tilde{F}^{\nu\mu} \right\}. \tag{5}$$

This yields the **Gauge Equation (Euler-Lagrange)**:

$$\nabla_\nu F^{\nu\mu} = \frac{1}{\kappa_2} \left(\kappa_1 K^{\mu\nu} D_\nu \theta + J^\mu + \frac{\alpha}{2\pi} (\partial_\nu \theta) \tilde{F}^{\nu\mu} \right). \tag{6}$$