Exploring Possible Emergence of SFIT from Loop Quantum Gravity (LQG)
Hypothetical Mathematical Relations

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1 Introduction

This document explores hypothetical mathematical relations that could show how Stevenson-Flux Information Theory (SFIT) emerges as a low-energy, coarse-grained effective theory from the microscopic spin-network structure of Loop Quantum Gravity (LQG).

SFIT operates at laboratory scales with a resonant information-carrying flux at $\nu_{\text{res}} = 1.20134\,\text{mHz}$ and coupling kernel $K = 1.060$. LQG describes Planck-scale discrete geometry via spin networks. We propose that collective, long-wavelength excitations of these networks can behave as the coherent SFIT flux, with K and ν_{res} emerging from coarse-graining parameters such as the Immirzi parameter γ and spin-network density.

All relations below are **speculative and exploratory**. They are constructed to be mathematically consistent with both frameworks and are intended as a starting point for further theoretical work.

2 Key LQG Ingredients

In LQG, the fundamental quantum geometry is described by spin networks. The area operator for a surface pierced by a link of spin j is

$$\hat{A} = 8\pi\gamma\ell_{\text{P}}^2\sqrt{j(j+1)},$$

where $\gamma \approx 0.2375$ is the Immirzi parameter and $\ell_\mathrm{P} = \sqrt{\hbar G/c^3}$ is the Planck length.

The number density of spin-network links per unit volume in a macroscopic region (e.g., near Earth's surface) can be denoted ρ_links. Coarse-graining over many links yields an effective continuous geometry.

3 Hypothetical Emergence Relations

3.1 1. Emergence of the SFIT Resonance Frequency ν_res

We hypothesize that the 1.20134 mHz Quantum Heartbeat arises as a collective low-frequency mode of spin-network excitations in Earth's gravitational field. A possible relation is

$$\nu_\mathrm{res} = \frac{3}{4} \cdot \frac{g}{2\pi R_E} \cdot f(\gamma, \rho_\mathrm{links}),$$

where g and R_E are Earth's surface gravity and radius (matching the SFIT geometric scaling), and $f(\gamma, \rho_\mathrm{links})$ is a dimensionless function encoding the collective mode frequency.

A simple ansatz motivated by spin-network statistics is

$$f(\gamma, \rho_\mathrm{links}) = K \cdot \sqrt{\gamma \cdot \rho_\mathrm{links} \cdot \ell_\mathrm{P}^2},$$

with $K = 1.060$ emerging as the effective coupling. This would tie ν_res directly to the underlying LQG discreteness while reproducing the exact SFIT prediction.

3.2 2. Emergence of the Coupling Kernel K

The refined coupling kernel $K = 1.060$ that appears in the SFIT potential

$$V_\mathrm{SFIT}(z,t) = m_n g z \left[1 + K \cdot \frac{z}{R_E} \mathrm{Re}(\cos(2\pi\nu_\mathrm{res} t))\right]$$

may emerge from averaging the LQG area/volume fluctuations. A possible coarse-graining relation is

$$K = \frac{\langle \delta A \rangle}{\langle A \rangle} \cdot \frac{1}{\gamma},$$

where $\langle \delta A \rangle / \langle A \rangle$ is the relative fluctuation amplitude of spin-network areas at the macroscopic scale. For typical values of $\gamma \approx 0.2375$, this would require a fluctuation amplitude of order ~ 0.25 to yield $K \approx 1.060$, consistent with collective excitations.

3.3 3. Non-Reciprocal Metric Correction from Spin-Network Dynamics

The SFIT non-reciprocal perturbation

$$h_{0z}^\mathrm{SFIT}(t) = \alpha_z \, \mathrm{Re}[\cos(\Omega_s t)], \quad \Omega_s = 2\pi\nu_\mathrm{res},$$

could emerge as the expectation value of a coarse-grained holonomy operator in a coherent spin-network state:

$$h_{0z}^\mathrm{SFIT}(t) \approx \frac{\langle \psi | \hat{h}_{0z}(t) | \psi \rangle}{\langle \psi | \psi \rangle},$$

where $\hat{h}_{0z}(t)$ is a time-dependent operator built from holonomies along the z-direction. The amplitude $\alpha_z \approx 0.00122$ would then be related to the spin-network density and Immirzi parameter via

$$\alpha_z \propto \gamma \cdot \rho_\mathrm{links} \cdot \ell_\mathrm{P}^2 \cdot \frac{g R_E}{c^2}.$$

3.4 4. KWW Relaxation Tails from Spin-Network Memory

The observed KWW tails ($\tau \approx 832.6\,\text{s}$, $\beta = K = 1.060$) after mirror steps may reflect the slow relaxation of perturbed spin-network states back to equilibrium. A possible effective description is that the memory kernel in the SFIT-modified TDSE arises from the autocorrelation of spin-network fluctuations:

$$\langle \delta A(t) \delta A(0) \rangle \propto \exp\left[-\left(\frac{t}{\tau} \right)^{\beta} \right],$$

with β inherited from the same collective-mode statistics that produce K. This would naturally link the stretching exponent to the coupling kernel.

4 Effective SFIT TDSE from LQG Coarse-Graining

Starting from an LQG-derived effective Hamiltonian for ultra-cold neutrons in Earth's gravity, a coarse-graining procedure over spin-network degrees of freedom could yield the SFIT-modified time-dependent Schrödinger equation:

$$i\hbar \frac{\partial \psi}{\partial t} = \left[-\frac{\hbar^2}{2m} \frac{\partial^2}{\partial z^2} + mgz \left(1 + K \frac{z}{R_E} \cos(\Omega_s t) \right) \right] \psi.$$

The correction term would be the leading-order contribution from the expectation value of the fluctuating LQG geometry.

5 Testable Consequences and Falsifiability

If SFIT emerges from LQG in the manner sketched above, then:

- The value of K should be related to γ and the local spin-network density near Earth.
- Future high-precision measurements of the 1.20134 mHz resonance (e.g., GRANIT) would constrain LQG parameters at macroscopic scales.
- Deviations from the predicted KWW tails or sideband ratios would falsify both the SFIT emergence picture and the specific coarse-graining ansatz.

6 Conclusion

The equations presented here are hypothetical but mathematically consistent attempts to derive SFIT parameters (K, ν_{res}, non-reciprocal h_{0z}, KWW exponent β) from LQG spin-network coarse-graining. They suggest that SFIT could be the low-energy, collective-mode limit of LQG, with the 1.20134 mHz Quantum Heartbeat arising as a resonant excitation of the underlying quantum geometry.

These relations provide a concrete pathway for unifying the Planck-scale discreteness of LQG with the laboratory-scale information flux of SFIT. They are offered as a stimulus for further theoretical investigation and as a guide for interpreting future experimental results from ultra-cold neutron gravity resonance spectroscopy.