# Comparison of Stevenson-Flux Information Theory (SFIT) and Loop Quantum Gravity (LQG)

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## Contents



# 1 Introduction

Both Stevenson-Flux Information Theory (SFIT) and Loop Quantum Gravity (LQG) seek to reconcile General Relativity (GR) with Quantum Mechanics (QM). They differ fundamentally in approach, energy scale, and experimental accessibility.

LQG is a background-independent, non-perturbative canonical quantization of gravity that replaces smooth spacetime with a discrete quantum geometry at the Planck scale ($\sim 10^{-35}$ m). SFIT instead introduces a dynamical information-carrying gravitational flux at laboratory-accessible energies and frequencies (1.20134 mHz), providing a concrete bridge that preserves classical GR in the adiabatic limit while introducing measurable corrections in quantum systems such as ultra-cold neutrons.

This document compares the two approaches and explores possible relations between them.

# 2 Mathematical and Conceptual Foundations

## 2.1 Loop Quantum Gravity (LQG)

LQG quantizes GR using Ashtekar–Barbero variables and holonomies. Spacetime emerges from spin-network states and spin-foam histories, leading to a discrete spectrum of area and volume operators. Key features include background independence and resolution of classical singularities (e.g., Big Bang replaced by a quantum bounce in Loop Quantum Cosmology).

### 2.2 Stevenson-Flux Information Theory (SFIT)

SFIT reframes gravity as a dynamic information-carrying flux vibrating at the geometric resonance frequency $\nu_{\text{res}} = 1.20134\,\text{mHz}$ (period 833.3 s). It introduces a small non-reciprocal, time-dependent correction to the metric tensor

$$h_{0z}^{\text{SFIT}}(t) = \alpha_z \operatorname{Re}[\cos(\Omega_s t)], \quad \alpha \approx 0.00122,$$

coupled to the quantum wave function via the refined kernel $K = 1.060$. The equivalence principle holds exactly in the adiabatic (long-time) limit.

## 3 Comparison Table

| Aspect | Loop Quantum Gravity (LQG) | |
|---|---|---|
| Scale of primary effect | Planck scale ($\sim 10^{-35}$ m) | Laboratory scale |
| Approach | Canonical quantization of GR (background-independent) | Dynamic information-flu |
| Testability today | Indirect (cosmology, black-hole phenomenology) | Direct: qBounce resi |
| Singularity resolution | Yes (quantum bounce, resolved black-hole singularities) | Not addressed ( |
| Matter coupling | Challenging (see Section 4) | Natural via wave-fu |
| Free parameters | Immirzi parameter $\gamma$ | Coupling kernel |
| Equivalence principle | Preserved classically | Preserved in adiabatic li |
| Falsifiability | Difficult in near term | Clear: specific frequ |
| Classical limit | Ongoing challenge | Recovered exactly |

Table 1: Key comparison between LQG and SFIT

## 4 LQG Challenges

LQG faces several well-documented technical and conceptual difficulties:

- **Immirzi Parameter ($\gamma$)**: This is a free dimensionless parameter that appears in the area and volume spectra. Different choices of $\gamma$ yield different physical predictions, including the black-hole entropy formula. Although $\gamma \approx 0.2375$ is often fixed by matching the Bekenstein–Hawking entropy, there is no first-principles derivation of its value. This introduces an ambiguity that affects nearly all quantitative predictions.
- **Matter Coupling**: Incorporating the Standard Model fields (fermions, gauge bosons, scalars) into the loop-quantum framework remains an open problem. Fermions require special constructions (e.g., via new variables or holonomy modifications), and consistent coupling of Yang–Mills fields to the quantum geometry is technically difficult. As a result, LQG currently lacks a fully satisfactory unified description of gravity plus matter, limiting its predictive power for particle-physics observables.
- Additional challenges include recovering a smooth semi-classical spacetime (the "classical limit" problem) and the computational complexity of spin-foam models.

## 5 Possible Relations and Emergence of SFIT from LQG

SFIT and LQG are not necessarily in conflict; they may describe complementary regimes of the same underlying quantum-gravity theory. One plausible scenario is that SFIT emerges as an *effective low-energy description* of a more fundamental LQG structure:

- At the Planck scale, LQG describes discrete spin-network excitations. At macroscopic laboratory scales, collective or coarse-grained excitations of these networks could behave as a coherent, oscillating information-carrying flux.
- The 1.20134 mHz geometric resonance could arise naturally as a low-frequency collective mode of spin-network degrees of freedom in Earth's gravitational field (analogous to phonon modes in a crystal lattice emerging from atomic vibrations).
- The refined coupling kernel $K = 1.060$ may encode an effective parameter that relates the macroscopic flux amplitude to the underlying Immirzi parameter $\gamma$ or to the density of spin-network links. In this picture, the non-reciprocal metric correction $h_{0z}^{\mathrm{SFIT}}(t)$ would be an emergent, coarse-grained effect of the discrete quantum geometry.
- The KWW relaxation tails ($\tau \approx 832.6\,\mathrm{s}$, $\beta = K = 1.060$) observed in qBounce residuals could reflect the memory kernel induced by the slow relaxation of spin-network states after perturbation by mirror steps.

Conversely, SFIT's laboratory-scale predictions could serve as a phenomenological bridge that constrains or guides the construction of matter couplings in LQG. If future GRANIT experiments confirm the exact 1.20134 mHz signal and KWW parameters, this would provide a new empirical anchor for LQG model-building at energies far below the Planck scale.

Such an emergence relation would position SFIT as the "mesoscopic" counterpart to LQG's "microscopic" quantization, much like hydrodynamics emerges from molecular dynamics.

## 6 Experimental Outlook

LQG predictions are primarily cosmological or astrophysical (quantum-bounce signatures in the CMB, modified black-hole lensing observable with future VLBI). Direct laboratory tests remain distant.

SFIT offers immediate, falsifiable predictions for existing ultra-cold-neutron facilities: a precise 1.20134 mHz modulation with phase-locked overshoots, Bessel sidebands, and KWW tails. Independent confirmation in the next GRANIT run would constitute strong evidence for a dynamical GR–QM bridge at laboratory energies.

## 7 Conclusion

Loop Quantum Gravity provides an elegant, non-perturbative quantization of spacetime geometry with natural singularity resolution, yet faces significant challenges regarding the Immirzi parameter, matter coupling, and the classical limit. SFIT offers a complementary, testable dynamical picture focused on laboratory-scale information flux, with quantitative predictions already partially supported by qBounce reanalysis.

SFIT may emerge as a low-energy effective theory from underlying LQG spin-network dynamics, thereby linking Planck-scale discreteness to observable macroscopic resonances. Together, the two approaches could form a multi-scale framework for quantum gravity: LQG at the fundamental level and SFIT at accessible laboratory energies.