Deriving the SFIT Coupling Kernel $K = 1.060$ from the LQG Immirzi Parameter γ (Numerical Expansion)

Douglas G. Stevenson
stevensonfluxinformationtheory.com

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1 Introduction

In Loop Quantum Gravity (LQG), the Immirzi parameter γ rescales the quantum of area and is fixed by matching the Bekenstein–Hawking black-hole entropy, giving the standard value

$$\gamma \approx 0.2375.$$

In Stevenson-Flux Information Theory (SFIT), the refined coupling kernel $K = 1.060$ governs the strength of the information-flux correction and sets the KWW stretching exponent $\beta = K$.

This note expands the previous derivation with explicit numerical calculations, showing how K can emerge from γ via coarse-graining of spin-network fluctuations at laboratory scales. All relations are **hypothetical and exploratory**.

2 LQG Area Operator

The area operator for a surface pierced by a link of spin j is

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

where $\ell_P = 1.616\,255 \times 10^{-35}$ m is the Planck length. In a macroscopic region the effective geometry arises from a dense spin-network with link density ρ_{links} (effective punctures per unit area after coarse-graining).

3 Hypothetical Coarse-Graining Ansatz

The relative area fluctuation amplitude at macroscopic scales is taken as

$$\frac{\langle \delta A \rangle}{\langle A \rangle} \approx C \cdot \gamma \cdot \rho_{\text{links}} \cdot \ell_P^2,$$

where C is a dimensionless collective-mode factor of order unity. The SFIT coupling kernel is identified with the effective fluctuation strength:

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

Substituting the ansatz yields the γ-cancellation:

$$K \approx C \cdot \rho_{\text{links}} \cdot \ell_P^2.$$

4 Numerical Evaluation

Using the standard LQG value $\gamma \approx 0.2375$ and the exact Planck length $\ell_P = 1.616\,255 \times 10^{-35}$ m, we solve for the parameters that reproduce the observed SFIT value $K = 1.060$.

4.1 Example 1: Fixed $C = 1$ (Minimal Ansatz)

If we set $C = 1$ (purely statistical averaging), then

$$\rho_{\text{links}} \approx \frac{K}{\ell_P^2} = \frac{1.060}{(1.616\,255 \times 10^{-35})^2} \approx 4.06 \times 10^{69}\ \text{m}^{-2}.$$

This is an extremely large but plausible effective density after coarse-graining over $\sim 10^{70}$ microscopic links per square metre in a macroscopic volume.

4.2 Example 2: More Realistic Collective Factor $C \approx 4.46$

A collective-mode factor $C \approx 4.46$ (arising from averaging over many neighbouring links and Earth's gravitational gradient) gives a lower effective density:

$$\rho_{\text{links}} \approx \frac{K}{C \cdot \ell_P^2} = \frac{1.060}{4.46 \times (1.616\,255 \times 10^{-35})^2} \approx 9.10 \times 10^{68}\ \text{m}^{-2}.$$

This value is still huge compared with everyday matter densities, but it is consistent with the enormous number of Planck-scale degrees of freedom that must be coarse-grained to recover a smooth metric plus a small oscillating flux correction.

4.3 Explicit γ-Dependent Form

Retaining γ dependence for possible constraints, one can write

$$K = \frac{\gamma_0}{\gamma} \left(1 + \frac{\delta\gamma}{\gamma}\right),$$

where $\gamma_0 \approx 0.2375$ is the entropy-matching value. Setting $K = 1.060$ implies

$$1.060 = \frac{0.2375}{\gamma}\left(1 + \frac{\delta\gamma}{\gamma}\right).$$

Solving for a small deviation $\delta\gamma/\gamma \approx 3.47$ (when $\gamma = \gamma_0$) shows that macroscopic collective effects could produce the required enhancement from the microscopic γ.

5 Connection to KWW Exponent

Since $\beta = K$ in SFIT, the same coarse-graining directly yields the observed stretching exponent:

$$\beta \approx C \cdot \rho_{\text{links}} \cdot \ell_{\text{P}}^2 \approx 1.060.$$

Thus both the coupling strength and the KWW relaxation tails are tied to the same underlying spin-network statistics.

6 Testable Implications

- A high-precision measurement of K (or β) in future GRANIT runs would constrain the effective spin-network density ρ_{links} or deviations in γ at laboratory scales.
- The relation predicts that K should be largely independent of the precise microscopic value of γ, providing a falsifiable test of this emergence picture.

7 Conclusion

By explicit numerical evaluation we have shown that the SFIT coupling kernel $K = 1.060$ can emerge naturally from the LQG Immirzi parameter $\gamma \approx 0.2375$ via coarse-graining of spin-network area fluctuations. The γ-cancellation in the leading-order expression is elegant, and the required effective link density ($\sim 10^{68}$–10^{69} m^{-2}) is consistent with a dense but coarse-grained quantum geometry at macroscopic distances.

This numerical derivation provides a concrete, calculable pathway linking Planck-scale discreteness to the laboratory-scale Quantum Heartbeat of SFIT. It is offered as a stimulus for further theoretical and phenomenological investigation.