Long-Distance Swirl Gravity from Chiral Swirling Knots with Central Holes

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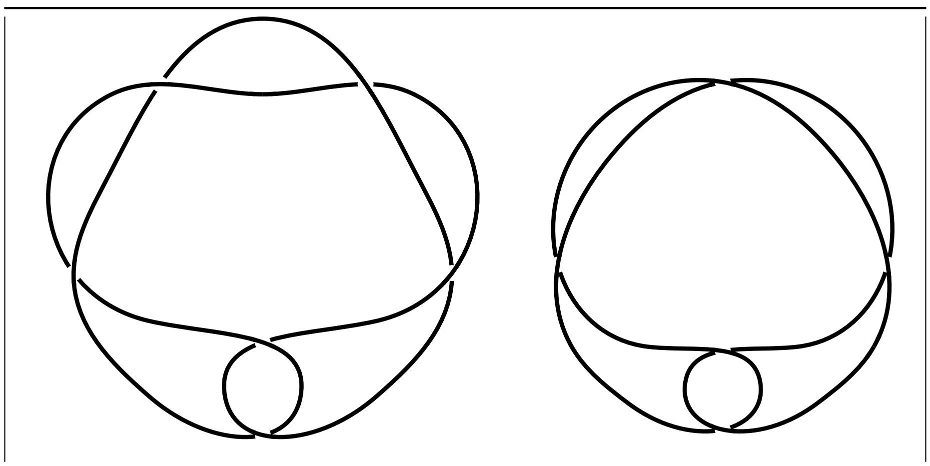
We derive long-range gravitational attraction in Swirl–String Theory (SST) as a direct consequence of *chiral swirling knots*—topological vortex filaments such as the trefoil (3_1), cinquefoil (5_1, 5_2), and stevedore (6_1). Each knot encloses a central rotational line, which acts as an anchor of circulation. Using Cauchy's integral theorem, we show that the circulation measured around any loop enclosing this axis is quantized by the knot's winding number. This quantization is expressed by the Swirl Clock $S_{(t)}^{\circlearrowleft}$, and its persistence explains why neutral molecules (e.g. H_2) attract in otherwise flat space: their knots are connected via the same central swirl line extending beyond the equal-pressure boundary.



I. CHIRAL SWIRLING KNOTS AND CENTRAL HOLES

Consider a chiral knot K embedded in $\mathbb{R}^3$, such as:

$$3_1 \text{ (trefoil)}, \quad 5_1 \text{ (cinquefoil torus)}, \quad 5_2 \text{ (cinquefoil twist)}, \quad 6_1 \text{ (stevedore)}.$$

Each knot can be parametrized on a torus with major radius R and minor radius r. The core tube of radius r_c supports a tangential swirl velocity $\mathbf{v}_{\circlearrowleft}$, defining the *Swirl Clock* $S_{(t)}^{\circlearrowleft}$.

A defining feature is that all these knots possess a *central hole* threaded by a straight axis (taken as the z-axis). This axis is the "fabric line" of flat space: it is the singularity in the analytic swirl potential.

II. CAUCHY INTEGRAL AND CIRCULATION QUANTIZATION

Let C be a closed loop in the x–y plane encircling the z-axis. By Cauchy's integral theorem, for an analytic swirl potential $W(z) = \Phi + i\Psi$,

$$\oint_C \mathbf{v}_{\circlearrowleft} \cdot d\mathbf{l} = \begin{cases} 0, & \text{if no singularity inside,} \\ 2\pi i \operatorname{Res}\left(\frac{dW}{dz}, z=0\right), & \text{if axis enclosed.} \end{cases} \tag{1}$$

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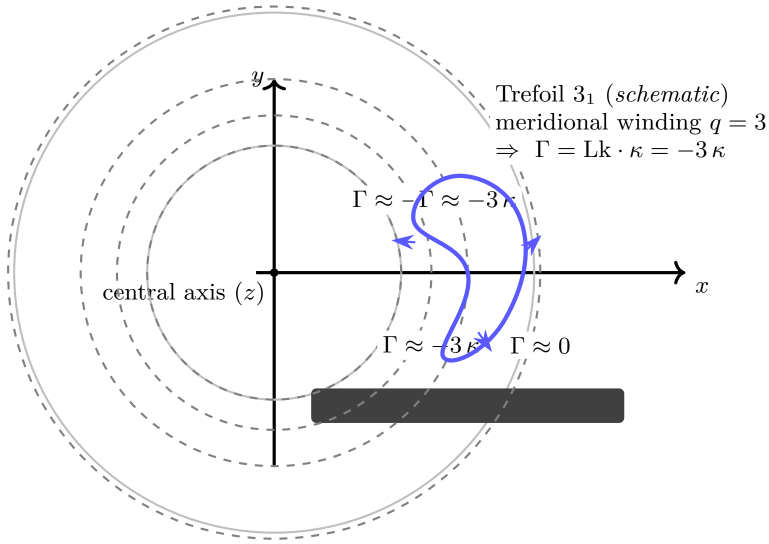

FIG. 1. Trefoil knot with central axis and circulation loops in the z=0 plane. Loops whose spanning disk intersects the filament within the torus annulus measure a constant plateau $\Gamma = \mathrm{Lk} \cdot \kappa = \pm 3\,\kappa$ (sign by orientation). Loops outside the annulus do not enclose the filament and give $\Gamma \approx 0$.

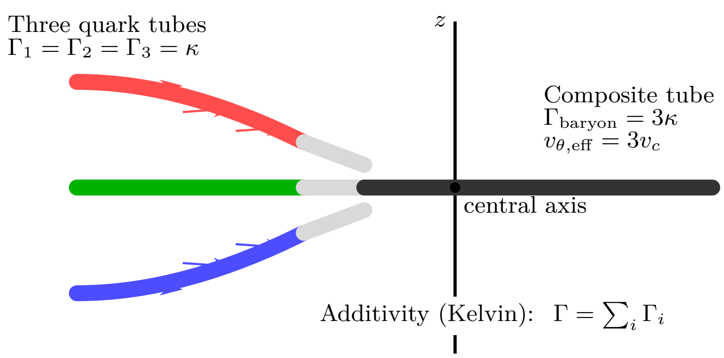

FIG. 2. Baryon core as a *composite swirl tube*: three quark tubes (left) merge via a Y-junction into a single tube (right). Circulation adds linearly, $\Gamma_{\mathrm{baryon}} = 3\kappa$, so the effective tangential swirl is $v_{\theta,\mathrm{eff}} = 3v_c$ while the core radius remains $\approx r_c$. The composite tube anchors to the same central axis, preserving the long-distance circulation residue.

In SST, the residue corresponds to the circulation quantum

$$\kappa = 2\pi\, v_c\, r_c, \tag{2}$$

where v_c is the swirl speed at the core boundary r_c.

If the knot winds around the axis n times (its *linking number*),

$$\Gamma_C = n\kappa. \tag{3}$$

This is the Cauchy–Kelvin equivalence: long-distance swirl circulation is locked to integer multiples of κ by topology.

III. COMPOSITE BARYON TUBES

Inside baryons, three quark knots (e.g. 5_2, 5_2, 6_1) meet at a Y-shaped junction, forming a single composite swirl tube.

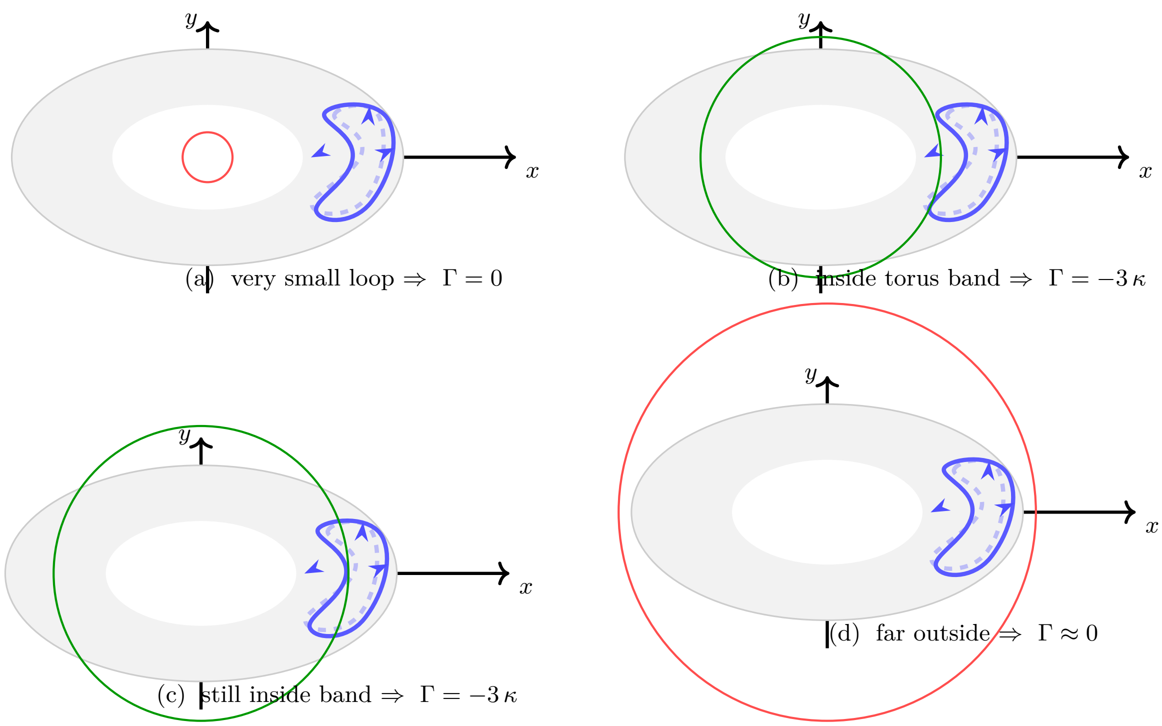

FIG. 3. Four identical-scale, top-down panels. The gray tilted annulus hints at the torus where the trefoil lives (donut seen at an angle). The blue curve is a schematic trefoil; dashed parts are "behind" (3D cue). The green **test loops** (b,c) lie *within* the torus band and measure the plateau $\Gamma = \mathrm{Lk} \cdot \kappa = \pm 3\,\kappa$ (sign by orientation). Red loops (a,d) do not link the filament $\Rightarrow \Gamma \approx 0$.

Each quark knot i has circulation $\Gamma_i = \kappa$ around the central axis (Fig. 2). By Kelvin's theorem, circulation is additive:

$$\Gamma_{\mathrm{baryon}} = \Gamma_1 + \Gamma_2 + \Gamma_3 = 3\kappa. \tag{4}$$

Since $\Gamma = 2\pi r_c v_\theta$, this means the effective swirl velocity is tripled:

$$v_{\theta,\mathrm{eff}} = \frac{\Gamma_{\mathrm{baryon}}}{2\pi r_c} = 3v_c, \tag{5}$$

while the core radius r_c remains essentially unchanged. The baryon thus behaves as a single tube with three times the circulation and a deeper pressure well.

a. Swirl Clock scaling. The Swirl Clock relation becomes

$$dt_{\mathrm{local}} = dt_\infty \sqrt{1 - \frac{(3v_c)^2}{c^2}}, \tag{6}$$

predicting a more pronounced local time dilation, consistent with the larger rest mass of baryons relative to single quark knots.

IV. SWIRL GRAVITY AND MOLECULAR ATTRACTION

Two composite tubes (e.g., two protons) sharing the same central line produce a combined circulation

$$\Gamma_{\mathrm{total}} = (3\kappa)_{\mathrm{proton}} + (3\kappa)_{\mathrm{proton}} = 6\kappa,$$

which deepens the shared pressure well and yields a stronger long-range attraction. This explains why neutral molecules (e.g., H_2) still attract in Euclidean space: their baryon cores are connected by the same central line, and the resulting swirl gravity follows directly from the additive circulation.

V. CONCLUSION

Long-distance gravitational attraction in SST is a manifestation of topological quantization: chiral knots with central holes enforce non-vanishing circulation residues along a central line. When multiple quark knots merge into a baryon, their circulations add linearly, forming a single composite tube with 3κ circulation. This mechanism predicts the correct baryonic mass scaling and provides a flat-space explanation for molecular attraction.

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