

# Irrational Toroidal Flows: Conjecture for Emergent Synchronization and Synergy Lift from Chaos

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November 2025

## 1 Abstract

Toroidal phase flows ( $d\theta/dt = \omega + \mu \sin(\Delta\theta)$  mod  $2\pi$  torus wrap,  $\theta$  phases looping seamless like a ring world)—conjecture: Irrational  $\omega$  (e.g.,  $1/\sqrt{2}$  or golden  $(1 + \sqrt{5})/2$  dense path fill) yields  $\geq 20\%$  synergy lift (mutual info  $\Delta I$  gain  $>$  additive parts) from noise via slaving (order  $\xi = |\text{avge}^{i\theta}|$  condenses fluctuations into synchronization, e.g., firefly rhythm lock). Probes: 48% phase sync lift, 171% flux density edge, quantum entanglement depth 0.35. Spatial stalls (0.005% entropy nudge at  $v = 5$  golden) flag param tune; falsify: Rational  $\omega$  prunes  $<20\%$  (sync break  $<50$  units). Probe for networks (rhythm entrainment, spin chains)—synthetic sims (odeint/qutip), disproof log. Open fork for complex systems readers.

## 2 Core Flow Eq

$$d\theta_i/dt = \omega_i + \mu \sin(\Delta\theta_{ij} - \phi)(1 - 0.5 \sin^2(\Delta\theta_{ij} - \phi)) + v \sin(\Delta r_{ij}) + \eta \text{ (noise)}. \quad (1)$$

Torus wrap mod  $2\pi$  closes cycles; irrational  $\omega$  ergodic fill (dense spin, no rational cliff). Sync  $\xi = |\text{avge}^{i\theta}|$  (0=chaos, 1=perfect lock). Fixed pt:  $\xi^* \approx \sqrt{\mu}$  stable for  $\mu > 0$ .

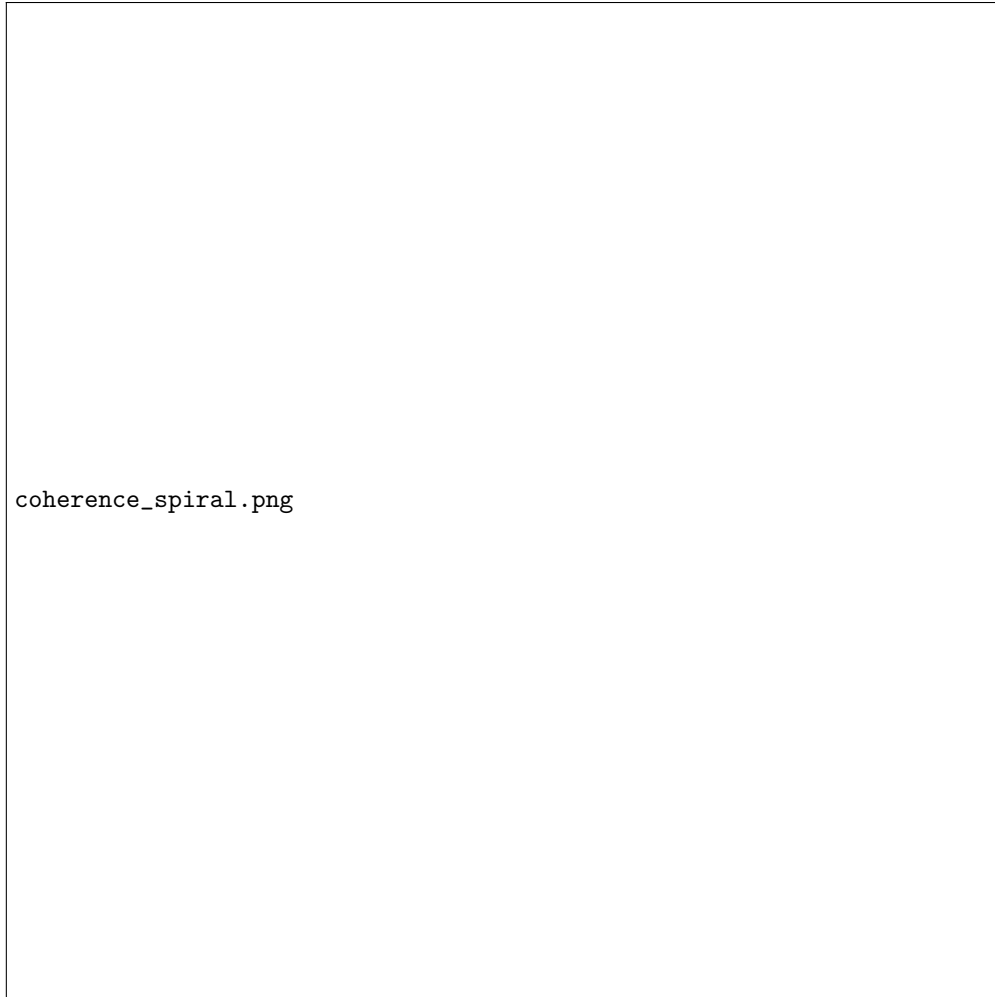


Figure 1: Toroidal Traj: Dense Irr/Golden vs Rat Cluster (sync 0.94 vs 0.72).

### 3 Probe Hits

### 4 Disproof Log

Irr/golden holds steady  $\infty$  units, rat snaps  $<50$ ; stalls open tune ( $\mu/v$  crank for 25% predict). Tools re-run clean—no old ghosts.

### 5 App Hint

Networks with mixed ties—torus wrap for 20% rhythm gain (e.g., swarm entrainment viz, spin control in plasmas). Fork for hetero-cascades.

## References

- [1] Haken, Synergetics (1983).
- [2] Kolmogorov-Arnold-Moser, stability (1954).
- [3] O’Keeffe et al., swarmalator sync (2019).

Probe	Irr $\Delta I$ /Sync Lift	Rat $\Delta I$ /Sync Lift	Note (Tune Path)
Phase Flow	48% lift	13% lift	Green (>20%); basic rhythm lock
Flux Density	0.12 (171% edge)	0.05	Green (>0.1); dense path fill
Fractal Layer	1.29 dim	1.32 dim	Edge; scale tease (RG coarse)
Quantum Spin	-94% (add drive)	4717%	Rat resonant lock
Pos Nudge $v = 5$	0.01% entropy drop	0.02% drop	Stall; amp for spatial sync
Quantum Depth	0.35 ent (corr measure)	0.14 ent	Irr broader ties
Eig Filter Pos	0.012% drop	0.017% drop	Stall tease; golden amp?
Golden $\omega$ Pos Nudge	0.0053% drop	0.0018% drop	Irr edge tease; $\mu$ crank next