

φ -Log-Spiral Resonators and Eight-Tick Scheduling: A Geometry-and-Control Foundation for Resonant Rotating-Field Experiments

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February 1, 2026

Abstract

Empirical claims of anomalous propulsion or weight modification in rotating-field experiments have historically failed reproducibility tests due to weak geometry specification, imprecise timing discipline, and inadequate falsifier design. This paper presents a rigorous mathematical framework comprising: (i) a parameterized φ -log-spiral geometry defining spatial scaffolds for rotors and phased arrays, (ii) an eight-tick neutrality scheduling discipline for temporal control, and (iii) a resonance map computation that outputs candidate drive bands from geometry inputs.

We derive closed-form invariants for the log-spiral family, prove shift-invariance of the neutrality predicate under 8-periodicity, and specify a minimal set of experimental falsifiers (banding, sign-flip, vacuum persistence). The framework is fully self-contained and does not depend on any specific physical outcome; rather, it provides the reproducible design language and testable predictions required for rigorous experimentation.

Keywords: logarithmic spiral, golden ratio, phased commutation, 8-phase scheduling, resonance mapping, falsifiers

1 Introduction

1.1 Motivation and Scope

The history of experimental claims involving rotating fields and anomalous weight or thrust

effects—from the Podkletnov experiments [1] to various replication attempts—is marked by a recurring failure mode: *under-specification*. When the precise geometry of the rotating element, the exact timing of the drive signals, and the expected signatures of success or failure are not mathematically specified in advance, post-hoc interpretations proliferate and reproducibility becomes impossible.

This paper addresses this failure mode by providing a complete mathematical specification for a class of rotating-field experiments. We define:

1. A **spatial scaffold** based on the golden-ratio (φ) log-spiral, parameterized by an integer pitch $\kappa \in \mathbb{Z}$.
2. A **temporal discipline** based on 8-tick neutrality, ensuring that drive signals sum to zero over every 8-sample window.
3. A **resonance map algorithm** that computes candidate drive frequencies from geometric inputs.
4. A **falsifier set** specifying what constitutes success, failure, and disqualification.

1.2 Scope Boundaries

This paper does **not** claim that any physical effect has been observed. It does **not** predict the magnitude or existence of any propulsion or weight modification. Rather, it establishes a *reproducible definition language* and *test design*

that would allow such claims to be rigorously evaluated.

1.3 Contributions

The main contributions are:

- Formal definitions of the φ -log-spiral family with closed-form step-ratio and per-turn-multiplier identities (Section 3).
- A formal definition of 8-tick neutrality with a proof of shift-invariance under periodicity (Section 4).
- A resonance-map algorithm with worked example (Section 5).
- A minimal experimental falsifier set (Section 6).

1.4 Document Roadmap

Section 2 establishes notation and conventions. Section 3 develops the φ -log-spiral geometry. Section 4 develops the 8-tick scheduling discipline. Section 5 presents the resonance-map computation. Section 6 specifies experimental falsifiers. Section 7 discusses limitations and future work. Section 8 concludes.

2 Notation and Conventions

2.1 Constants and Symbols

Definition 2.1 (Golden Ratio). *The golden ratio is defined as*

$$\varphi := \frac{1 + \sqrt{5}}{2} \approx 1.6180339887. \quad (1)$$

Key properties used throughout:

- $\varphi > 0$
- $\varphi^2 = \varphi + 1$
- $\varphi^{-1} = \varphi - 1 \approx 0.618$

Additional notation:

- $r_0 \in \mathbb{R}_{>0}$: base radius (scale parameter)

- $\theta \in \mathbb{R}$: angular coordinate (radians)
- $\kappa \in \mathbb{Z}$: integer pitch parameter
- $t \in \mathbb{N}$: discrete tick index
- $c \approx 2.998 \times 10^8$ m/s: speed of light

2.2 Reproducibility Conventions

All experiments should report parameter sets in the canonical form:

$$\mathcal{P} = (r_0, \kappa, n_{\text{coils}}, f_{\text{max}}, \text{constraints}) \quad (2)$$

where n_{coils} is the number of discrete elements (coils or magnets) and f_{max} is the maximum drive frequency.

3 Spatial Scaffold: φ -Log-Spiral Geometry

3.1 The Log-Spiral Family

Definition 3.1 (φ -Log-Spiral). *For base radius $r_0 > 0$, angle $\theta \in \mathbb{R}$, and integer pitch $\kappa \in \mathbb{Z}$, the φ -log-spiral is defined by:*

$$r(\theta; r_0, \kappa) := r_0 \cdot \varphi^{\kappa\theta/(2\pi)}. \quad (3)$$

This is a logarithmic spiral where the growth rate is controlled by powers of the golden ratio. The parameter κ determines the “tightness” of the spiral:

- $\kappa = 0$: constant radius (circle)
- $\kappa > 0$: outward spiral
- $\kappa < 0$: inward spiral

Remark 3.1. *The restriction $\kappa \in \mathbb{Z}$ (rather than $\kappa \in \mathbb{R}$) is a design choice that quantizes the space of allowable geometries into discrete “pitch families.” This has implications for manufacturability and for the hypothesis that certain discrete configurations may exhibit resonance.*

3.2 Closed-Form Step Ratio

Definition 3.2 (Step Ratio). *For angular increment $\Delta\theta$, the step ratio is the ratio of radii at consecutive angular positions:*

$$R(\theta, \Delta\theta; r_0, \kappa) := \frac{r(\theta + \Delta\theta; r_0, \kappa)}{r(\theta; r_0, \kappa)}. \quad (4)$$

Theorem 3.1 (Step-Ratio Closed Form). *For $r_0 \neq 0$, the step ratio depends only on $\Delta\theta$ and κ :*

$$R(\theta, \Delta\theta; r_0, \kappa) = \varphi^{\kappa\Delta\theta/(2\pi)}. \quad (5)$$

Proof. By direct computation:

$$R = \frac{r_0 \cdot \varphi^{\kappa(\theta+\Delta\theta)/(2\pi)}}{r_0 \cdot \varphi^{\kappa\theta/(2\pi)}} \quad (6)$$

$$= \varphi^{\kappa(\theta+\Delta\theta)/(2\pi) - \kappa\theta/(2\pi)} \quad (7)$$

$$= \varphi^{\kappa\Delta\theta/(2\pi)}. \quad (8)$$

The factor r_0 cancels, and the base angle θ drops out. \square

Corollary 3.2 (Scale Invariance). *For any $c \neq 0$:*

$$R(\theta, \Delta\theta; c \cdot r_0, \kappa) = R(\theta, \Delta\theta; r_0, \kappa). \quad (9)$$

This means the *shape* of the spiral (as characterized by step ratios) is independent of overall scale.

3.3 Per-Turn Multiplier

Definition 3.3 (Per-Turn Multiplier). *The per-turn multiplier is the step ratio for one complete revolution ($\Delta\theta = 2\pi$):*

$$M(\kappa) := R(\theta, 2\pi; r_0, \kappa) = \varphi^\kappa. \quad (10)$$

Theorem 3.3 (Per-Turn Ratio). *For any $r_0 \neq 0$ and $\theta \in \mathbb{R}$:*

$$\frac{r(\theta + 2\pi; r_0, \kappa)}{r(\theta; r_0, \kappa)} = \varphi^\kappa. \quad (11)$$

Proof. Immediate from Theorem 3.1 with $\Delta\theta = 2\pi$, noting that $\kappa \cdot 2\pi/(2\pi) = \kappa$. \square

3.4 Discrete Pitch Families

Theorem 3.4 (κ -Discreteness). *Shifting κ by an integer $d \in \mathbb{Z}$ shifts the per-turn multiplier by a φ -power:*

$$M(\kappa + d) = M(\kappa) \cdot \varphi^d. \quad (12)$$

Proof. $M(\kappa + d) = \varphi^{\kappa+d} = \varphi^\kappa \cdot \varphi^d = M(\kappa) \cdot \varphi^d$. \square

This theorem captures the idea that the space of φ -log-spirals is organized into discrete “pitch families,” with adjacent families differing by a factor of φ in their per-turn growth.

3.5 Tetrahedral Symmetry (Optional)

For multi-rotor configurations, we note the *tetrahedral angle*:

$$\theta_{\text{tet}} = \arccos\left(-\frac{1}{3}\right) \approx 109.47. \quad (13)$$

This angle arises in sp^3 hybridization and tetrahedral molecular geometry. It provides a natural symmetry for 4-fold rotor arrangements.

3.6 Discrete Layout Mapping

For practical implementation, the continuous spiral (3) is sampled at n discrete angles:

$$\theta_k = \frac{2\pi k}{n}, \quad k = 0, 1, \dots, n-1. \quad (14)$$

Each sample point yields a radius $r_k = r(\theta_k; r_0, \kappa)$, which specifies a coil position or magnet placement.

4 Temporal Scaffold: Eight-Tick Scheduling Discipline

4.1 Drive Signals and Windows

Let $w : \mathbb{N} \rightarrow \mathbb{R}$ be a discrete-time drive signal, where $w(t)$ represents the drive value (e.g., voltage, current, or logical state) at tick t . \square

Definition 4.1 (8-Window Sum). *The 8-window sum (or neutrality score) starting at tick t_0 is:*

$$S(w, t_0) := \sum_{k=0}^7 w(t_0 + k). \quad (15)$$

Definition 4.2 (8-Gate Neutrality). *A signal w satisfies 8-gate neutrality at t_0 if:*

$$S(w, t_0) = 0. \quad (16)$$

Intuitively, 8-gate neutrality requires that the drive signal is “mean-free” over every 8-tick window. This is analogous to AC coupling in electronics: no DC component accumulates.

4.2 Periodicity

Definition 4.3 (8-Periodicity). *A signal $w : \mathbb{N} \rightarrow \mathbb{R}$ is 8-periodic if:*

$$\forall t \in \mathbb{N} : w(t+8) = w(t). \quad (17)$$

4.3 Shift Invariance

Lemma 4.1 (Neutrality Score Shift). *If w is 8-periodic, then for any $t_0 \in \mathbb{N}$:*

$$S(w, t_0 + 1) = S(w, t_0). \quad (18)$$

Proof. Expand both sums:

$$S(w, t_0) = \sum_{k=0}^7 w(t_0 + k), \quad (19)$$

$$S(w, t_0 + 1) = \sum_{k=0}^7 w(t_0 + 1 + k). \quad (20)$$

Reindex the second sum by $j = k + 1$:

$$S(w, t_0 + 1) = \sum_{j=1}^8 w(t_0 + j) = \sum_{j=1}^7 w(t_0 + j) + w(t_0 + 8). \quad (21)$$

By 8-periodicity, $w(t_0 + 8) = w(t_0)$. Thus:

$$S(w, t_0 + 1) = \sum_{j=1}^7 w(t_0 + j) + w(t_0) = \sum_{k=0}^7 w(t_0 + k) = S(w, t_0). \quad (22)$$

Theorem 4.2 (Shift Invariance of Neutrality). *If w is 8-periodic, then 8-gate neutrality is shift-invariant:*

$$S(w, t_0) = 0 \iff S(w, t_0 + 1) = 0. \quad (23)$$

Proof. Immediate from Lemma 4.1: $S(w, t_0 + 1) = S(w, t_0)$, so one equals zero if and only if the other does. \square

This theorem is important for practical implementation: if an 8-periodic signal achieves neutrality at *any* starting tick, it achieves neutrality at *every* starting tick.

4.4 Coherence and Jitter

For real implementations, perfect periodicity is unattainable. We define:

Definition 4.4 (Phase Jitter). *Let τ_{nom} be the nominal tick period. The phase jitter at tick t is:*

$$J(t) := |T_{actual}(t) - \tau_{nom}| \quad (24)$$

where $T_{actual}(t)$ is the measured period at tick t .

Definition 4.5 (Coherence Bound). *A signal is coherent to tolerance ϵ if:*

$$\forall t : J(t) < \epsilon \cdot \tau_{nom}. \quad (25)$$

The specific value of ϵ is an engineering parameter and is not specified in this document.

5 Resonance Map Computation

5.1 Physical Hypothesis

The resonance-map computation is based on a hypothesis (not a proven physical law): that a rotating field may exhibit special behavior when its characteristic velocity matches specific values related to fundamental constants.

Definition 5.1 (Tip Speed). *For a rotating element of diameter D at frequency f (Hz):*

$$v_{tip} = \pi D f. \quad (26)$$

The hypothesis posits that resonance occurs when:

$$v_{tip} = c \cdot \varphi^{-N} \quad (27)$$

\square for integer N , where c is the speed of light.

5.2 Derivation of Candidate Frequencies

Solving (27) for frequency:

$$f_N = \frac{c \cdot \varphi^{-N}}{\pi D}. \quad (28)$$

Converting to RPM:

$$\text{RPM}_N = 60 \cdot f_N = \frac{60c \cdot \varphi^{-N}}{\pi D}. \quad (29)$$

5.3 Algorithm

Algorithm 1: Resonance Map Computation

Input: Diameter D (meters), max RPM R_{\max}

Output: Table of $(N, v_{\text{tip}}, f, \text{RPM})$

1. Set $\varphi \leftarrow (1 + \sqrt{5})/2$
2. Set $c \leftarrow 2.998 \times 10^8$ m/s
3. Compute N_{\min} such that $\text{RPM}_{N_{\min}} \leq R_{\max}$
4. **For** $N = N_{\min}$ to $N_{\min} + 50$ **do**:
 - (a) $v_{\text{tip}} \leftarrow c \cdot \varphi^{-N}$
 - (b) $f \leftarrow v_{\text{tip}}/(\pi D)$
 - (c) $\text{RPM} \leftarrow 60f$
 - (d) **If** $\text{RPM} \geq 1$ **then** output $(N, v_{\text{tip}}, f, \text{RPM})$

5.4 Worked Example: 275 mm Disk

For a disk of diameter $D = 0.275$ m (similar to Podkletnov’s reported setup) with max RPM = 10,000:

Table 1: Resonance Map for $D = 275$ mm

N	v_{tip} (m/s)	f (Hz)	RPM
37	61.24	70.91	4,254.7
38	37.86	43.83	2,629.7
39	23.40	27.09	1,625.5
40	14.46	16.74	1,004.7
41	8.94	10.35	621.0
42	5.52	6.40	383.8

The predicted “critical speeds” for this geometry cluster around 4,000–4,300 RPM (near $N = 37$), with harmonics at lower RPMs.

6 Experimental Falsifiers

A rigorous experiment must specify in advance what constitutes success, failure, and disqualification. We propose the following minimal set.

6.1 Banding (Frequency Selectivity)

Prediction: Any effect proxy (force, weight change, thermal signature) should peak at the discrete frequencies predicted by the resonance map, not at arbitrary frequencies.

Null Expectation: The response is smooth across frequencies, with no peaks beyond measurement noise.

Test: Sweep drive frequency through the predicted bands and log the effect proxy at each set-point.

6.2 Sign Flip (Directionality)

Prediction: Reversing the rotation direction (or phase sequence) reverses the sign of the effect proxy.

Null Expectation: The effect is symmetric under reversal.

Test: Run forward and reverse sweeps; compare sign of effect proxy.

6.3 Vacuum Persistence (Environmental Robustness)

Prediction: If the effect is not aerodynamic, it persists under reduced atmospheric pressure.

Null Expectation: Effect diminishes proportionally to air density.

Test: Repeat experiments at ~ 1 mbar pressure.

6.4 Disqualifiers

The following confounders, if not controlled, disqualify results:

- **Thermal buoyancy:** Heated air rising.
- **Vibration coupling:** Mechanical transmission to sensor.
- **EMI coupling:** Electromagnetic interference in sensor electronics.

- **Magnetic coupling:** Forces on nearby ferromagnetic materials.

6.5 Required Logged Signals

At minimum, experiments should log:

1. Drive: phase, frequency, duty cycle, current, voltage
2. Sensors: force (or weight proxy), temperature, vibration, EMI
3. Environment: pressure, ambient temperature

7 Discussion

7.1 What This Paper Does Not Claim

This paper provides a mathematical framework, not experimental results. It does **not**:

- Claim that any propulsion or weight-modification effect exists.
- Predict magnitudes of any effects.
- Validate the resonance hypothesis.

7.2 What This Paper Does Claim

This paper **does**:

- Provide reproducible geometric and scheduling definitions.
- Derive closed-form invariants (step ratio, per-turn multiplier, shift invariance).
- Specify a computational method for generating candidate drive frequencies.
- Define a minimal falsifier set for rigorous experimentation.

7.3 Relationship to Prior Work

The φ -log-spiral family generalizes the Archimedean spiral used in some antenna and inductor designs. The 8-tick neutrality condition is analogous to balanced modulation

schemes in communications. The resonance hypothesis, while speculative, provides concrete predictions that can be tested and falsified.

7.4 Limitations

1. The resonance hypothesis (27) is not derived from first principles in this paper; it is posited as a testable claim.
2. Manufacturing tolerances and material properties are not addressed.
3. Multi-rotor synchronization is mentioned but not fully developed.

8 Conclusion

We have presented a complete mathematical framework for designing and evaluating rotating-field experiments based on φ -log-spiral geometry and 8-tick scheduling. The framework includes:

1. Formal definitions of the φ -log-spiral with closed-form invariants.
2. A temporal discipline with provable shift-invariance.
3. A resonance-map algorithm for generating candidate frequencies.
4. A minimal set of experimental falsifiers.

This framework enables rigorous, reproducible experimentation. Whether any physical effect exists remains an open empirical question; this paper provides the tools to answer it definitively.

A Proof Details

A.1 Positivity of φ^x

Lemma A.1. *For all $x \in \mathbb{R}$: $\varphi^x > 0$.*

Proof. Since $\varphi > 0$ and the real exponential function preserves positivity, $\varphi^x = e^{x \ln \varphi} > 0$ for all $x \in \mathbb{R}$. \square

A.2 Non-Degeneracy of Log-Spiral

Lemma A.2. For $r_0 \neq 0$ and any θ, κ :
 $r(\theta; r_0, \kappa) \neq 0$.

Proof. $r(\theta; r_0, \kappa) = r_0 \cdot \varphi^{\kappa\theta/(2\pi)}$. Since $r_0 \neq 0$ and $\varphi^{\kappa\theta/(2\pi)} > 0$, their product is nonzero. \square

B Parameter Schema (JSON)

```
{  
    "r0_mm": 137.5,  
    "kappa": 1,  
    "n_coils": 8,  
    "f_max_hz": 1000,  
    "constraints": {  
        "duty_max": 0.5,  
        "v_max": 48  
    }  
}
```

C Resonance Map Pseudocode

See Algorithm 5.3 in the main text.

References

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