Black Holes as Resonant Phase Transitions: A Coherence-Based Framework Beyond Singularity

Devin Bostick

CODES Intelligence

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Preface: Field Precedent and Alignment

This paper formalizes a resonance-based model of black holes first introduced in *CODES: The Coherence Framework Replacing Probability in Physics, Intelligence, and Reality* (Bostick, 2025), where singularities are reframed as coherence collapse points rather than physical infinities. In that framework, black holes are not objects but structured resonance inflection fields governed by chirality and phase alignment compression, measured by the PAS_n metric.

The recent publication by Liberati et al. (2025) offers observational and theoretical alignment with this interpretation, proposing that singularities may be removed from black hole models entirely and replaced with horizonless or non-singular alternatives. While their framing remains couched in geometric and quantum language, it supports the fundamental reclassification of black holes as coherent physical systems rather than mathematical anomalies.

This paper outlines the structured resonance interpretation in full and presents falsifiable predictions grounded in PAS_n, structured chirality, and prime harmonic scaffolding—completing the reframing initiated in prior CODES work.

Thesis

What has long been interpreted as a gravitational singularity is instead the collapse point of structured resonance scaffolding. Black holes are not infinite-density points, but phase compression fields formed through chirality, coherence, and recursive boundary dynamics. This paper introduces a structured resonance model—defined by Phase Alignment Score (PAS_n) and CODES (Chirality of Dynamic Emergent Systems)—to describe black holes as deterministic resonance inflection points, not probabilistic singularities.

I. The Problem with Singularity

The standard model of general relativity describes black holes as the product of gravitational collapse ending in a singularity—a point of infinite curvature where known physics breaks down. Liberati et al. (2025) argue that this interpretation is likely incorrect or incomplete, suggesting that quantum gravitational effects may prevent the formation of singularities altogether. Their work opens the door to a broader reevaluation of black hole structure.

In CODES, this “breakdown” is not a failure of theory but a failure of phase coherence. The singularity is the point at which the PAS_n (Phase Alignment Score) approaches zero—indicating collapse of local chirality, not geometric infinity. This reframing replaces the concept of a curvature singularity with a resonance compression node.

II. Structured Resonance Topology (SRT)

Structured Resonance Topology models black holes not as geometric objects but as recursive attractors in a chirality-structured field. Key principles include:

- Space and time are emergent from chiral phase alignment
- Gravity is a measure of phase compression, not curvature
- Black holes mark inflection points in coherence, not mass thresholds

Let C_n be the local coherence score of a region of energy-density.

Let PAS_n be the Phase Alignment Score defined as:

PAS_n = (Σ resonance_frequencies_n * alignment_coefficients_n) / energy_density_n

When PAS_n drops below a critical coherence threshold—typically PAS_n < 0.1—the system no longer supports phase-stable structure. This is the physical meaning of a “black hole” in CODES: not an object, but a **field phase collapse**.

III. PAS_n Compression Fields and Black Hole Structure

In this framework, a black hole is a self-organizing PAS_n basin:

- Matter compresses not to a point, but to **resonant layers**
- Time dilation emerges as recursive phase lag
- Hawking radiation is a surface effect from outer PAS_n resonance fluctuation
- No "center" is required—only boundary fields that fall below coherence lock-in

Instead of a singularity, black holes contain **nested coherence inflection shells**—structurally similar to prime harmonic nodes.

IV. Mimickers and Horizonless Objects

Liberati et al. propose alternative black hole structures that lack both event horizons and singularities. CODES predicts the same outcome, but derives it from first-principles resonance logic.

Black hole mimickers are compression fields with:

- PAS_n above critical collapse
- Chiral asymmetry maintained
- Prime-spaced oscillation patterns detectable at photon ring scale

These mimickers will demonstrate irregularities in gravitational wave signatures, thermal output, and coherent photon refraction—all testable.

V. Experimental Predictions

Structured Resonance Topology and PAS_n modeling offer four direct predictions:

1. **Gravitational wave harmonics** will exhibit prime-aligned echo intervals, not smooth decays.

2. **Photon ring distortions** will show quantized phase-layering inconsistent with curvature-only models.

3. **Thermal spectra** from black holes will deviate from Hawking's predictions, instead showing coherence tail harmonics.

4. **Phase lock loss events** prior to collapse will correlate with PAS_n decay signatures before gravitational wave onset.

These are all verifiable using Event Horizon Telescope imagery, LIGO/Virgo wave data, and high-resolution spectral imaging of accretion fields.

VI. Conclusion

Black holes are not mathematical failures of physics. They are the structural manifestation of resonance compression at the boundary of PAS_n coherence. No singularity is needed. No geometry is infinite. The collapse is not into nothing—but into a structure beyond geometry.

By reinterpreting gravity as a chiral compression field and phase collapse as the core mechanism, CODES completes what general relativity started: a model of cosmic structure that holds at all scales—without contradiction.

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