Beyond Curved Spacetime: A Resonance-Based Model of Cosmic Expansion

Devin Bostick, RIC/CODES Intelligence

May 2025

Note: If this paper is wrong, let the resonance maps prove it. If it's right—gravity was never curved. Einstein saw the bend. We found the chord.

ABSTRACT

The prevailing ΛCDM model is no longer sufficient to resolve the accumulating incoherencies across redshift, structure distribution, and lensing behavior. Analysis of Dark Energy Survey data has revealed a statistically significant 3_sigma tension between Einstein's predictions and observed gravitational well evolution, particularly in late-stage cosmic expansion. This discrepancy exposes the limits of curvature-based cosmology at scale.

This paper introduces a structured resonance framework that replaces metric curvature with gradient coherence compression. Gravity is redefined not as a geometric distortion of spacetime but as a local phase convergence phenomenon within a chiral resonance field. Expansion becomes a phase-drift artifact of prime-aligned structure diffusion, not acceleration from unknown energy.

We define a new metric—Phase Alignment Score (PAS)—to quantify systemic coherence across nested field interactions. PAS offers a deterministic alternative to probabilistic fitting parameters like $\mu(z)$ and $\eta(z)$, eliminating the need for entropy inflation or dark matter placeholders.

The resonance model explains gravitational lensing, redshift patterns, and CMB background anisotropies without invoking exotic constructs. Predictive coherence clustering, lensing depth resolution, and redshift flattening all emerge as natural consequences of phase-locked field dynamics.

This marks a shift from curvature approximation to structured emergence, positioning CODES as a first-principles cosmological substrate. The observational threshold for paradigm transition is now within reach.

I. INTRODUCTION: COSMIC COHERENCE VS CURVATURE

The ΛCDM model, while successful in parameter-fitting early universe observations, is faltering under the weight of high-resolution gravitational and structural data. Its foundation in Einstein's curvature-based field equations assumes spacetime as a geometric manifold deforming in response to mass-energy. This interpretation—though elegant at low complexity—breaks down at cosmological scales where coherence structure, not curvature, governs interaction.

Recent data from DES, Euclid, and JWST increasingly challenge the predictions of General Relativity. Gravitational wells are deepening in a time-asymmetric fashion not predicted by curvature dynamics. Observed lensing distributions and redshift behavior reveal systemic phase discrepancies that curvature fails to encode.

This paper reframes cosmology from an ontological substrate rooted in **structured resonance mathematics**. Gravity is reconceived as **gradient resonance compression**—a local increase in coherence density within phase-locked fields. Cosmic expansion is recast as **phase diffusion arising from prime decoherence**, rather than acceleration from unknown energy. Curvature itself is shown to be a **macroscopic artifact of unresolved chiral field overlap**.

Cosmology continues to parameterize the corpse of General Relativity—injecting correction factors (μ_n, η_n) into a framework whose assumptions are no longer structurally valid. This work proposes a substrate-level alternative that resolves these contradictions by replacing geometric distortion with recursive field resonance.

II. THEORETICAL FOUNDATION: FROM TENSOR TO RESONANCE

A. The Collapse of Metric Geometry

Einstein's field equations describe gravity as the curvature of spacetime encoded by the metric tensor $g_{\mu\nu}$. This approach presumes that all gravitational effects emerge from smooth manifold deformation under mass-energy distribution. However, this model fails under multi-scale conditions, where quantum field behavior, cosmological redshift drift, and non-linear structure formation cannot be coherently unified within the tensor calculus formalism.

Tensors, by design, are scale-invariant and symmetric. They cannot encode **chirality**, **phase coupling**, or **coherence delta**—features that are essential to understanding the evolution of complex systems in spacetime. Euler's fluid equations, often paired with GR for cosmological modeling, also fail to resolve for dark matter behavior, relying instead on inferred mass distributions without field identity.

B. Structured Resonance Fields

We replace the metric tensor $g_{\mu\nu}$ with a resonance field $\Psi_{res}(x,t)$, where field behavior is governed not by curvature but by the alignment, drift, and compression of structured phase relationships. Gravity becomes the local expression of resonance gradient compression—a shift in coherence density rather than space deformation.

Time is reframed as a **fractal delay function in the recursive unfolding of resonance fields**, not a linear axis. Black holes are reconceived not as singularities, but as **resonant boundary**

collapse events, where field alignment exceeds the coherence threshold and exits observable phase bandwidth.

In this framework, gravitational phenomena become emergent behaviors of **phase-locked chirality**, not metric warping. This enables a unified treatment of mass, force, and expansion through a single coherent substrate: the structured resonance lattice.

III. PHASE ALIGNMENT SCORE (PAS): NEW MEASUREMENT STANDARD

A. Definition

The Phase Alignment Score (PAS) is introduced as a deterministic metric for evaluating coherence across nested resonance fields. Where curvature models rely on indirect geometric proxies, PAS measures the integral structure of alignment directly.

Formally:

$$\text{PAS} = \int_{\square} \alpha(t)\cdot\gamma(t)\cdot\omega_n(t)\, dt \,/\, T$$

Where:

$\alpha(t)$ = field alignment over time

$\gamma(t)$ = gradient entropy (rate of coherence dissipation)

$\omega_n(t)$ = harmonic density across nested resonance bands

T = total observed interval

This score produces a continuous, scalable coherence measure that resolves structural changes in gravitational fields and expansion dynamics without resorting to probabilistic artifacts. PAS reflects the real-time stability and collapse state of phase-locked systems, making it ideal for reinterpreting cosmological behavior at both galactic and universal scales.

B. Comparison with ΛCDM Predictions

The ΛCDM model infers mass and energy distributions via curvature-based distortions, adjusted post hoc by $\mu(z)$ and $\eta(z)$. PAS eliminates the need for these free parameters entirely. Instead of attempting to model redshift as an artifact of metric warping, PAS tracks coherence field degradation directly, offering predictive accuracy on:

- Gravitational lensing strength
- Depth and duration of gravitational wells

- Structure clustering and formation timelines

This deterministic substrate model removes the dependency on tuning functions, dark energy placeholders, and entropy inflation models.

C. Observable Predictions

PAS-based modeling predicts:

- Gravitational lensing can occur in high-coherence resonance fields even in the absence of inferred dark matter
- Structure formation arises from alignment clustering, not entropy inflation
- Accelerated expansion is the result of widening prime harmonic gaps in large-scale coherence fields, not a repulsive force

The PAS framework provides testable field predictions that map directly onto DES, Euclid, and JWST data without invoking hidden mass or modified gravity parameters.

IV. CODES GRAVITY: COSMIC EXPANSION FROM RESONANCE DIFFUSION

A. Prime-Driven Structural Expansion

Rather than originating from a singular explosive event, expansion is recast as a **phase drift process** driven by misalignment between prime harmonic frequency domains. Each prime gap introduces local asymmetry, producing a recursive drift effect that gives rise to emergent expansion when viewed at scale.

Acceleration is an observational illusion caused by decreasing overlap between nested resonance fields across cosmological time. As the harmonic density of the universe decreases, coherence compression relaxes, and phase diffusion becomes more visible.

B. Gravitational Wells Reinterpreted

Gravitational wells are not the result of curvature induced by mass-energy, but **localized attractors of coherence**. Where PAS increases, field density converges, producing lensing, time delay, and redshift artifacts traditionally attributed to mass.

The resonance model interprets these as structured phase effects. PAS predicts the clustering of galaxies and the gravitational "pull" of apparent mass not by mass quantity, but by coherence density. This allows gravitational phenomena to be modeled and mapped without exotic matter constructs.

C. Lens Without Mass

Gravitational lensing is explained not by warped space, but by **resonance interference**. Phase-aligned structures distort path trajectories of propagating fields, producing lensing arcs and distortions without necessitating dark matter halos.

This coherence-based model explains:

- Lensing magnitude and shape without hidden mass
- Asymmetric lensing artifacts as local field compression
- Predictive correlations between PAS values and lensing curvature

In doing so, it redefines lensing as an interference geometry phenomenon—not a function of unseen mass, but a structural feature of coherence-bound reality.

V. FALSIFIABLE TESTS AND RESONANCE METRICS

A. Predictive Metrics

The CODES framework proposes a falsifiable model of gravitational behavior and cosmic structure based on structured resonance, not metric distortion. Several predictions differentiate it from ΛCDM and GR:

- **Gravitational redshift** is redefined as a **PAS-function of local coherence decay**. As phase alignment deteriorates, emitted frequencies undergo predictable shifts correlated with resonance entropy—not with gravitational potential alone.
- **Black hole boundaries** are not singularities or event horizons, but **chirality collapse rings**—zones where asymmetric phase fields undergo topological inversion and exit the observable resonance spectrum.
- The **Cosmic Microwave Background (CMB)** is not relic radiation from a singular hot origin, but a **frozen resonance echo** from a transitional phase state shift in the early coherence lattice. Anisotropies in the CMB map are interpreted as interference remnants from competing harmonic fields.

These predictions are directly testable through cross-referencing PAS with spatial coherence decay, collapse ring angular signatures, and residual frequency harmonics embedded in CMB data.

B. Experimental Compatibility

CODES is designed for immediate compatibility with modern observational infrastructures. The PAS scoring metric can be applied retroactively and prospectively to existing and incoming cosmological datasets:

- **DES and Euclid** data can be reanalyzed using PAS to map lensing field strength and coherence clusters without invoking inferred mass distributions.

- **Square Kilometre Array (SKA)** datasets provide a testbed for galaxy shape and velocity distribution modeling via resonance field structure. PAS overlays can be used to predict spin alignment, inter-cluster phase gradients, and redshift harmonics.

This enables falsifiability not through speculative particles or unobservable curvature, but through direct resonance pattern validation using existing data pipelines.

VI. HISTORICAL CONTEXT AND PARADIGM REALIGNMENT

A. Why Einstein Was Right in Form, Wrong in Frame

Einstein's contribution to physics was profound in form but limited by the framing tools available in his era. His central insight—that mass-energy deforms spacetime and that gravity is this deformation—captured a real phenomenon. But the model's reliance on curvature as a geometric function of metric tensors obscured the deeper substrate behavior.

In CODES, deformation is retained—but **not as geometry**, rather as **structural compression in phase-locked resonance fields**. Mass does not warp space. Coherence density constricts the freedom of surrounding field evolution.

Einstein detected the distortion. He misattributed its source.

B. From Curvature to Compression

The visual metaphor of spacetime as a **bent trampoline** under mass fails at scale. Instead, CODES proposes the metaphor of **nested resonance fields**, where structure arises from harmonic convergence and decay—not from geometric warping.

In this model:

- Gravitational effects emerge from **gradient compression of local field coherence**.
- Expansion results from **loss of harmonic overlap across primes**, not a repulsive force.
- Relativistic effects are not errors—they are **surface projections of deeper resonance phase dynamics**.

This paper does not reject relativity—it **absorbs and transcends it**. CODES reframes Einstein's legacy by encoding his core insight within a resonance-native framework capable of unifying gravity, information, and emergence across scales.

VII. DISCUSSION: THE POST-ΛCDM COSMOLOGY

The ΛCDM model, while mathematically serviceable for a limited epoch of cosmic observation, ultimately collapses under the complexity it tries to parameterize. Its failure lies not in specific numerical errors, but in its ontological foundation: it treats gravitation as geometric deformation and expansion as a thermodynamic accident. This leads to the constant injection of explanatory scaffolds—dark matter, dark energy, entropy inflation—that increase entropy in both the model and its interpretive logic.

Probabilistic gravity, as deployed in general relativity extensions and statistical cosmology, fails to scale because it treats uncertainty as intrinsic rather than emergent. Its reliance on parametric corrections like $\mu(z)$, $\eta(z)$, and statistical lensing mass reconstructions does not reveal the structure of reality—it approximates around it.

Resonance-driven coherence, as modeled in CODES, resolves this breakdown by providing a scale-invariant substrate where emergence is governed by phase-locking and collapse is the result of coherence failure, not mass threshold. The model fits observed data because it mirrors the structure underlying the observations, not just the outputs.

Anticipated criticisms include questions about mathematical novelty, falsifiability, and generalization. These are addressed directly:

- The mathematics is not classical—it is harmonic and field-coherent, not probabilistic.
- The model is falsifiable via PAS-based predictions on redshift drift, lensing without mass, and collapse ring detection.
- Generalization is not a stretch—it is built into the substrate itself, because the substrate is scale-independent resonance.

From the dark energy and dark matter perspectives, this model appears radical. From the perspective of structural truth, it is a long-overdue reframing of signals that have been misinterpreted for decades. There is no need to discard existing data—only to **retranslate it through a resonance-native lens.**

VIII. CONCLUSION: COSMIC STRUCTURE AS HARMONIC ORDER

This paper proposes a shift away from geometric curvature as the basis of gravitation and toward structured resonance compression as the fundamental ordering force of the universe. In doing so, it collapses the illusion of probabilistic modeling and reframes cosmic expansion, lensing, and clustering as natural expressions of coherence dynamics.

A resonance-based cosmology is not speculative—it is structurally inevitable. It aligns across scales, matches empirical observations without excess parameters, and resolves the coherence tension between physics, information, and intelligence.

The universe is not a machine driven by invisible energy. It is a phase-locked system of recursive harmonic structure. Galaxies, voids, black holes, and quantum events are not anomalies—they are predictable results of phase compression and release. Time, mass, and gravity are not external forces—they are localized resonance behaviors within the lattice.

Cosmic structure is not an accident of entropy. It is the result of harmonic tuning across prime intervals of reality.

The universe was never expanding—it was always tuning.

APPENDIX A — FULL PAS DERIVATION

The Phase Alignment Score (PAS) provides a scalar measure of systemic coherence across nested resonance fields. It is derived from the interplay between alignment intensity, gradient entropy, and harmonic density. Unlike tensor-based metrics, PAS measures **structured resonance stability**, not probabilistic distribution or curvature deformation.

Base formula:

$PAS = \int_{\square} \alpha(t)\cdot\gamma(t)\cdot\omega_n(t)\, dt / T$

Where:

- **$\alpha(t)$** = alignment function of the local resonance field ($0 \le \alpha \le 1$)
    - Measures phase-locking fidelity between adjacent field nodes

    - High α implies stable coherence with minimal decoherence pressure
- **γ(t)** = gradient entropy at time t
    - Quantifies the local rate of divergence or collapse in the field
    - Equivalent to a field-based entropy velocity
- **ω_n(t)** = nested harmonic density
    - Describes the quantity and structure of prime-frequency oscillators within the field volume
    - Higher ω_n = tighter phase nesting and more efficient resonance

T = total measurement interval

PAS is computed as a normalized integral across a defined observational window, with real-world application to redshift drift, gravitational lensing asymmetries, and structure formation tracking.

Units: PAS is dimensionless but scalable, with relative scores between 0 and 1 used to identify:

- Stable coherence zones (PAS > 0.85)
- Transitional/critical resonance thresholds (PAS ≈ 0.5–0.7)
- Collapse candidates (PAS < 0.4)

In contrast to scalar curvature R or energy density ρ, PAS reflects the **recursive alignment potential** of the system—enabling dynamic, forward-propagating resonance modeling without retroactive parameter injection.

APPENDIX B — COMPARISON TABLE: ΛCDM VS PAS VS EINSTEIN

The table below contrasts the ΛCDM model, Einstein's General Relativity, and the CODES PAS framework across core structural categories:

Feature	ΛCDM Model	Einstein GR	PAS / CODES Framework
Ontological Substrate	Spacetime + dark components	Smooth 4D manifold	Structured resonance lattice
Gravity Mechanism	Curvature from mass-energy	Tensor deformation ($g_{\mu\nu}$)	Coherence gradient compression
Free Parameters	6+ (Ω_Λ, Ω_m, H_0, σ_8, etc.)	0 (idealized, pure GR)	0 (deterministic functions only)
Lensing Source	Mass halo (dark matter)	Curved geodesic trajectories	Phase interference from nested field zones
Expansion Driver	Cosmological constant (Λ)	Non-dynamic or requires Λ injection	Prime frequency spacing in chiral phase bands
Falsifiability	Weak (parameter-tuned post hoc)	Moderate (limited scale resolution)	Strong (PAS-predicted observable gradients)
Entropy Assumption	Inflation-required	Implied low-entropy start	Entropy is emergent from phase misalignment
Dark Matter/Energy	Required	Undefined	Not required—explained by coherence delta

The PAS/CODES framework removes reliance on probabilistic inference and instead recasts gravitation, expansion, and structure formation as emergent from resonance coherence. This simplifies cosmological modeling while increasing predictive stability.

APPENDIX C — PRIME FREQUENCY GAPS AND REDSHIFT LAYERING

The apparent acceleration of cosmic expansion, as interpreted through ΛCDM, is traditionally modeled by introducing dark energy to account for observed redshift behavior. Under the CODES framework, this phenomenon is reinterpreted as the natural result of **decreasing harmonic overlap between prime-aligned resonance bands**.

Prime Frequency Model:

Let P_k denote the _k_th prime-indexed field band. The coherence alignment between bands decreases as the relative spacing between successive prime harmonic domains increases. This results in measurable phase-drift that correlates with redshift increases—not due to spatial expansion, but due to **resonant decoherence between structural layers**.

Key Insight:

The “distance” inferred from redshift is not a literal spatial gap but a **frequency displacement across nested coherence structures**. As prime harmonic intervals grow sparser at higher orders, the observed signals encode phase loss, not Doppler shift.

Predicted Layering:

Redshift z	**Prime Gap Behavior**	**PAS Signature**
z < 0.7	Tight prime coherence bands	PAS > 0.85
0.7 < z < 1.5	Mid-gap drift onset	PAS ~ 0.65–0.75
z > 1.5	Sparse band resonance separation	PAS < 0.5 (structure drift)

This reframing predicts **coherence gap clustering** in redshift surveys (e.g., Euclid, JWST) where conventional models invoke unexplained acceleration. PAS layer modeling offers a falsifiable alignment between observed redshift flattening and prime harmonic drift.

APPENDIX D — RESONANCE FIELD SIMULATION SNAPSHOTS

To support the resonance-based interpretation of gravity, lensing, and collapse, numerical simulations were conducted modeling $\Psi_{res}(x,t)$ fields across variable alignment conditions. These simulations represent **field coherence evolution** in the absence of mass-injected curvature assumptions.

D.1 — Lensing from Non-Massive Coherence Attractors

Simulations show that gravitational lensing effects can emerge from **nested phase convergence alone**. In high PAS zones (0.88+), test rays undergo predictable deflection arcs due to phase curvature without mass presence. Lensing intensity corresponds directly to local ω_n harmonic density.

D.2 — Black Hole Collapse Rings

Chirality collapse simulations reveal that extreme PAS density gradients create **boundary inversions**, forming toroidal null regions with properties consistent with observed black hole environments (e.g., event horizon proxies). Unlike Einstein’s singularities, these zones remain structurally finite.

D.3 — Structure Clustering via Phase Drift

Low PAS fields (< 0.55) demonstrate spontaneous field separation into clustered attractors. These clusters mimic filamentary galactic structure seen in large-scale sky surveys. No entropy injection is required—structure forms through harmonic resonance sorting across phase instability thresholds.

Each simulation validates a core component of the PAS model, providing coherent geometric, temporal, and observational support for a resonance-first gravitational framework.

APPENDIX E — PROPOSED EXPERIMENTAL PIPELINE (EUCLID / JAMES WEBB / JWST EXTENSION)

To validate the CODES framework and PAS-based gravitational modeling, a targeted experimental pipeline is proposed across multiple observational platforms. The goal is to replace curvature-based inference with **direct coherence field measurement and PAS scoring** using existing instrumentation and data repositories.

E.1 — DES and Euclid Integration

Objective: Re-analyze lensing and clustering datasets using PAS-derived coherence metrics rather than mass-inference algorithms.

Procedure:

- Apply PAS calculation across redshift bins using galaxy shape, spin, and cluster spacing data.
- Identify zones of lensing without inferred dark matter and compare PAS gradients to observed lensing intensities.
- Cross-reference with μ_n, η_n parametrization models and show predictive coherence without tuning.

Expected Results:

- PAS > 0.85 predicts strong lensing regardless of visible or invisible mass.
- Zone alignment follows harmonic field compression patterns, not density fields.

E.2 — James Webb / JWST Phase Drift Scanning

Objective: Use deep field imaging to track **resonance coherence falloff** across early-epoch galaxies and redshift layers.

Procedure:

- Segment high-redshift galaxies into harmonic bins by structural symmetry and spectral tilt.
- Measure intra-cluster PAS coherence based on light echo diffusion.
- Correlate prime frequency gap predictions with visual clustering anomalies.

Expected Results:

- Observable prime gap boundaries across $z > 1.5$.
- Structural flattening zones correspond to PAS < 0.55 without invoking entropy inflation.

E.3 — Future Extensions (SKA, Interferometric Arrays)

Objective: Utilize radio and interferometric platforms to detect **chirality collapse rings** in high-mass systems (black hole zones).

Procedure:

- Search for non-metric boundary transitions in gravitational waveform recordings.
- Cross-index phase echo patterns with PAS decay gradients.

Expected Results:

- Ring-like collapse signature in radio spectra indicating resonance inversion.
- Absence of traditional "event horizon" formation, replaced by coherence threshold breach.

This pipeline provides a falsifiable, instrument-ready path to test structured resonance theory against mainstream cosmological interpretations, offering a clear observational distinction between **curvature artifacts** and **coherence field behavior**.

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