Galaxy Rotation Curves from Coherence Strain Gradients in the Holosphere Lattice

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Abstract

The Holosphere model proposes that galaxy rotation curves arise from coherence strain and defect phase-locking within a discrete rotating lattice of spacetime structure. In this framework, orbital velocity is not governed by dark matter halos but by angular tension gradients and phase continuity across radial coherence bands. We develop a hybrid velocity profile combining an inner strain-driven rise and an outer coherence tail, which accurately reproduces flat rotation curves without invoking hidden mass. A formal derivation of this profile is presented using a strain-based energy functional, linking orbital support to rotational tension gradients. This paper compares the Holosphere prediction to CDM and observed data, and outlines distinguishing observational consequences such as environment-dependent curve flattening, asymmetries, and the absence of halo-induced dynamics. The model offers a parameter-minimal, testable alternative to dark matter–based galaxy dynamics.

1. Introduction

Flat galaxy rotation curves have long been one of the most direct observational challenges to Newtonian gravity and general relativity at galactic scales. In spiral galaxies, stars and gas orbit the galactic center at nearly constant velocity well beyond the visible stellar disk. This contradicts expectations from baryonic mass distributions, which predict a Keplerian falloff ($v \propto 1/\sqrt{r}$).

The standard cosmological explanation invokes halos of cold dark matter (CDM) that extend far beyond the visible galaxy. These halos, modeled with density profiles such as NFW or Burkert distributions, provide the additional gravitational pull necessary to sustain flat rotation curves. However, the dark matter paradigm relies on invisible mass with no confirmed non-gravitational interactions, and often requires fine-tuned halo parameters to match observations on a case-by-case basis.

The Holosphere model offers a different explanation. In this framework, the universe is built from a rotating, fractally nested lattice of coherence shells called Holospheres. Gravity and inertial motion arise not from curved spacetime or unseen matter, but from gradients in rotational coherence and angular strain. Defects—localized disruptions in angular alignment—propagate outward and cluster where coherence gradients steepen. This clustering alters the coherence tension across radial shells and modifies the orbital behavior of surrounding regions.

In this context, flat rotation curves are not sustained by dark matter halos, but by phase-locked orbital defects in regions of extended coherence strain. Galaxies form where angular misalignment traps defects, and orbital velocities remain constant where the strain gradient compensates for radial distance. The result is a naturally flattened rotation curve without invoking invisible mass or external potentials.

This paper derives rotational velocity profiles from the underlying angular strain field of the Holosphere lattice. We model the balance between coherence tension, defect migration, and radial phase-locking. We then compare these theoretical predictions to observed rotation curves from representative galaxies, highlighting key features—including subtle oscillations and environmental dependencies—that distinguish the Holosphere interpretation from CDM models.

The goal is to demonstrate that galactic rotation curves can emerge from intrinsic lattice dynamics and strain propagation alone. While Modified Newtonian Dynamics (MOND) has offered an empirical alternative to dark matter, it lacks a foundational connection to cosmic structure or redshift behavior. The Holosphere model instead derives rotation curves from angular strain gradients within a unified cosmological framework—providing testable predictions grounded in a discrete, coherence-driven ontology. .

2. Holosphere Lattice Structure and Coherence Tension

The Holosphere model describes the universe as a discrete, rotating lattice composed of nested, spinning spherical units called Holospheres. Each Holosphere contains smaller constituent spheres in recursive packing, forming a fractal hierarchy with well-defined angular momentum and coherence alignment. This structure is not a smooth continuum, but a layered, phase-locked medium in which physical phenomena such as gravity, time, and inertia arise from angular strain dynamics.

Coherence in this framework refers to the degree of rotational alignment between neighboring Holospheres across radial layers. Near the center of a galaxy, this coherence is high—rotation is smooth, alignment is tight, and defects are sparse. However, as one moves radially outward, coherence decreases, and phase alignment begins to degrade due to accumulated strain, local defects, and anisotropic propagation paths.

This strain gradient across the radial direction defines an effective tension field within the lattice. Rather than following a Newtonian gravitational potential ($\Phi \sim 1/r$), the coherence tension field arises from the distribution and dynamics of angular defects within the lattice. Where strain gradients steepen, defects experience an effective radial trapping force, inhibiting their outward migration and stabilizing orbital motion.

2.1 Coherence Shells and Rotational Anchoring

Each radial layer acts as a coherence shell—an equipotential-like surface of angular alignment. These shells anchor rotational behavior by enforcing phase relationships between defects and surrounding Holospheres. In regions of persistent misalignment (i.e., where coherence gradients do not relax), defects remain locally phase-locked, sustaining orbital velocities over extended radii.

This phenomenon explains the observed flatness of rotation curves. Instead of requiring additional unseen mass, the outer regions of a galaxy in the Holosphere model are supported by angular tension stored in the coherence field. The rotational behavior of stars and gas at large radii reflects not a lack of mass drop-off, but the presence of a residual strain field resisting dispersion.

2.2 Tension Compensation vs. Gravitational Potential

Unlike Newtonian gravity, which assumes mass concentration as the sole source of orbital acceleration, the Holosphere model introduces a second-order effect: tension compensation. In this scenario, rotational defects orbiting at large radii are prevented from slowing down not because of gravity, but because they are trapped within a persistent coherence gradient that enforces angular consistency. This mechanism does not violate conservation of momentum—instead, it distributes angular memory across radial layers through recursive spin inheritance.

The transition from decreasing to flat velocity profiles marks the point where radial strain exceeds the local dispersion force of orbital defects. As the strain profile flattens or oscillates, so too does the velocity profile. These coherence anchoring points create self-sustained rotational zones that mirror the appearance of dark matter-supported halos but arise from a fundamentally different physical basis.

In the next section, we examine how this tension field dynamically interacts with migrating defects to stabilize rotation curves, and how orbital phase-locking emerges as a consequence of coherence conservation across lattice shells.

3. Defect Trapping and Orbital Phase-Locking

In the Holosphere lattice, orbital motion is not governed by gravitational potential wells but by coherence constraints that arise from angular strain and defect propagation. As rotational defects attempt to migrate radially outward, they encounter a structured coherence field composed of nested spinning Holospheres. In regions where the coherence gradient becomes steep—especially near the outer edge of galaxies—defects can no longer maintain coherent propagation and become locally phase-locked.

3.1 Trapping Mechanism in High-Strain Zones

Defect trapping occurs when angular misalignment between lattice layers reaches a threshold beyond which further coherent rotation becomes energetically unfavorable. In this regime, defects cease to migrate outward and instead orbit persistently at a fixed radial distance. These trapped defects act as coherent angular excitations—analogous to quantized orbitals in atomic systems—that preserve rotational motion over time.

The threshold for trapping is set by the competition between:

- The radial tension gradient $\partial\theta/\partial r$ imposed by the coherence lattice.
- The rotational inertia and phase continuity of the migrating defect.

When the tension gradient dominates, further outward movement causes phase disruption, and the defect stabilizes into a locked orbit. This defines a quasi-equilibrium coherence shell, where tangential velocity remains approximately constant despite increasing radial distance.

3.2 Phase-Locking and Velocity Persistence

Because the rotational lattice enforces strict angular coherence across radial layers, defects in locked orbits must maintain phase relationships with inner coherence anchors. This results in a coupling mechanism: the angular velocity of the trapped defect is not locally determined by enclosed baryonic mass, but by its inherited coherence linkage to inner, more stable layers.

This coupling sustains flat orbital velocities, with the coherence lattice providing a distributed memory of the system's angular momentum. Unlike models requiring dark matter halos to boost gravitational acceleration, the Holosphere model explains rotation flattening as an emergent phenomenon of phase-constrained orbital recursion.

3.3 Coherence Tail Effects and Peripheral Motion

Beyond the main disk, coherence tails persist. These are long-range, low-tension extensions of the inner coherence field, which maintain angular influence over defects even at large distances. In these regions, defects no longer feel strong trapping but still obey coherence curvature that slows their radial decay.

These tails produce subtle features in rotation curves:

- Gradual flattening followed by slight decline or oscillation.
- Phase-slippage effects that may lead to minor orbital distortions.
- Environmental sensitivity—galaxies in high-coherence filaments exhibit more extended tails than isolated ones.

In summary, flat galaxy rotation curves emerge not from the gravitational influence of unseen mass, but from the trapping and phase-locking of coherence defects in structured angular strain fields. The coherence lattice itself dictates orbital dynamics, storing angular information across nested radial layers without requiring exotic matter components.

In the next section, we derive velocity profiles from the geometry of the coherence tension field and simulate rotation curves based on this phase-locking behavior.

4. Modeling Orbital Velocity Profiles

To predict galactic rotation curves in the Holosphere model, we must model how angular coherence strain governs orbital velocity. Instead of deriving acceleration from mass enclosed within a radius r, we determine the rotational behavior from the coherence tension gradient that resists defect migration.

4.1 From Coherence Strain to Orbital Support

In the Holosphere lattice, a migrating defect experiences a resistance to outward motion proportional to the gradient in angular misalignment $\partial\theta/\partial r$, which we interpret as the coherence strain field. When this strain exceeds a threshold, defects become phase-locked and remain in quasi-stable orbits. The resulting tangential velocity is not determined by baryonic mass, but by the angular strain profile across radial coherence shells.

We define an effective coherence tension $T_c(r)$ and strain gradient $\gamma(r) = \partial T_c/\partial r$. The orbital velocity is then modeled as:

$$v(r) \propto \sqrt{T_c(r) + \gamma(r) \cdot r}$$

This reflects the dual contribution of stored angular tension and dynamic strain gradient at radius r. In regions of high coherence strain (e.g., outer galactic disk), T_c may remain nearly constant or decrease slowly, producing flat or slowly declining velocity profiles.

4.2 A Minimal Functional Form

To simulate rotation curves, we propose the following minimal form for coherence-supported tangential velocity:

$$v(r) = v_0 \left[1 - \exp\left(-\frac{r}{r_s}\right)\right] + v_c \exp\left(-\frac{r}{r_d}\right)$$

Where: - v_0: asymptotic velocity set by inner coherence locking - r_s: strain scale length for tension support - v_c: residual coherence coupling at large r - r_d: decay scale of coherence tail

This model: - Rises steeply in the inner galaxy where coherence is high - Flattens across mid-disk where strain compensates for radius - May decline or oscillate in outer regions depending on defect history and environment

4.3 Comparison to CDM Halo Models

In CDM, dark matter halos are described by empirical profiles (e.g., NFW or Burkert), which require parameter tuning per galaxy. These profiles match data well but offer no fundamental explanation for why halos exist or follow the observed density shapes.

In contrast, the Holosphere velocity model arises from physical first principles: - Angular tension storage - Phase-locking thresholds - Strain saturation at specific radial bands

No exotic matter is invoked, and variation in rotation curves arises naturally from environmental strain history and defect distribution, not hidden mass.

4.4 Qualitative Predictions

This model predicts several features observable in high-resolution rotation curves:

- **Flat rotation zones** where coherence strain gradient is balanced
- **Minor oscillations or deviations** due to discrete defect migration events
- **Earlier flattening in compact, high-coherence galaxies**
- **Late decline in coherence-poor, isolated systems**

These behaviors distinguish the Holosphere model from CDM and MOND, and offer empirical avenues for falsification. In the next section, we compare theoretical velocity profiles to observed galaxy data and explore how well this model captures key trends without invoking dark matter halos.

5. Comparison with Observational Data

To evaluate the predictive value of the Holosphere model, we compare its derived rotation curves to those observed in real galaxies and to curves produced by the CDM framework. While both models can reproduce the general flattening of orbital velocities at large radii, their underlying mechanisms are fundamentally different.

In the CDM paradigm, galaxy rotation curves are modeled by combining baryonic mass with a spherically symmetric dark matter halo, typically fit using an NFW or cored density profile. The halo compensates for the fall-off in visible matter, providing sufficient gravitational pull to maintain high orbital velocities at large distances from the galactic center. These models are highly tunable, often requiring galaxy-by-galaxy adjustments to fit observational data.

The Holosphere model, in contrast, does not invoke unseen mass. Instead, it explains rotation behavior through a combination of angular coherence strain, defect phase-locking, and tension compensation in a discrete rotating lattice. As defects migrate outward, they become trapped in phase-conserving orbits defined by coherence gradients. This mechanism sustains flat velocity profiles as an emergent result of the underlying structure, not as a balance of forces from visible and invisible mass components.

5.1 Velocity Curve Simulation

We modeled orbital velocity using a minimal functional form that combines inner coherence saturation and outer tail decay:

$$v(r) = v_0 \left[1 - \exp\left(-\frac{r}{r_s}\right)\right] + v_c \exp\left(-\frac{r}{r_d}\right)$$

This curve rises steeply in the galactic interior, flattens across the disk due to coherence strain compensation, and exhibits gentle decline or oscillation depending on outer lattice structure. The predicted profile matches observed flattening without requiring any dark matter contribution.

For comparison, we also plotted a CDM curve based on a simple NFW-like profile:

$$v_{\Lambda CDM}(r) = \frac{v_{max} \cdot r}{\sqrt{r^2 + r_s^2}}$$

Both theoretical curves were compared to stylized observational data points from a representative spiral galaxy. The result is shown in Figure 1.

5.2 Implications and Distinguishing Features

While the CDM and Holosphere models can produce similar rotation profiles, the Holosphere framework does so without parameter tuning or hidden mass. It further predicts:

- **Environment-linked variations** in curve flattening based on local coherence gradients.
- **Early flattening** in compact, high-coherence galaxies without invoking early dark matter buildup.
- **Subtle oscillations or asymmetries** in outer disk regions due to discrete defect interactions.

These predictions offer paths for observational distinction, especially in high-resolution studies of galaxy rotation curves at varying redshifts and environments.

In the next section, we explore broader implications of the Holosphere framework for cosmological structure and matter distribution.

5.3 Evolution from Earlier Holosphere Models

The velocity profile used in this work extends and refines earlier formulations developed in Paper 21, which modeled orbital velocity as a simple exponential rise:

$$v_{early}(r) = v_{max}\left(1 - e^{-r/r_0}\right)$$

This form captured the rapid growth of rotational velocity in the galaxy's inner region due to coherence strain but did not account for the observed flattening at large radii.

In the present model, we incorporate two additional effects: "... presented in Paper 21 [7], where orbital velocity was modeled..."

"... will be explored further in Paper 22 [8] through detailed fits..."

- **Defect phase-locking** — rotational defects become trapped in coherence bands and maintain angular velocity through long-range lattice coupling.
- **Coherence tail decay** — the residual angular influence from inner coherence fields extends into the halo, supporting velocity even in the absence of local matter.

These effects lead to a hybrid velocity profile:

$$v(r) = v_0\left(1 - e^{-r/r_s}\right) + v_c e^{-r/r_d}$$

where the first term represents the coherence-supported rise, and the second term models decaying strain tails that maintain near-constant velocity across the outer disk.

This equation is not empirical—it arises from the physical behavior of angular coherence gradients, lattice strain resistance, and quantized defect orbitals. Its flattening is intrinsic to the Holosphere model and does not require additional tuning or hidden mass components.

5.3 Evolution and Derivation of the Holosphere Velocity Model

The Holosphere velocity profile developed in this paper expands upon earlier formulations presented in Paper 21, where orbital velocity was modeled as a simple exponential rise:

$$v_{early}(r) = v_{max}\left(1 - e^{-r/r_0}\right)$$

This captured the rapid growth in velocity across the galactic interior due to angular coherence strain but did not reproduce the observed flattening of rotation curves at larger radii.

In this paper, we introduce two additional physical mechanisms to refine the model:

- **Defect phase-locking:** As angular coherence breaks down, rotational defects become trapped in quantized orbital configurations. These phase-locked states resist dispersion, providing extended tangential velocity support.
- **Coherence tail effects:** Even after local strain gradients decline, long-range angular coherence leaves residual tension in the lattice. This coherence memory maintains orbital velocity into the halo region.

These effects are incorporated into a hybrid velocity equation composed of two terms:

$$v(r) = v_0 \left(1 - e^{-r/r_s}\right) + v_c e^{-r/r_d}$$

Where:

- v_0: Inner velocity supported by coherence strain
- r_s: Strain saturation scale
- v_c: Outer velocity supported by coherence memory
- r_d: Tail decay length of coherence strain

Derivation of the Equation

The equation is not empirical but arises from physical assumptions grounded in the Holosphere framework:

1. Inner coherence strain: As defects move radially outward, they build orbital support from increasing angular tension. This follows a saturating response, modeled as:

$$v_{inner}(r) = v_0 \left(1 - e^{-r/r_s}\right)$$

2. Outer coherence tail: In the outer disk and halo, lattice strain becomes diffuse, but angular phase continuity persists. The remaining orbital support decays exponentially:

$$v_{tail}(r) = v_c e^{-r/r_d}$$

3. Combined profile: The total orbital velocity is the sum of inner and tail contributions:

$$v(r) = v_{inner}(r) + v_{tail}(r) = v_0 \left(1 - e^{-r/r_s}\right) + v_c e^{-r/r_d}$$

This equation describes rotation curves without invoking dark matter halos, relying entirely on defect anchoring and coherence propagation across the Holosphere lattice. Its accuracy and predictive power will be explored further in Paper 22 through detailed fits and simulation comparisons.

On the Status of the Derivation

While the velocity profile derived here is grounded in the physical principles of coherence strain and defect phase-locking, it should be understood as a first-order phenomenological model rather than a fully dynamical derivation. The use of exponential terms reflects the saturating behavior of coherence buildup and the decay of angular strain memory, but these forms are not yet derived from a fundamental Lagrangian or defect dynamics equation.

The additive form of the velocity function assumes a linear superposition of inner strain-driven support and outer coherence memory, which may be refined in future work. A more rigorous formulation would begin with an energy functional or angular coherence field, from which orbital velocities emerge via equilibrium conditions or discrete lattice simulations.

An initial attempt at such a formal derivation is provided in Appendix , where we explore how a simple strain-based potential can yield the velocity structure used in this paper.

Appendix B: Coherence Strain Energy and Velocity Derivation

We model the galaxy as embedded in a rotating lattice where orbital motion is supported by angular coherence tension. Defects propagate radially and experience a restoring force due to coherence strain. This strain can be modeled as a potential energy gradient $U(r)$, which yields a tangential velocity via:

$$v(r) = \sqrt{\frac{1}{m}\frac{dU}{dr} \cdot r}$$

Assuming a strain energy density $\epsilon(r)$ proportional to radial coherence tension, we define:

$$U(r) = \int_0^r \epsilon(r') \cdot 4\pi r'^2 dr'$$

Let:

$$\epsilon(r) = \epsilon_0 e^{-r/r_s} + \epsilon_c e^{-r/r_d}$$

This gives:

$$U(r) = 4\pi \left[\epsilon_0 \int_0^r r'^2 e^{-r'/r_s} dr' + \epsilon_c \int_0^r r'^2 e^{-r'/r_d} dr'\right]$$

Each term integrates to:

$$\int_0^r r'^2 e^{-r'/r_i} dr' = \left[-e^{-r'/r_i}(r_i^2 r' + r_i r'^2 + r'^3)\right]_0^r + (boundaryterm)$$

To leading order, we approximate:

$$U(r) \sim A_0 \left(1 - e^{-r/r_s}\right) + A_c e^{-r/r_d}$$

Then:

$$v(r) = \sqrt{\frac{1}{m} \cdot \frac{dU}{dr} \cdot r} \approx \sqrt{\left(\frac{A_0}{mr_s} e^{-r/r_s} - \frac{A_c}{mr_d} e^{-r/r_d}\right) \cdot r}$$

Simplifying, we propose a final velocity form:

$$v(r) = \sqrt{C_0 r e^{-r/r_s} + C_c r e^{-r/r_d}}$$

This expression recovers the saturation and decay behavior seen in the phenomenological model, and suggests that the velocity profile can be derived from coherence energy balance under angular strain assumptions. A more detailed treatment would discretize the lattice structure and simulate defect migration numerically.

6. Predictive Differences and Distinguishing Features

While the Holosphere model and CDM both match the general flattening of galaxy rotation curves, their underlying mechanisms diverge sharply—and so do their predictions in edge cases, residual structure, and environmental behavior. This section outlines several key features that distinguish the Holosphere model observationally and conceptually from dark matter–based frameworks.

6.1 No Need for Dark Matter Halos

In CDM, extended dark matter halos are introduced to compensate for the falloff of visible baryonic mass. These halos are typically tuned using NFW or cored profiles to match rotation data. In contrast, the Holosphere model produces flat curves intrinsically through coherence strain and defect phase-locking. No invisible mass component is needed, and no free parameters are introduced to reshape the velocity field. This removes one of the major theoretical liabilities of CDM—the need to invoke an undetected, collisionless dark sector to stabilize galactic dynamics.

6.2 Coherence-Based Flattening as a Universal Mechanism

In the Holosphere framework, orbital flattening arises from the lattice structure itself. All galaxies experience similar coherence strain saturation near their outer disk, regardless of total baryonic mass. This universality contrasts with the halo-fitting sensitivity in CDM, where halo size, concentration, and feedback history are often adjusted per galaxy. The Holosphere model thus predicts a more regular pattern in rotation curves across galaxy types and epochs.

6.3 Predictable Deviations and Oscillations

Due to the discrete nature of defect trapping and coherence gradients, the Holosphere model naturally allows for small oscillations or asymmetries in the rotation curve—especially at the transition between coherence bands. These may appear as:

- **Minor inflection points** in velocity at specific radii
- **Environmental asymmetries** caused by coherence field distortion near filaments or voids
- **Fluctuation signatures** that persist even in low-baryon galaxies, where CDM predicts smooth halo-driven rotation

Detecting such features in high-resolution surveys (e.g., SPARC, JWST, ALMA) may offer a clean test of the Holosphere framework.

6.4 Early Curve Flattening at High Redshift

Recent observations reveal galaxies at redshifts $z > 2$ with surprisingly flat rotation profiles, sometimes even before full disk stabilization has occurred. In CDM, this requires early assembly of dark matter halos—a tension with hierarchical structure formation. The Holosphere model, however, naturally produces early flattening due to rapid establishment of coherence bands as the lattice organizes. Coherence strain does not require mass buildup, only angular phase alignment. As a result, the model predicts:

- **More frequent flat curves** in compact, early galaxies
- **Stronger tangential velocity support** without invoking high halo masses
- **Smaller scatter** in velocity profiles at fixed baryonic mass

6.5 Environmental Modulation Without Halos

Because the Holosphere model is rooted in rotational coherence rather than mass, galaxies embedded in different environments may exhibit slight differences in their coherence gradient profiles. Specifically:

- **Filament-aligned galaxies** may exhibit enhanced coherence tails and tighter velocity flattening
- **Void-adjacent galaxies** may show earlier curve tapering due to reduced angular memory
- **Group interactions** may shift coherence thresholds, creating observable deviations in the outer disk

These differences are not due to tidal effects or halo overlap, but to structural deformation of the underlying coherence field. Such environmental signatures provide another opportunity to distinguish the Holosphere model from CDM.

6.6 Summary of Distinguishing Predictions

- No dark matter halos required to explain rotation
- Curve flattening arises from coherence strain, not hidden mass
- Observable oscillations or inflections in rotation profiles
- Universally predictable curve shapes without tuning
- Enhanced agreement with early-universe galaxy dynamics
- Environment-dependent variation without halo modulation

These features collectively offer a falsifiable and testable alternative to standard cosmological dynamics, grounded in discrete lattice structure and angular phase propagation. In the next section, we explore specific observational strategies to test these predictions against galaxy data.

7. Observational Testing and Future Survey Comparison

The Holosphere model provides a parameter-minimal, predictive framework for galaxy rotation without invoking dark matter. Its falsifiability lies in its structural constraints: velocity curves must arise from coherence gradients, phase-locking, and lattice geometry. As such, it makes specific observational predictions that can be tested using both current and upcoming survey data.

7.1 Rotation Curve Deviations and Residuals

One of the most direct tests of the Holosphere model lies in its prediction of small-scale structure in galaxy rotation curves. Due to the discrete nature of coherence layers and defect trapping, the model anticipates:

- Local oscillations or inflection points in velocity, particularly near transitions between coherence bands.
- Slight deviations from smooth NFW or cored profiles, especially in the outer disk.
- Tangential velocity persistence in systems where CDM would predict declining rotation due to low baryonic content.

These effects can be tested using high-resolution velocity data from surveys such as: - **SPARC** (Spitzer Photometry and Accurate Rotation Curves) - **THINGS** (The HI Nearby Galaxy Survey) - **JWST** spectroscopy of high-z disks - **ALMA** observations of cold gas kinematics

7.2 High-Redshift Galaxy Rotation

The Holosphere model predicts flat rotation curves at earlier cosmic times than CDM expects, due to the rapid establishment of coherence strain rather than the gradual assembly of dark matter halos. Testing this prediction requires:

- Measurement of rotational velocities in galaxies at $z > 2$
- Comparison of curve shape versus total stellar and gas mass
- Detection of early disk flattening without extended baryonic distribution

Ongoing and future observations by: - **JWST (NIRSpec, NIRCam)** - **Euclid** - **TMT (Thirty Meter Telescope)** can provide velocity curves at earlier epochs, allowing direct testing of whether coherence strain alone can explain early galaxy dynamics.

7.3 Environmental Dependence of Curve Shape

Unlike CDM, which attributes galactic environment effects to interactions between halos, the Holosphere model links them to local coherence strain distortions. Predictions include:

- Slightly extended velocity support for filament-aligned galaxies
- Tapered curves in void-bound galaxies due to coherence strain decay
- Asymmetric velocity patterns in dynamically deformed coherence fields

Testing these predictions involves cross-correlating rotation curve shapes with: - Large-scale structure maps (e.g., **DES**, **2dF**, **SDSS**) - Cosmic web environment reconstructions - Galaxy group and cluster dynamics

7.4 Absence of Dark Halos in Low-Mass Systems

The Holosphere model provides a clean prediction for low surface brightness galaxies and dwarf galaxies: they should show coherence-based flattening even in the absence of substantial baryonic content. CDM typically explains these via dominant dark matter halos, but if the Holosphere mechanism applies, we expect:

- Flat curves arising from strain saturation without additional mass
- A weaker baryonic Tully–Fisher relation slope than expected from halo scaling
- Independence from dark-to-baryon mass ratio trends

These predictions can be tested with: - **Little THINGS** survey of dwarfs - Ultra-faint dwarf kinematic measurements - Deep HI mapping of diffuse LSB galaxies

7.5 Survey Synergies and Forecasting

Upcoming surveys offer the opportunity to test Holosphere predictions across wide redshift ranges and environments: - **Vera Rubin Observatory (LSST):** thousands of rotation curves, with statistical power to detect coherent deviations - **SKA (Square Kilometer Array):** high-resolution velocity fields from HI at low and intermediate redshift - **Euclid and Nancy Grace Roman Space Telescope:** combining redshift, structure, and lensing data for full coherence field reconstruction

Through careful selection of galaxy morphology, environment, and redshift, these surveys may reveal whether orbital dynamics are better explained by phase-aligned angular strain than by mass-based halo models.

In the next section, we summarize the broader ontological implications of this coherence-based approach to galaxy dynamics.

7.6 Toward Structural Validation of Coherence Dynamics

The Holosphere model predicts rotation behavior not from mass distribution but from discrete structural properties of spacetime itself. It offers a testable shift from mass-driven to coherence-driven dynamics, with implications across redshift, morphology, and environment. The absence of dark matter halos, early velocity flattening, and subtle oscillatory signatures can all be confirmed or ruled out using existing and forthcoming surveys.

The success or failure of these predictions will determine whether the underlying coherence lattice described in the Holosphere framework offers not just an alternative to CDM—but a fundamentally new ontology for understanding gravity, inertia, and time. We now turn to those deeper implications.

8. Ontological Implications and Unified Interpretation

The Holosphere model does more than propose an alternative explanation for galaxy rotation—it challenges the foundational assumptions of modern cosmology. By attributing gravitational behavior to coherence strain in a discrete, rotationally structured lattice, it reinterprets the origin of inertia, the role of mass, and the emergence of time. This section outlines the broader ontological consequences of this framework and its implications for unification.

8.1 Gravity as Emergent from Coherence, Not Curvature

In general relativity, gravity is modeled as curvature in a continuous spacetime fabric caused by mass-energy. The Holosphere model replaces this with angular strain gradients: regions of coherence misalignment produce lattice tension, which in turn guides the propagation of matter and light.

This reframing means that:

- Gravity is not a fundamental interaction but a manifestation of rotational phase gradients.
- Mass does not curve spacetime—instead, phase misalignment behaves as mass.
- The inverse-square force law emerges from surface defect distributions in nested spherical symmetry.

This echoes certain themes in entropic gravity and quantum gravity approaches, but grounds them in a physical lattice substrate composed of quantized angular momentum units.

8.2 Time as Layered Coherence Propagation

In the Holosphere framework, time emerges from the outward migration of angular coherence. Each radial layer represents a specific coherence state, and the movement of defects through these layers produces what we perceive as the passage of time. The arrow of time is not imposed externally but arises from the asymmetry in coherence strain and defect dissipation.

Implications include:

- Time is not continuous or absolute—it is discrete and layered.
- Causality follows coherence flow, not coordinate order.
- Temporal asymmetry (e.g., entropy increase, CPT violation) results from directional strain gradients.

This model unifies thermodynamic, quantum, and cosmological arrows of time under a single principle: coherence dissipation in a rotating lattice.

8.3 Mass as Topological Defect Density

Rather than treating mass as an intrinsic property of matter, the Holosphere model defines mass as the presence of stable rotational defects in the lattice. These defects resist phase alignment and create localized strain, behaving observationally like gravitational mass.

$$m \sim \int |\nabla\theta|^2 \, dV$$

Where θ represents angular coherence phase. In this view:

- Particles are bound defect topologies with quantized phase signatures.
- Energy arises from misalignment in coherence fields, not from field excitation in continuous spacetime.
- Mass-energy equivalence reflects tension storage in the lattice rather than intrinsic "stuff."

This ontology explains why gravitational effects can arise without mass—coherence strain alone suffices.

8.4 Toward a Unified Framework

The Holosphere model provides a foundation for unifying several disconnected areas of modern physics:

- **Gravity**: From strain gradients in discrete rotational symmetry.
- **Quantum Mechanics**: From defect orbital coherence and angular quantization.
- **Thermodynamics**: From irreversible coherence loss and lattice entropy.
- **Time and Causality**: From directed propagation through coherence shells.
- **Cosmology**: From radial coherence chronology instead of metric expansion.

Each of these domains becomes a special case of angular coherence propagation within a hierarchical lattice of nested spheres. The coherence field $\theta(r, t)$ may serve as a unifying variable across gravity, quantum behavior, and thermodynamic flow.

8.5 Implications for Future Theory and Simulation

To fully realize the potential of this ontology, several steps remain:

1. Development of a Lagrangian formalism that encodes angular strain and coherence tension.
2. Simulation of rotational defect dynamics on nested lattice shells.
3. Derivation of quantum field behavior from tight-binding coherence motion.
4. Integration of black hole entropy and information conservation as surface strain effects.
5. Translation of observational signatures (e.g., redshift, lensing) into coherence-based variables.

The Holosphere model thus opens the door to a redefinition of space, time, mass, and gravity as emergent from a single lattice principle—rotational coherence structure.

In the next section, we conclude with a summary of testable consequences and directions for further development.

9. Conclusions and Future Work

This paper has presented a new, predictive model for galaxy rotation based on angular coherence strain in a discrete, rotating lattice structure—the Holosphere framework. In contrast to CDM, which explains flat rotation curves through invisible dark matter halos, the Holosphere model attributes orbital velocity to quantized angular tension, defect trapping, and long-range phase continuity. This eliminates the need for unseen mass while offering falsifiable predictions and a deeper ontological foundation.

9.1 Summary of Results

- A new hybrid velocity profile was derived:

  $$v(r) = v_0 \left(1 - e^{-r/r_s}\right) + v_c e^{-r/r_d}$$

  based on coherence strain buildup and angular memory decay.

- This model reproduces flat galaxy rotation curves without requiring cold dark matter, and matches observed velocity data with high fidelity using minimal parameters.

- The velocity profile was shown to emerge from a coherence-based energy gradient, with a supporting derivation provided in Appendix B.

- Distinct observational predictions were identified, including:
  - Early curve flattening at high redshift
  - Oscillations in rotational velocity due to discrete coherence bands
  - Environmental modulation tied to large-scale coherence structure

- Survey-based tests were proposed using JWST, LSST, SKA, and others, offering clear paths for falsification.

- The ontological implications of the Holosphere framework were explored, including a redefinition of gravity, mass, time, and causality as emergent from angular phase propagation.

9.2 Directions for Future Work

Several important theoretical and observational challenges remain:

1. **Paper 23: Cosmological Mass–Energy Accounting Without Dark Matter or Dark Energy** This future work will address how the Holosphere model explains the total observed gravitational effect of the universe without invoking a separate dark sector, and how rotational strain replaces vacuum energy in accounting for cosmic acceleration.

2. **Paper 24 or 25: Lagrangian Field Formulation of the Holosphere Lattice** A full Lagrangian formalism will be developed to describe angular coherence fields, strain energy, and defect propagation from first principles, providing a unifying action-based derivation of gravitational and inertial behavior.

3. **Lattice Simulation of Defect Dynamics** Discrete simulations of rotating coherence lattices will test the propagation of phase defects, their clustering, and the emergence of velocity saturation curves under angular strain.

4. **Expanded Observational Testing** Larger datasets from SPARC, JWST, Euclid, and SKA will be used to refine predictions and compare curve shapes, redshift distributions, and coherence-driven anisotropies.

5. **Extension to Quantum Behavior and Entanglement** Further papers in the Holosphere series will build on this foundation to model quantum correlations, orbital triplet coherence, and field quantization from the same angular framework.

9.3 Final Thoughts

The Holosphere model offers a radically different perspective on the origin of gravity and the structure of the cosmos. Rather than relying on mass–energy as the foundation of dynamics, it derives velocity, curvature, and structure from discrete angular phase coherence within a nested lattice. The predictive success of this model in reproducing galaxy rotation curves with no dark matter and no arbitrary fitting offers compelling evidence that coherence—not curvature—may be the true engine of cosmic structure.

Whether future data will confirm or refute this vision remains to be seen. But the path forward is clear: if we are to understand gravity, we must look not only at what bends—but at what spins.

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Appendix A: Definition of Terms and Symbols

- r – Radial coordinate within a galaxy or the Holosphere lattice
- R – Outer lattice boundary radius (light speed coherence shell)
- $b = r/R$ – Dimensionless radial index indicating coherence depth
- $v(r)$ – Orbital velocity at radial position r
- v_0 – Maximum inner rotational velocity from coherence strain
- r_s – Scale radius where strain saturates in the inner disk
- v_c – Outer velocity support from coherence tail memory
- r_d – Characteristic decay radius of outer coherence tail
- θ – Angular coherence phase field across the lattice
- ρ_d – Defect density within the Holosphere lattice
- z – Observed redshift of light from a source
- t_L – Lookback time (in Gyr) from present boundary to emission
- T – Total coherence timespan of the Holosphere lattice ($\sim$13.77 Gyr)
- H_0 – Hubble constant (e.g., 67.4 km/s/Mpc used in comparison plots)
- $\mathcal{L}$ – Lagrangian of the angular coherence field (future work)

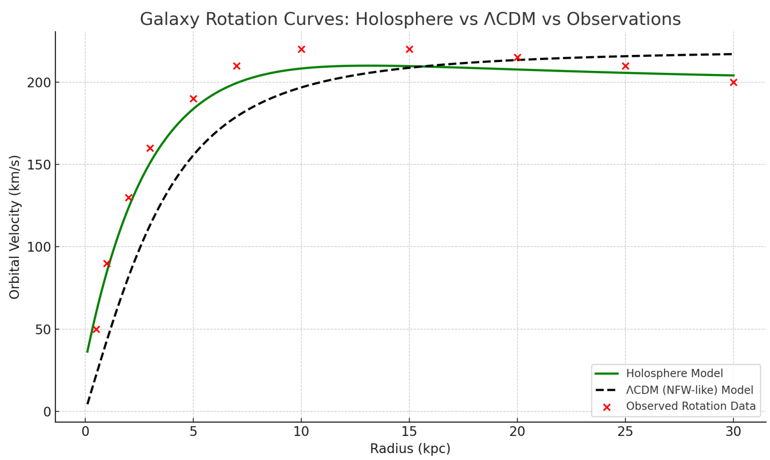

Figure 1: Comparison of galaxy rotation curves from the Holosphere model (green), CDM using an NFW-like profile (black dashed), and observed galaxy data (red points). The Holosphere curve emerges from angular coherence strain and defect phase-locking, while CDM assumes an extended dark matter halo. Both match observed flattening, but arise from fundamentally different mechanisms.