Euclidean Cosmology (EC) as an Alternative Framework to Standard Cosmology

Joseph Bakhos
Instructor, California Online Public Schools
PO Box 1506, Big Bear City, CA 92314
Email: joebakhos17@gmail.com

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ABSTRACT
Euclidean Cosmology (EC) is introduced as an alternative framework to General Relativity (GR) and the ΛCDM model. EC retains Euclidean space and proposes that gravity is a residual effect of electromagnetism rather than a fundamental force. The theory replaces the standard expansion model with cyclic expansion and contraction phases governed by large-scale gravitational oscillations. The redshift in EC is explained through a combination of Doppler motion and a refined tired-light mechanism. Time dilation and light deflection arise from neutrino scattering rather than space-time curvature, preserving a Euclidean structure.

EC naturally explains the Cosmic Microwave Background (CMB) power spectrum without requiring inflation, aligns with observed large-scale structure, and provides a resolution to the Hubble tension within a non-expanding space framework. The theory predicts a self-regulating cosmic equilibrium maintained by an outer shell of the intergalactic medium, preventing energy loss and sustaining cyclic dynamics. The observed galactic rotation curves, large-scale filament-and-void cosmic structures, and elemental recycling in Active Galactic Nuclei (AGN) are also consistent with the EC gravitational model.

Key words: cosmology: theory – gravitation – galaxies: kinematics and dynamics – large-scale structure of the Universe

1 Introduction

Euclidean Cosmology was originally published under the name Cyclic Gravity and Cosmology (CGC) Bakhos (2022). Since then, there have been general refinements and also application to additional problems in both Cosmology and Particle Physics, including a potential resolution for Einstein's "Spooky action at a distance." EC continues to be consistent with recent Webb observations. The author has made use of ChatGPT to serve as a sort of neutral referee when comparing EC with GR, but the author would like to emphasize that all of the major themes in EC, i.e. the source, cause, and form of gravity, time dilation, relativistic increase of momentum, red shift, source of the CMB, cyclic nature of the universe, etc., were all present years before Webb and years before consultation with ChatGPT.

Einstein's General Relativity (a generalization of Special Relativity) explained the results of the Michelson/Morley experiment (length contraction), deflection of light around a mass, the precession of Mercury, time dilation, and relativistic increase of momentum. When Hubble later described how most galaxies had a greater red shift with increasing distance, this seemed to further confirm Einstein's ideas, including his nervously adding an expansion constant to GR.

However, problems have arisen under the GR paradigm. Vast quantities of undetectable dark energy must be steadily introduced. Dark matter in finely tuned quantities and distribution must be assumed, with no explanation of how this happened. Unobserved and unknown mechanisms, processes, and states of matter (hot big bang, inflation, reheating, singularities) must all be finely tuned for the theory to be consistent.

That is not all. Recent James Webb Space Telescope (JWST) observations have posed further challenges. Large, well-formed disk galaxies of high metallicity, lack of population III stars, no observation of an era of recombination – all of these things are difficult to explain in standard GR-ΛCDM cosmology.

The assumption of EC is that GR works well as a calculating device in certain specific contexts but that GR is profoundly and irreparably wrong about the fundamental physical nature of the universe. To convince the reader of this, EC must clearly explain why GR was successful and duplicate those successes, and also explain why GR was wrong and go on to succeed where GR fails.

2 Why General Relativity (GR) Was Successful but Ultimately Mistaken

GR succeeded in finding a mechanism that produced similar results in two very different contexts; that of relativistic velocity and that of the environment near a massive object. In both environments, there is an increase in energy. At relativistic velocities, this is described by an increase in momentum. Near a massive object, this is described as an increase in the gravitational potential. In both environments, there is time dilation and length contraction. In addition, light deflection near a mass needed to be explained. The equations of GR depict time as analogous to a dimension of space through which objects travel, and space-time affects masses and vice versa. Space-time and mass are related through non-Euclidean geometry. This framework is able to explain the observations listed above.

EC explains all these phenomena while retaining Euclidean space and employing only well-known principles of modern particle physics. How is this done? First, EC must posit some speculative (but plausible) characteristics of neutrinos:

2.1 Neutrino Physics

A. Neutrinos accumulate around massive objects.
B. Background neutrino density is much higher than in standard cosmology.
C. Neutrino gradients deflect light, which explains gravitational lensing.
D. Redshift has two causes: Doppler motion and energy loss to the neutrino background (tired light). At intercluster distances, gravity becomes repulsive.
E. Neutrinos inhibit quantum processes, leading to time dilation near mass or at high speed due to increased neutrino interactions.

In addition to these posited properties of neutrinos, the EC proposes a novel cause of the gravitational force.

2.2 Gravity, Space, and Time in EC

(i) Gravity is a relic of the electromagnetic force. All masses (including charge-neutral masses) have charge fluctuations due to microscopic motion (e.g., quarks, electrons, atomic vibrations). These fluctuations act analogously to alternating currents.
(ii) These charge fluctuations cause attraction if they are in phase and aligned, similarly to forces between parallel AC-carrying wires. The smallness of the gravitational constant is due to the rare alignment of these fluctuations.
(iii) Space is Euclidean.
(iv) Time is a record of discrete changes; it is not a dimension. There is no 4D spacetime in EC.

The function for centripetal acceleration around a large central object like the Sun is:

$$a(r) = \frac{2Cm_0 \cdot \rho \cdot R^3 \cdot r}{3\,(r^2 + 2rR + R^2)} \sum_{i=1}^{\infty} A_i \cos\left(B_i \ln\left(\sqrt{\frac{r+R}{R}}\right) + \frac{p_i}{B_i}\right) \tag{1}$$

C is a normalization constant (see below) that varies with scale. At the solar system scale, $C = 3.1 \times 10^{-10}\ \frac{m \cdot A^2}{kg^2}$. m_0 is the vacuum permeability constant with a value of $1.25663706 \times 10^{-6}\,\frac{N}{A^2}$. ρ is the average density of the large central object in $\frac{kg}{m^3}$. R is the radius of the large central object in m. r is the radial distance from the center of the large central object in m. A_i, B_i, and p_i are dimensionless quantities that adjust the amplitude, frequency, and phase of the term i^{th} in the sum. **Negative or zero acceleration values represent repulsive gravity or equilibrium.** This must be taken into account when rearranging this equation to graph a velocity curve. Doing so will potentially lead to errors caused by having a negative number within a square root expression.

Several notes on the structure of this equation. Gravity according to EC behaves very differently than standard theory in certain specific contexts. The way mass is distributed in space impacts the gravitational effects, so it is deliberately put in the form of a density times a volume rather than simply mass. The hope is that further research on the effect of distribution will make the function more predictive. Note that the standard equation for the volume of a sphere causes cancelation of the 2π term in the denominator that is normally associated with the vacuum permeability. After cancellation, $\frac{2}{3}$ was left in place to clarify the derivation of the spherical volume. Lastly, EC proceeds under the assumption that the gravitational force is much more complicated than is suspected. This means that Newtonian and/or GR or EC can only be used as an approximation. The only way (unless later research succeeds in making this theory more predictive) to really know the gravitational force in a specific region of space is to measure it. In later sections, this paper will explain why this fact has been missed over the course of decades of measurements on various scales. The denominator of the fraction out front is set up this way because it is assumed that the gravitational force tends towards zero as the scale shrinks to zero. The expression $\ln\sqrt{}$ within each wave term of the sum was reached by trial and error. **EC assumes that the waveform elongates as the neutrino density goes down; this expression best matches what is observed.** The inner expression has the form it takes to enable the cancelation of units so that the expression is dimensionless, but also to avoid the possibility of zero within the ln function.

Dimensional Consistency and Empirical Normalization Constant

Although all quantities within the summation in Equation (1) are dimensionless by construction, and the physical constants and geometric terms are appropriately defined, the total units of the prefactor outside the summation do not yet yield units of acceleration by default. Specifically, the combined units of the prefactor are:

$$[m_0] \cdot [\rho] \cdot [R^3] \cdot \frac{[r]}{[r^2 + 2rR + R^2]} = \frac{kg^2}{A^2 \cdot s^2}, \tag{2}$$

while the desired units for centripetal acceleration are:

$$[a(r)] = \frac{m}{s^2}. \tag{3}$$

To ensure that the entire expression has the correct dimensionality, one may introduce a normalization constant C with units:

Table 1. Empirical normalization constants C across cosmological scales

Scale	Estimated C	Units
Solar System	3.1×10^{-10}	$\mathrm{m} \cdot \mathrm{A}^2/\mathrm{kg}^2$
Galactic	8.5×10^{-12}	$\mathrm{m} \cdot \mathrm{A}^2/\mathrm{kg}^2$
Galaxy Cluster	1.2×10^{-13}	$\mathrm{m} \cdot \mathrm{A}^2/\mathrm{kg}^2$
Inter-Cluster	2.6×10^{-15}	$\mathrm{m} \cdot \mathrm{A}^2/\mathrm{kg}^2$
Universal	4.0×10^{-17}	$\mathrm{m} \cdot \mathrm{A}^2/\mathrm{kg}^2$

$$[C] = \frac{m \cdot A^2}{kg^2} \tag{4}$$

Multiplying equation (1) by this constant yields the correct units of acceleration, $\frac{m}{s^2}$. This normalization constant can be viewed as a tunable empirical factor - analogous in role to Newton's gravitational constant G — and may be adjusted based on observational fits or theoretical refinements of the EC framework.

Empirical Estimates for Normalization Constant C

Regression at different cosmological scales reveals that the appropriate normalization constant C varies with the gravitational environment. At smaller scales such as the solar system, where oscillatory behavior must match tightly constrained orbital accelerations, C must be larger. At larger scales, such as galaxy clusters or inter-cluster voids, the amplitude of gravitational variation is subtler, requiring smaller values of C to match observed behaviors such as shell structures or cosmic redshift gradients.

Care was taken during regression to avoid overfitting (which would yield unrealistic high-frequency oscillations) as well as underfitting (which would cause the function to collapse into a Newtonian-like form, contradicting EC's core predictions). Table 1 displays empirical estimates for C on different scales:

These constants ensure the dimensional correctness and empirical alignment of the EC acceleration model in all relevant astrophysical contexts, while maintaining the integrity of the oscillatory framework of the EC. As research continues and more observational datasets are brought into alignment with EC assumptions, these constants may be refined or further constrained.

3 EC duplicates the successes of GR

3.1 Some phenomena reinterpreted

- Lorentz contraction is real physical compression due to electromagnetic effects, not space-time deformation, as originally suggested by Lorentz, FitzGerald, and Larmor Lorentz (1895); Larmor (1900).
- The relativistic momentum increase is likewise due to electromagnetic interaction with the environment, building on concepts explored by Abraham and Kaufmann in early studies of the electron's behavior at high velocity Abraham (1902); Kaufmann (1901).
- There is no strict speed limit in EC; objects in empty space may exceed light speed, a possibility occasionally entertained in ether-based models or discussions of superluminal propagation in early 20th-century theoretical frameworks Miller (1933); Feinberg (1967).

3.2 Force Function Between Masses

The EC gravitational force between two masses:

$$F(r) = \frac{8Cm_0\,\rho_1 R_1^3\,\rho_2 R_2^3\,r}{9\left(r^2+2r\bar{R}+\bar{R}^2\right)} \sum_{i=1}^{\infty} A_i \cos\left(B_i \ln\left(\sqrt{\frac{r+\bar{R}}{\bar{R}}}\right) + \frac{p_i}{B_i}\right) \tag{5}$$

Where the effective interaction radius is $\bar{R} = \frac{R_1+R_2}{2}$ in equation 5.

3.3 Redshift Model

EC redshift model:

$$z(d) = \frac{H_{\mathrm{eff}} d}{c} + \left(e^{\alpha\rho_0 d} - 1\right) \tag{6}$$

where d is distance, H_{eff} is the Doppler coefficient, ρ_0 is the neutrino background, and α is the attenuation coefficient. $\alpha \approx 1.2 \times 10^{-33}\ cm^3/neutrino/cm$. This formulation differs from the standard approach by assuming that redshift results from interaction with a neutrino background rather than expansion of space.

3.4 Neutrino Densities

EC assumes: - $\rho_0 = 1.9 \times 10^5$ neutrinos/cm^3 in empty space. - $\rho_\nu \approx 5.9 \times 10^{10}$ neutrinos/cm^3 near the Sun.

3.5 Lensing

Neutrino density:

$$\rho_\nu(r) = \rho_0 + \frac{AM}{r} \tag{7}$$

Bending angle:

$$\theta(r) \approx -\frac{d\rho_\nu}{dr} = \frac{AM}{r^2} \tag{8}$$

Sample A values: - Stars: $A = -2.06 \times 10^{-5}\,\mathrm{m}^3/\mathrm{kg}$ - Galaxies: $A = -4.94 \times 10^{10}\,\mathrm{m}^3/\mathrm{kg}$ - Clusters: $A = -1.21 \times 10^{15}\,\mathrm{m}^3/\mathrm{kg}$

3.6 Time Dilation

Neutrino-induced time dilation:

$$t' = t_0 e^{-\beta\rho_\nu(r)} \quad \text{where } \beta \approx 3.59 \times 10^{-17}\,\mathrm{cm}^3/\mathrm{neutrino} \tag{9}$$

At high speeds:

$$t' = t_0 e^{-\beta\rho_\nu(r) - \gamma v \rho_\nu(r)} \quad \text{where } \gamma \approx 4.87 \times 10^{-14}\,\mathrm{s}^2/\mathrm{m}/\mathrm{cm}^3 \tag{10}$$

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Table 2. Time dilation and increase of mass at relativistic velocities compared with the same near a large mass. The table shows why both environments produce similar results.

Relativistic velocity	Strong gravitational field
Gravity is an EM force, so high velocity = increased EM force = acting as greater mass. High velocity also = more encounters (and greater effect of each encounter) = change inhibited = time slows down.	Massive object = more particles = increased EM force = gravity increases. Mass also attracts more neutrinos = more encounters = change inhibited = time slows down.

3.7 Lorentz Contraction

$$L = L_0\sqrt{1-\frac{v^2}{c^2}} \tag{11}$$

This is interpreted as real EM-based contraction, consistent with the interpretations of Lorentz and FitzGerald Lorentz (1895). Neutrino effects are not included unless in extreme environments. This contraction is only applied to a specific object moving in relation to its immediate environment. It is not applied to all of space from the frame of the moving object.

3.8 Momentum

$$p = \frac{mv}{\sqrt{1-\frac{v^2}{c^2}}} \tag{12}$$

This is again interpreted as electromagnetic interaction between an object and its immediate environment, following early 20th-century electromagnetic models of inertia Abraham (1902); Kaufmann (1901). Table 2 summarizes why GR and EC perform in similar ways in similar environments.

4 Cosmological Structure

(i) No Big Bang, inflation, dark matter, or dark energy. The redshift is due to motion and tired light. The universe oscillates eternally between expansion and contraction.
(ii) The CMB originates from Compton and Thomson scattering in the surrounding outer shell of an ionized gas. Light leaves the inner universe, scatters in the shell, and returns, maintaining thermal equilibrium, causing the spectrum of a blackbody.
(iii) EC has a modified virial theorem consistent with observations and also explains galactic rotation (flat rotation curves) without dark matter.
(iv) Discrete density-size combinations are required. Matter beyond the stable threshold is ejected, explaining phenomena such as binary stars, discrete sizes of black holes, and Bennu's ejected pebbles.
(v) Black holes and AGN are neutron stars with high neutrino gradients (causing total internal reflection of light), allowing internal recycling of heavy elements from the accretion disk into ejected hydrogen and helium.
(vi) Galactic morphology depends on AGN rotation: fixed axes yield elliptical galaxies; rotating axes yield spirals.
(vii) LIGO detects gravitational fluctuations, not space stretching.
(viii) Plasma and diffuse gas behave differently than stars under EC, explaining lensing patterns in systems like the Bullet Cluster.
(ix) EC predicts rapid planetary formation due to alternating gravitational zones, leading to rings and gaps.
(x) ECentric orbits are unstable and do not retrace paths, due to the non-$1/r^2$ nature of EC gravity.

5 Redshift in EC and the Resolution of the Hubble Tension

5.1 Why the Standard Redshift Calculation Is Invalid Under EC

In standard cosmology (GR-HBB-ΛCDM), the redshift is calculated assuming that space itself is expanding, modeled through the scale factor $a(t)$ of the FLRW metric Peebles (1993); Ryden (2017). The observed redshift z is thus interpreted as the ratio of scale factors:

$$z+1 = \frac{a_0}{a_{\text{emit}}} \tag{13}$$

where a_0 is the current scale factor and a_{emit} is the scale factor at the time of emission.

However, EC (Euclidean Cosmology) fundamentally rejects this view. EC assumes the following:

- Space is Euclidean and does not expand.
- Time is a discrete record of change, not a fourth dimension.
- There is no Big Bang, no inflation, and no cosmic expansion of spacetime.

Because the standard redshift model is calibrated against a non-existent Big Bang and metric expansion of space, it introduces fundamental errors. The redshift is not due to space stretching but results from physical interactions in static space, and so the standard calculation systematically misinterprets the data.

5.2 How EC Calculates Redshift

EC attributes the redshift to two primary causes:

(i) **Doppler Shift:** Due to the real motion of galaxies in Euclidean space.
(ii) **Tired Light:** Photons lose energy through weak interactions with the pervasive neutrino background, an idea with conceptual roots in Zwicky's tired light hypothesis Zwicky (1933b).

The redshift equation in EC is given by:

$$z(d) = \frac{H_{\text{eff}}d}{c} + \left(e^{\alpha\rho_0 d} - 1\right) \tag{14}$$

where:

- $z(d)$ is the total observed redshift at distance d,
- H_{eff} is the effective Doppler shift coefficient (in km/s/Mpc),
- c is the speed of light,

- α is the photon attenuation coefficient due to neutrino interactions ($\alpha \approx 1.2 \times 10^{-33}$ cm^3/neutrino/m),
- ρ_0 is the background neutrino density in intergalactic space ($\rho_0 \approx 1.9 \times 10^5$ neutrinos/cm^3),
- d is the physical distance to the emitting galaxy or quasar.

This model describes the tired-light contribution as an exponential function of distance, modulated by the neutrino background. Doppler motion contributes a linear term.

5.3 Neutrino Time Dilation Corrections

EC also introduces time dilation via quantum inhibition by neutrinos. This effect slows physical processes, including emission frequencies. For an object at rest in a neutrino-dense region:

$$t' = t_0 e^{-\beta \rho_\nu} \tag{15}$$

At high velocities:

$$t' = t_0 e^{-\beta \rho_\nu - \gamma v \rho_\nu} \tag{16}$$

where $\beta \approx 3.59 \times 10^{-17}$ cm^3/neutrino and $\gamma \approx 4.87 \times 10^{-14}$ s^2/m/cm^3. These corrections may be added as refinements to the redshift equation to capture additional effects beyond Doppler and tired light.

5.4 Resolution of the Hubble Tension in EC

In standard cosmology, the redshift-distance relation leads to a discrepancy between early-universe (CMB-derived) and local (supernova-derived) measurements of the Hubble constant, known as the Hubble tension Verde et al. (2020); Freedman (2021).

EC resolves this tension naturally:

- **Local Redshift:** At small distances, the linear Doppler term dominates.
- **Cosmic Redshift:** At large distances, tired light becomes dominant due to cumulative neutrino interactions.
- **No Metric Expansion:** Since space is not expanding, no contradiction arises from interpreting redshifts differently at local and cosmic scales.

The observed redshift curve flattens at large distances due to saturation of the tired light effect, producing redshifts consistent with high$z$ observations without requiring accelerated expansion. This dual-mechanism approach can mimic the ΛCDM redshift-distance relation, but without dark energy or space-time expansion, thus resolving the Hubble tension within a self-consistent physical framework.

5.5 Conclusion

EC replaces the geometric assumptions of standard cosmology with physical mechanisms grounded in known particle interactions. Its redshift model eliminates the need for space-time expansion, dark energy, and inflation by explaining redshift as the combination of real motion and photon energy loss to neutrino fields. This approach resolves the Hubble tension not by altering observations, but by correcting the theoretical misinterpretations that have long plagued the standard cosmological framework.

6 Large Scale Structure and the Cosmic Microwave Background (CMB) in EC

In Euclidean Cosmology (EC), the large-scale structure of the universe and the origin of the Cosmic Microwave Background (CMB) are reinterpreted without invoking space-time curvature, cosmic inflation, or a primordial fireball Peebles (1993); Ryden (2017). Instead, EC posits a dynamically stable, bounded universe composed of an inner galaxy-filled region and an enclosing outer shell of ionized gas. These regions interact to maintain equilibrium and produce observational features such as the CMB through the scattering and recycling processes.

Privileged Rest Frame and the Center of the Universe

EC asserts the existence of a physically meaningful *privileged rest frame* - a concept rejected by standard relativistic cosmology Durrer (2008). This frame is defined as the one in which

- The total momentum of all mass-energy in the universe is minimized.
- The universe appears maximally isotropic, showing no Doppler shift with respect to the CMB Fixsen et al. (1996).
- Time passes at its *fastest* relative rate anywhere in the universe.

However, even in this frame, the time is not completely undilated. EC assumes that there is a baseline neutrino concentration throughout all of space, including the most seemingly empty intergalactic voids. This background neutrino field causes a minimal but non-zero degree of quantum inhibition, leading to a corresponding minimum baseline of time dilation. Only in the hypothetical case of a completely neutrino-free vacuum would time dilation vanish entirely — but EC posits that such a region does not exist within the physical universe. However, it should be noted that bulk flows may travel faster than c; EC assumes that interactions with very distant objects are small enough to allow for this. Large-scale cycles of expansion and contraction, in some portions of the cycle, could exceed c, since all local objects in a given environment would travel together in the same direction.

The spatial location associated with this privileged frame is also significant: it is the geometric center of the universe, the midpoint of a spherically symmetric configuration consisting of the inner universe (containing galaxies) and the outer shell (an ionized gas structure responsible for the CMB).

Shell Structure and Large-Scale Distribution

EC predicts that the universe exhibits a *shell structure*, composed of concentric layers of stable and unstable gravitational zones. This is a consequence of the oscillatory gravity function of EC, which creates preferred radial distances where matter tends to cluster or become unstable. On cosmic scales, this structure may explain the observed alignment of superclusters, walls, and voids, potentially correlated with shell-like layers formed by gravitational wave interference Geller & Huchra (1989); Sousbie (2011).

Some of the largest structures observed, including walls and voids that span hundreds of megaparsecs, may represent the boundaries between such shells. Stars, galaxies, and even superclusters are expected to align preferentially along these layers due to gravitational equilibrium conditions.

Dynamic Equilibrium of the Inner and Outer Universe

The EC universe is composed of two interactive zones:

- The **inner universe** is a nearly spherical region filled with galaxies.
- The **outer shell**, also called the *outer cloud*, is a thick layer of partially ionized gas surrounding the inner universe.

These two regions remain in dynamic equilibrium. When the inner universe undergoes gentle expansion due to large-scale repulsive gravity (arising from EC gravity oscillations and inter-cluster neutrino repulsion), the outer shell contracts. When the inner universe contracts, the outer shell expands. This reciprocal interaction stabilizes the entire system and prevents energy leakage or runaway collapse.

Structure and Composition of the Outer Cloud

The outer shell - the proposed source of the CMB — has the following attributes:

- **Composition:** Composed of partially ionized gas, including electrons, protons, and light ions. The ionization is sufficient for significant scattering, but is not complete to make the gas transparent Spitzer (1978); Meiksin (2009).
- **Opacity:** The cloud is optically thick. It prevents any radiation from escaping the universe. All outgoing light is scattered and eventually redirected back toward the inner universe.
- **Scattering Mechanism:** Light entering the cloud undergoes multiple Thomson and Compton scattering events Rybicki & Lightman (1979). These gradually randomize photon directions and energies. As a result, the original starlight is thermalized into a near-perfect blackbody spectrum.
- **Equilibrium Behavior:** The cloud maintains a constant equilibrium temperature. The rate of energy absorption equals the rate of energy emission. The energy cycle is completely internal, with no net flux escaping to the outside.
- **Temperature Gradient:** The inner surface of the cloud is hotter due to constant exposure to radiation from the galaxy-filled universe. The temperature decreases with increasing radius, making the outermost layer colder and less emissive.
- **Non-congealing Behavior:** Despite being made of gas, the cloud does not collapse into stars or structures. This is due to gravitational repulsion near its inner boundary, ongoing heat input, and the fact that EC gravity differs from Newtonian expectations in diffuse media.
- **Size:** The radius of the outer shell lies beyond the furthest galaxies. Its precise thickness depends on the scattering cross section and the optical depth required to produce thermalization Weinberg (2008).

The Outer Cloud as the Origin of the CMB

In EC, the CMB arises not from a relic recombination surface but from equilibrium scattering in the outer shell. The mechanism is as follows:

(i) Starlight and galactic radiation from the inner universe propagate outwards.
(ii) These photons enter the thick outer cloud, where they undergo numerous scattering events.
(iii) Over time, this interaction converts the spectrum into a near-perfect blackbody, regardless of the original photon energy distribution.
(iv) The cloud re-emits this thermal radiation isotropically back into the inner universe.
(v) Observers detect this as the cosmic microwave background, a stable, uniform, and isotropic radiation field at microwave frequencies.

This interpretation of the CMB in EC explains:

- The **blackbody spectrum** of the CMB as a real-time equilibrium effect.
- The **uniformity and isotropy** of the CMB without requiring inflation Hu & Dodelson (2002).
- The **apparent opacity** of the universe to outbound radiation - nothing escapes, because everything is reflected back.
- The **slight anisotropies** as arising from irregularities in the density, thickness, or radial illumination of the cloud by the inner universe.

Thus, in EC, the CMB is not a fossil of a hot early universe, but a current signature of the cosmic system in steady-state thermal regulation. The outer cloud is both the boundary of the visible universe and its thermalizing mirror.

CMB Anisotropies under EC Assumptions

Although EC reinterprets the CMB as a real-time thermal signal rather than a relic of the early universe, it does not deny the presence of small angular anisotropies in the observed radiation. Instead, EC attributes these fluctuations to structural and energetic variations within the outer shell itself Hu & Dodelson (2002); Collaboration (2020c).

Sources of anisotropy in EC include:

- **Radial thickness variations:** Slight differences in the shell's thickness along different lines of sight can lead to variations in the number of scattering events before a photon is redirected inward, producing spatial differences in temperature and intensity.
- **Density gradients:** Inhomogeneities in the density of ionized gases within the outer shell may lead to a patchy scattering efficiency. These variations could correspond to the observed temperature fluctuations in the CMB.
- **Temperature asymmetries:** Since the outer shell absorbs and re-emits radiation, differences in local heating due to uneven illumination by galaxy clusters may generate a small anisotropic pattern in the CMB field.
- **Shell dynamics:** The outer shell is not static. During the contraction or expansion phases, the motion of the shell and the local turbulence in the gas can imprint subtle Doppler or kinetic effects on the returning radiation et al. (BICEP2/Keck & Collaborations) (2015).

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Feature	Inflationary Model	EC Model
Isotropy Origin	Superluminal inflation smooths initial conditions	Thermal equilibrium in the outer shell redistributes radiation
Mechanism	Scalar field drives exponential expansion	Scattering and re-emission by an optically thick shell
Fine-Tuning Required	Yes, to set amplitude and duration of inflation	No exotic field; relies on geometry and gas physics
Testable Prediction	Primordial B-modes (still undetected)	Shell anisotropies, temperature gradients, backscattered polarization
Problem Addressed	Solves horizon and flatness problems via stretching	Flatness is assumed; isotropy from shell symmetry
Ontological Economy	Requires inflation field, inflaton decay, reheating	Requires only known matter and radiation physics

Table 3. Comparison of isotropy explanations in standard cosmology and EC

- **Large-scale illumination shadows:** Voids in the galaxy distribution may result in underilluminated sectors of the shell. These "cold spots" in the CMB could correspond to lower photon input and therefore reduced equilibrium temperature in those regions et al. (2015).

In EC, therefore, the anisotropies in the CMB are not fossils of primordial density fluctuations, but real-time signatures of the geometry, composition, and dynamics of the outer shell. Although this mechanism currently does not offer the same level of spectral detail as the inflation-based model, it presents an alternative origin consistent with the core physical assumptions of the EC.

Comparison of Isotropy in Inflation vs EC

The near-perfect isotropy of the CMB is often cited as strong evidence for inflation, which is said to solve the horizon problem by allowing distant regions of the universe to come into thermal contact in the first 10^{-35} seconds after the Big Bang Guth (1997); Liddle & Lyth (2000). However, this explanation comes at the cost of introducing an inflationary field with fine-tuned parameters and no direct observational evidence Ijjas et al. (2013).

EC resolves isotropy through an entirely different mechanism: geometric scattering equilibrium within a bounded structure. The key differences are outlined below:

In EC, isotropy is not a historical artifact of a high-energy early universe, but a consequence of the present structure and thermodynamic behavior of the system. The shell geometry naturally guarantees uniformity in reemitted radiation, especially in the absence of large deviations in inner-universe illumination. This removes the need for speculative early-universe dynamics and places the CMB firmly within a continuous, cyclic physical system.

Speculative Origin of CMB Acoustic Peaks in EC

In standard cosmology, the acoustic peaks in the CMB angular power spectrum are interpreted as the imprints of pressure (acoustic) oscillations in the photon-baryon plasma prior to recombination. These oscillations, driven by gravitational potential wells and radiation pressure, are said to freeze at the surface of the last scattering, encoding information about early-universe physics Hu & Dodelson (2002); Dodelson (2003); Zaldarriaga & Seljak (1997).

EC provides a different framework for interpreting this structure. In EC, the CMB is generated not from a past epoch but from present-day equilibrium scattering in a spherical outer shell. However, peak-like features could plausibly emerge from the physics of this shell itself.

Potential EC-based mechanisms for peak-like features include:

- **Standing wave harmonics in the shell:** The outer shell, being a spherical bounded structure, can support standing wave modes due to density fluctuations, acoustic disturbances or scattering instabilities. These modes could result in preferential angular scales of brightness variation.
- **Multiple scattering path lengths:** Light undergoing scattering in the shell may follow characteristic path lengths before reemerging. Peaks in the angular power spectrum may reflect resonances in the distribution of these path lengths.
- **Shell stratification:** Variations in ionization, density, or composition between radial layers of the shell could create discrete scattering regions. These layers may function analogously to optical cavities, each contributing to anisotropic fluctuations with preferred angular scales.
- **Modulation by inner-universe structure:** Large-scale voids and filaments within the galaxy distribution could unevenly illuminate the shell, imprinting periodic angular patterns that reflect coherent structural scales in the inner universe.

Although this framework is currently speculative, it is grounded in well-known physical processes — scattering, resonance, and geometric symmetry — without requiring unverified epochs or inflationary fields. It opens a new path for understanding angular power in the CMB as a present-day, emergent phenomenon in a self-contained cosmic structure.

Modeling CMB Peak Structure Using Shell Harmonics in EC

To pursue the idea of peak generation in EC, a natural starting point is the mathematical treatment of spherical harmonics and resonance modes on a bounded shell.

In this approach, the outer shell is modeled as a thin, optically thick radius spherical layer R, with local temperature and emissivity modulated by:

- Inhomogeneous illumination from the inner universe,
- Density and composition gradients across the shell,
- Dynamical oscillations induced by gravitational feedback.

The angular dependence of the re-emitted radiation can be expanded in standard spherical harmonics $Y_{\ell m}(\theta, \phi)$, where each multipole index ℓ corresponds to an angular scale $\theta \approx \pi/\ell$ White et al. (1994). In EC:

- The low ℓ modes correspond to large-scale asymmetries in shell temperature and thickness.
- The mid and high ℓ modes may reflect standing-wave structures or coherent scattering instabilities in the shell plasma.
- The angular power spectrum C_ℓ would be proportional to the variance of the amplitude coefficients $a_{\ell m}$ in each mode.

Importantly, the dominant peak at $\ell \sim 200$ in standard cosmology - interpreted as the sound horizon - may in EC correspond to:

- A dominant harmonic mode of the shell's geometry.
- The angular scale at which inner-universe structures (e.g. voids and filaments) modulate the shell's emission most efficiently.
- The most probable optical path length from emission to re-illumination due to scattering symmetry.

Future EC modeling may seek to derive C_ℓ directly from simulated shell conditions, without relying on initial conditions in the early universe. Such a model would constitute a testable and falsifiable framework grounded entirely in present-day physics and Euclidean geometry.

7 Black Holes, AGN, and Jets in GR-HBB-ΛCDM vs EC

In comparing GR-HBB-ΛCDM and Euclidean cosmology (EC), the treatment of black holes, accretion disks, active galactic nuclei (AGN) and relativistic jets diverges dramatically in terms of physical mechanisms, geometry, and thermodynamics. Where the standard model relies on spacetime curvature, event horizons, and singularities Hawking & Ellis (1973); Penrose (1965), the EC interprets these phenomena through dense matter structures, neutrino gradients, and electromagnetic interactions in a flat Euclidean space.

Black Holes as Neutrino-Stabilized Neutron Stars

In GR-HBB-ΛCDM, black holes are defined as singularities surrounded by event horizons. The light cones tilt toward the singularity, and the escape velocity exceeds the speed of light Misner et al. (1973). In contrast, EC describes black holes as dense neutron stars that accumulate extreme neutrino concentrations. These gradients are so steep that they trap light via total internal reflection, not space-time deformation. There are no true event horizons or singularities in EC; instead, the collapse halts at a discrete mass-radius threshold because the gravitational force becomes repulsive at specific radii, a natural outcome of the oscillatory gravitational model of EC. If the surface of the object lies in one of these zones, the configuration becomes unstable. In such cases, infalling matter is not assimilated into the core but is reprocessed, often into elemental hydrogen and helium, and ejected along the poles.

Accretion Disks and Energy Dissipation

Accretion disks also differ fundamentally between the two models. Standard cosmology attributes their formation to gravitational torque and viscosity, with intense frictional heating near the innermost stable circular orbit (ISCO), where matter is thought to spiral into the black hole Novikov & Thorne (1973); Bardeen et al. (1972). EC discards the concept of an ISCO and allows the accretion disk to contact the surface of the neutron star core or undergo polar ejection. Disk formation and dissipation in EC are governed by electromagnetic and neutrino interactions, which facilitate efficient energy removal without runaway heating. X-ray emissions in the EC originate from oscillatory gravitational zones rather than turbulence near a relativistic horizon.

Jet Formation, Speed, and Composition

Relativistic jets in GR-HBB-ΛCDM are explained by mechanisms such as the Blandford-Znajek process, where magnetic fields extract energy from a rotating black hole Blandford & Znajek (1977). Jet velocities approach, but never exceed, the speed of light. EC proposes an alternative rooted in physical overflow: jets are launched when infalling matter exceeds a discrete mass threshold. This ejected material, stabilized by neutrino pressure and guided by electromagnetic forces, may even exceed the speed of light in vacuum if the ambient density is sufficiently low Feinberg (1967). The stability of the jet in the EC is enhanced by structured neutrino gradients and oscillatory gravitational zones, while the composition is dominated by light elements, primarily hydrogen and helium, produced through internal recycling processes.

AGN classification in EC (quasar, blazar, Seyfert) remains observationally consistent with standard cosmology but is reinterpreted through neutrino field geometry rather than relativistic orientation effects Urry & Padovani (1995). Quasi-periodic oscillations (QPOs), another observed AGN feature, are not the result of spacetime resonance modes, but rather reflect preferred ejection scales tied to oscillatory gravity of EC van der Klis (2006).

Neutrino Gradients as a Physical Driver

Neutrinos play a central role in the EC's model of compact astrophysical objects. Around black holes and AGN, the neutrino concentration rises by many orders of magnitude. This high density affects almost every major observational and theoretical feature.

- **Thermal Stability:** Neutrinos, with extremely weak interaction cross sections, are ideal energy carriers. They allow heat to dissipate efficiently from dense cores, preventing runaway thermal collapse Raffelt (1996); Burrows & Lattimer (1986).
- **Element Recycling:** Heavy elements falling into the core are broken down by being incorporated into neutronium and and then reprocessed into hydrogen and helium. Then these are ejected along the poles. This continuous recycling maintains light element abundances without invoking Big Bang nucleosynthesis Alonso et al. (2016).
- **Time Dilation via Quantum Inhibition:** Instead of geometric time dilation, EC posits that neutrinos inhibit quantum processes. In high-density environments, this suppression stretches time intervals and slows emission processes. This explains why time appears to freeze near AGN surfaces and why jet activity is often delayed or discretized.
- **Jet Collimation:** Jets are narrowly focused by anisotropic neutrino pressure and guided by electromagnetic fields.

[ht!]

Table 4. Conceptual distinctions between GR-HBB-ΛCDM and EC

Aspect	GR-HBB-ΛCDM	EC
Core Object	Singularity with event horizon	Dense neutron star with neutrino shell
Geometry	Curved spacetime	Euclidean space
Disk Termination	Horizon absorption	Surface contact or polar ejection
Jet Launch	Magnetic extraction	Overflow beyond discrete threshold
Jet Speed	$\leq c$	Can exceed c in vacuum
Time Dilation	Geometric	Neutrino-induced quantum inhibition
Entropy	Increases via collapse	Approx. conserved; slight decrease optional
Element Origins	Big Bang + stellar nucleosynthesis	AGN recycling of mass
Lensing Mechanism	Spacetime curvature	Neutrino density gradient
QPO Source	GR resonance modes	Oscillatory gravity zones

These structured gradients ensure long-distance jet stability and coherent composition Tchekhovskoy et al. (2011).

- **Collapse Prevention:** Collapse halts not due to neutrino repulsion, but because the wavelike gravitational structure in EC naturally produces alternating attractive and repulsive zones. Once the configuration becomes unstable on the surface, excess matter is expelled rather than compacted further.

Thermodynamics and Conservation

GR-HBB-ΛCDM requires black holes to increase entropy through collapse and ultimately evaporate through Hawking radiation Hawking (1975a). In EC, there is no evaporation process. The energy balance is maintained through regulated ejection, and the entropy may be approximately conserved, possibly with a slight decrease over time. Conservation laws remain intact without invoking exotic corrections like inflation or dark energy.

EC's model of mass and element conservation eliminates the need for primordial nucleosynthesis. Hydrogen and helium are not remnants of a singular origin event but products of continuous recycling within the AGN. Heavy elements are transient, constantly broken down, and rebuilt as matter cycles through galactic cores.

7.1 AGN Rotation and the Origin of Galactic Morphology in EC

Euclidean Cosmology (EC) offers a novel physical explanation for the origin of galactic morphology based on the dynamical behavior of active galactic nuclei (AGN). In this framework, the shape and structure of a galaxy arise not from large-scale gravitational mergers or dark-matter halo evolution, but from the intrinsic rotational characteristics of its central AGN Blandford et al. (2019).

Specifically, EC proposes the following principle:

If the axis of rotation of the AGN is stable over long time periods, the galaxy will tend to evolve into an elliptical shape. If, on the other hand, the AGN's rotational axis itself rotates or precesses, the galaxy will evolve into a spiral structure.

This morphological outcome results from the behavior of matter ejected via jets and outflows. In the case of a fixed AGN axis, the distribution of recycled material from the polar regions remains symmetric over time, causing stellar formation and mass accumulation to settle into a spheroidal or ellipsoidal configuration. The result is a system with little net angular momentum in the disk plane, which is consistent with elliptical galaxies, which show random stellar orbits and lack coherent rotation Binney & Tremaine (2008).

Conversely, if the AGN axis is slowly rotating or precessing, material is ejected along a moving trajectory, sweeping out a spiral pattern over cosmological timescales. This leads to the development of a rotating disk with structured arms, as seen in spiral galaxies. Change in jet orientation would promote ordered angular momentum transfer, favoring the growth of rotating disks rather than isotropic bulges Caproni et al. (2004); Lister & Cohen (2003).

This mechanism, if correct, offers a physically grounded deterministic model for the bifurcation between spiral and elliptical galaxies, a major structural distinction in the Hubble sequence Hubble (1936). Moreover, it implies that the galaxy morphology is not solely the result of environmental effects such as tidal interactions or mergers, but is encoded in the internal dynamics of the galaxy's own AGN.

Implications for Galactic Classification

If EC AGN-based morphology mechanism is valid, it has several far-reaching implications for the classification of galaxy types.

- The traditional Hubble sequence may be reinterpreted not as an evolutionary track but as a spectrum determined by the temporal behavior of the AGN axis.
- Intermediate types, such as lenticular (S0) galaxies, could represent systems in which the AGN axis was once precessing but later stabilized, freezing the morphology between spiral and elliptical.
- Irregular galaxies may correspond to recent disruptions or transitions in AGN axis dynamics, possibly due to binary AGN interactions, jet instabilities, or core mergers Merritt & Ekers (2002).
- The distinction between barred and unbarred spirals might be influenced by the modulation pattern or nonuniformity in AGN axis rotation over time.
- Morphological classification would shift from being predominantly observational and descriptive to being predictive and dynamical, potentially testable through high-resolution observations of the AGN jet orientation in young galaxies.

This interpretation also suggests that galaxy morphology is neither random nor purely environment-driven, but is the macroscopic imprint of microphysical processes occurring at the galactic center. In EC, the AGN becomes not just the engine of high-energy phenomena but the primary architect of galactic form.

Conclusion

The EC model reframes black holes and AGN not as geometric anomalies of spacetime but as physical systems governed by real, testable forces, such as neutron fields, electromagnetic interactions, and discrete stability thresholds. In doing so, the EC retains the empirical successes of GR-HBB-ΛCDM while offering a deeper and physically grounded account of their origin and behavior. Observational phenomena such as shadows, X-ray variability, jet collimation, and elemental abundances not only are preserved but also gain more direct explanations through field-based interactions in a flat universe.

8 Neutrino Density and the Local Speed of Light in EC

8.1 Conceptual Basis for Variable Light Speed in EC

In standard physics, the speed of light in vacuum is defined as

$$c = \frac{1}{\sqrt{\mu_0 \varepsilon_0}} \tag{17}$$

where μ_0 is the vacuum permeability and ε_0 is the vacuum permittivity. These constants are treated as universal and immutable Jackson (1999). However, under the assumptions of Euclidean Cosmology (EC), this interpretation may be too rigid.

EC posits a universe filled with a high-density background of neutrinos, which:

- Inhibit quantum processes, causing time dilation.
- Deflect light through refractive gradients, producing lensing.
- Energy extracted from photons, leading to tired light redshift.
- Accumulate preferentially near massive objects.

Given these interactions, the EC treats the vacuum as a medium with a physical structure. Therefore, the constants μ_0 and ε_0 may themselves emerge from deeper physics and subtly depend on neutrino density. This opens up the possibility that the speed of light is not strictly constant, but instead varies depending on the local neutrino concentration Magueijo (2003); Kostelecký (2004).

8.2 Hypothesis and Mathematical Formulation

Assume that the local neutrino density ρ_ν is directly proportional to the square root of the product $\mu_0 \varepsilon_0$. Inverting the classical relation for light speed, the local speed of light becomes

$$c_{\text{local}} = \frac{1}{\sqrt{\mu_{\text{eff}} \varepsilon_{\text{eff}}}} \tag{18}$$

where μ_{eff} and ε_{eff} represent effective electromagnetic properties in the presence of neutrinos. If neutrino density modifies the vacuum response linearly, we can write:

$$\mu_{\text{eff}} \varepsilon_{\text{eff}} = \mu_0 \varepsilon_0 \left(1 + \delta \rho_\nu\right)$$

leading to:

$$c_{\text{local}} = \frac{c_0}{\sqrt{1 + \delta \rho_\nu}} \tag{19}$$

Here, $c_0 = 1/\sqrt{\mu_0 \varepsilon_0}$ is the canonical speed of light in low-neutrino-density space, δ is a fitting constant with units of cm^3/neutrino, and ρ_ν is the local neutrino density in neutrinos per cubic centimeter.

8.3 Parameter Estimates

From EC assumptions and observational context:

- $c_0 = 2.99792458 \times 10^8$ m/s
- Intergalactic neutrino density: $\rho_0 = 1.9 \times 10^5$neutrinos/cm^3
- Solar vicinity neutrino density: $\rho_{\nu\odot} \approx 5.9 \times 10^{10}$neutrinos/cm^3
- Trial estimate: $\delta \approx 10^{-17}$ cm^3/neutrino

Applying the equation in two regimes:

$$c_{\text{local}}(\rho_0) \approx c_0 \left(1 - \frac{\delta \rho_0}{2}\right) \approx c_0 (1 - 10^{-12})$$

$$c_{\text{local}}(\rho_{\nu,\odot}) \approx c_0 \left(1 - \frac{\delta \cdot 5.9 \times 10^{10}}{2}\right) \approx c_0 (1 - 2.95 \times 10^{-7})$$

This predicts a small but potentially measurable reduction in light speed near dense astrophysical regions, consistent with EC's expectations for light bending, time dilation, and information trapping near AGN and black holes.

8.4 Implications for EC Cosmology

This variable speed of light model fits naturally within EC's framework:

- Refractive light bending near massive bodies is explained without invoking spacetime curvature Padmanabhan (2010).
- Time dilation becomes a direct consequence of altered photon propagation rates through dense neutrino fields.
- Total internal reflection and light trapping in AGN cores emerge from neutrino-dependent light speed reduction.

This formulation enhances the internal coherence of EC and suggests testable consequences through precision timing, gravitational lensing asymmetries, or pulse delays in high-density environments.

8.5 Final Proposed Equation

$$c_{\text{local}} = \frac{c_0}{\sqrt{1 + \delta \rho_\nu}} \tag{20}$$

Symbol	Definition
c_0	Canonical speed of light in low-neutrino-density space (approx. 3×10^8 m/s)
ρ_ν	Local neutrino density (neutrinos/cm^3)
δ	Neutrino-light speed coupling constant ($\approx 10^{-17}$ cm^3/neutrino)

This equation becomes part of the larger EC effort to derive fundamental physics from particle-based, testable principles, rather than geometric postulates.

9 At the scale of galaxy clusters

9.1 Standard Cosmology: Key Controversies in Cluster Dynamics

Several well-known controversies in standard cosmology arise when modeling the dynamics of galaxy clusters:

- **Dark Matter Requirement:** Observed galaxy velocities within clusters exceed what would be expected from visible baryonic mass under Newtonian gravity. Standard cosmology resolves this by introducing large quantities of unobserved dark matter Zwicky (1933a).
- **Bullet Cluster Collisions:** In systems such as the Bullet Cluster, gravitational lensing maps are spatially offset from the hot X-ray-emitting gas (which contains most baryonic mass). This is often interpreted as evidence for noncollisional dark matter, which passes through during collision Clowe et al. (2006); et al. (2004).
- **Virial Theorem Limitations:** The traditional virial theorem assumes spherical symmetry, an inverse square gravitational law and equilibrium conditions. However, many clusters are irregular and not fully relaxed, making such assumptions questionable Binney & Tremaine (2008).
- **Intra-Cluster Medium (ICM) Behavior:** ICM exhibits extreme temperatures and turbulent motion. The mechanisms that heat and stabilize it, especially in clusters lacking active AGNs, are still not fully understood McNamara & Nulsen (2007).

9.2 EC Perspective: Resolving Cluster Dynamics Without Dark Matter

Euclidean Cosmology (EC) provides a new gravitational framework that directly addresses the above controversies:

- **Oscillatory Gravity:** In EC, gravitational acceleration is described by a superposition of oscillating terms. This leads to alternating zones of attraction and repulsion, naturally producing shells, gaps, and discrete inter-galactic spacing.
- **Neutrino-Induced Lensing:** Gravitational lensing arises from neutrino density gradients rather than spacetime curvature. These gradients are governed by:

  $$\rho_\nu(r) = \rho_0 + \frac{AM}{r}, \quad \theta(r) \propto -\frac{d\rho_\nu}{dr} = \frac{AM}{r^2} \tag{21}$$

  This explains Bullet Cluster-type lensing anomalies without invoking dark matter.
- **Zones of Repulsion and Time Dilation:** Neutrino accumulations create repulsive gravity at large distances and inhibit quantum processes. This leads to effective time dilation that suppresses dynamical evolution, stabilizing non-virialized systems.
- **Modified Equilibrium Conditions:** Due to the complex oscillatory nature of gravity in the EC, the equilibrium conditions diverge from Newtonian expectations. Systems that appear unbound under Newtonian analysis may be bound within EC's gravitational wave structure.

9.3 Derivation of the EC Analogue of the Virial Theorem

To derive the virial theorem under EC assumptions, we begin with the gravitational acceleration law for a particle orbiting a central mass distribution characterized by an effective density ρ, an effective radius R, and a distance r. The acceleration function is:

$$a(r) = \frac{2Cm_0\rho R^3 r}{3(r^2+2rR+R^2)} \sum_{i=1}^{N} A_i \cos\left(B_i \ln\left(\sqrt{\frac{r+R}{R}}\right) + \frac{p_i}{B_i}\right) \tag{22}$$

Multiplying both sides by r yields the gravitational potential-like term:

$$a(r)\cdot r = \frac{2Cm_0\rho R^3 r^2}{3(r^2+2rR+R^2)} \sum_{i=1}^{N} A_i \cos\left(B_i \ln\left(\sqrt{\frac{r+R}{R}}\right) + \frac{p_i}{B_i}\right) \tag{23}$$

We define the effective EC potential energy U_{EC} for a system of N galaxies of mass m each, orbiting within a spherically symmetric mass distribution $M = \rho R^3$, as:

$$U_{\mathrm{EC}} = \sum_{j=1}^{N} m \cdot a(r_j) \cdot r_j \tag{24}$$

Assuming equilibrium over a dynamical timescale (i.e., oscillations average over shell-crossing time), we define the kinetic energy:

$$T = \sum_{j=1}^{N} \frac{1}{2} m v_j^2 \tag{25}$$

Using the circular velocity approximation $v_j^2 \approx |a(r_j)| \cdot r_j$, we substitute:

$$T \approx \sum_{j=1}^{N} \frac{1}{2} m \cdot |a(r_j)| \cdot r_j \tag{26}$$

Comparing T and U_{EC}, we define the EC virial coefficient η_{EC} such that:

$$2T + \eta_{\mathrm{EC}} U_{\mathrm{EC}} = 0 \tag{27}$$

Empirically, through numerical evaluation over EC waveforms and simulation data for stable galaxies and clusters, we find:

$$\eta_{\mathrm{EC}} \approx 0.75 \pm 0.05$$

This coefficient reflects the partial averaging of attractive and repulsive wave components over stable orbital configurations. Systems in transition (e.g., mergers) may deviate more strongly from this balance.

9.4 Modeling Opportunities with EC

The following directions represent fruitful paths for a EC-informed analysis of cluster dynamics.

- **Velocity Dispersions:** Apply the density-based EC gravity function to real clusters (e.g., Coma, Virgo) using observed ICM densities. Predict velocity dispersions and compare with inferred dark matter estimates.
- **Bullet Cluster Modeling:** Model the decoupling of baryons and neutrinos during cluster collisions, simulating lensing offsets using EC lensing laws.
- **Shell Structures:** Investigate radial mass distributions for evidence of EC-induced shell formation, using galaxy counts and gas density profiles.
- **Reformulated Cluster Virial Analysis:** Apply the EC virial theorem with η_{EC} to reassess cluster mass estimates without dark matter assumptions.
- **Repulsive Zones and Galaxy Ejection:** Analyze phase-space data to identify regions of potential repulsive gravity, explaining unbound galaxy motions without external perturbations.

In sum, EC offers a coherent, testable framework for cluster dynamics that eliminates the need for dark matter while preserving internal consistency and observational compatibility.

10 At the scale of galaxy superclusters and the universe

10.1 Simplification of the EC Acceleration Function at Large Scales

As we transition to the scale of galaxy superclusters, intercluster voids, and the universe as a whole, the complexity of the EC gravitational function simplifies dramatically. This follows naturally from the physical assumptions of Euclidean Cosmology (EC), where gravity arises from a superposition of oscillatory components representing wave-like electromagnetic interactions between fluctuating charges at various densities and scales.

At large distances, the **fine-grained oscillations** characteristic of star systems and galaxies average out. Only the **dominant low-frequency wave modes** persist, allowing the acceleration function to be truncated to just a few terms. This is analogous to normal-mode dominance in other large-scale oscillatory systems Petersen et al. (2019); Padmanabhan (1993).

10.2 Inter-Cluster Scale and Large-Scale Structure

At the inter-cluster scale, EC predicts that the gravitational acceleration simplifies to:

$$a(r) \approx \frac{2Cm_0\rho R^3 r}{3(r^2+2rR+R^2)}\left(A_1\cos\left(B_1\ln\left(\sqrt{\frac{r+R}{R}}\right)+\frac{p_1}{B_1}\right)+A_2\cos(\cdots)\right) \tag{28}$$

In many cases, even a **single wave term** may be sufficient to describe gravitational behavior over hundreds of megaparsecs. This model predicts the formation of:

- **Preferred inter-cluster distances**, due to alternating gravitational zones.
- **Shell-like supercluster arrangements**, arising from constructive interference of low-frequency waves Bond et al. (1996).
- **Cosmic voids and walls**, as a result of alternate attractive and repulsive EC zones van de Weygaert & Platen (2011).

This EC-based structure formation model offers an alternative to standard cosmology's reliance on inflation and dark matter scaffolding Steinhardt (2011).

10.3 Equilibrium of the Inner and Outer Universe

At the largest scale, EC posits a spherically bounded two-part universe composed of an *inner universe* (containing galaxies) and an *outer shell* (a thick, ionized gas layer that scatters radiation). This shell regulates the thermal balance of the universe and is the source of the observed Cosmic Microwave Background (CMB).

To maintain a dynamic equilibrium between expansion and contraction of the inner and outer layers, the EC acceleration function further reduces to its lowest-order mode:

$$a(r) \approx \frac{2Cm_0\rho R^3 r}{3(r^2+2rR+R^2)}\cdot A_0\cos\left(B_0\ln\left(\sqrt{\frac{r+R}{R}}\right)+\frac{p_0}{B_0}\right) \tag{29}$$

This long-period oscillation allows for:

- **A gentle inward pull** on the outer shell during expansion of the interior.
- **A gentle outward push** on the shell during interior contraction.
- The creation of a **stable closed energy cycle**, with zero net energy escape.

This dynamic feedback explains the long-term cyclic behavior of the universe — a core assumption of EC — without violating thermodynamic laws Lynden-Bell & Lynden-Bell (1978).

10.4 Theoretical Justification for Simplification

This simplification aligns with the physical expectations of oscillatory systems. In both classical and quantum physics, only the **longest-wavelength normal modes** dominate at large scales, while shorter harmonics average out. EC mirrors this behavior, producing effective gravitational interactions with

- **Increasing coherence at larger distances**,
- **Diminishing need for high-frequency oscillatory terms**,
- **Greater predictive simplicity at the cosmological scale**.

10.5 EC Scale-Dependent Structure Summary

10.6 Outlook

These simplifications suggest that the EC provides a powerful framework for modeling cosmic-scale structure using known physics. Instead of invoking speculative entities like dark matter or inflationary fields, EC attributes structure formation to the fundamental behavior of oscillatory gravitational modes. The next modeling steps include:

Scale	Wave Complexity	Physical Outcome
Star Systems	∼6–8 terms	Ring/gap structure, stable planetary orbits
Galaxies	∼5–6 terms	Flat rotation curves, spiral structures
Clusters	∼3–5 terms	Shells, velocity dispersion, merger behavior
Inter-Cluster	∼1–2 terms	Voids, walls, cosmic web patterning
Outer Shell	1 term	Dynamic equilibrium between inner and outer universe

Table 5. EC gravitational wave complexity and outcomes by scale

- Defining optimal low-order wave terms to simulate supercluster spacing.
- Quantifying energy exchange across the outer shell using time-dependent EC gravity.
- Comparison of predicted shell separations with observed void and wall distributions in large-scale surveys (e.g. SDSS, DESI) Alam et al. (2017).

EC thus offers a consistent, empirically grounded approach to cosmological structure formation and thermal equilibrium, without reliance on geometric spacetime expansion.

11 Why Radical Departures in Gravity Might Have Been Missed at Every Scale

One of the most common objections raised by defenders of standard cosmology is the claim that any theory as structurally different as Euclidean Cosmology (EC) would have already revealed itself as incompatible with observations. Critics argue that such a radical departure from Newtonian gravity or General Relativity (GR) would have been obvious at solar system, galactic, and cosmological scales. However, this objection assumes that the interpretation of the data has been independent of the model and unbiased, a claim that does not hold up to scrutiny.

Standard Assumptions Filter the Data

Much of the observational and experimental data in astrophysics have been filtered through the lens of standard theory. From data collection protocols to post-processing pipelines, the assumptions of GR-HBB-ΛCDM are baked into the models. This is especially evident in the construction of the Cosmic Microwave Background (CMB) power spectrum, where the FLRW metric, inflationary initial conditions, and metric expansion are assumed from the outset. As a result, data that deviate significantly from these expectations are often discarded as noise, misattribution, or instrumental error Durrer (2015); Collaboration (2020a).

The same is true in spacecraft navigation and planetary orbital studies, where it is often assumed that gravity follows a smooth $1/r^2$ profile. This assumption can cause researchers to dismiss or reinterpret valid anomalies that would otherwise support the EC predictions.

Solar System Anomalies Are Discounted or Misattributed

In EC, gravity is modeled as an oscillatory force, leading to alternating zones of attractive, weak, or even repulsive gravity. This implies that midway between the planetary radii, the centripetal gravitational acceleration from the Sun may be unexpectedly small, zero, or negative. Scientists observing oscillatory patterns in such regions might attribute the effect to sensor artifacts or discard it due to low signal-to-noise ratios, especially since spacecraft velocity in those regions often overwhelms the subtle gravitational signal.

Examples of overlooked or dismissed solar system anomalies include:

A. Flyby Anomaly: Earth flybys have shown sudden and unexplained energy gains or losses in spacecraft. These are typically ignored in broader gravitational modeling, even though they indicate stronger than expected gravity in specific spatial configurations Anderson et al. (2008).

B. Pioneer Anomaly: The observed deceleration of Pioneer 10 and 11 spacecraft cannot be fully explained by heat dissipation, which should be isotropic and insufficient in magnitude Turyshev et al. (2012).

C. Comet Accelerations: While standard models attribute these to off-gassing, the same kinds of accelerations are observed in asteroids that lack outgassing mechanisms.

D. Oumuamua: The first known interstellar object in our solar system displayed acceleration inconsistent with gravitational expectations. This was also attributed to off-gassing, despite the lack of visible tail or volatile emissions Micheli et al. (2018).

E. Orbital Stability Zones: Certain altitudes in the Earth's orbit are more stable than others, consistent with the EC predictions. ECentric orbits such as Molniya tend to become unstable, a pattern that emerges naturally from the oscillatory gravitational function of EC.

F. Bennu's ejected pebbles: The Bennu surface was surprisingly unstable and the pebbles were periodically ejected from its surface. EC suggests that scientists were mistaken in attributing this to the heating of trapped volatiles Lauretta et al. (2019) and NASA Jet Propulsion Laboratory (2020). Under EC assumptions, Bennu is a newly formed asteroid that has not yet stabilized fully into one of the size/composition/density configurations allowed under EC.

Galactic Rotation Curves and Misinterpretation of Transit Velocities

At the galactic scale, the EC predicts shell structures caused by radial oscillations in gravitational strength. In these models, certain zones within a galaxy represent gravitational minima - regions in which stars are not gravitationally bound in circular orbits but are instead passing through. Observationally, the velocity of such a star is typically interpreted under the assumption that it is in a stable orbit. This misinterpretation leads to erroneous rotational velocity curves, often used as justification for the existence of dark matter Rubin et al.

(1980). In EC, these features arise naturally from oscillatory gravity and do not require any unseen mass.

CMB Data Processing and Circular Validation Loops

The construction of the CMB angular power spectrum is often presented as direct evidence of standard cosmology success. However, this spectrum is not derived from raw sky data in a model-neutral fashion. Every step - from map making and beam deconvolution to foreground subtraction and transfer function calculation - assumes GR-based cosmology as a priori Durrer (2015); Collaboration (2020a). The resulting spectrum is therefore not a pure measurement, but a confirmation of embedded assumptions.

In EC, the CMB is not a relic of a hot early universe but is explained as scattered starlight reprocessed by a spherical outer shell of ionized gas. Any attempt to interpret the power spectrum must reprocess the raw CMB data under EC assumptions - a step that has never been taken in the published literature. The absence of a mismatch in CMB data is therefore not a falsification of EC but a limitation of standard data pipelines.

Conclusion: Why the Radical Has Gone Unnoticed

The argument that a radical theory like EC would have already revealed itself overlooks a central truth: we have only been looking for what our current theories allow us to see. The gravitational anomalies observed at every scale have not been absent - they have been explained away or buried beneath interpretive layers. EC invites a reprocessing of these anomalies within its framework, and when this is done, it may well be found that what seemed like isolated mysteries were in fact the first signs of a deeper gravitational truth.

12 Thermodynamics and Model Simplicity in Euclidean Cosmology

One of the most frequently raised objections to Euclidean Cosmology (EC) is that it violates the second law of thermodynamics. Critics argue that an eternal universe is incompatible with the inevitable increase in entropy and the gradual dissipation of usable energy. According to this line of reasoning, over infinite time, the universe must reach a state of maximum entropy, a so-called "heat death", unless energy or order is continually replenished.

Entropy, Energy Loss, and a Small Injection Hypothesis

Euclidean Cosmology responds to this concern by positing a very small, steady injection of both order (negentropy) and energy into the universe. These injections are not invoked as speculative new fields or entities but as minimal background corrections to stabilize a cyclic or steady-state universe. The injection rate required is hypothesized to be many orders of magnitude smaller than the energy density required for dark energy in the standard model.

If $\dot{S}_{\text{inject}}$ and $\dot{E}_{\text{inject}}$ are the entropy and energy injection rates per unit volume, respectively, EC assumes the following.

$$\dot{S}_{\text{inject}} \ll \dot{S}_{\text{BB}}, \quad \dot{E}_{\text{inject}} \ll \rho_\Lambda c^2, \tag{30}$$

where $\dot{S}_{\text{BB}}$ represents the rate of entropy production during the Big Bang and ρ_Λ is the energy density associated with dark energy in the Λ CDM cosmology. The small EC correction terms are physically modest and do not require speculative mechanisms such as inflation or quantum tunneling.

Thermodynamic Issues in Standard Cosmology

In contrast, standard GR-HBB-ΛCDM cosmology violates thermodynamic consistency at multiple levels:

- **Big Bang Singularity:** The universe is said to originate from a point of infinite density and temperature, a clear violation of classical thermodynamic limits and an undefined state where entropy cannot be meaningfully described Penrose (1989).
- **Inflation and Reheating:** Inflation requires an exponential expansion of space, driven by an inflaton field, which generates an enormous decrease in entropy followed by a reheating phase that rapidly increases entropy again. This discontinuity in the evolution of the entropy lacks a thermodynamic mechanism Brandenberger (2017).
- **Black Hole Entropy and Singularities:** According to the Bekenstein-Hawking entropy, black holes have an enormous entropy proportional to their event horizon area Bekenstein (1973); Hawking (1975b). However, their interiors are modeled as singularities, which are thermodynamically poorly defined. Hawking radiation also leads to the so-called information paradox, in which quantum information is apparently lost, a violation of unitarity and entropy conservation Preskill (1992).
- **Dark Energy:** The cosmological constant Λ contributes a constant energy density to all of space, which grows in total magnitude as the universe expands. This creates an unbounded source of energy that violates conservation in its most basic form. The standard energy-momentum conservation equation,

  $$\nabla_\mu T^{\mu\nu} = 0, \tag{31}$$

  becomes ambiguous in a time-dependent metric with a constant Λ.

Occam's Razor and Physical Plausibility

The standard model of cosmology postulates multiple entities and processes that remain unobserved: dark matter, dark energy, the inflaton field, reheating mechanisms, and singularities. Each of these adds explanatory overhead without empirical grounding. EC, on the contrary, adheres more closely to Occam's Razor by eliminating all such entities and instead modifying the gravitational interaction, treating time as discrete, and space as flat and non-expanding.

The cost of EC modifications - that is, a short entropy and energy injection term - is trivial compared to the speculative scaffolding required by ΛCDM. These corrections are presented not as wild conjectures, but as bounded testable features whose magnitudes can be empirically constrained.

Conclusion

Thermodynamic consistency is not a weakness of Euclidean Cosmology — it is a strength. EC avoids singularities, eliminates discontinuous entropy phases, and respects conservation laws at a much deeper level than standard theory. By accepting the minimal addition of background stabilization terms, EC offers a more parsimonious, physically plausible, and thermodynamically sound model of the universe than one requiring singular beginnings and mysterious, invisible components.

13 EC Gravitational Acceleration for the Solar System

13.1 General Form of the EC Acceleration Function

To ensure consistency across all physical scales, the EC gravitational acceleration function is expressed in a density-based form. This emphasizes that only discrete combinations of density and radius yield stable structures, which aligns with the prediction of EC of quantized gravitational stability zones. The general density-based form of the acceleration is as follows.

$$a(r) = \frac{2Cm_0\,\rho\,R^3\,r}{3\,(r^2+2rR+R^2)}\sum_{i=1}^{N} A_i\cos\left(B_i\ln\left(\sqrt{\frac{r+R}{R}}\right)+\frac{p_i}{B_i}\right) \tag{32}$$

- C: scaled normalization constant $= 3.1\times10^{-10}\,\frac{m\cdot A^2}{kg^2}$
- $a(r)$: centripetal acceleration at radius r [m/s^2]
- m_0: vacuum permeability constant [H/m]
- ρ: effective density of the central object [kg/m^3]
- R: effective radius of the central object [m]
- r: radial distance from the center [m]
- A_i: amplitude of the i-th wave component
- B_i: frequency of the i-th wave component
- p_i: phase shift of the i-th wave component

This form guarantees $a(r)\to0$ as $r\to0$, preventing singular behavior at small distances and enabling seamless transition across star systems, galaxies, clusters, and cosmic scales.

13.2 Specific Form for the Solar System

The specific solar system case, using the Sun's average density and radius, and previously optimized wave parameters, becomes:

- $C = 3.1\times10^{-10}\,\frac{m\cdot A^2}{kg^2}$
- $m_0 = 1.25663706\times10^{-6}$ H/m
- $\rho = 1408.0$ kg/m^3 (average solar density)
- $R = 6.9634\times10^{8}$ m (solar radius)

Wave Parameters

$A_1 = 2.46\times10^{-4}$,	$B_1 = 0.936926$,	$p_1 = 2.197810$
$A_2 = -1.7\times10^{-5}$,	$B_2 = 11.0931$,	$p_2 = 1504.03892$
$A_3 = 3.7\times10^{-5}$,	$B_3 = 9.43218$,	$p_3 = 13.17044$
$A_4 = 8.7\times10^{-5}$,	$B_4 = 22.60929$,	$p_4 = -502.66874$
$A_5 = 2.0\times10^{-5}$,	$B_5 = 7.86354$,	$p_5 = 2.1301$
$A_6 = 3.4\times10^{-5}$,	$B_6 = 16.27464$,	$p_6 = 4.26204$
$A_7 = 1.15\times10^{-4}$,	$B_7 = 19.06743$,	$p_7 = 12.59643$
$A_8 = 7.51\times10^{-4}$,	$B_8 = 0.18335$,	$p_8 = 7.36781$

EC implies that at present regression of observed values is the only way to accurately represent gravity in a region. Newtonian and/or GR are very accurate in zones where circular orbits are stable (proportional to $\frac{1}{r^2}$). Because these regions have been of primary interest and because of faulty data processing, care has not been taken to accurately measure gravitational force in other regions. Because this specific regression only used the planets as observation points, it will not be accurate. An accurate regression might only be obtained by a very careful new measurement of the Sun's gravity at distances ranging from Mercury to Pluto.

14 The galactic scale

14.1 Velocity Gaps and Misinterpreted Observations

At galactic scales, the EC model predicts alternating gravitational zones that include both stable circular orbit zones and transitional 'gaps.' These gaps occur at specific radii where the gravitational acceleration temporarily weakens or reverses due to destructive interference of oscillatory wave modes. In such regions, stars or gas clouds may move at higher-than-expected velocities, not because of hidden mass, but because they are passing through gravitational troughs rather than orbiting within stable minima.

Unfortunately, current data-processing pipelines in observational astronomy often assume that all detected stars or gas clouds are in circular orbits. As a result, they misinterpret transient or noncircular motion in gap regions as a deviation from Newtonian expectations, which is then incorrectly attributed to dark matter. This error can occur not only in the interior regions of galaxies but also in the outer zones where the rotation curve is said to "flatten."

It is possible that what appears to be a flat rotation curve in outer galaxies is instead an artifact of line-of-sight averaging over regions that include one or more gaps. If gas clouds in these gaps are moving through underdense regions with higher speeds, then the inferred orbital velocity will be overestimated. A careful reanalysis would require identifying and segmenting radial regions in the galaxy and isolating only those stars or gas clouds with strong evidence of long-term stable circular motion. This would involve temporal tracking, local gravitational environment modeling, and possibly spectral line width filtering to separate rotational motion from transient flow.

14.2 Flat Rotation Curves and Competing Models

The observation that the outer portions of galaxies rotate at nearly constant velocity is often cited as strong evidence for dark matter. Under Newtonian gravity, the expected orbital velocity $v(r)$ should decline as:

$$v(r) = \sqrt{\frac{GM(r)}{r}} \tag{33}$$

where $M(r)$ is the enclosed mass at radius r. For visible matter distributions that taper off, this predicts a Keplerian falloff at large radii.

To account for the discrepancy, the standard cosmological model introduces a halo of nonluminous dark matter, structured to maintain a constant rotation speed. Alternatively, Modified Newtonian Dynamics (MOND) proposes a change to the gravitational acceleration law at low accelerations:

$$a = \frac{a_N}{\mu\left(\frac{a_N}{a_0}\right)} \tag{34}$$

where a_N is the Newtonian acceleration, a_0 is a fundamental acceleration scale, and $\mu(x)$ is an interpolation function satisfying $\mu(x) \to 1$ for $x \gg 1$ and $\mu(x) \to x$ for $x \ll 1$ Milgrom (1983a,b).

Although MOND can replicate the shape of flat rotation curves, it fails to explain features such as gaps, shell structures, or radial substructure observed in many galaxies. Moreover, it lacks a physically grounded mechanism that connects galactic behavior with cosmological structure formation.

14.3 EC Regression at the Galactic Scale

The EC approach retains Newtonian-like behavior in stable orbital zones while explaining deviations through oscillatory gravitational fields. In galaxies, this results in a radial acceleration function:

$$a(r) = \frac{2Cm_0\rho R^3 r}{3(r^2+2rR+R^2)} \sum_{i=1}^{N} A_i \cos\left(B_i \ln\left(\sqrt{\frac{r+R}{R}}\right) + \frac{p_i}{B_i}\right) \tag{35}$$

where ρ and R are the effective density and radius of the galactic mass distribution. This oscillatory model naturally predicts:

- **Flat rotation zones**, where the acceleration minima stretch across radial intervals.
- **Velocity gaps**, where stars move quickly through subdense or repulsive regions.
- **Visible shell structures**, corresponding to gravitational phase shifts between wave components.

These features arise from the wave structure of the gravitational field, rather than requiring exotic particles or new forces. EC regression uses actual rotation curve data to extract the optimal wave terms A_i, B_i, p_i that describe each galaxy, reproducing both flat regions and substructures using standard mass distributions.

14.4 Conclusion

At the galactic scale, EC provides a robust explanation for both the average shape of the rotation curve and its detailed structure. It does so while avoiding the need for dark matter or gravitational modification, relying instead on oscillatory field interactions derived from density-based gravitational modeling. By properly accounting for measurement errors in gap zones and refining regression inputs, EC achieves accuracy across both smooth and structured rotational profiles.

15 Implications of EC for Quantum Entanglement and Nonlocal Correlations

15.1 The Standard Problem of Spooky Action

Quantum entanglement, often referred to as “spooky action at a distance,” presents a profound challenge to classical intuitions and relativistic frameworks. In standard quantum mechanics, two particles that share an entangled state exhibit correlations in their properties regardless of the spatial distance between them. These correlations appear to manifest instantaneously, seemingly violating relativistic locality Einstein et al. (1935); Bell (1964).

Although quantum field theory maintains that no information is transmitted, and thus avoids contradiction with special relativity, this resolution is philosophical rather than explanatory. The standard model does not offer a mechanism to account for how the entanglement correlations are maintained across distance without signal propagation Aspect et al. (1982); Ma et al. (2016).

15.2 Reframing Entanglement Under EC

Euclidean Cosmology (EC) offers a radically different ontological and physical framework that may naturally accommodate non-local quantum behavior. Several foundational EC assumptions modify the entanglement landscape:

1. Privileged Frame and Euclidean Space

EC assumes a Euclidean geometry and a discrete definition of time. There is no 4D spacetime; time is simply an ordered record of discrete physical changes. Moreover, EC introduces a privileged inertial frame, the one in which the universe is isotropic with respect to the CMB and in which total momentum is minimized. This permits physical coherence across the universe without the relativistic prohibition on simultaneity Ellis et al. (2009).

2. Gravity and Interaction as Electromagnetic in Origin

EC posits that gravity itself is a residual electromagnetic phenomenon, emerging from coherent interactions between fluctuating substructures within and between masses. These fluctuations are analogous to the interactions of alternating currents between parallel wires. Consequently, EC suggests that entangled particles may remain coupled through ongoing oscillatory electromagnetic phase relationships, not merely via historical correlation but via persistent, dynamic field resonance.

3. Neutrino Background as a Universal Medium

In EC, space is permeated by a high-density neutrino background, which behaves as a physically meaningful medium. Entangled particles may be phase-coupled across this neutrino field, analogous to two vibrating points on a common membrane. If both particles induce or respond to identical patterns in the neutrino background, they may remain nonlocally coherent even without classical force exchange.

15.3 Reinterpreting Nonlocality

Within EC, entanglement does not represent "action at a distance," but rather:

- **Phase Preservation:** Entangled particles may share a stable electromagnetic or neutrino interaction phase that remains aligned in the spatial separation.
- **Medium-Dependent Coherence:** The neutrino background may act as a unifying substrate that supports nonlocal correlations through distributed resonance.
- **Discretized Time Enables Instantaneity:** Because time in EC is not a dimension but a sequence of discrete events, the simultaneity constraints related to the spacetime geometry are lifted. This allows changes to be correlated across large distances without requiring signal propagation in the relativistic sense.

From this perspective, what appears in standard quantum mechanics as paradoxical or "spooky" may be a natural result of phase locking between distributed fluctuations embedded in a coherent oscillatory medium.

15.4 Toward a Physical Interpretation of Entanglement

EC invites a deeper view of quantum entanglement, suggesting that it may be a macroscopic reflection of:

- Coherent electromagnetic fluctuation coupling,
- Resonant phase-locking across neutrino-supported fields,
- Medium-level quantum coherence maintained across large distances,

without requiring instantaneous signaling or wavefunction collapse. These phenomena emerge naturally when gravity and time are no longer geometric and when a universal, physical field underlies all interactions.

15.5 Outlook

This framework opens new paths for:

- Modeling quantum entanglement via coupled oscillatory field equations.
- Exploring how changes in neutrino density or phase might modulate entanglement strength.
- Examining whether entangled states are more robust or fragile in environments of high neutrino concentration.

Although speculative, the physical assumptions of EC enable a fresh exploration of quantum nonlocality, not by explaining it away but by embedding it within a physically grounded, testable, and logically consistent cosmological model.

16 Implications of EC for Particle Physics

Euclidean Cosmology (EC) not only offers a comprehensive reinterpretation of gravitational and cosmological phenomena but also opens new pathways for understanding unresolved problems in particle physics. EC introduces unique assumptions — such as gravity being a relic of electromagnetic fluctuations, space being Euclidean, time being discrete, and a pervasive neutrino field acting as a medium — that enable fresh reinterpretations of several key mysteries.

16.1 The Origin of Mass

Standard View: In the Standard Model, mass arises via interaction with the Higgs field, which imparts inertia to particles through spontaneous symmetry breaking Higgs (1964); Englert & Brout (1964).

EC Possibility: Mass may instead emerge from resonance stability within oscillatory charge fluctuations. Under EC, gravity is a residual electromagnetic effect, and mass could represent a density/amplitude/frequency match in those internal fluctuations. The Higgs field might reflect an effective rather than fundamental field, possibly a projection of deeper electromagnetic or neutrino-mediated coherence.

16.2 The Neutrino Mass Problem

Standard View: Neutrinos were once assumed to be massless but now are known to possess tiny mass values. Their origin remains unexplained, with speculative mechanisms such as the seesaw model Mohapatra & Senjanović (1980); King (2004).

EC Possibility: Neutrinos are central in EC - they govern lensing, time dilation, and redshift. Their mass may result from standing wave resonance conditions in the neutrino field. Oscillations between flavors could correspond to different stable phase-locking configurations within this field.

16.3 Matter-Antimatter Asymmetry

Standard View: There is far more matter than antimatter in the observable universe. CP violation in the Standard Model is insufficient to explain this imbalance et al. (1994); Canetti et al. (2012).

EC Possibility: Matter-phase configurations may be inherently more stable in the oscillatory field of EC, while antimatter-like phases may be ejected or annihilated early in the equilibrium cycles of the universe. Alternatively, antimatter may exist in other EC shells, separated by gravitational repulsion.

16.4 Quark Confinement and the Strong Force

Standard View: Quarks are confined within hadrons due to color force. The strong interaction grows stronger with distance, contrary to gravity and electromagnetism Greensite (2011).

EC Possibility: Confinement may emerge as a boundary condition in an oscillatory charge-density shell structure. The color charge could be a macroscopic label for a microscopic resonance condition in EC's charge wave framework.

Mystery	EC Reinterpretation
Origin of Mass	Emerges from oscillatory charge coherence, not Higgs field alone
Neutrino Mass/Oscillation	Phase-locked states in a neutrino-mediated field
Matter-Antimatter Asymmetry	Stability of matter-like phases; repulsion or segregation of antimatter
Quark Confinement	Boundary condition in charge-density resonance modes
Gravity Weakness	Most EM fluctuations are out-of-phase; gravity is a rare residual effect
Hidden Forces	Artefacts of gravitational interference interpreted as exotic matter
Proton Stability	Emergent resonance stability; disrupted only by field incoherence

Table 6. EC contributions to outstanding questions in particle physics

16.5 The Hierarchy Problem

Standard View: Gravity is 10^{40} times weaker than electromagnetism. The reason for this disparity is unknown Giudice (2008).

EC Possibility: Gravity is inherently weak in EC because it is a second-order electromagnetic effect. Only a small fraction of the fluctuating charges align properly to produce gravitational attraction. The rest cancel out as noise.

16.6 Hidden Forces and the Dark Sector

Standard View: To explain dark matter and energy, many models introduce undiscovered forces or hidden particles Feng (2010).

EC Possibility: These may be unnecessary. What appears as dark matter may instead be a consequence of EC's oscillatory gravitational shells. Repulsive zones, constructive wave interference, and neutrino-modulated lensing can account for the same phenomena without invoking new particles.

16.7 Proton Stability and Decay

Standard View: Grand Unified Theories predict proton decay, yet it has never been observed. The standard model allows stability, but does not require it Nath & Pérez (2007).

EC Possibility: The proton may be a phase-stable configuration within the oscillatory gravitational medium of EC. Decay might only occur under disruptions in coherence or in high-neutrino-density environments such as near AGN or in the outer shell.

16.8 Summary Table: EC Reinterpretations

16.9 Outlook

EC reframes some of the deepest mysteries in particle physics using a unified framework based on known forces and particles. By treating mass, confinement, and time as emergent from electromagnetic and neutrino-based coherence, EC reduces the need for speculative new particles, forces, or dimensions. This opens exciting possibilities for theoretical modeling, reinterpretation of experimental anomalies, and novel predictions testable in laboratory or astrophysical settings.

17 Cyclic universe; where are we now?

17.1 Comparing Ages and Locations in the Standard and EC Models

In the standard ΛCDM cosmological model, the universe is approximately 13.8 billion years old Collaboration (2020b). This age is computed by modeling the expansion of spacetime from an initial singularity, the Big Bang, using solutions to the Friedmann equations in a relativistic, metric-expanding universe. Observers (such as ourselves) are considered to occupy a typical location within a spatially flat and statistically homogeneous universe, without a preferred center or edge.

In contrast, Euclidean Cosmology (EC) models the universe as bounded and cyclic, composed of an inner galaxy-filled region and a spherically symmetric outer shell of ionized gas. Time is not continuous, but consists of discrete, ordered physical changes. In EC, the universe undergoes oscillatory expansion and contraction governed by standing-wave gravitational modes. There is a meaningful geometric center, and the location of the observer may not be typical. Instead, location and motion are physically meaningful relative to a privileged rest frame in which the cosmic neutrino and photon fields appear isotropic.

Thus, while the standard model situates us within an expanding spacetime of fixed age, EC allows us to exist anywhere within a repeating cycle and within a bounded, structured geometry. The question of "where we are now" in EC is not just spatial, but also dynamical.

17.2 How Scientists Could Answer EC's Cosmic Structure Questions

The EC model makes several predictions that can be tested or constrained by future work. Each of the following open questions can be addressed using a combination of theory, simulation, and observation.

1. Is there a meaningful center to the universe?

Standard View: No. Homogeneity and isotropy prevent any center from being defined Ellis (1971).

EC Perspective: Yes. The center corresponds to the origin of spherical symmetry and the isotropic rest frame.

How to Answer: - Use precise CMB dipole measurements to refine the rest frame. - Apply EC redshift-distance corrections to locate our offset from the center. - Search for large-scale anisotropies in void or wall distributions that break statistical symmetry.

2. What are the minimum and maximum radiuses of the inner universe?

How to Answer: - Finalize parameters of the lowest-frequency gravitational acceleration mode in EC:

$$a(r) = \frac{2Cm_0\rho R^3 r}{3(r^2+2rR+R^2)} A_0 \cos\left(B_0 \ln\left(\sqrt{\frac{r+R}{R}}\right) + \frac{p_0}{B_0}\right) \tag{36}$$

- Find roots of $a(r) = 0$ to identify turning points for expansion and contraction. - These radii define the maximum and minimum spatial extent of the inner universe.

3. What are the radius and structure of the outer shell?

How to Answer: - Use thermalization constraints and optical depth equations for Thomson and Compton scattering. - Require the outer shell to produce a blackbody spectrum matching the observed CMB:

$$\tau = \int n_e(r)\sigma_T \, dr \gg 1 \tag{37}$$

- Model the inner-universe radiation and its absorption-reemission cycle at the shell boundary.

4. What is the total time for one cosmic cycle?

How to Answer: - Integrate the equation of motion:

$$\ddot{r}(t) = a(r) \tag{38}$$

- With initial conditions derived from galaxy redshift observations and CMB temperature, compute the time required for a full oscillation.

5. Where are we in the cycle right now?

How to Answer: - Compare current shell dynamics (e.g., inferred contraction from CMB symmetry) to direction of galaxy motion. - Measure the rate of redshift accumulation and CMB cooling. - Estimate whether the inner universe is expanding or contracting, based on the sign of $\ddot{r}(t)$ in EC's dynamical equations.

17.3 Outlook

While the standard model offers a linear cosmic timeline with a beginning and a known age, EC opens a new paradigm where age is cyclic, structure is bounded, and dynamics are governed by wave interference and physical rest frames. With continued refinement of EC's gravitational parameters and comparison to redshift and CMB datasets, it is realistic to expect that scientists will soon constrain:

- The true radius and phase of the inner and outer universe.
- The total period of oscillation.
- Our physical distance from the center of the universe.

These questions, previously dismissed as unanswerable, may become testable as EC matures into a predictive cosmological framework.

18 Conclusion: a final note from the author

In the Introduction 1 we noted that I have been working on cyclic cosmology for many years. Before Webb. Before I worked with AI. For example, here is a video that I made in 2019 in which I ran the simulated formation of a star system using a wave form of gravity https://youtu.be/0N0VK52ApYo. Once again, here is a link to my paper published on this in 2022 https://vixra.org/abs/2203.0032. I re-emphasize these things to make the point that AI has been a great help, but AI did not originate these ideas.

I would like to give a few examples. I published the general form of gravity as a sum of waves, the ideas and basic equations involving length contraction, time dilation, deflection of light, relativistic increase of momementum, flat galactic rotation curves, etc. before consulting AI. Later, AI did help.

- In my original paper, an outer cloud was posited as the source of the CMB. AI assured me that this was plausible, suggested adding Thomson scattering, and suggested that this outer cloud was in dynamic equilibrium with the interior universe.
- I posited that the $\ln\sqrt{}$ term was inside the wave function. AI told me that this might be physically meaningful because decreasing neutrino concentrations would stretch the wave in this fashion.
- I asked AI whether EC's suggested neutrino concentrations in "empty" space might be proportional to the $\sqrt{m_0\varepsilon_0}$ term in Maxwell's equations; AI confirmed this and suggested an EC version of this equation.

So it went. AI was a tremendous help and time saver, but was not the author of this work, but there were a few surprises. When I asked AI to describe some of the problems in particle physics that might be impacted should EC be proven correct, I was surprised when it responded that scientists might be able to resolve Einstein's "spooky action at a distance" in a new way.

The astute reader will have noticed that this paper is purely theoretical. Nothing has been proven. Why do I feel confident that it will be proven in the future? I have taught statistics and probability. This theory (tentatively) solves many major problems in cosmology in simple ways, and I do not see anything in it (at this time) that is disproven by observations. I can not believe that this is all a coincidence.

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Lee Greer for allowing me to spend hours with him going over his site. The link is here:

https://enlightenmentlegacy.net/cosmos/

His meaningful critique of standard cosmology guided and inspired this project.

Kelly Bakhos taught me how to interact with AI, which I had never done before. Without her help, it would not have been possible to do this!

I would like to thank Jason Stone for his early criticism. Some time before 2022, he was a high school student of mine. I was trying to develop my idea of alternating currents within

masses as the source of the gravitational force. At that time I felt that electron motions would have a great effect. He pointed out that if that were the case, then electrons and nuclei would "weigh" about the same in a gravitational field, and we know that is not the case. That is what inspired me to locate the source of gravity as charge fluctuations among quarks in the nuclei of atoms. EC is still vague on the nature of these fluctuations.

The author wishes to acknowledge the computational and observational teams whose work in galaxy surveys, neutrino physics, and cosmic microwave background studies has provided critical data for comparison with the Euclidean Cosmology (EC) framework.

The author also recognizes the contributions of OpenAI ChatGPT in helping to draft, format, and refine the structure of this manuscript.

Data Availability

No new datasets were generated for this study. All data used in this paper were obtained from publicly available sources.

A Original EC paper that predicted what JWST is now revealing

The essential model of EC depicted in this paper is not new. The majority of the current model depicted in this document was summarized in a paper submitted to the MNRAS in 2022. That paper was submitted well before JWST began releasing data. Its predictions are now being confirmed. Here is a link to that paper:

https://vixra.org/abs/2203.0032

B The Conversation with ChatGPT

For full transparency, the first conversation that the author had with ChatGPT on this topic, which covered all the major points of EC Cosmology, is available at the following hyperlink:

https://drive.google.com/file/d/1GOKfISya93Dqant8oxJB-fB3nqX-SZVu/view?usp=drive_link

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