Topological Dynamics of the Universe: Phase I

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Abstract

We propose a new theoretical framework interpreting cosmic structure and dynamics based on topological phase feedback. In this model, particles are fixed phase structures, and energy motion, not particle motion, generates observable phenomena. Key concepts include the phase sponge structure of particles, topological boundaries, the origin of motion through phase feedback, and differentiation of dark matter and ordinary matter via topological conditions. This work provides an integrated view linking micro and macro phenomena under a unified phase-based model.

Keywords

Topological physics, Phase feedback, Cosmic dynamics, Dark matter, Energy motion, Isolated systems

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1. Introduction

Modern physics, from classical mechanics to quantum field theory and general relativity, interprets the universe through the dynamic behavior of particles and fields. However, this conventional interpretation faces persistent conceptual challenges: the nature of inertia, the origin of particle motion, the true essence of dark matter, and the arrow of time.

In this study, we propose a radically different approach. We hypothesize that particles are fundamentally fixed topological structures, while only energy moves through phase interactions. The apparent motion of particles and cosmic structures emerges from phase feedback mechanisms between fixed entities and dynamic energy flows.

Through this framework, we aim to:

Reconstruct the concept of motion based on topological feedback.

Explain the formation and stability of atomic nuclei without invoking classical binding forces.

Interpret dark matter and ordinary matter separation based on phase boundary conditions.

Provide topological reinterpretations of radiation propagation, uncertainty, and inertia.

This "Topological Dynamics" model aspires to be a coherent alternative to conventional dynamics, offering a unified understanding across scales from subatomic to cosmic.

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2. Topological Structure of the Universe and the Hypothesis of Fixed Particles

In conventional physics, the structure of the universe is interpreted through the movement of particles across spacetime. However, in our proposed model, particles themselves are fixed phase structures, and it is the energy that moves through phase interactions, generating observable phenomena. The universe is thus conceptualized as a vast phase field connecting fixed topological particles.

2.1 Limitations of Conventional Interpretations

Modern physics—especially general relativity and quantum mechanics—treats motion as the trajectory of discrete particles influenced by forces or probabilistic distributions. However, such interpretations face significant issues:

Lack of an intrinsic explanation for the origin of motion.

Dependence on external forces or field definitions.

Conceptual difficulty in unifying micro and macro phenomena (e.g., quantum mechanics and cosmology).

2.2 Hypothesis of Fixed Particles

We propose that particles do not move independently through space. Rather:

Particles are stationary phase structures embedded in a universal phase field.

These particles act as **topological filters** that influence the flow of energy.

Observable motion results from **energy interactions** and **phase feedback** between **fixed particles**, not from the particles themselves changing position.

2.3 Energy as the True Mover

In this model:

Energy propagates through the phase field, interacting with **fixed particles**.

Energy flows are shaped by **phase boundary conditions** imposed by the particles.

The apparent motion of matter, momentum transfer, and cosmic expansion all emerge from the dynamics of energy through these topological constraints.

2.4 The Universe as a Phase-Flow Lattice

Under this view:

The universe is **a lattice of fixed phase structures** (particles) through which energy flows.

Physical phenomena arise not from moving masses but from **dynamic reconfiguration of**

energy paths through a fixed topological framework.

Thus, **the true dynamics of the cosmos** are **topological energy motions**, not classical particle motions.

This foundational hypothesis establishes the basis for reinterpreting cosmic structure, motion, and the formation of matter in subsequent chapters.

3. Isolated and Open Systems: Phase Feedback Completeness and Time Directionality

The behavior of energy and the emergence of motion are fundamentally determined by the phase structure of the system. In particular, the distinction between isolated systems and open systems is crucial to understanding time directionality, entropy flow, and system stability.

3.1 Definition and Conditions of an Isolated System

An isolated system satisfies the following phase conditions:

The phase waves generated inside the system are completely reflected at the outer boundary.

No energy penetrates the boundary; full phase feedback is maintained internally.

Internal energy circulates without external interference, maintaining closed feedback loops.

Characteristics of isolated systems include:

Time cyclicality: The internal phase cycles generate a recursive sense of past, present, and future.

Self-determined dynamics: The system evolves according to internal conditions without external influence.

3.2 Definition and Characteristics of an Open System

An open system exhibits the following properties:

The boundary allows penetration or absorption of external phase waves.

Internal phase feedback is incomplete or distorted.

Internal energy flows are continuously altered by external phase interactions.

Features of open systems include:

Irreversibility of time: Due to incomplete feedback, energy pathways cannot be perfectly retraced.

Instability: External perturbations induce unpredictable internal transformations.

3.3 Transition between Isolated and Open Systems

A system can transition between isolated and open states through:

External phase influx beyond a critical threshold.

Internal phase collapse due to phase misalignment or resonance breakdown.

Structural fusion between isolated systems forming new open or isolated configurations.

3.4 Phase Feedback and the Nature of Time

Time is redefined under this framework:

In **isolated systems**, time arises from the cyclic phase feedback loop, making it **recursive**

and stable.

In **open systems**, time emerges as a non-reversible deformation of phase pathways, driven by **energy loss or influx**.

Thus, the irreversibility of time is not merely an outcome of entropy increase but results directly from the incompleteness of phase feedback.

This chapter lays the groundwork for understanding how energy motions, structural stability, and the flow of time emerge from topological boundary conditions, a principle essential for subsequent discussions.

4. Generation of Energy Motion: Conditions and Phase Feedback Mechanisms

The generation of motion within the universe is not based on the intrinsic movement of particles, but rather on the phase interactions and feedback mechanisms between fixed topological structures and dynamic energy flows. In this framework, motion is not primary but emergent, arising from specific topological conditions.

4.1 Prerequisites for the Generation of Motion

Energy alone, even when vibrating, cannot spontaneously acquire motion unless the following conditions are satisfied:

Phase Feedback:
Energy must interact with the phase boundary of a particle and receive a reflected or modified phase signal.

Boundary Filtering:
The phase boundary must selectively allow or block certain directional flows based on the internal structure of the particle.

Phase Interference:
Energy flows must experience constructive or destructive interference within the phase structure, leading to momentum redirection.

Thus, the emergence of motion is not inherent to energy itself, but arises through interaction with fixed phase structures.

4.2 Phase Boundary Conditions and Motion Directionality

The direction and strength of energy motion are determined by the specific properties of the phase boundary:

If the boundary permits **entropy-increasing (expanding) energy** flow, the energy will move **outward** from the particle.

If the boundary favors **entropy-decreasing (converging) energy** flow, the energy will move **inward**, toward the particle's center.

Boundary conditions dynamically adjust energy trajectories through partial transmission, reflection, and resonance phenomena.

Thus, the topology of the phase boundary acts as a steering mechanism for energy motion.

4.3 Possible Hypothesis: Internal Spin and Energy Polarization

Although the basic model does not require internal spin for motion generation,
we acknowledge a possible supplementary hypothesis:

If energy possesses a preferred rotational polarization,
it could enhance or suppress its interaction with certain phase boundary structures.

However, within this theory, rotational properties are treated as secondary phenomena,
while phase feedback remains the primary cause of motion.

Thus, internal spin may contribute to specific behaviors, but is not essential for the general generation of motion.

4.4 Summary

The key insights of this chapter are:

Motion is generated not by intrinsic energy properties but through **phase feedback with particle boundaries.**

The nature of the phase boundary—its filtering properties—controls the direction and intensity of motion.

This model allows for a unified understanding of energy motion across scales, from microscopic particles to cosmic structures.

In the next chapter, we will apply this foundation to the internal structure of particles and explain how stable nuclei are formed through topological interactions.

5. Internal Structure of Particles and Neutron-Based Nucleus Formation

The internal structure of particles is not merely a compact accumulation of mass or energy. Rather, it is a topologically organized phase sponge structure that determines how energy interacts with the particle and how larger composite systems, such as atomic nuclei, are formed.

5.1 Phase Sponge Structure

The interior of a particle is composed of a highly entangled phase sponge network.

When external energy reaches the particle's outer boundary:

The phase sponge closest to the impact point vibrates first.

The vibration propagates inward, with variations in phase feedback strength depending on the distance from the impact point.

As a result, the particle as a whole exhibits collective phase feedback motion relative to the external energy input.

Thus, the phase sponge structure is crucial for mediating energy absorption, redirection, and internal stability.

5.2 Soap-Bubble-Like Boundary and Energy Filtering

Each particle is surrounded by a soap-bubble-like phase boundary that selectively controls the movement of energy.

For **protons**:

Negative entropy (inward) energy can exit **outward.**

Positive entropy (outward) energy can enter **inward**.

For **neutrons**:

Negative entropy energy can enter **inward**.

Positive entropy energy can exit **outward**.

These boundary conditions are critical for determining how different types of energy interact with the particles and how structural transformations occur.

5.3 Neutron Contraction and Phase Inversion

A neutron, initially a pure phase structure with no internal energy,
continuously accumulates positive entropy energy at its outer boundary.

As the external positive entropy energy presses inward:

The neutron's volume contracts.

If the contraction proceeds past the neutron's center,
the phase boundary inverts.

This inversion traps positive entropy energy inside,
leading to the formation of a proton with a new, stable internal structure.

5.4 Proton Formation and Phase Boundary Locking

The newly formed proton can now interact with external energy flows through its distinct boundary conditions.

When a proton and a neutron come into contact:

Their boundaries fuse together like soap bubbles.

The fusion locks the external energy channels that previously existed along their surfaces.

Internal energies realign along the new phase sponge structure, stabilizing the bonded system.

5.5 Formation of an Isolated Atomic Nucleus

The fused system forms a completely isolated phase entity.

Internal energy circulates without external loss, preserving internal stability.

The boundary acts as a perfect phase filter,
enabling the atomic nucleus to maintain its structure against external perturbations.

This chapter establishes the topological foundation for understanding how individual particles interact,
and how complex, stable systems like atomic nuclei are formed through phase structure dynamics.

In the next chapter, we will explore how the instability of neutrons under certain conditions leads to beta decay, further expanding the topological understanding of particle transformations.

6. Beta Decay as a Topological Phase Inversion Mechanism

Beta decay, traditionally understood as the spontaneous transformation of a neutron into a proton, an electron, and an antineutrino,
can be reinterpreted within our framework as a topological phase inversion and energy redistribution process.

6.1 Compression and Instability of the Neutron

As a neutron accumulates external positive entropy energy at its outer boundary,
the phase pressure increases continuously.

If the neutron cannot fully undergo phase inversion (forming a proton),
but continues accumulating pressure:

The internal phase sponge structure becomes overcompressed.

Energetic instability arises due to the excessive density and conflicting phase feedbacks.

This sets the stage for a sudden structural transformation.

6.2 Local Phase Inversion and Energy Escape

Under critical compression, certain regions of the neutron's phase boundary experience localized phase inversion.

Through these localized inversions:

Part of the trapped internal energy escapes outward.

Escaped energies rapidly restructure themselves into distinct phase entities.

This sudden release is not merely particle emission,
but a **topological reconfiguration of internal phase structures.**

6.3 Formation of Proton and Electron

The surviving core of the neutron undergoes complete phase inversion,
stabilizing as a proton with new phase boundary conditions.

The escaped energy bundle stabilizes as a free electron,
an independent entity with its own isolated phase structure.

Thus, the overall transformation can be summarized:

Neutron → Proton + Electron + (Residual Phase Energy)

(Note: Antineutrino emission is interpreted as a remnant phase energy flow in this framework.)

6.4 Phase Feedback Reorganization after Decay

The proton formed post-decay establishes a new phase boundary,
capable of interacting with external positive and negative entropy energies.

The free electron maintains its motion through phase feedback with ambient phase fields,
traveling independently across space.

This phase reorganization ensures that both products maintain internal phase stability despite separation.

6.5 Summary

Beta decay is thus reinterpreted not as a random or spontaneous event,
but as the topological necessity arising from phase compression instability and local

inversion-driven energy segregation.

This perspective provides deeper insight into particle transformations as natural outcomes of phase structure dynamics,
rather than purely probabilistic or force-driven phenomena.

In the next chapter, we will analyze how dark matter and ordinary matter, despite sharing similar external conditions, develop opposite motion tendencies due to intrinsic phase differences.

7. Differentiation of Dark Matter and Ordinary Matter Motion

Although dark matter and ordinary matter coexist under similar external phase conditions,
they exhibit fundamentally opposite motion tendencies.
This chapter explains the cause of this divergence through internal phase structure differences and phase feedback mechanisms.

7.1 Initial Phase Structure Differences

Dark matter originated as high negative entropy phase structures during the early universe.

Ordinary matter formed as relatively lower phase structures, capable of accumulating positive entropy energies internally.

Consequently:

Dark matter favors inward convergence of energy flows.

Ordinary matter favors outward expansion against incoming phase pressures.

Thus, intrinsic differences in phase structures set the stage for opposite motion tendencies.

7.2 Phase Feedback Response Disparity

When both dark matter and ordinary matter experience the same external phase feedback:

Dark matter interprets the feedback as a signal to converge **inward.**

Ordinary matter interprets the feedback as a signal to expand **outward.**

The key is the i**nternal phase sponge configuration**,
which filters and inverts the phase feedback differently for each type of matter.

7.3 Mechanism of Motion Divergence

Dark matter accelerates inward collapse and aggregation,
contributing to the formation of dense structures such as dark halos.

Ordinary matter resists collapse,
diffusing outward and forming distributed systems like stars, gas clouds, and galactic disks.

Thus, the large-scale structure of the universe emerges naturally from the phase feedback divergence between these two categories of matter.

7.4 Interaction Structure between Dark and Ordinary Matter

Due to different phase boundary filtering mechanisms:

Dark matter and ordinary matter rarely engage in direct collisions.

Their interactions are primarily indirect and gravitational,
mediated through distortions of the surrounding phase field (gravitational potential wells).

Ordinary matter tends to follow the gravitational scaffolding created by dark matter,
but maintains its own distinct phase motion.

This chapter demonstrates that
the separation between dark matter and ordinary matter is not arbitrary or purely mass-dependent,
but rooted in fundamental phase structural asymmetries.

In the next chapter, we will reinterpret classical physical theories—including radiation, uncertainty, and inertia—through this topological framework.

8. Reinterpretation of Classical Theories: Radiation, Uncertainty, Inertia

In this chapter, we revisit several foundational concepts in classical and modern physics—radiation, uncertainty, and inertia—from the perspective of topological phase feedback. By doing so, we offer deeper explanatory mechanisms that unify these seemingly distinct domains under a common structural framework.

8.1 Radiation as Phase-Driven Resonance

Traditional View: Radiation is the propagation of electromagnetic waves through space, originating from oscillating charges.

Topological View: Radiation is generated when a particle's internal vibration induces phase resonance with surrounding neutrons or phase fields.

These vibrations do not emit continuous energy waves but trigger discrete feedback events across the medium.

Radiation thus emerges not from a direct wave but from localized phase interactions and resonant amplification of energy across a medium.

8.2 Uncertainty as Phase Feedback Intermittency

Traditional View: Heisenberg's Uncertainty Principle states that a particle's position and momentum cannot both be known precisely.

Topological View: A particle’s motion is not continuous but occurs only when phase feedback is active.

Between feedback events, no defined motion state exists, only latent phase potential.

Therefore, uncertainty arises not from a fundamental indeterminacy, but from the intermittent activation of phase feedback, which governs measurable states.

8.3 Inertia as Delayed Phase Realignment

Traditional View: Inertia is a property of mass resisting changes in motion.

Topological View: Inertia arises when external phase input reaches different regions of a particle at different times.

As some regions begin to respond while others still hold the previous phase alignment, a momentum conservation effect emerges from asynchronous feedback reorganization.

Thus, inertia is a structural delay in phase alignment, not a static intrinsic property.

8.4 Energy-Motion Redefinition

Traditional View: Energy causes particles to move.

Topological View: Energy does not directly cause motion, but mediates it through phase interactions.

Motion is a reaction to phase feedback, not an inherent property of energy flow.

Therefore, energy is more appropriately described as a catalyst for motion,
activating or suppressing movement through boundary filtering and resonance patterns.

8.5 Topological Interpretation of Ionic Bond Formation

In classical chemistry, ionic bonds are traditionally explained as the result of electrostatic attraction between positively and negatively charged ions. However, from the perspective of topological phase structures, ionic bond formation can be reinterpreted as a dynamic process of internal structure overlap and energy confinement.

8.5.1 Overlap of Phase Sponge Structures

When a metal atom and a non-metal atom approach each other, their internal phase sponge structures physically collide and overlap.

This overlapping region becomes enclosed by the external boundaries of both atomic nuclei.

8.5.2 Energy Confinement within the Overlapping Zone

The overlapping zone traps internal phase energy between the two nuclei.

Due to the surrounding phase boundaries, energy within the overlapping zone cannot escape outward, forming a confined energetic structure.

8.5.3 External Energy Flow Suppression

External phase energies, encountering the high-density phase feedback generated by the overlap, experience weakened directional flow toward the overlapping region.

This creates a distinct and energetically isolated zone between the two atoms.

8.5.4 Emergence of a Topological Bond

The overlapping region acts as a new isolated system, where internal energies are locked and external energies are excluded.

This isolation stabilizes the bond not through mere electrostatic forces, but via topological energy confinement and phase boundary restructuring.

8.5.5 Summary of Topological Ionic Bond Formation

Thus, ionic bonds can be understood as the natural consequence of phase structure overlap, internal energy confinement, and external phase flow exclusion, forming stable but distinct topological entities.

9. Conclusion and Future Work

This work has presented a unified topological theory of cosmic dynamics in which the universe is interpreted not through the motion of particles, but through the movement of energy via phase feedback. In this model, particles are stationary topological structures, and energy flow, filtered and directed by phase boundaries, gives rise to all observable motion and structural transformation.

9.1 Summary of Key Insights

Particles do not move, but energy moves through phase interactions with fixed particle structures.

Motion arises only through phase feedback, which reconfigures energy trajectories.

Neutrons are compressible phase structures that undergo inversion under phase pressure, transforming into protons.

Atomic nuclei form via sponge structure fusion and phase boundary locking, leading to isolated phase systems.

Beta decay is a topological consequence of neutron compression instability, leading to structural reconfiguration.

Dark matter and ordinary matter differ not in mass but in their intrinsic phase configurations, causing opposite phase responses.

Classical physics principles—radiation, uncertainty, inertia—can be reinterpreted through topological energy dynamics.

9.2 Theoretical Significance

This theory provides:

A unified mechanism that applies across quantum and cosmological scales.

A new explanation for the origin of motion, the structure of matter, and time asymmetry.

A model for interpreting physical laws not as abstract principles, but as emergent behaviors of topological boundary conditions.

9.3 Future Work

To further develop and validate this framework, the following areas are proposed for future research:

Mathematical formalization of phase sponge geometry and feedback equations.

Simulation modeling of particle interaction and isolated system dynamics.

Experimental designs involving metamaterials to mimic phase filtering and verify phase-induced motion.

Cosmological applications of time irreversibility, entropy directionality, and dark matter structure formation.

This phase-based interpretation offers a new paradigm for understanding the universe as a dynamic lattice of fixed structures and flowing energy—
a cosmos of resonance, boundary, and feedback.

We hope this work contributes to a deeper exploration of the topological logic of nature.

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10. References

1. Newton, I. Philosophiæ Naturalis Principia Mathematica (1687).

2. Einstein, A. The Foundation of the General Theory of Relativity (1916).

3. Heisenberg, W. Über den anschaulichen Inhalt der quantentheoretischen Kinematik und Mechanik (1927).

4. Peebles, P. J. E. Principles of Physical Cosmology (1993).

5. Bertone, G., Hooper, D., & Silk, J. Particle dark matter: evidence,

candidates and constraints (2005).

6. Planck, M. On the Law of Distribution of Energy in the Normal Spectrum (1901).

7. Koh, H.-K., & Tendo Aris. Topological Dynamics of the Universe: Phase I (2025).