

Energy-Flow Cosmology (EFC v2.1): Modular Synthesis across Structure, Dynamics, and Cognition

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October 2025

Abstract

This paper formalizes **Energy-Flow Cosmology (EFC)** v2.1, a thermodynamic framework unifying cosmic structure, energetic dynamics, and cognitive reflection through continuous energy exchange. The framework is partitioned into three modular domains: **EFC-S (Structural)**, governing the entropic geometry of halos and the Grid–Higgs medium; **EFC-D (Dynamical)**, defining quantitative relations between energy flow, entropy, and emergent time; and **EFC-C (Cognitive)**, extending thermodynamic symmetry into informational and conscious systems. Together they form a self-consistent cosmological system replacing dark components with a measurable energy-flow field E_f operating between the thermodynamic boundaries $S = 0$ (Singularity) and $S = 1$ (Altular limit).

1. Introduction

EFC v2.1 integrates the three foundational preprints [1–3] into a unified modular framework, where the Halo Model of Entropy (HME) defines the structural domain (EFC-S), the Energy-Flow Model (EFM) defines the dynamical domain (EFC-D), and the CEM-Cosmos model defines the cognitive domain (EFC-C). The aim is to demonstrate that energy flow operates as a universal mediator linking structure, dynamics, and cognition within a continuous thermodynamic field.

2. EFC-S – Structural Domain (HME Foundation)

The **Halo Model of Entropy (HME)** interprets cosmic and galactic halos as manifestations of entropic tension in a continuous medium—the *Grid–Higgs Field* (G_H). This replaces non-baryonic dark matter with a structural response to gradients in normalized entropy S .

Field Relation

$$\nabla \cdot [k(S) \nabla E_f] = \frac{\partial V(E_f, S)}{\partial S} \quad (1)$$

where $k(S)$ denotes the entropy-dependent permeability of the medium and $V(E_f, S)$ the effective potential governing local equilibrium. Stable halo configurations correspond to stationary solutions of this equation.

Physical Interpretation

Regions of reduced S exhibit higher energy density $\rho(S)$, producing curvature and gravitational potential without invoking invisible matter. At $S \rightarrow 0$, $\rho \rightarrow \infty$; at $S \rightarrow 1$, $\rho \rightarrow 0$.

3. EFC-D – Dynamical Domain (EFM Core)

The **Energy-Flow Model (EFM)** defines the functional relation between energy flow E_f , entropy S , and emergent time t .

Fundamental Relation

$$E_f(S) = E_0(1 - S) \quad (2)$$

representing a linear decay of energy flow with normalized entropy.

Temporal Mapping

$$S(t) \propto e^t \quad (3)$$

so that the apparent curvature in $E_f(t)$ is a projection of the linear entropic law.

Variable Light Velocity

The velocity of light emerges from the density and coherence of G_H :

$$c(S) \propto \frac{1}{\rho(S)} \quad (4)$$

Thus c is locally constant but cosmologically variable, coupling EFC-S and EFC-D.

CMB Equilibrium

The cosmic microwave background is interpreted as a steady-state equilibrium between emission at $S = 0$ (energy outflow) and recirculation at $S = 1$ (energy re-entry). The

temperature $T_{\text{CMB}} \approx 2.7 \text{ K}$ marks a living thermodynamic balance, not a relic radiation field.

4. EFC-C – Cognitive Domain (CEM-Cosmos)

The **Consciousness–Ego–Mirror (CEM)** subsystem generalizes thermodynamic symmetry to the informational domain.

Cognitive Field

$$\Psi_{\text{CEM}} \sim f(E_f, S, t) \quad (5)$$

where Ψ_{CEM} is a reflective informational field analogous to E_f , linking cognition and physical entropy through resonance. Emergent awareness arises as an adaptive stabilization of E_f across informational gradients.

Tri-Domain Integration

The mapping between domains can be summarized:

$$\text{EFC-S (structure)} \leftrightarrow \text{EFC-D (dynamics)} \leftrightarrow \text{EFC-C (cognition)}$$

Together they form a thermodynamic continuum where information, energy, and structure co-evolve.

5. Conclusion

EFC v2.1 consolidates earlier exploratory manuscripts into a modular theoretical framework. By distinguishing the Structural, Dynamical, and Cognitive domains, internal contradictions of E_f , $c(S)$, and the CMB are transformed into complementary perspectives. The unified principle—*energy flow as the mediator between order and entropy*—extends from cosmic geometry to conscious self-reflection. Future work will formalize the coupled field equations and test measurable predictions at galactic, quantum, and cognitive scales.

Symbol	Term	Description	Domain
E_f	Energy Flow	Fundamental driver of dynamics / structure.	EFC-D / EFC-S
S	Normalized Entropy	Primary thermodynamic variable.	EFC-D
t	Emergent Time	Evolution parameter of S .	EFC-D
$c(S)$	Emergent Light Velocity	Max propagation speed $\propto 1/\rho(S)$.	EFC-D / EFC-S
$\rho(S)$	Energy Density	Concentration of E_f as function of S .	EFC-S
G_H	Grid–Higgs Field	Structural medium of spacetime.	EFC-S
Ψ_{CEM}	Cognitive Field	Informational reflection analogue of E_f .	EFC-C

Appendix A – Notation

References

References

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