# Seed Structures and the Origin of Cosmic Web Filaments in UMT

Richard Bernot

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**Abstract**

Universal Motion Theory (UMT) proposes that large-scale cosmic structures arise not solely from matter overdensities but from early curvature activation patterns. This addendum explores how over-activated patches seed filamentary structures, models network growth based on activation gradients, and offers an alternative to traditional matter-driven cosmic web formation. The derivation extends UMT's predictive reach beyond recombination into the genesis of the cosmic web.

## 1 Introduction

In standard cosmology, cosmic web structures emerge from the gravitational amplification of primordial matter overdensities. Universal Motion Theory (UMT) introduces an alternative mechanism: early curvature activation gradients $\nabla(\Phi\kappa)$ define preferred motion paths and seed the large-scale filamentary structure of the universe.

## 2 Curvature Activation and Early Seeding

The curvature activation function is:

$$\Phi(\rho) = \frac{1}{1 + e^{-k(\rho - \rho_{th})}} \tag{1}$$

where $k$ is the steepness parameter and $\rho_{th}$ the activation threshold.

Early universe patches with $\Phi(\rho) \gtrsim 0.9$ act as seed points for structure formation. Regions with $\nabla(\Phi\kappa) \neq 0$ guide the flow of motion, channeling emerging matter and energy into filamentary paths.

# 3 Network Growth from Activation Gradients

The growth of the cosmic web under UMT follows these principles:

- **Motion Channeling:** Activated regions with strong gradients guide material motion.
- **Filament Formation:** Persistent curvature tension gradients sustain long-range structural coherence.
- **Void Definition:** Under-activated regions ($\Phi \approx 0$) expand relative to activated filaments, forming voids.

The emergent filamentary network reflects the initial spatial distribution of curvature activation, not purely matter fluctuations.

# 4 Predicted Observational Features

UMT predicts:

- **Coherent filament alignment** with early curvature activation patterns.
- **Void expansion rates** dependent on activation suppression rather than simple matter underdensity.
- **Persistent anisotropies** in cosmic web structure tied to primordial activation gradients.

Comparisons with cosmic microwave background (CMB) anisotropies and large-scale structure surveys (e.g., SDSS, DESI) can test these predictions.

# 5 Alternative to Matter-Driven Formation

While ΛCDM attributes structure formation to matter overdensity amplification via gravitational instability, UMT proposes:

- **Curvature-guided motion** precedes significant matter clustering.
- **Filament scaffolding** is geometrically seeded before baryonic matter accumulation.
- **Early web patterns** arise from geometry, not only from density perturbations.

This offers a falsifiable distinction between UMT and traditional cosmological models.

# 6 Conclusion

This addendum formalizes the role of curvature activation in seeding cosmic web structures under Universal Motion Theory. It extends UMT's explanatory power beyond recombination, offering testable predictions for the emergence and anisotropy of large-scale cosmic networks.

### References


1. Bernot, R. (2025). Universal Motion Theory Manuscript.
2. Bond, J. R., Kofman, L., Pogosyan, D. (1996). How filaments of galaxies are woven into the cosmic web.
3. Libeskind, N. I., et al. (2018). Tracing the cosmic web.