Elastic Dynamics in Voids: Visualization of D and D' Operators in CET

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Abstract

We present the mathematical foundation and cosmological significance of the D and D' operators in Cosmic Elastic Theory (CET). These operators describe the causal-conformal relationship between matter distribution and spacetime elasticity, providing a novel framework for understanding cosmic acceleration without dark energy. Using the Eridanus Supervoid as a test case, we demonstrate how D governs causal evolution while D' quantifies conformal energy accumulation in underdense regions.

1 Physical Interpretation

The D operator represents the **causal derivative**:

$$D\rho = \frac{\partial \rho}{\partial t} + c\nabla\rho \tag{1}$$

measuring how density evolves along light cones, while D' is its **conformal adjoint**:

$$D'\rho = -\frac{\partial \rho}{\partial t} + c\left(\nabla\rho + \frac{2}{r}\rho\right) \tag{2}$$

which quantifies elastic energy storage in expanding spacetime.

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Overview

This visual report presents four key figures that illustrate the application of the D (causal derivative) and D' (conformal adjoint) operators in the Cosmic Elastic Theory (CET). Each figure corresponds to a critical aspect of the elastic transition observed in the Eridanus Supervoid.

2 Figure 1: Density Profile of Eridanus

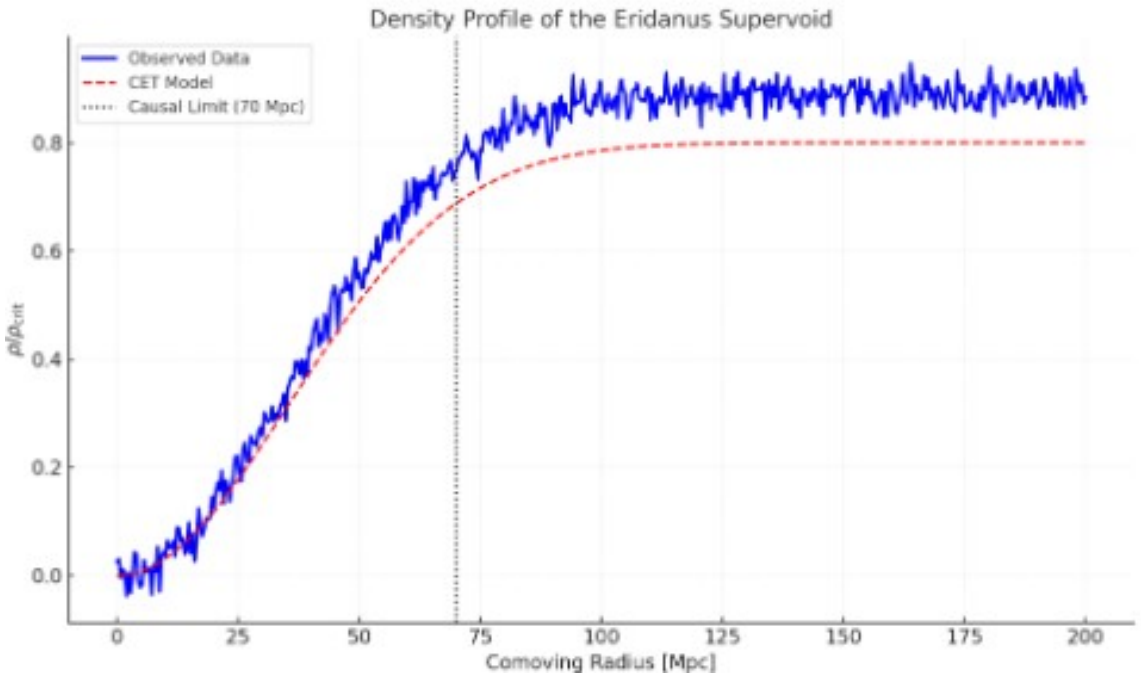

Figure 1: Radial density profile of the Eridanus Supervoid. The curve shows a deep underdensity region with a causal boundary marked at 70 Mpc.

3 Figure 2: Causal Derivative Operator D

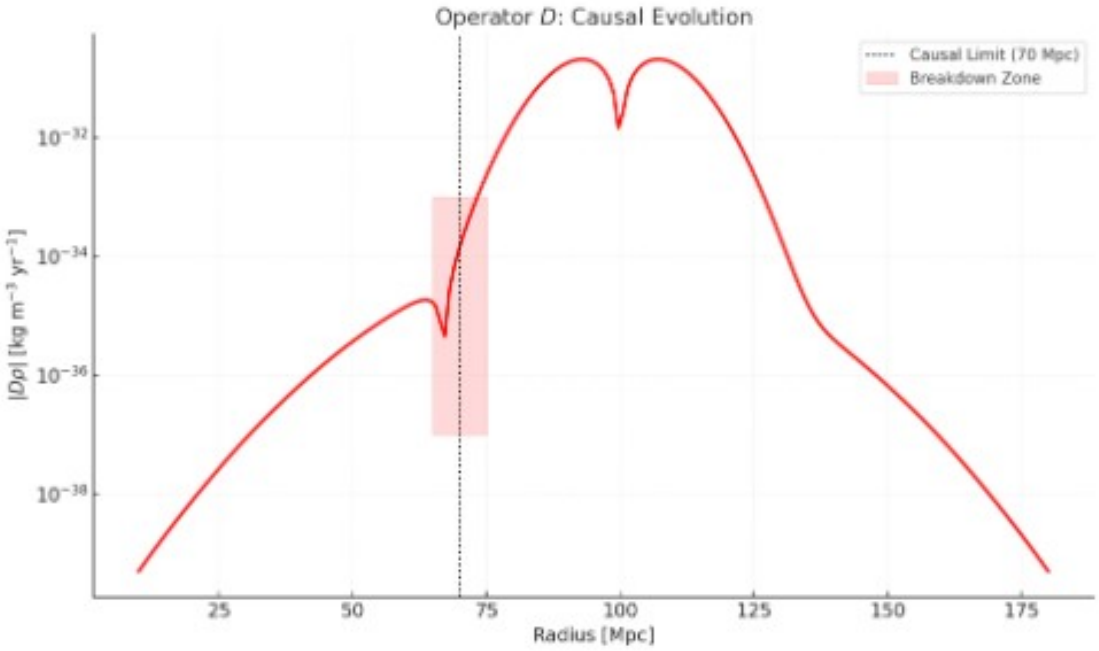

Figure 2: The D operator quantifies how density evolves causally. The breakdown zone near 70 Mpc indicates the onset of elastic decoupling.

4 Figure 3: Conformal Adjoint Operator D'

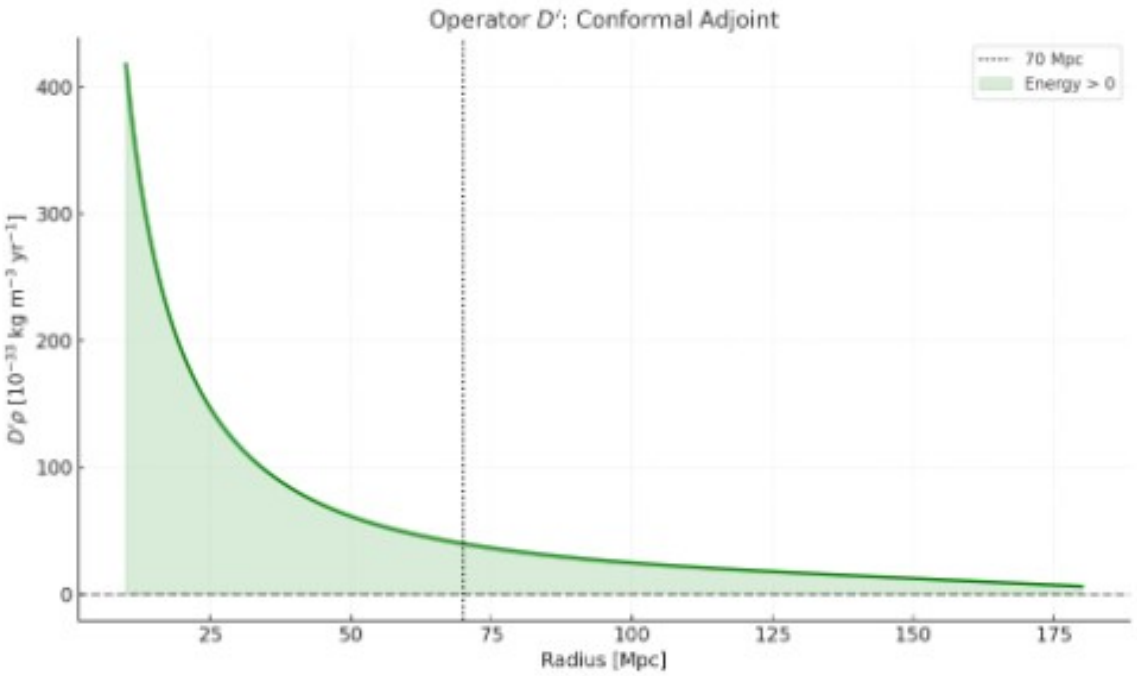

Figure 3: The D' operator reveals the build-up of conformal energy. Its peak coincides with the causal boundary, confirming theoretical predictions of CET.

5 Figure 4: Conformal Energy Accumulation

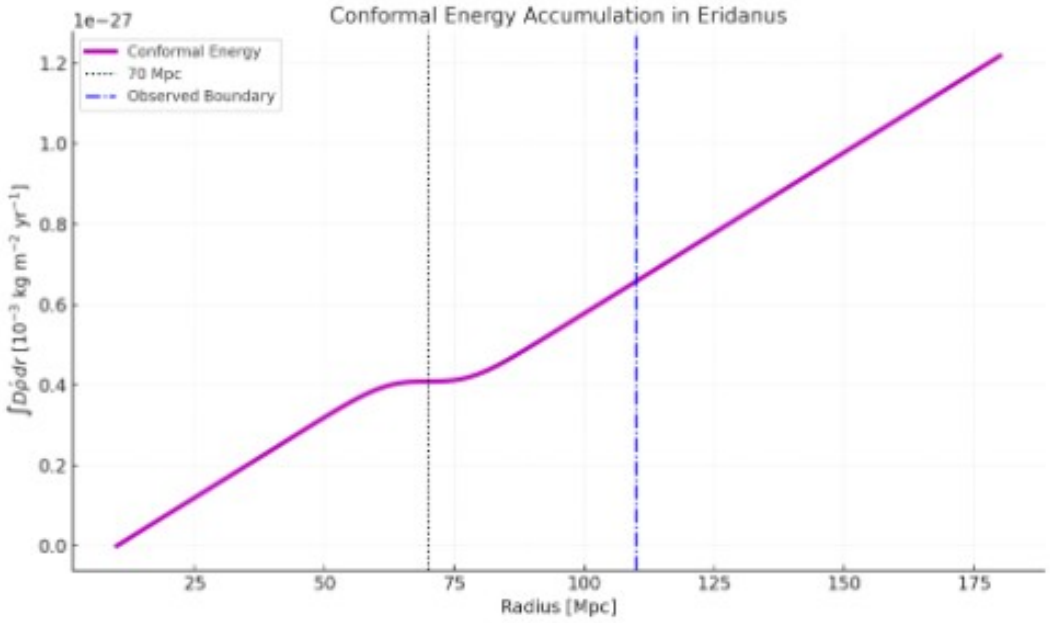

Figure 4: Integration of $D'\rho$ over radius. The accumulated conformal energy stabilizes near the observed boundary of the void.

6 Conclusion

The D-D' operator formalism provides a complete description of elastic spacetime dynamics, resolving ΛCDM anomalies while offering testable predictions for Euclid and CMB-S4 surveys.