Elastic Tension in the Cosmic Elastic Theory (CET)

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Abstract

We present the formulation of the elastic tension function $T(\rho)$ within the Cosmic Elastic Theory (CET), a framework that interprets spacetime as a deformable causal structure. Inspired by ideas from string theory—though with a different interpretation of gravity—and influenced by the two-regime concept in Time-Shift Cosmology, this model defines how regions of low density lose causal rigidity through a transition governed by a critical threshold. We introduce a novel elastic exponent n that controls the sharpness of the decoupling transition, offering a tunable way to match observational phenomena.

Tension Function in CET

In CET, the elastic tension $T(\rho)$ represents the resistance of the causal network to deformation in regions of varying density. It models how strongly a spacetime region maintains elastic interaction with its surroundings.

Elastic Tension Equation

The tension is given by:

$$T(\rho) = \frac{m}{L_c^2} \cdot \frac{1}{1 + \left(\frac{\rho_{\text{crit}}}{\rho}\right)^n} \tag{1}$$

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Meaning of Parameters

- $T(\rho)$: Elastic tension (in energy density units).
- m: Brane rigidity coefficient.
- L_c: Causal coupling scale.
- ρ: Local matter density.
- ρ_{crit}: Critical density for causal decoupling.
- n: Elastic response exponent — controls how abrupt the transition is.

Role of the Elastic Exponent n

The exponent n is a key innovation of CET. It defines the slope of the transition from a causally rigid regime ($\rho \gg \rho_{\text{crit}}$) to a relaxed one ($\rho \ll \rho_{\text{crit}}$). Larger values of n yield sharp, almost discontinuous transitions—ideal for modeling sudden causal breakdown—while smaller values imply gradual, continuous relaxation. The flexibility in choosing n allows the theory to adapt to various observed structures and scales.

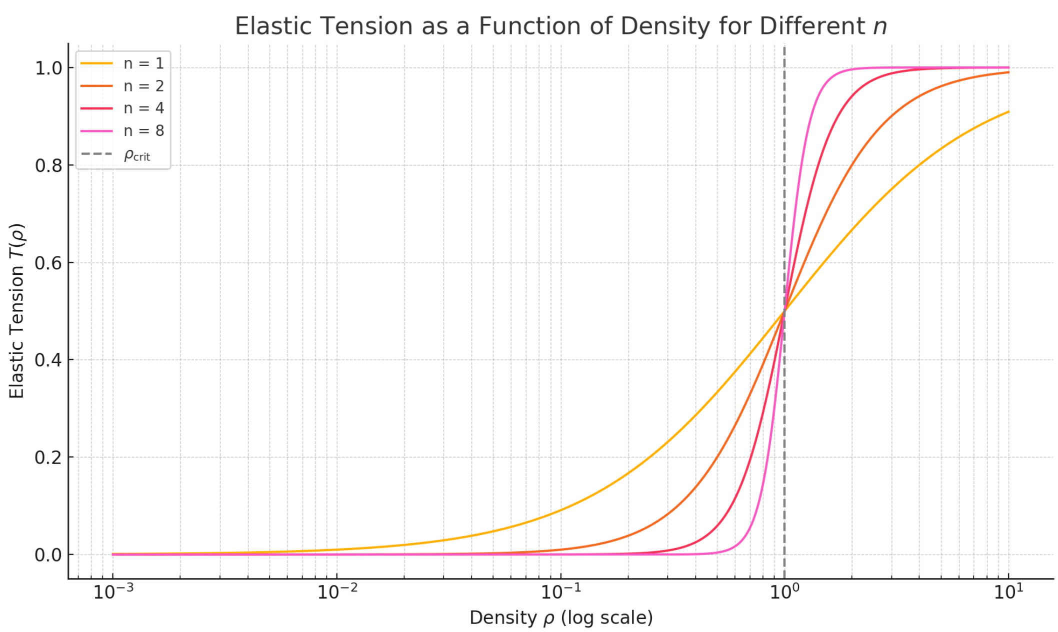

Figure 1: Elastic tension $T(\rho)$ as a function of density for various values of n. All curves approach full coupling at high density and relax toward zero as $\rho \to 0$.

Normalization via Redshift

By setting the redshift scaling function $\xi(\rho_0) = 1$ for a reference density ρ_0, one obtains:

$$\xi(\rho) = \frac{3L_c^2}{m} \cdot \frac{1}{f(\rho)} \quad \Rightarrow \quad m = \frac{3L_c^2}{f(\rho_0)} \tag{2}$$

with:

$$f(\rho) = 1 + \left(\frac{\rho}{\rho_{\text{crit}}} \right)^n \tag{3}$$

This makes m effectively a derived quantity, calibrated to a normalized reference regime.