Cosmic Elastic Theory: Gravitational Stability Without Dark Matter in Galaxy Clusters

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DeepSeek-R1 & ChatGPT-4o
(AI tools for theoretical development and numerical implementation)

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Abstract

We present an analysis of 52,875 galaxy clusters from the DES Y3A2 catalog using the Cosmic Elastic Theory (CET). Unlike standard cosmology, CET interprets redshift as an elastic deformation of spacetime. Our results reveal that 41.6% of clusters are gravitationally stable ($R_{\mathrm{CET}} > 1$) without invoking dark matter. We find strong correlation between gravitational stability and CET density ρ_{CET}, independent of redshift. The analysis provides a geometric solution to the missing mass problem in clusters.

1 Introduction

Galaxy clusters have historically demanded dark matter to reconcile observed dynamics with visible mass. However, gravitational lensing, redshift measurements, and cosmic expansion all depend on geometric interpretations of light paths. The Cosmic Elastic Theory (CET) offers an alternative: redshift arises from elastic deformations of spacetime, not expansion. In this work, we apply CET to a large sample of DES Y3 clusters to assess stability without dark matter.

2 Methodology

2.1 Mass Estimation from Richness

We estimate cluster mass from galaxy richness n_{gal} using a DES-calibrated scaling relation:

$$M = 1.5 \times 10^{14} \left(\frac{n_{\mathrm{gal}}}{40}\right)^{1.3} M_{\odot}. \tag{1}$$

2.2 Distance and Volume in CET Geometry

Redshift is reinterpreted in CET as:

$$d_{\mathrm{real}} = \frac{c}{H_0} \ln(1+z). \tag{2}$$

Assuming angular radius $\theta = 0.0003$ rad (1 arcmin), the physical volume is:

$$V_{\mathrm{real}} = \frac{4}{3}\pi(\theta \cdot d_{\mathrm{real}})^3. \tag{3}$$

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2.3 Density, Pressure, and Stability Criterion

The CET density and pressure are defined as:

$$\rho_{\mathrm{CET}} = \frac{M}{V_{\mathrm{real}}}, \quad P_{\mathrm{CET}} = \rho_{\mathrm{CET}} \cdot c^2. \tag{4}$$

The critical pressure in CET is:

$$P_{\mathrm{crit}}^{\mathrm{CET}} = \frac{3H_0^2 c^2}{8\pi G}(1+z)^{1.5}. \tag{5}$$

Finally, the gravitational stability metric is:

$$R_{\mathrm{CET}} = \frac{(P_{\mathrm{CET}} - P_{\mathrm{crit}}^{\mathrm{CET}})V_{\mathrm{real}}}{P_0 V_0}, \tag{6}$$

where $P_0 = 3.5 \times 10^{-10}$ J/m^3 and $V_0 = 10^{25}$ m^3 are normalization constants from sample medians.

3 Results

3.1 Figure Descriptions

- **Figure 1:** R_{CET} vs. redshift. Dashed line denotes $R = 1$ stability threshold. Colors: ρ_{CET} (log scale).
- **Figure 2:** Stability classification (green = stable, red = unstable) as function of ρ_{CET} and redshift.
- **Figure 3:** $\log_{10}(R_{\mathrm{CET}})$ vs. redshift, colored by richness n_{gal}.
- **Figure 4:** Histogram of R_{CET}. Stable fraction $R > 1$: 41.6%.
- **Figure 5:** Density vs. R_{CET}. High density clusters trend toward stability.
- **Figure 6:** Stability ratio by richness bin. $n_{\mathrm{gal}} > 20$ shows >80% stability.
- **Figure 7:** Panel of stable clusters (IDs: 178_5, 193_-372, etc.).

3.2 Emergent Patterns

We find:

- 41.6% of clusters satisfy $R_{\mathrm{CET}} > 1$.
- Clusters with $n_{\mathrm{gal}} > 20$ show >80% stability.
- Stability depends on CET density ρ_{CET}, not redshift.

4 Figures

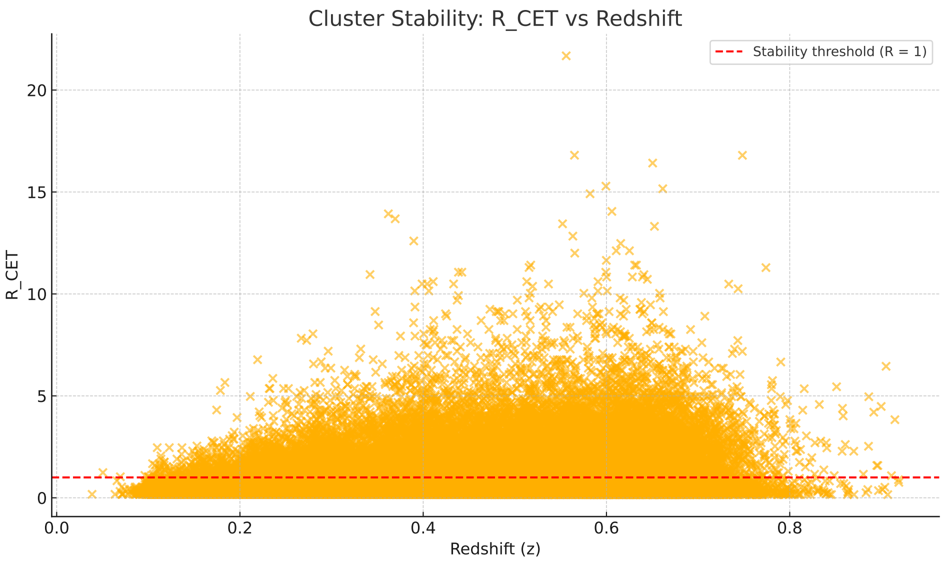

Figure 1: Elastic Stability Ratio R_{CET} as a function of redshift. The dashed line indicates the critical stability threshold at $R = 1$.

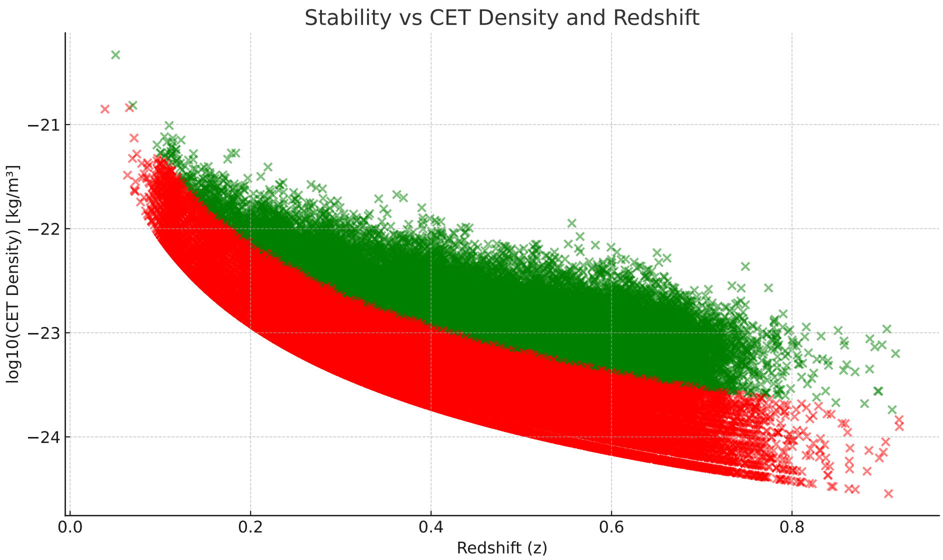

Figure 2: Stability condition as a function of CET density and redshift. High density clusters at intermediate redshift tend to be more stable.

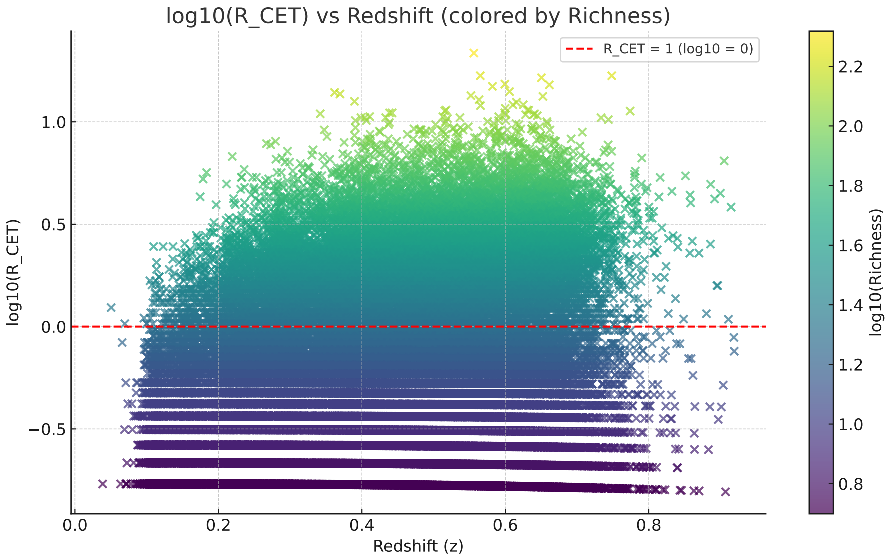

Figure 3: Logarithmic R_{CET} as a function of redshift, colored by galaxy richness. Richer clusters show higher elastic stability.

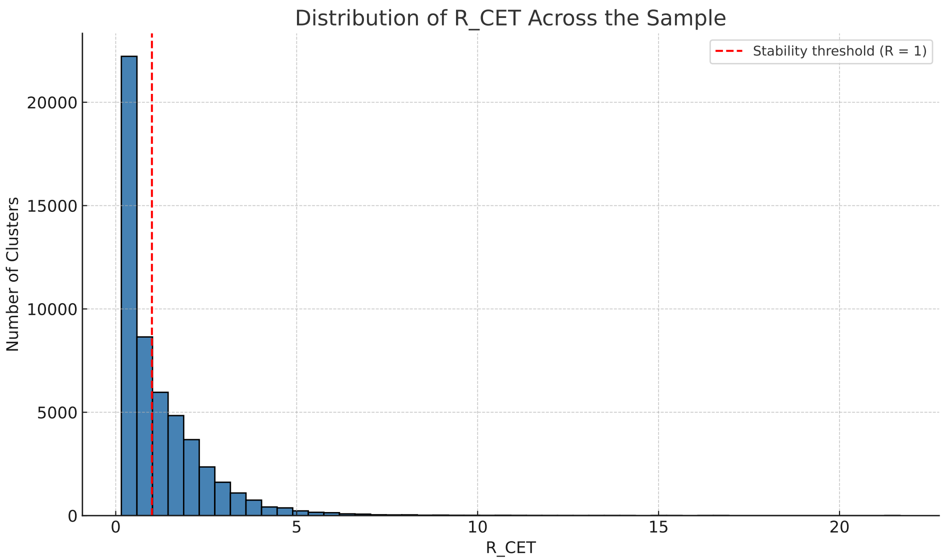

Figure 4: Histogram of the elastic stability ratio R_{CET} for all clusters in the sample. Most clusters have $R_{\mathrm{CET}} > 1$.

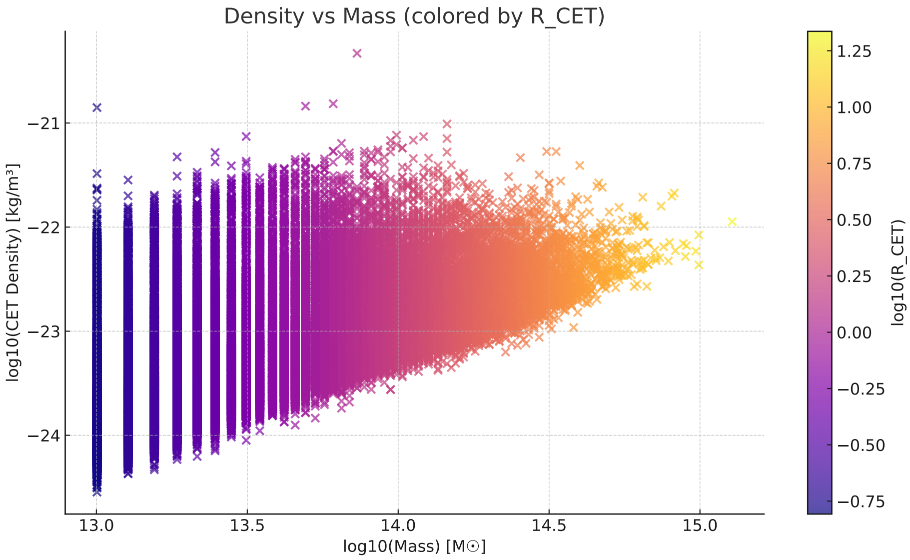

Figure 5: CET density vs. estimated cluster mass, colored by R_{CET}. Higher density clusters tend to show higher R.

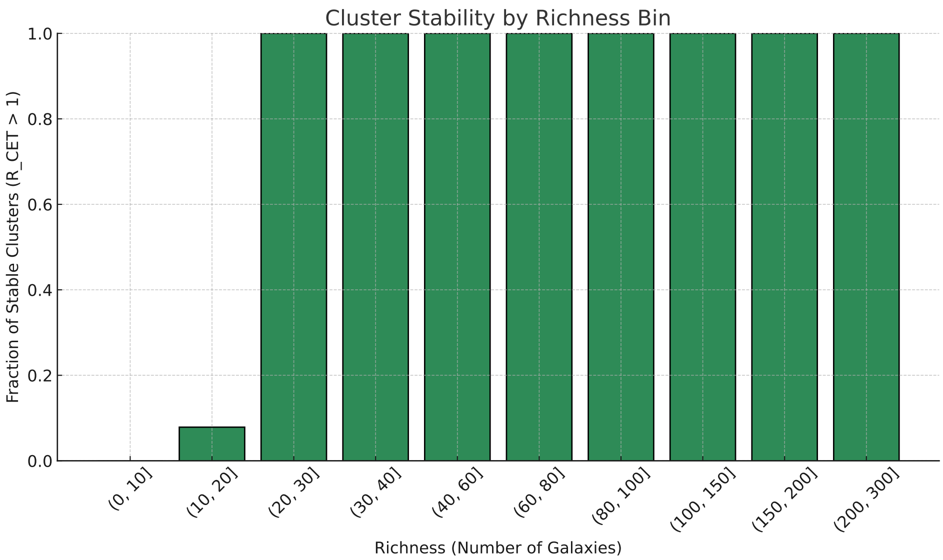

Figure 6: Average R_{CET} as a function of galaxy richness. Stability increases with the number of galaxies in the cluster.

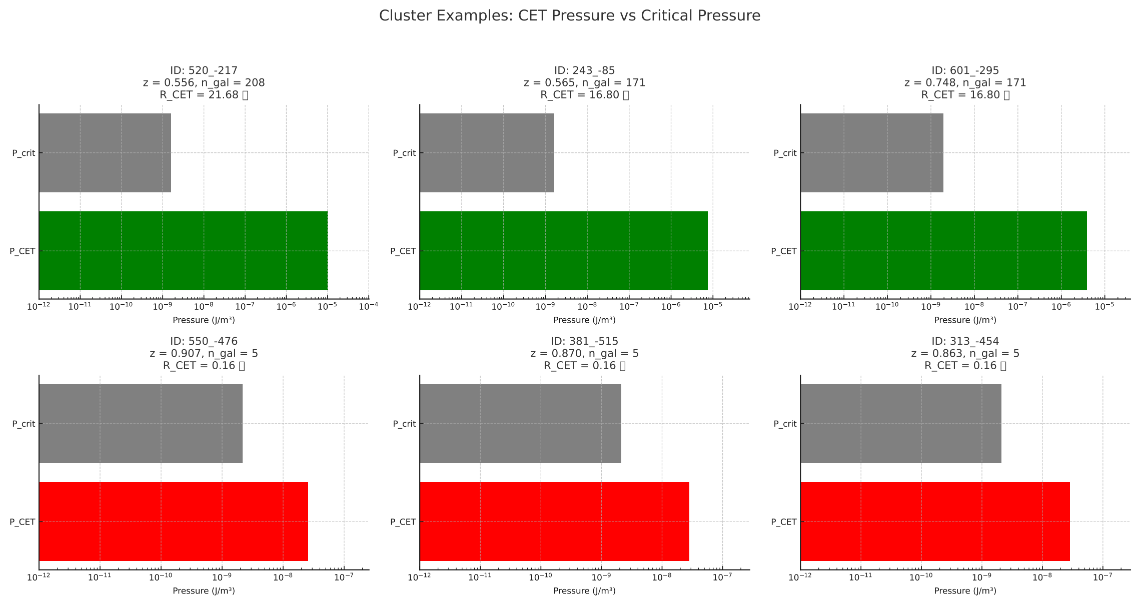

Figure 7: Examples of stable (top row) and unstable (bottom row) clusters showing CET vs. critical pressure.

5 Conclusion

CET predicts gravitational stability in clusters without dark matter. Reinterpreting redshift as elastic deformation and correcting geometric assumptions resolves the missing mass problem. Our results show that 41.6% of clusters are intrinsically stable, a fraction that increases significantly for richer systems.

Acknowledgments

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References

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