Fast Radio Burst Generation from Curvature Activation Collapses: A Detailed Model under UMT

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Abstract

Universal Motion Theory (UMT) predicts that fast radio bursts (FRBs) may originate from sudden collapses of curvature activation gradients. This addendum presents a detailed model of FRB generation, connecting burst rates, timing, and energy scales to rapid $\Phi(\rho)$ activation transitions. Predictions include statistical clustering near void edges and localization patterns consistent with emerging observational data. The derivation expands UMT's explanatory framework for high-energy astrophysical phenomena.

1 Introduction

Fast radio bursts (FRBs) are intense, millisecond-duration pulses of radio waves of extragalactic origin. Their cause remains uncertain under standard astrophysics. Universal Motion Theory (UMT) provides a natural mechanism: sudden collapses in curvature activation gradients $\nabla(\Phi\kappa)$ can release localized energy bursts, manifesting as FRBs.

This addendum expands on the initial FRB framework suggested in the core UMT manuscript.

2 Curvature Activation Collapse Mechanism

The curvature activation function is:

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

where k is the steepness parameter and ρ_{th} is the activation threshold.

Sudden spatial or temporal perturbations near activation thresholds can cause rapid activation transitions:

$$\Delta\Phi \sim \mathcal{O}(1) \quad \text{over} \quad \Delta t \ll 1\,\text{ms} \tag{2}$$

This abrupt shift liberates constrained curvature tension, emitting coherent radio-frequency energy.

3 FRB Rate and Energy Scaling

The energy E released during a collapse event scales with the local curvature gradient:

$$E \propto |\nabla(\Phi\kappa)|\, V \tag{3}$$

where V is the effective collapse volume.

FRB event rates Γ are proportional to the density of near-threshold activation zones:

$$\Gamma \propto \int_{\text{void boundaries}} \delta(\Phi(\rho) - \Phi_{th})\, dV \tag{4}$$

where δ is a Dirac delta function selecting regions near Φ_{th}.

4 Predicted Spatial Clustering

UMT predicts that FRBs preferentially occur:

- Near cosmic void boundaries where $\nabla(\Phi\kappa)$ is steep.
- In regions of dynamic curvature perturbation (e.g., filament mergers, tidal gradients).
- With statistically anisotropic distributions correlated with large-scale structure.

Early FRB localizations already hint at clustering near underdense regions, consistent with UMT's predictions.

5 Comparison to Alternative Models

Conventional FRB models often invoke compact object interactions (e.g., neutron star mergers, magnetar flares). UMT offers:

- A curvature-driven, non-baryonic energy release mechanism.
- Predictable spatial correlations with cosmic structure.
- Consistency with both repeating and non-repeating FRB populations depending on environmental curvature dynamics.

6 Conclusion

This addendum presents a detailed curvature activation collapse model for fast radio burst generation under Universal Motion Theory. It provides falsifiable predictions for FRB rates, energy scaling, and spatial localization patterns, offering a geometric alternative to standard astrophysical models.

References

1. Bernot, R. (2025). Universal Motion Theory Manuscript.
2. CHIME/FRB Collaboration (2019). Observations of fast radio bursts.
3. Katz, J. I. (2016). Fast radio bursts — A brief review: Some questions, fewer answers.