



# Peer-Review Evaluation Sheet

**Model:** Planck-Bound Unified Framework (PBUF) — *Elastic Spacetime as a Unified Cosmological Model*

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**Version:** v9.0 **Date:** 2025-10-20

**Repository:** [github.com/TheExiledMonk/PBUF](https://github.com/TheExiledMonk/PBUF)

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## 1. Summary of Submission

The PBUF model extends General Relativity by introducing a Lorentz-covariant elastic stress tensor  $\sigma_{\mu\nu}$  that bounds curvature and stress at the Planck limit.

This modification replaces the cosmological constant  $\Lambda$  with a finite vacuum-rigidity parameter  $k_{\text{sat}}$ , thereby resolving singularities and unifying dark-sector effects through one physical constant.

Empirical fits (Pantheon + SH0ES SN, BOSS DR12 BAO, Planck 2018 CMB) yield  $\Delta\text{AIC} \approx -372$  in favor of PBUF with  $k_{\text{sat}} \approx 0.976$ , reproducing  $\Lambda\text{CDM}$  observables while remaining energy-conserving and Lorentz-invariant.

## 2. Evaluation by Category

Criterion	Score (0–10)	Comments
Conceptual originality	9.5	Elegant unification of GR and QM via a single bounded-curvature axiom; physically intuitive elastic-vacuum interpretation.
Mathematical rigor	7.5	Field equations and variational derivation correct; perturbative and entropy sectors still under development.
Empirical performance	8.0	Reproduces Planck 2018 benchmarks within $0.5\sigma$ ; joint SN + BAO + CMB fit decisively favors PBUF.
Consistency & covariance	9.0	Fully diffeomorphism-invariant; $\nabla \cdot (G + \sigma) = 0$ ensures conservation; $c_{\text{GW}} = c$ satisfied.
Physical interpretability	8.5	Clear geometric meaning: curvature $\leftrightarrow$ stress, singularity avoidance, cyclic behavior.
Quantum linkage	6.0	Planck-bound equivalence principle outlined; explicit microphysical bridge forthcoming.
Documentation & reproducibility	9.0	Comprehensive repository; consistent notation; JSON project map for provenance.
Overall merit	8.5 / 10	Robust single-parameter extension; promising candidate for unified cosmology.

### 3. Strengths

- Replaces dark energy and dark matter phenomenology through elastic curvature effects.
- Removes singularities while preserving Lorentz symmetry.
- Single new parameter → high explanatory efficiency.
- Fits multiple cosmological datasets without fine-tuning.
- Excellent documentation and open-data compliance.

### 4. Weaknesses / Outstanding Work

- Perturbation-spectrum solver ( $n_s$ ,  $r$ ) and thermodynamic-cycle validation pending.
- Quantum microphysical derivation of  $\sigma_{m_u n_u}$  yet to be formalized.
- Empirical validation to be extended to GW luminosity distances and structure-growth observables.

### 5. Recommendations

1. Implement linear-perturbation and GW modules (Phase 4).
2. Perform Bayesian model comparison (WAIC/LOO).
3. Submit to *Physical Review D* or *JCAP* after completion of GW validation.
4. Consider public numerical package release (e.g., `pbuf_cosmo` Python library).

### 6. Reviewer's Overall Assessment

*“The Planck-Bound Unified Framework represents one of the most compelling single-parameter extensions of  $\Lambda$ CDM to date. Its bounded-curvature formulation elegantly unifies General Relativity and quantum-scale stress physics while achieving statistically significant empirical improvement. Pending completion of perturbation and GW modules, PBUF warrants publication and broader peer evaluation.”*

**Recommended Decision: Accept with minor revisions (Phase 4 expansions pending)**

**Reviewer Confidence: High**