Could the Universe Endure a NEC Fracture?

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Recent observations suggest dark energy might have been of phantom type in the past, implying violation of the null energy condition (NEC). It is a well-known fact that quantum states can violate the NEC, but at the same time, it is a challenge to come up with theoretically robust and stable quantum field theories that could behave as phantom dark energy. In fact, there should be a theoretical limit to how much "negative energy" can accumulate over time and space. The smeared null energy condition is a quantum-inspired revision of the null energy condition, which provides such a bound. When applied to dark energy, we show how the smeared null energy condition implies different theoretical lower bounds on the dark energy equation of state. We also comment on how such bounds may be used to set better-motivated priors when doing Bayesian inference. Mainly based on arXiv:2503.19955.

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