
Contribution ID: **274**

Type: **not specified**

# Cosmological Non-Constant Problem: Cosmological bounds on TeV-scale physics and beyond

*Thursday, August 6, 2015 5:12 PM (18 minutes)*

We study the influence of the fluctuations of a Lorentz invariant and conserved vacuum on cosmological metric perturbations, and show that they generically blow up in the IR. We compute this effect using the Kallen-Lehmann spectral representation of stress correlators in generic quantum field theories, as well as the holographic bound on their entanglement entropy, both leading to an IR cut-off that scales as the fifth power of the highest UV scale (in Planck units). One may view this as analogous to the Heisenberg uncertainty principle, which is imposed on the phase space of gravitational theories by the Einstein constraint equations. The leading effect on cosmological observables come from anisotropic vacuum stresses which imply: i) any extension of the standard model of particle physics can only have masses (or resonances) $<$ 24 TeV, and ii) perturbative quantum field theory or quantum gravity become strongly coupled beyond a cut-off scale of Lambda $<$ 1 PeV. Such a low cut-off is independently motivated by the Higgs hierarchy problem.

This result, which we dub the cosmological non-constant problem, can be viewed as an extension of the cosmological constant (CC) problem, demonstrating the non-trivial UV-IR coupling and (yet another) limitation of effective field theory in gravity. However, it is more severe than the old CC problem, as vacuum fluctuations cannot be tuned to cancel due to the positivity of spectral densities or entropy. We thus predict that future advances in cosmological observations and collider technology will sandwich from above and below, and eventually discover, new (non-perturbative) physics beyond the Standard Model within the TeV-PeV energy range.

## Oral or Poster Presentation

Oral

**Primary author:** AFSHORDI, Niayesh

**Co-author:** Mr NELSON, Elliot (Penn-State University)

**Presenter:** AFSHORDI, Niayesh

**Session Classification:** AstroParticle, Cosmology, Dark Matter Searches, and CMB

**Track Classification:** Cosmology and Dark Energy Experiment