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Risking your NEC

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Energy conditions, especially the null energy condition (NEC), are generically imposed on solutions to retain a physically sensible classical field theory and they also play an important role in the AdS/CFT duality. Using this duality, we study non-trivially deformed strongly coupled quantum field theories at large-Nc. For this, we construct the corresponding dual classical gravity solutions, which entail the use of radially non-monotonic D-brane distributions. The distributions are phenomenological in the sense that they do not correspond to the smearing of known probe D-brane embeddings. These gravity backgrounds are supersymmetric and hence perturbatively stable, and do not possess curvature singularities. There are no short-cuts through the bulk spacetime for signal propagation which assures that the field theory duals are causal. Nevertheless, some of the constructed solutions violate the NEC in the gravity dual. In these cases the non-monotonicity of the D-brane distributions is reflected in the properties of the renormalization group flow: none of the c-functions proposed in the literature are monotonic. This further suggests that the non-monotonic behavior of the c-functions within previously known anisotropic backgrounds does not originate from the breaking of Lorentz invariance. We surmise that NEC violations induced by quantum corrections also need to be considered in holographic duals, but can be studied already at the classical level

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