Casimirs of Casimirs: Ruling out scale-separated vacua with moduli space Laplacians

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Abstract

Supergravity compactifications supported by fluxes and Casimir energy offer a simple strategy to concoct explicit, controlled and isolated vacua with parametric scale separation and soft supersymmetry breaking. Exploiting the properties of the Casimir potential with respect to Laplacian operators, we prove that the simplest such class of solutions, given by toroidal compactifications of eleven-dimensional supergravity threaded by any fluxes, always exhibit perturbative instabilities in the form of tachyonic modes. Furthermore, this no-go theorem applies to compactifications of any effective theory of gravity coupled to form fields, regardless of supersymmetry (except for a few three-dimensional exceptions). In addition, we examine a number of examples of Riemann-flat toroidal orbifolds, again finding tachyonic modes in addition to the universal non-perturbative instabilities mediated by brane nucleation. These examples lead us to formulate a heuristic argument for Riemann-flat manifolds.

Keywords: string compactifications, supergravity, M, theory, scale separation

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