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Modular bootstrap for BPS indices on Calabi-Yau threefolds

Abstract

Unlike in cases with maximal or half-maximal supersymmetry, the spectrum of BPS states in type II string theory compactified on a Calabi-Yau threefold with generic SU(3) holonomy remains partially understood. Mathematically, the BPS indices coincide with the generalized Donaldson-Thomas invariants associated to the derived category of coherent sheaves, but they are rarely known explicitly. String dualities indicate that suitable generating series of rank 0 Donaldson-Thomas invariants counting D4-D2-D0 bound states should transform as vector-valued mock modular forms, in a very precise sense. I will spell out and test these predictions in the case of one-modulus compact Calabi-Yau threefolds such as the quintic hypersurface in P^4, where the polar terms can (at least in principle) be computed from higher-genus Gopakumar-Vafa invariants, using recent mathematical results by S. Feyzbakhsh and R. Thomas.