Unifying Particle Physics and Cosmology in Type IIA String Theory

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Abstract

We propose a unified framework within Type IIA string theory, based on a globally consistent intersecting D6-brane model compactified on a $T^6/(\mathbb{Z}_2 \times \mathbb{Z}_2)$ orientifold. The model realizes the MSSM-like spectrum providing a framework for addressing four fundamental problems: CP violation originates from both perturbative phases induced by $E2-$instantons; the observed baryon asymmetry arises via instanton-mediated operators combined with moduli-driven leptogenesis; the electroweak hierarchy is stabilized through control scale gravitino mass near a metastable vacuum; and a de Sitter uplift is achieved via anti-$D6-$branes in an STU moduli stabilization scheme. Crucially, the interplay of intersecting brane geometry, Euclidean D2-instantons, and flux-induced moduli potentials provides a coherent mechanism linking collider, flavor, and cosmolog

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