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The Complete Matter Sector in a Three-Generation Compactification

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Abstract. We consider a Calabi–Yau compactification paradigm with three light generations and an R-symmetry. From a special form of the Tian–Yau manifold, we also construct a new three-generation model with markedly different phenomenology. The *complete* spectrum of all light matter fields is obtained in a universal way and moreover in a physically suitable basis, allowing a straightforward analysis of all their couplings. Here we discuss all the renormalizable Yukawa couplings. This computation can equally well be repeated for all compactification models based on Calabi–Yau complete intersections in products of homogeneous spaces.

1. Introduction

The main purpose of this article is to provide a comprehensive presentation of the cohomology techniques of exact and spectral sequences (TESS for short) [1–4] with the aid of which the *complete* light matter sector for a large class of Calabi–Yau string compactifications can be computed. In principle, this includes all the couplings and here we exemplify this by discussing the renormalizable terms; more general results and especially non-renormalizable couplings are reported in [5].

In this article, we focus on a construction that features a discrete R-symmetry. The reason for this is twofold. Firstly, it has been argued recently [6] that the R-symmetry in this model ensures the existence of a flat direction in the field space which allows a deformation of the model in which the initial E_6 gauge-symmetry is broken to $SO(10)$ or even $SU(5)$. Here we show that, upon inclusion of all light matter superfields, this deformation indeed is possible; a more complete analysis will be given in ref. [5]. In addition, we find two distinct three-generation models obtained following the Tian–Yau construction [7], one of which exhibits several phenomenologically interesting effects. They differ in the discrete symmetries of the interactions among the matter superfields.

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