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Endomorphism Valued Cohomology and Gauge-Neutral Matter

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Abstract. For several physically interesting Calabi-Yau manifolds, we count and parametrize gauge-neutral matter particles occurring in corresponding superstring compactifications. To this end, we use the technique of exact and spectral sequences and then describe and discuss our results in the more familiar tensor notation.

0. Preliminaries

An appreciable subset of consistent and possibly realistic superstring models is constructed on an "internal," complex 3-dimensional Calabi-Yau manifold [1], denoted $\mathcal{M}$. The particles of the low energy effective model correspond to elements of various cohomology groups on $\mathcal{M}$. For a very large family of (three dimensional) Calabi-Yau manifolds all relevant such groups have been determined in the literature [2], except for $H^1(\mathcal{M}, \operatorname{End}\mathcal{T}_{\mathcal{M}})$, where $\operatorname{End}\mathcal{T}_{\mathcal{M}}$ denotes the bundle of *traceless* endomorphisms of $\mathcal{T}_{\mathcal{M}}$, the holomorphic tangent bundle of $\mathcal{M}$. Elements of $H^1(\mathcal{M}, \operatorname{End}\mathcal{T}_{\mathcal{M}})$ correspond to matter particles which are neutral with respect to any Yang-Mills gauge interaction but interact directly with the particles of the standard model. Even though these particles tend to receive large masses, they may have a desirable phenomenological impact [3].

In this paper we determine $H^*(\mathcal{M}, \operatorname{End}\mathcal{T}_{\mathcal{M}})$ for a number of Calabi-Yau manifolds that lead to phenomenologically interesting models. We relate the elements of $H^1(\mathcal{M}, \operatorname{End}\mathcal{T}_{\mathcal{M}})$ to cohomological data entirely on an ambient space $\mathcal{W}$, in which $\mathcal{M}$ is embedded. To this end we use the technique of exact and spectral sequences (TESS) as in [2], except that we shall now employ it to its full extent instead of using only the vanishing part.

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