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Calculating Endomorphism Valued Cohomology: Singlet Spectrum in Superstring Models

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Abstract. We present a computational strategy based on exact sequences for determining the dimension of endomorphism valued cohomology groups for complete intersections in complex projective space. This cohomology group gives rise to part of the gauge singlet spectrum in superstring compactifications. We establish the underlying justification for the known deformation theoretical algorithm, and by comparison with the exact sequence method, indicate its limitations.

1. Introduction

Any attempt to extract phenomenological predictions from the compactified superstring requires, as the most basic ingredient, an understanding of the low energy particle content. As is by now quite familiar, for smooth manifold compactification this corresponds to an understanding of the cohomology of the compactified manifold as well as that of certain holomorphic vector bundles constructed upon it. To be concrete, we specialize to the $E_8 \times E_8$ Heterotic string [1] compactified on a Calabi-Yau manifold K (a complex threefold of $SU(3)$ holonomy). Although there are other possibilities (for example orbifolds [2]), Calabi-Yau compactification has so far yielded the most realistic superstring phenomenology [3]. As described in [3, 4] the massless particle content of such a theory is given by bundle valued $\bar{\partial}$ harmonic forms $H^*(K, B_i)$, where the B_i are various vector bundles associated to the vacuum gauge bundle V_1 to which (half of) the left moving world sheet fermions couple [1] (more precisely, vector bundles associated to the principle bundle $\mathscr{V}_1$ associated to V_1). The latter arise from the representations of S, the structure group of $\mathscr{V}_1$ which appear in the decomposition

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