Soft terms in string compactifications

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Abstract

Supersymmetry is a generic prediction of string theory. Given that it is not an exact symmetry of nature, in order to connect string compactifications to particle physics, we must understand how supersymmetry is broken. This issue is intimately related to the moduli stabilisation problem in string theory, as the latter determines the vacuum structure of the theory. Interestingly, SUSY-breaking in string theory is typically soft, which means that the supersymmetric cancellation of quadratic divergences in the Higgs mass endures. Such breaking is then parameterised by soft terms, which roughly determine the masses of superpartners. If SUSY-breaking generates soft-terms at energy scales accessible to particle accelerators (as expected if low-energy SUSY is the correct way of addressing the hierarchy problem) then, remarkably, they would directly relate properties of the string compactification to experiments.

We will begin by reviewing the motivation and description of soft SUSY-breaking in the MSSM and supergravity, commenting on current constraints from the LHC. We will then describe the main mechanisms for moduli stabilisation, SUSY-breaking and mediation in string theory. Putting these tools together we will illustrate, within the Heterotic and Type IIB theories, interesting possibilities for the soft-terms in string compactifications. A particular focus will be on the interplay with cosmology, which has been best studied in Type IIB models. The presence of moduli in these compactifications leads to a modification of the standard Big Bang Theory, in which the reheating of the universe is driven by the decay of the lightest modulus. In particular, we will show that such non-standard cosmological history of the universe plays a crucial role in constraining SUSY-breaking in string models. Interestingly, it turns out that, once all the cosmological constraints are taken into account, it is actually rather difficult to get low-energy SUSY from string theory. Finally, we will briefly review the cosmological scenarios which could arise from such string compactifications.

References

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