

Abstract

According to high-energy accelerator experiments, supersymmetry has not been confirmed. Motivated by that fact, I have been focusing on non-supersymmetric string theories and investigating what kind of top-down approaches are possible under the assumption that supersymmetry is broken at very high energy scale. In particular, I have been considering the question of whether it is possible to realize very small cosmological constant without supersymmetry, and if so, whether the moduli can be stabilized under such conditions. I have also studied some interesting properties of non-supersymmetric string theories.

Cosmological constant and moduli stability

It is known that in string models in which supersymmetry is broken by the Scherk-Schwarz mechanism (the S-S mechanism), the cosmological constant can be exponentially suppressed if the Bose-Fermi degeneracy is realized only in the massless level. In a series of our studies, I investigated whether such special conditions are realizable or not in the heterotic models. As a result, I found that such conditions are satisfied at some special points on the moduli space. I also analyzed the stability of the moduli and clarified that the points with suppression of the cosmological constant correspond to saddle points of the potential.

T-duality of non-supersymmetric strings

It is known that the gauge symmetry is enhanced at special points where the cosmological constant is suppressed. It is also known that such points correspond to fixed ones under T-duality transformations. In our study, I investigated the structure of T-duality in models whose supersymmetry is broken by the S-S mechanism. As a result, it is shown that T-duality transformations in non-supersymmetric models are restricted to congruent subgroups of the T-duality group of supersymmetric ones.

Non-supersymmetric string model with reduced rank

The models studied so far are constructed by starting from a maximally supersymmetric model with not reduced rank $16 + 2d$ and breaking the supersymmetry by the S-S mechanism. On the other hand, it is known that a maximally supersymmetric model with reduced rank can be constructed by compactifying with an asymmetric orbifold. In one of our study, I constructed non-supersymmetric models whose rank is reduced to $8 + 2d$ by starting from so-called CHL string model which has maximal supersymmetry and reduced rank, and showed that the gauge symmetry can be enhanced to non-simply-laced group. I also studied the cosmological constant and the moduli stability in such models, and showed that the cosmological constant can be exponentially suppressed.