

Aspects of string phenomenology

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1 Abstract

Despite the important experimental success of General Relativity, there are several theoretical reasons indicating that gravitational phenomena may change radically from the predictions of Einstein's theory at very short distances. A main motivation comes from studies of unifying all fundamental forces in the framework of a consistent quantum theory, called string theory. This theory introduces a new physical constant, the string length, under which a new fundamental structure appears, changing drastically the laws of nature.

In my lectures, I will discuss some of the main aspects of string phenomenology using different approaches in different perturbative string vacua. The appropriate and most convenient framework for low energy supersymmetry and grand unification is the perturbative heterotic string. Indeed, in this theory, gravity and gauge interactions have the same origin, as massless modes of the closed heterotic string, and they are unified at the string scale which is predicted in terms of the Planck mass.

Another perturbative framework that has been studied extensively is type I string theory with D-branes. Unlike in the heterotic string, gauge and gravitational interactions have now different origin. The latter are described again by closed strings, while the former emerge as excitations of open strings with endpoints confined on D-branes, leading to a braneworld description of our universe. This setup allows lowering the string scale in the TeV region, providing a theoretical framework for solving the so-called mass hierarchy problem: the apparent weakness of gravity can be accounted by the existence of large internal dimensions, in the submillimeter region, and transverse to a braneworld where our observed universe is confined. This scenario predicts new gravitational phenomena that can be observed at both particle colliders, and in non-accelerator experiments searching for new short range forces.

2 Outline

1. Main questions, mass hierarchy and list of possibilities
2. General issues of high string scale
heterotic string and intersecting branes
3. Models and phenomenology of low string scale
large extra dimensions and experimental predictions

4. Framework of magnetized branes
moduli stabilization, model building, SUSY breaking

References

- [1] I. Antoniadis, lecture notes “Topics on String Phenomenology” at Les Houches 2007 Summer School ”String Theory and the Real World”, arXiv:0710.4267 [hep-th].