Research Activity

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My research activity has been centered on the study of String Theory. The main results can be summarized as follows:

- 1988-1995: study of the basic properties and of the building rules of Open String Models (Type I from Type IIB Strings, now currently known as Orientifolds). In particular, the classification of the *complete* consistency conditions for Conformal Field Theories on (non-orientable) Riemann Surfaces with boundaries (Boundary Conformal Field Theories). In this context, the new description of the orientifold of a Z_2 toroidal orbifold, the first example in which appear branes that do not invade the whole space-time, i.e. open strings with Dirichlet boundary conditions along the compact directions, later interpreted by Polchinsky as D-branes.

- 1996-2003: string phenomenology and model building. Discovery of the first four dimensional $N = 1$ orientifold with three generations of chiral matter. Discovery of the first class of orientifolds with branes at angles, independently described by the german group of D. Luest, R. Blumenhagen and collaborators. Study of "intersecting brane models" or magnetized strings (compactifications with constant magnetic background fluxes) in four dimensions, and analysis of stringy mechanisms for supersymmetry breaking on the branes.

- 2004 - present: study of model independent aspects of the so called "String Landscape", the space of vacua in String Theory. In particular:

  - interpretation of amplitudes in the presence of tadpoles.
  - study of non perturbative effects due to gauge and "stringy" instantons.
  - the problem of moduli stabilization: the description of a class of type I free fermionic models with a small number of moduli. They correspond to compactifications on Calabi-Yau manifolds with small (both) Hodge numbers and exhibit neatly a tension between chirality and moduli stabilization.
  - the analysis of the phenomenon of "brane recombination" (the stringy analog of the Higgs mechanism) in models with intersecting or magnetized branes.

Brane recombination allows to connect vacua that exhibit very different configurations. Moreover, it allows to describe the "transmutation" of a brane into an abelian background magnetic field, whose nature is due to the compactness of the target manifold.

– a stringy inspired model that extends the Minimal Supersymmetric Standard Model by the addition of an anomalous $U(1)$ vector multiplet and a Stueckelberg multiplet. The aim was to describe possible signatures of string theory that are, at least in principle, visible at the LHC running at CERN.