

Séminaire de matrices, cordes et géométries aléatoires

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Orme des Merisiers Salle Claude Itzykson, Bât. 774

Heterotic Standard Models and Line Bundle Cohomology

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It is generally believed that string compactifications that can accommodate the standard model of particle physics are few in number. The first message of this talk is that, although such compactifications may be rare and hard to find, their number is substantial. I discuss various aspects of heterotic string compactifications on smooth Calabi-Yau threefolds with abelian internal fluxes and present an approximate analytic relation between the number of such compactifications with the exact charged matter content of the standard model of particle physics and the topological data of the internal manifold, the former scaling exponentially with the number of Kahler parameters. The relation gives about 10^{23} string theory standard models for the CICY list; for the class of Calabi-Yau hypersurfaces in toric varieties, it gives about 10^{723} standard models.

The second part of the talk focuses on bundle valued cohomology, which is often the criterion for deciding whether a particular string model leads to the standard model spectrum or not. Cohomology is usually computed using algorithmic methods. In practice, these are computationally intense and provide little insight into the origin and structure of the results, representing a major obstacle in the way of progress in model building. This state of affairs has recently changed with the discovery that line bundle cohomology follows astonishingly simple patterns described by closed-form analytic formulae. Machine learning plays an important role in finding and generalising the formulae. A rigorous mathematical understanding of the analytic formulae for line bundle cohomology is currently emerging - I will present the state of the art results.
