Cosmology and High Energy Physics VII

Laboratoire Charles Coulomb
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Abstracts

Guillaume Bossard

Exact couplings in string theory

One can compute the low energy effective action in many string theory vacua using the perturbative genus expansion. However, relevant physical questions often require to consider a finite string coupling constant, for example for black hole physics or approximately de Sitter cosmology. One therefore needs to compute non-perturbative effects in string theory. This is generically very difficult, but this can be done using supersymmetry and duality symmetries in particularly simple string theory vacua. In this talk I will review such constructions, focusing on the prototypical example of type IIB string theory in ten dimensions.

Philippe Brax

K-mouflage in duality and conformally invariant electromagnetism

Guglielmo Lockhart

Taub-NUT partition functions of 6d SCFTs

A distinguishing feature of six-dimensional superconformal field theories (SCFTs) is the existence of BPS strings, whose worldsheet theories are a very useful probe into the physics of the SCFTs. In this talk I will discuss how BPS strings can be exploited to compute partition functions of 6d SCFTs on manifolds which are the product of a two-dimensional torus and a Taub-NUT space. The main example I will consider is the 'M-string' SCFT, where results can be matched against gauge theory computations by Bruzzo, Pedrini, Sala, and Szabo, and are closely related to the equivariant version of the Vafa-Witten partition function. This talk is based on an upcoming work with Michele Del Zotto.

Patrick Peter

Unitarily inequivalent quantum cosmological bouncing models

Bouncing alternatives to inflationary cosmology permit to avoid the Big-Bang singularity that plagues most other models. As the singularity is a consequence of the classical theory of gravitation (general relativity), it is expected to be naturally avoided upon quantisation, as is indeed often seen to be the case in practice.

Quantising general relativity is notoriously difficult (and yet undone!), but there are ways to at least get an idea of what to expect. I will describe the canonical quantisation procedure and show how to apply it in the simplest case relevant for cosmology: the so-called Friedmann minisuperspace. I'll explain how this permits to obtain regular, bouncing, semiclassical approximations.

To compare with observational data as those provided by the CMB, one then needs to calculate the predicted spectrum of primordial perturbations. I will then show that there exists some ambiguities, directly related with the quantisation process: a given classical theory has precisely two different sets of predictions, and observations are required to raise the degeneracy, as if also the case in all quantum mechanical systems.

Thorsten Schimannek

Non-commutative geometry and degeneracies of black holes with discrete charges

String compactifications and string dualities provide a powerful dictionary between geometries, effective quantum field theories, and the mathematical properties of the observables. A prime example have been compactifications of IIA/IIB strings on six-dimensional Calabi-Yau manifolds. Mirror duality famously enables the exact calculation of certain couplings in the effective supergravities, including their highly non-trivial non-perturbative corrections. Those couplings in turn encode both the counts of curves on Calabi-Yau manifolds as well as degeneracies of certain supersymmetric black holes. It turns out that a corresponding relation exists for particular "non-commutative" resolutions of singular Calabi-Yau spaces. In particular, there exists a good notion of counting curves and this relates to the degeneracies of black holes that carry discrete charges. I will give a non-technical introduction to these results.