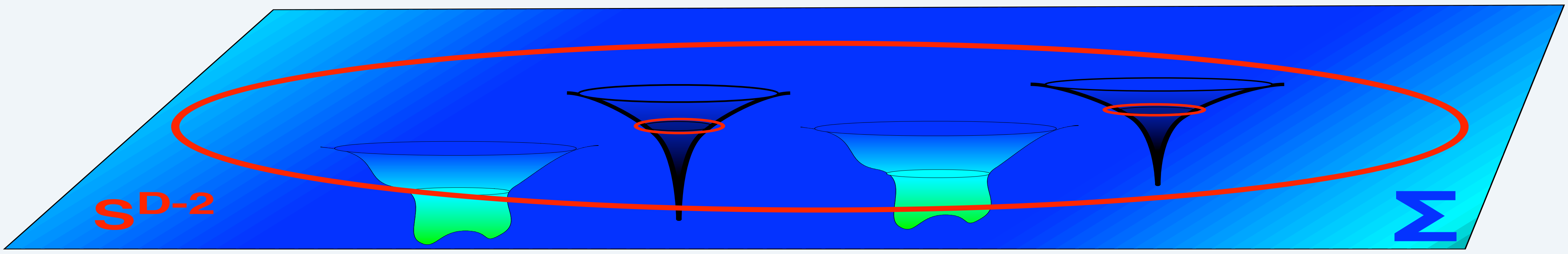
Institut de Physique Théorique

Cours de Physique Théorique



Black holes and microstate geometries

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On Fridays 3, 10, 17, 24 May 2019, from 10:00 to 12:15.

The last few years have seen a remarkable shift in thinking about black holes and the information problem: There is a growing consensus that new physics must emerge at the horizon scale. Microstate Geometries provide the only classical mechanism that can evade a multitude of "no-go" theorems and actually support horizon-scale structure. Such geometries are smooth, horizonless, solitonic solutions of massless supergravity that look just like black holes from far away but differ dramatically as one approaches the horizon scale.

This course will examine supersymmetric "black-hole-like" solutions of supergravity in various dimensions.

> We will start by constructing the simplest charged black-hole geometries, and will show how supersymmetry greatly simplifies the solutions, and the "BPS equations" that govern them. We will then use supersymmetry to construct multi-centered BPS black-hole solutions. We will study the near-horizon geometry and the tidal forces experienced by geodesic probes.
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> To construct gravitational solitons, we will dissect one of the original "no go" theorems in five-dimensional gravity and show how Chern-Simons interactions and magnetic fluxes threading non-trivial spatial topology provides a way around the standard dogma that there are "no solitions without horizons."
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> In five dimensions, supersymmetry reduces the "BPS equations" to a linear "electromagnetic problem" and we will use this to construct large families of supersymmetric solitons in five-dimensional supergravity. We discuss the regularity and moduli spaces of such solutions.

If there is sufficient time, we will survey an even richer classes of six-dimensional microstate geometries and discuss the tidal forces on geodesic probes. We will see that, unlike their black-hole counterparts, microstate geometries generate large tidal forces well before the probe reaches the horizon scale. This has very important implications for how infalling matter is "scrambled by the black hole.

IPhT, CEA-Saclay
Itzykson room
courses.ipht.fr