

COURS D'ÉCOLE DOCTORALE

COURS AVANCÉS DE PHYSIQUE THÉORIQUE DES HAUTES ÉNERGIES

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QUANTUM BLACK HOLES

A Course of Lectures from 15 February to 26 April 2010

10h30 to 11h30 & 11h45 to 12h45

Venue: LPTHE Bibliothèque, 5th floor, Tour 24-25, UPMC Jussieu

In recent years there has been enormous progress in understanding the entropy and other thermodynamic properties of black holes within string theory going well beyond the thermodynamic limit. It has become possible to begin exploring finite size effects in perturbation theory in inverse size and even nonperturbatively, with highly nontrivial agreements between thermodynamics and statistical mechanics.

These lectures will review these developments alternating between two tracks with topics listed below. We will meet for two lectures every Monday with a short break in-between. See dates below.

Track-I: BLACK HOLE THERMODYNAMICS

- Schwarzschild and Reissner-Nordstrom black holes, Kruskal extension
- Near horizon geometry, surface gravity, area, Euclidean temperature
- Rindler spacetime, Bogoliubov transformations, Hawking temperature
- Bekenstein-Hawking entropy, Wald entropy
- Extremal black holes, quantum entropy function
- String effective actions and sub-leading corrections
- Aspects of AdS/CFT holography

Track-II: BLACK HOLE STATISTICAL MECHANICS

- D-branes, Type-II string theory on K3
- Exact counting formula for five-dimensional D1-D5 system
- Strominger-Vafa black hole and leading entropy, 4d-5d lift
- Exact counting formula for four-dimensional dyonic black holes
- Siegel modular forms, wall-crossing phenomenon, duality orbits of dyons
- Contour prescription, asymptotic expansions, comparison with thermodynamics
- CHL models, Borchers symmetry, precision holography

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Dates: 15/02, 22/02, 01/03, 08/03, 22/03, 29/03, 05/04, 12/04, 19/04, 26/04