Geometry and physics of black holes
May 11, May 15-19, 2017

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- **Thursday 11 May**
  Lecture 1: Null hypersurfaces and event horizons (at 15:00 in Blokhintsev-hall)
- **Monday 15 May**
  Lecture 2: Differential geometry with the open-source software system SageMath (at 15:00 in Lecture Hall, II floor)
- **Tuesday 16 May**
  Lecture 3: The Schwarzschild black hole (at 15:00 in Lecture Hall, II floor)
- **Wednesday 17 May**
  Lecture 5: The Kerr black hole (at 15:00 in DIAS hall)
- **Thursday 18 May**
  Lecture 6: Evolution and thermodynamics of black holes (at 15:00 in DIAS-hall)
- **Friday 19 May**
  Lecture 7: The quasi-local approach: trapping horizons (at 15:00 in DIAS- hall)

Abstract:

The lectures introduce some aspects of black hole physics via a geometrical approach. The prerequisite is some basic knowledge of general relativity, at the level of an introductory course. The first part of the course focuses on the geometry of null hypersurfaces, in order to investigate the main properties of an event horizon. Non-expanding horizons are then discussed, with the important subcase of Killing horizons. Conformal completion is introduced and the general definition of a black hole is exposed. The Schwarzschild solution and its maximal extension are then studied. Dynamical black holes are introduced next via the study of exact solutions describing the formation of a black hole by gravitational collapse (Vaidya and Lemaître-Tolman solutions). The Kerr solution is then examined, as well as its maximal extension. This is followed by a course on black hole thermodynamics. The quasi-local approach, based on the concept of trapping horizons, is then briefly presented. The last lecture is devoted to black holes in higher dimensions and their role in the gauge-gravity dualities.