SSM
Scuola Superiore Meridionale

Course title:

Black Hole Physics

Duration [number of hours]**: 12**

PhD Program [MERC/MPS/SPACE]**: SPACE**

Name and Contact details of unit organizer(s):

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Course Description [max 150 words]**:**

The purpose of this course consists in analysing the geometric structures and dynamics of classical black hole solutions of General Relativity, specifically the Schwarzschild, Kerr, Reissner–Nordström, and Kerr–Newman metrics. Besides focusing on mathematical aspects, we also discuss their phenomenology within the current high-energy astrophysics' scenario. The main goal of these lectures is both to deliver mathematical techniques, which can be exploited also in other theories of gravity different from General Relativity, and to have insight into physical applications and observations.

Syllabus [itemized list of course topics]**:**

1) General Relativity – brief summary
2) Definition of a black hole & No-Hair Theorem
3) Schwarzschild solution – inner and outer case, mathematical properties
4) Schwarzschild solution – orbits
5) Kerr solution - mathematical properties
6) Kerr solution – orbits
7) Reissner–Nordström – mathematical properties
8) Kerr–Newman – mathematical properties
9) High-energy astrophysical applications
10) Challenges of Modern Astrophysics

Assessment [form of assessment, e.g., final written/oral exam, solutions of problems during the course, final project to be handed-in, etc.]**:**

Discussion of a final project

Suggested reading and online resources:

1. Chandrasekhar - "*The mathematical theory of black holes*", New York, 1992
2. Misner, Thorne, Wheeler - "*Gravitation*", San Francisco, 1973
3. Shapiro, Teukolsky - "*Black Holes, White Dwarfs, and Neutron Stars: The Physics of Compact Objects*", Weinheim 1983
4. S. Capozziello & V. Faraoni "*Beyond Einstein gravity*", Springer, Dodrecht, 2011
5. Notes provided by the teacher.