UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

General Relativity

2627-1-F1703Q010

Aims

1. Knowledge and understanding
   Students will acquire a solid understanding of the physical and mathematical foundations of General Relativity, including the geometric formulation of gravity.
2. Applying knowledge and understanding
   Students will be able to apply General Relativity to the analysis of exact solutions, to the description of black holes, and to fundamental models in physical cosmology.
3. Making judgements
   Students will develop the ability to critically evaluate gravitational and cosmological models, recognizing their domains of validity and consistency with observations.
4. Communication skills
   Students will be able to clearly and rigorously present and discuss the theoretical structures of General Relativity, using appropriate technical language and supporting arguments with explicit calculations.
5. Learning skills
   Students will develop the ability to independently deepen their knowledge of advanced topics in gravity, cosmology, and theoretical physics, also in preparation for research or further postgraduate study.

Contents

1. Principles and equations of general relativity.
2. Elements of differential geometry.
3. Black hole physics.
4. Elements of cosmology.

Detailed program

1. Summary of special relativity. Minkowski spacetime.
2. Equivalence principle. Accelerated observers.
3. Elements of differential geometry. Curvature. Geodesics.
4. Physics on curved spaces. Curvature and gravity. Einstein’s equations. Rudiments of Hamiltonian treatment. Vielbein formalism.
5. Gravitational waves. Black holes: Schwarzschild, charged, rotating solutions. Definition of mass in general relativity. Causality.
6. Elements of cosmology. De Sitter and anti-de Sitter spaces.

Prerequisites

Undergraduate degree in physics.

Teaching form

24 2-hour lectures, delivered didactics, in presence. In English.

Textbook and teaching resource

Lecture notes available at https://www.dropbox.com/s/t84lftb2llgb87w/GR.pdf?dl=0P

Semester

First semester

Assessment method

Written exam. Five open questions, five exercises, three hours. Object of evaluation will be the logic used in the resolution of the problems.
It is possible to hold the exam in English.

Office hours

By appointment

Sustainable Development Goals

QUALITY EDUCATION