UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

SYLLABUS DEL CORSO

Quantum Gravity

2526-1-F1703Q042

Aims

Knowledge and understanding: The student will learn the fundamental challenges in formulating a quantum theory of gravity.

Applying knowledge and understanding: The student will learn black hole thermodynamics, along with holography and the AdS/CFT correspondence.

Making judgments: The student will develop critical thinking and judgment skills in selecting the most appropriate tool, among those provided during the course, to solve a specific problem.

Communication skills: The student will be expected to acquire a correct and appropriate scientific language suited to the topics covered in the course.

Learning skills: The student will be able to deepen their understanding of specific concepts not covered during the course and to independently pursue advanced study using specialized scientific texts.

Contents

1. Challenges related to the quantization of gravity.

2. Black hole thermodynamics and the information paradox.

3. Introduction to holography and the AdS/CFT correspondence.

Detailed program

Semi-Classical Quantum Gravity

- Non-renormalizability of gravity.

- The cosmological constant problem.

- Black holes. Hakwing radiation, black hole thermodynamics, the black hole information paradox.

Introduction to the AdS/CFT Correspondence

- Introduction to conformal field theory

- Anti de Sitter space and its geometrical features.

- Introduction to the AdS/CFT correspondence

- Tests of the duality

Prerequisites

Courses of General Relativity and Theoretical Physics I and II.

Teaching form

Lectures on the blackboard.
Class format: in person (exceptionally, a lecture or two may happen online)

Textbook and teaching resource

-- black holes:
• Tom Hartman lecture notes: http://www.hartmanhep.net/topics2015/
• Harlow Lecture notes on the BH info paradox: https://arxiv.org/abs/1409.1231

-- Introduction CFT:

• Schellekens lecture notes: https://www.nikhef.nl/ t58/CFT.pdf
• Ginsparg Les Houches lectures: https://arxiv.org/abs/hep-th/9108028
• The yellow book: Conformal Field Theory by Di Francesco, Mathieu, Senechal

-- Introduction to the AdS/CFT correspondence:

• MAGOO review: https://arxiv.org/abs/hep-th/9905111
• McGreevy introduction: https://arxiv.org/abs/0909.0518
• Kraus AdS3/CFT2: https://arxiv.org/abs/hep-th/0609074

• Penedones TASI notes: https://arxiv.org/abs/1608.04948
• Zaffaroni Lecture notes: https://virgilio.mib.infn.it/~zaffaron/lezioniLosannafin.
pdf
• Skenderis AAdS spacetimes: for example hep-th/0010138

Semester

second semester, four hours per week.

Assessment method

Oral exam bases on the exposition of an argument not discussed during the lessons (to be agreed with the instructors) and some very general questions about the course.
The final evaluation will take into account the level of comprehension of the study topic and the clarity of presentation, as well as the way the student answers general questions concerning the main subjects introduced in the course.

Office hours

At the end of lectures or by appointment contacting:

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Sustainable Development Goals

QUALITY EDUCATION