UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Quantum Gravity

2223-1-F1701Q136

Aims

Discussion of problems in quantum gravity.

Contents

1. Problems related to the quantization of gravity.

2. Semiclassical quantization.

3. Proposals for ultra-violet completion of the theory.

Detailed program

- Non-renormalizability of gravity.

- The hierarchy problem; the cosmological constant problem.

- Black holes. Hakwing radiation, black hole thermodynamics, the entropy problem.

- Elements of supersymmetry and supergravity.

- Introduction to the theory of boson strings and superstrings in the Neveu Schwarz-Ramond formulation.

- D-branes: Dirichlet and Neumann boundary conditions. T-duality. Dp-branes and their physical interpretation.

- Anti de Sitter space and its geometrical features.

- The holographic principle.

- Introduction to the AdS/CFT correspondence. Discussion of its first crucial tests.

Prerequisites

Courses of General Relativity and Theoretical Physics I and II.

Teaching form

Lecture and tutorial classes

Textbook and teaching resource

References for the first 5 weeks:

- T. Hartman, lectures on black holes: http://www.hartmanhep.net/topics2015/
- Caroll, an introduction to general relativity, chapter 9
- Review on the cosmological constant problem: https://arxiv.org/abs/1205.3365
- D. Harlow, Jerusalem lecture notes on quantum information and black holes: https://arxiv.org/abs/1409.1231
- Wess and Bagger, Supersymmetry and Supergravity

-- online lectures on black holes:

A. Tomasiello, Lectures on quantum gravity

-- online lectures on supersimmetry:

S. Martin: Supersymmetric primer;

Quevedo et al. Cambridge lectures on supersymmetry and extra-dimensions

-- string theory:

R. J. Szabo, An introduction to string theory and D-branes dynamics, World Scientific ed.

D. Tong, String theory, arXiv:0908.0333

-- Introduction to the AdS/CFTcorrispondence:

L. Susskind, J. Lindesay, An introduction to black holes, information and the string theory revolution: the holographic universe, World Scientific ed.

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