UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Theoretical Physics II

2627-1-F1703Q054

Aims

Knowledge and understanding: the student will learn advanced topics of relativistic quantum field theory and non-abelian gauge theories, including the formulation of the Standard Model of fundamental interactions.

Applying knowledge and understanding: the student will learn to apply the quantum field theory to the study of fundamental interactions.

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

Quantization of the electromagnetic field and introduction to the Standard Model of fundamental interactions

Detailed program

- Covariant quantization of the electromagnetic field
- Radiative corrections in quantum electrodynamics (QED)

- Anomalous magnetic moment of the electron
- Regularization methods of divergent integrals in 4 dimensions
- Vertex and propagator corrections for fermions and photons
- Charge renormalization
- Ward's identity
- Introduction to the Standard Model of elementary particles
- Global and local symmetries
- The Yang-Mills interaction
- Non-abelian gauge theories: SU(2)xU(1) gauge symmetry
- The model of Weinberg, Glashow and Salam
- Parity violation
- Muon decay in the Fermi's effective field theory and in the Standard Model
- Spontaneous symmetry breaking
- The Goldstone's theorem
- The Brout-Englert-Higgs mechanism
- The electroweak Lagrangian: derivation of the propagators and vertices of the Standard Model

Prerequisites

Knowledge of the topics covered in the courses of Quantum Mechanics, Relativity and Theoretical Physics I

Teaching form

Lectures in person

Textbook and teaching resource

M. Maggiore, A Modern Introduction to Quantum Field Theory, Oxford
M.D. Schwartz: Quantum Field Theory and The Standard Model
M.E. Peskin, D.V. Schroeder: An Introduction to Quantum Field Theory
F. Mandl, G. Shaw: Quantum Field Theory

L. Maiani: Electroweak Interactions

B.G. Chen, D. Derbes, D. Griffiths et al: Lectures of Sidney Coleman on Quantum Field Theory https://arxiv.org/abs/1110.5013

Further material can be found at the page https://virgilio.mib.infn.it/~oleari/

Semester

First semester, eight hours per week, second half of the semester

Assessment method

The exam consists of a **written** part with exercises and problems on the whole course and an **oral** part. The oral part focuses on the whole program of the course, including exercises and insights carried out during the lessons, which are an integral part of the course.

The final result is not a weighted average of the results of the written and oral tests, but is determined by a global assessment, based on: precision and correctness in solving the exercises,
knowledge of the topics, clarity of exposition.

Office hours

On student request upon appointment. Please send an email to fix the date.

Sustainable Development Goals

QUALITY EDUCATION