# Gauge theories

## Prof. Roberto Auzzi

***COURSE AIMS AND INTENDED LEARNING OUTCOMES***

The course aims to treat the application of quantum field theory to Gauge theories.

At the end of the course, the student will be able to apply the formalism of quantum field theory to several problems in elementary particle physics. The student will understand the basics of Standard Model as a unified description of particle physics. He will appreciate the relevance of several open problems in fundamental physics which require the introduction of Beyond the Standard Model physics.

***COURSE CONTENT***

Spin 1, gauge invariance, quantum electrodynamics

Application of path integral to systems with gauge invariance for the calculation of elementary processes

Renormalization of quantum electrodynamics at one loop, beta function

Introduction to Lie groups and algebras

Yang-Mills theories and their quantization. Running of the couplings at one loop. Introduction to QCD.

Application of spontaneous symmetry breaking to particle physics: pions and kaons. Brout-Englert-Higgs mechanism.

Weak interactions, introduction to Glashow-Weinberg-Salam model.

***BIBLIOGRAPHY***

- M. D. Schwartz, *Quantum Field Theory and the Standard Model (Cambridge Univ. Press,* 2014).

- M. SREDNICKI, *Quantum Field Theory* (Cambridge Univ. Press, 2007).

- M. PESKIN AND D.V. SCHROEDER, *An introduction to quantum field theory* (Westview, 1995).

- A. ZEE, *Quantum field theory in a nutshell* (Princeton University Press, 2010).

***TEACHING METHOD***

Lectures in classroom.

***ASSESSMENT METHOD AND CRITERIA***

Oral examination. The oral exam intends to evaluate the assimilation of the concepts presented during the course, and will focus on the candidate's discussion and presentation of some points of the program. The evaluation of the oral test will take into account the correctness of the answers, their logical and methodological rigor, and the effectiveness of the presentation.

***NOTES AND PREREQUISITES***

The student must have basic knowledge of quantum field theory for scalar fields.

Covid-19

In case the current Covid-19 health emergency does not allow frontal teaching, remote teaching will be carried out following procedures that will be promptly notified to students.

Prof. Roberto Auzzi receives in the office after the lessons.