UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Particle Physics I

2627-1-F1703Q032

Aims

The course aims to provide a basic introduction to the physics of particles by discussing their properties and classification scheme and the main laws that govern their interactions. The course will be accompanied by numerical examples and exercises. For those who wish, there is the possibility of taking the exams in English for Erasmus students.

Contents

Particles classification. Most relevant experiments and historical development of the field.. Interactions and fields.Barions and mesons, leptons. Hadrons. Quarks in hadrons. Deep inelastic scattering. Color. Interactions of quarks and QCD. Weak interactions. Fermi theory.

Detailed program

Background

The first discoveries in the cosmic rays; the experiments of the 50's

Nucleons, leptons and mesons

The muon and the pion; strange mesons and hyperons; the quantum numbers of the pion; leptons; antiparticles;

Hadrons

Resonances; production and formation; cross sections ?(K)-proton; interactions in the final state; Dalitz plot; the hadron resonances and hyperons; meson and baryon multiplets; the ?-? puzzle and the triangular Dalitz plot; quantum numbers of resonances; pseudo-scalar and vector mesons; SU(3)f and the quark model; the ? and ?; the ? and color; the J / ? and charm; the third family of quarks; the Y particles; the quarkonium.

QCD

Colliders e + e-; R ratio and the color; jets; spin of the gluon; DIS: kinematics and cross sections of Rutherford, Mott and Rosenbluth; Bjorken scaling and partons, structure functions; the gluons; scaling violations; elementary applications of QCD: color factors in the bound states and in the hadron cross sections; hadron-related states; renormalization in QCD and ?s(Q^2); the OZI rule; confinement and hadron masses.

Weak interactions

Classification; the Fermi constant; universality; beta decay; ?-e scattering; ?-? puzzle; parity violation; Dirac spinors; chirality and helicity; mass terms; weak charged (CC) and neutral (NC) currents; the discovery of neutral currents; helicity of the neutrino; pion decay; V-A theory; strange particles and Cabibbo angle; GIM mechanism; CP and quark mixing; CKM matrix; neutrino beams; cross sections of neutrino

Prerequisites

Structure of matter. Very basic understanding of the particle names and main interactions nomenclature. Relativistic kinematics concepts. Operation of the main types of particle detectors. Symmetry in quantum mechanics.

Teaching form

- Lectures

- Classes

- All lectures will be recorded and accessible at the times defined in the academic calendar 2023-24.

Textbook and teaching resource

Course slides and main articles of experiments of historical importance.

Suggested text: A. Bettini - Introduction to Elementary Particle Physics 2nd Ed. - Cambridge University Press

Semester

First semester

Assessment method

The exam will consist of a discussion of the topics covered in the lectures, designed to establish both the degree of preparation and understanding of the topics covered. It will include both an oral and a written part consisting of solving a few exercises related to the course content.

Office hours

Students can come to my office for clarification at any time. If needed, send an email to schedule an appointment.

Sustainable Development Goals