UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Experimental Methods in High Energy Physics

2324-1-F1701Q104

Aims

To provide the basic knowledge to understand a modern High Energy Physics experiment.

Contents

Particle accelerators. High Energy Physics experiment typology. Radiation detectors and their employ in the HEP experiments. The present experiments at the HE frontier: ATLAS and CMS. Prospects for HEP experiments.

Detailed program

Acceleration technique evolution and future prospects.

Synchrotron radiation and its impact on the accelerator techniques: proto-synchrotrons and linear accelerators.

Accelerator physics: basic concepts, linearization of the beam transport-equation, Liouville's theorem, evolution of the phase-space ellipse, emittance and luminosity.

Beam exploitation: collider mode and fixed target experiments.

Secondary beam production: pion, kaon, photon and neutrino beams.

Main features, limits and performance of the most important detectors: scintillators, wire chambers, TPC, solid-state detectors and Cerenkov detectors.

Theory of detector signal formation: derivation of Ramo's Theorem.

Detector organization in an experimental apparatus.

Momentum measurement with a magnetic spectrometer and achievable resolution.

Particle ID by time of flight, threshold/differential/ring-imaging Cerenkov detectors, and transition-radiation detectors.

Energy measurement and ID by total absorption of particles: EM and hadronic calorimetry.

Energy resolution of calorimeters and the compensation challenge.

Features of ATLAS and CMS experiments: basic approach and implications.

Comparative discussion of their performance and complementarity level.

Prerequisites

Foundations of Mechanics, Electromagnetism, Optics, Special Relativity, Structure of Matter, and Particle Physics.

Teaching form

Lectures, 6 credits

In the case of pandemic restrictions, the lectures will be video-recorded and, whenever possible, given in live streaming with the possibility to ask questions.

Textbook and teaching resource

K. Wille, "The Physics of Particle Accelerators"

J. Rossbach, "Basic Course on Accelerator Optics"

T. Ferbel, "Experimental Techniques in High Energy Physics"

Review of Particle Physics, J. Beringer et al. (Particle Data Group), Phys. Rev. D86, 010001 (2012)

L.D. Landau, "The Classical Theory of Fields"

L.D. Landau, "Mechanics"

Semester

Second semester

Assessment method

Discussion of an experiment chosen by the student

Office hours

On student's request

Sustainable Development Goals

QUALITY EDUCATION