PHYS-311

Particles and fundamental interactions

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Cursus	Sem.	Type
Physics	BA6	Obl.

Language of teaching	English
Credits	4
Session	Summer
Semester	Spring
Exam	Written
Workload	120h
Weeks	14
Hours	**4 weekly**
Courses	2 weekly
Exercises	2 weekly
Number of positions	

Summary

General overview of current knowledge in elementary particle physics: from relativistic kinematics to the phenomenological interpretation of high-energy collisions.

Content

Introduction
Fundamental forces and elementary constituents of matter.
Relativistic kinematics and dynamics
Lorentz transformations. Invariants and four-vectors. Conservation of energy and momentum.
Interaction of Radiation with Matter
Energy loss and Coulomb scattering of charged particles. Photon interactions with matter. Introduction to Feynman diagrams.
Particle Detection
Scintillators, counters and multi-wire gas ionization chambers, semiconductor detectors, Cherenkov detectors, electromagnetic and hadronic calorimeters.
Particle Accelerators
Linear accelerator, cyclotron, synchro-cyclotron, synchrotron, collider.
Particle Physics
Positron and antimatter. Neutrino, Pauli's hypothesis and its discovery. Pion and muon, discoveries and properties. Fermi's Golden Rule. Metastable states and resonances.
Particle Classification and Conservation Laws
Spin, isospin, baryon number, strangeness, lepton numbers.
Quark Structure of Hadrons
Quarks, gluons, and the strong interaction.
Heavy Flavors
Charm, beauty, top quark, and the tau lepton.
Weak Interaction and Vector Bosons
W and Z bosons. The Higgs boson.

Keywords

Elementary particle physics
High energy physics

Learning Prerequisites

Required courses

- Physics IV
- Quantum mechanics I

Important concepts to start the course

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Learning Outcomes

By the end of the course, the student must be able to:

- Explain the concepts covered in the course
- Apply correctly the concepts covered in the course
- Reason effectively using the concepts covered in the course
- Solve problems using the concepts covered in the course
- Distinguish correctly the relevant orders of magnitude in particle physics

Teaching methods

Ex cathedra and exercises in class

Assessment methods

Written exam

Supervision

Office hours	No
Assistant.e.s	Yes
Forum	Yes

Resources

Virtual desktop infrastructure (VDI)

No

Bibliography

See moodle

Notes/Handbook

Course handout and lecture slides

Moodle Link

- https://go.epfl.ch/PHYS-311

Prerequisite for

All particle physics courses at the Master's level