

## Elementary Particle Physics (C004224)

**Course size** *(nominal values; actual values may depend on programme)*

**Credits 4.0** **Study time 120 h**

**Course offerings and teaching methods in academic year 2025-2026**

|                |         |      |         |
|----------------|---------|------|---------|
| A (semester 2) | English | Gent | lecture |
|                |         |      | seminar |

**Lecturers in academic year 2025-2026**

|                     |      |                    |
|---------------------|------|--------------------|
| Dobur, Didar        | WE05 | lecturer-in-charge |
| Stachurska, Juliana | WE05 | co-lecturer        |

**Offered in the following programmes in 2025-2026** **crdts** **offering**

|                                                               |   |   |
|---------------------------------------------------------------|---|---|
| Bachelor of Science in Physics and Astronomy                  | 4 | A |
| Exchange programme Faculty of Sciences (bachelor's level)     | 4 | A |
| Preparatory Course Master of Science in Physics and Astronomy | 4 | A |
| Preparatory Course Master of Science in Physics and Astronomy | 4 | A |

**Teaching languages**

English

**Keywords**

Particle physics

**Position of the course**

This course unit belongs to the learning pathway "Structure of Matter" in the Bachelor program Physics and Astronomy.

An introduction in elementary particle physics is given.

**Contents**

- Preliminary notions
  - Reminders of relativistic kinematics
  - Collisions and decays of particles
  - Elementary particles and fundamental interactions
- Particle detectors and accelerators
  - Passage of radiation through matter
  - The sources of high-energy particles and accelerators
  - Particle detectors
- Nucleons, Leptons and mesons
  - The muon and the pion
  - Strange mesons and hyperons
  - The Dirac equation, positron and anti-proton
- Symmetries and conservation laws
- Hadrons
  - Resonances
  - Pseudovector and scalar mesons
  - The quark model
  - Mesons, Baryons, Charmed hadrons and the 3rd family
- Quantum electrodynamics (QED)
- Quantum Chromodynamics
- Weak Interaction
  - Helicity and chirality
  - Parity violation
  - Quark mixing

- CP violation and meson oscillation
- Brief description of Neutrino oscillations

#### **Initial competences**

Basics of quantum mechanics and special relativity

#### **Final competences**

- 1 Form the basis to be able to follow advanced courses in high energy particle physics in particular Subatomic physics II.
- 2 Have a consistent picture of the deepest structure of matter, in particular elementary particles in nature and the different interactions among them.
- 3 Symmetries and conservation of quantum numbers, get familiar with parity violation, CP, lepton, baryon numbers.
- 4 Ability to make connections between experimental results and theoretical predictions.

#### **Conditions for credit contract**

Access to this course unit via a credit contract is determined after successful competences assessment

#### **Conditions for exam contract**

This course unit cannot be taken via an exam contract

#### **Teaching methods**

Seminar, Lecture

#### **Study material**

Type: Handbook

Name: Particles and Nuclei: An Introduction to the Physical Concepts

Indicative price: Free or paid by faculty

Optional: no

Author : Povh, Rith, Scholz, Zetsche and Rodejohann

ISBN : 978-3-54079-367-0

Oldest Usable Edition : Seventh Edition

Online Available : Yes

Additional information: Available online:

<https://www.phenix.bnl.gov/WWW/publish/elke/EIC/BOOKs/ParticlesAndNuclei.pdf>

#### **References**

Introduction to Elementary Particle Physics , Alessandro Bettini, Cambridge 2nd

Edition

David Griffiths "Introduction to Elementary Particles" (Wiley VCH, 2nd edition 2008)

#### **Course content-related study coaching**

Students have individual access to the lecturer after the lectures. The lecturer is always reachable through e-mail.

#### **Assessment moments**

end-of-term and continuous assessment

#### **Examination methods in case of periodic assessment during the first examination period**

Oral assessment, Written assessment with open-ended questions

#### **Examination methods in case of periodic assessment during the second examination period**

Oral assessment, Written assessment with open-ended questions

#### **Examination methods in case of permanent assessment**

Assignment

#### **Possibilities of retake in case of permanent assessment**

examination during the second examination period is possible in modified form

#### **Extra information on the examination methods**

Written examination with open questions where the book can be used only for exercise questions, oral examination, assignment.

During the semester students will be assigned exercise homeworks, one or two times per semester.

#### **Calculation of the examination mark**

- Theory: 40%

- Exercises: 40%
- Homework assignment: 20%

Small deviations from the exact division are possible, depending on the difficulty of the questions in each category.