

# Course Specifications

Valid as from the academic year 2024-2025

# Elementary Particle Physics (C004224)

Course size	se size (nominal values; actual values may depend on programme)					
Credits 4.0	Study time 120 h					
Course offerings and	teaching methods in academic ye	ear 2024-2025				
A (semester 2)	English	English Gent		seminar		
			lecture			
Lecturers in academi	c year 2024-2025					
Stachurska, Juli	Stachurska, Juliana			lecturer-in-charge		
Dobur, Didar			WE05	co-lecturer		
Offered in the following programmes in 2024-2025				crdts	offering	
Bachelor of Science in Physics and Astronomy				4	А	
Exchange programme Faculty of Sciences (bachelor's level)				4	А	
Preparatory Course Master of Science in Physics and Astronomy				4	А	
Preparatory Course Master of Science in Physics and Astronomy				4	А	

# 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.