UNIVERSITEIT GENT

Studiefiche

Vanaf academiejaar 2024-2025

Subatomic Physics (C004502)

Cursusomvang *(nominale waarden; effectieve waarden kunnen verschillen per opleiding)*

Studiepunten 6.0 **Studietijd 180 u**

Aanbodsessies in academiejaar 2024-2025

A (semester 1) Engels Gent

Lesgevers in academiejaar 2024-2025

Page, Ben	WE05	Verantwoordelijk lesgever
Boone, Matthieu	WE05	Medelesgever
Dobur, Didar	WE05	Medelesgever
Jachowicz, Natalie	WE05	Medelesgever

Aangeboden in onderstaande opleidingen in 2024-2025	**stptn**	**aanbodsessie**
Educatieve Master of Science in de wetenschappen en technologie(afstudeerrichting fysica en sterrenkunde)	6	A
Master of Science in de fysica en de sterrenkunde	6	A
Master of Science in Physics and Astronomy	6	A
Uitwisselingsprogramma fysica en sterrenkunde (niveau master)	6	A

Onderwijstalen

Engels

Trefwoorden

Particle Physics, Nuclear Physics

Situering

This course builds on the courses 'Particle Physics' and 'Nuclear Physics' in the Bachelor of Physics and Astronomy. Several concepts that were introduced in these courses are studied in more depth. This course prepares for several elective courses in the field of particle physics, nuclear physics and medical physics.

Inhoud

Part 1 : Physics of nuclear, particle and medical instrumentation (2 weeks)
- Particle interactions with matter: interactions of heavy charged particles, electron/muon interactions, photon interactions, neutron interactions
- Radiation detection: general properties; detection mechanisms; detector types
- Accelerators and artificial radiation sources: acceleration of charged particles; X-ray tubes; synchrotron radiation

Part 2 : Particle Physics (7 weeks)
- The Dirac Equation and Spin& Helicity & Interaction by Particle Exchange
- Electron – Positron annihilation
- Particle detectors, detection techniques & accelerators (largely discussed in Lecture 1&2)
- Symmetries and the Quark Model & QCD and Colour
- Weak interaction and parity violation & Leptonic Weak Interactions
- Neutrino mixing and Neutrino Oscillations
- Quark mixing and CP Violation
- Electroweak Unification and tests of the Standard Model& The Higgs Boson (˜QFT. Phenom.)

Part 3 : Nuclear Physics (3 weeks)
- Nucleon-Nucleon interaction : nucleon-nucleon scattering ; general form of the NN interaction ; the deuteron ; EFT and the NN interaction
- Models of many-body nuclei and nuclear structure : from the NN force to the

nuclear mean field, shell model versus collective models ; beyond the mean field : long- and short-range correlations in the nucleus, meson-exchange currents
- Scattering from the nucleus and nuclear excitations : coherent - resonance region - quasi-elastic – resonance excitation and pion production – deep inelastic scattering and duality ; lepton scattering off the nucleus

Begincompetenties

The students master the basic principles of subatomic physics. They have a good working knowledge of quantum mechanics and special relativity.

Eindcompetenties

1 The students have a good working knowledge of the concepts of subatomic physics.
2 They can independently or as a team attack problems in this field. They
- are able to situate the position of subatomic physics in the description of the microscopic structure of matter
- explain the role of symmetry in the description of subatomic physics
- have a thorough knowledge of elementary particles
- explain various key phenomena in subatomic physics
- appreciate the structure of subatomic matter at different length and energy scales and observe the synergies and similarities between phenomena and processes at different scales
- are familiar with the description of leptonic scattering interactions with targets at different scales and why (leptonic) probes provide a powerful tool to study subatomic systems in scattering interactions
- apply the concepts mentioned above in problems at an intermediate level
- have a general overview of detection methods and accelerator systems and the physics underlying these systems

Creditcontractvoorwaarde

Toelating tot dit opleidingsonderdeel via creditcontract is mogelijk na gunstige beoordeling van de competenties

Examencontractvoorwaarde

Dit opleidingsonderdeel kan niet via examencontract gevolgd worden

Didactische werkvormen

Werkcollege, Hoorcollege

Toelichtingen bij de didactische werkvormen

Learning material: Lecture notes

Studiemateriaal

Type: Handouts

Naam: Cursusmateriaal
Richtprijs: Gratis of betaald door opleiding
Optioneel: nee
Bijkomende info: via Ufora beschikbaar

Referenties

- Knoll 'Radiaton detection and measurement' ; Lilley, 'Nuclear Physics : Principles and applications' ; Leroy and Rancoita, 'Principles of Radiation Interaction in Matter and Detection'
- Modern Particle Physics, Thomson, Cambridge ; Introduction to Elementary Particle Physics, Bettini, Cambridge, 2008 ; Introduction to high energy physics, Perkins, 4th ed., Cambridge ; Particle physics, Martin and Shaw, 2nd ed., Wiley ; Quarks and leptons, Halzen and Martin, Wiley ; Introduction to Elementary Particles, Griffiths, Wiley
- 'Foundations of nuclear and particle physics', T.W. Donnelly et al, Cambridge ; 'Subatomic Physics', Frauenfelder and Henley ; 'Nuclear Physics', Wong ; 'A modern Primer in Particle and Nuclear Physics' F. Terranova, Oxford

Vakinhoudelijke studiebegeleiding

The students can individually or in group request further explications in between or after lectures. The lecturer can always be reached by e-mail.

Evaluatiemomenten

periodegebonden en niet-periodegebonden evaluatie

Evaluatievormen bij periodegebonden evaluatie in de eerste examenperiode

Schriftelijke evaluatie met open vragen

Evaluatievormen bij periodegebonden evaluatie in de tweede examenperiode

Schriftelijke evaluatie met open vragen

Evaluatievormen bij niet-periodegebonden evaluatie

Schriftelijke evaluatie met open vragen

Tweede examenkans in geval van niet-periodegebonden evaluatie

Examen in de tweede examenperiode is mogelijk

Toelichtingen bij de evaluatievormen

The coursework consists of periodic problem sets (open book) and a final written examination which includes a written an oral exam part. The course grade is the weighted average of all homework (15% weight) and the written exam (85% weight).

Eindscoreberekening

Periodical (final exam) 85% + non-periodical (continuous assessment) 15%.
Small deviations from the exact division are possible, depending on the difficulty of the questions in each category.

Faciliteiten voor werkstudenten

Lecture slides & book