UNIVERSITY OF GOTHENBURG

DEPARTMENT OF PHYSICS

FYP204 Subatomic physics, 7.5 credits

Subatomär fysik, 7,5 högskolepoäng

First Cycle

Confirmation

This course syllabus was confirmed by Department of Physics on 2012-03-14 and was last revised on 2020-03-02 to be valid from 2020-03-02, spring semester of 2020.

Field of education: Science 100%
Department: Department of Physics

Position in the educational system

The course is included in Physics and Medical Physics programs and is also given as a standalone course.

The course can be part of the following programmes: 1) Bachelor of Science in Physics (N1FYS) and 2) Medical Physicist Programme (N1SJU)

Main field of studies	*Specialization*
Physics	G2F, First cycle, has at least 60 credits in first-cycle course/s as entry requirements

Entry requirements

For admission to the course, completed courses are required from the first three semesters of the Physics program as well as having completed the course FYP203 Quantum Physics A, or that the equivalent knowledge has been acquired in some other way.

Learning outcomes

On completion of the course, the student is expected to:

Knowledge and understanding

- have knowledge of the constituents and nuclear models of the atomic nucleus
- understand binding energies and interactions between particles
- have knowledge of strong, weak and electromagnetic interaction and radioactive decay
- have knowledge of nuclear reactions in nucleosynthesis and laboratory experiments
- understand fusion and fission reactions
- know about the standard model/quark model
- be familiar with different particles (baryons, mesons, leptons, antiparticles) and understand relativistic effects
- have knowledge of nuclear astrophysics
- be familiar with different experimental methods in the field

Competence and skills

- be able to calculate binding and decay energies
- on the basis of nuclear models be able to estimate the shape of nuclei and calculate energy levels
- be able to estimate/calculate lifetimes for atomic nuclei and particles
- on the basis of conservation laws be able to analyse/predict decay and/or reactions
- be able to apply quantum mechanics and special relativity theory in the subatomic world
- have ability to identify the physical background of nuclear physics applications
- have ability to qualitatively evaluate both risks of injuries and therapeutic effects of radioactive radiation and irradiation

Judgement and approach

- have obtained understanding of a reality that cannot described in classical physical terms, and which furthermore due to their small size cannot be observed by the human eye but is studied indirectly
- be able to evaluate scales with respect to size, energy etc in the subatomic world
- have obtained understanding in processes creating the elements and the connection between micro and macro cosmos

Course content

Concepts and nomenclature in nuclear physics. The need to introduce interactions beyond electromagnetic forces and gravity to explain the stability of atomic nuclei. Interaction mechanisms between nucleons with a treatment of the deuteron as a starting point. Nuclear models based on quantum mechanics. The statistical nature of

radioactive decay along with the mechanisms for alpha-, beta- and gamma-emission. The interaction of radioactive radiation with matter, including the effects on humans and other living organisms. Radiation detection methods. Various types of nuclear reactions as well as processes such as fission, fusion and energy production in the sun. Meson physics and particle physics; leptons and quarks, and their relations baryons and mesons. Nucleosynthesis and the formation of leptons, quarks and photons during the Big Bang.

Different aspects of the contents are treated in two sub-courses with separate assessment and examination.

Sub-courses

1. **Subatomic physics** *(Subatomär fysik),* 6 credits
   Grading scale: Pass with Distinction (VG), Pass (G) and Fail (U)
2. **Laboratory sessions** *(Laborationer),* 1.5 credits
   Grading scale: Pass (G) and Fail (U)

Form of teaching

Sub-course 1: Lectures and tutorials.
Sub-course 2: Three compulsory laboratory sessions.

Language of instruction: Swedish and English

Assessment

Part 1: written exam, 6.0 credits
Part 2: A pass grade (G) requires active participation in all laboratory sessions. Active participation is assessed on an individual basis by the responsible teacher present during the laboratory session.

Grades

The grading scale comprises: Pass with Distinction (VG), Pass (G) and Fail (U).
Pass (G) on the entire course requires Pass grades on both sub-course 1 and sub-course 2. Pass with Distinction on the entire course requires Pass with distinction on sub-course 1 and Pass on sub-course 2.

Course evaluation

A course evaluation should be arranged after the course has ended where all participating students are given the possibility to provide anonymous feedback via a course survey. The course responsible should, together with student representatives,

discuss and assess the completed survey. Meeting notes should afterwards be made available via the university learning platform.