SH2103 Subatomic Physics 7.5 credits

Subatomär fysik

This is a translation of the Swedish, legally binding, course syllabus.

Establishment

Course syllabus for SH2103 valid from Autumn 2010

Grading scale

A, B, C, D, E, FX, F

Education cycle

Second cycle

Main field of study

Physics

Specific prerequisites

Modern physics, SH1009 or equivalent.

Language of instruction

The language of instruction is specified in the course offering information in the course catalogue.

Intended learning outcomes

A main learning objective is that the student should be able to describe the basic building blocks of nature, as well as the forces and interactions on the scale of the atomic nucleus and elementary particles. The student should be able to give an account for some of the basic models used to explain phenomena on the subatomic scale. In addition, the student should be able to apply this knowledge for solving some basic problems in nuclear and particle physics.

To pass the course, the student must be able to:

- describe the basic parts and general attributes of the atomic nucleus.
- explain the origin of ionizing radiation (alpha, beta, gamma, etc) and solve basic problems involving radioactive decay and radiation.
- use the mass and binding energy of a nuclide to assess its stability against various decays.
- classify and describe different types of nuclear reactions, including fission and fusion.
- give an account for solutions to the shell model in different model potentials, explain the appearance of magic numbers, and give examples of collective excitations of the nucleus.
- use standard reference material (the nuclide chart and the table of isotopes) and apply the nuclear models for solving problems regarding excited states in nuclei and decay chains.
- explain how some of the the basic discoveries in nuclear and particle physics were made.
- critically assess advantages and limitations of different models on the subatomic scale.
- give an account of the nucleosynthesis of matter.
- give an account of the basic models describing the weak-, strong-, and electromagnetic interactions.
- describe the Standard Model, its particles and interactions.
- read and draw Feynman diagrams of basic particle interactions and decays.
- with the use of conservation laws determine if particle interactions and decays are possible.
- give an account of the basic particle interactions with matter.
- explain how to apply particle interactions with matter in the design of detector systems.
- explain how nuclei and elementary particles can be studied with the use of accelerators.
- give examples of and explain the origin of natural background radiation.
- give an account for the basic principles of the big bang model and the experimental evidence for it

Course contents

The course is focused on the physics of nature's building blocks and forces, on the subatomic scale. Basic models of the atomic nucleus, neutrons, protons, quarks, and leptons will be presented, including the Standard Model. Forces acting on the particles will be discussed, as well as force carriers. Binding energy and limits of stability as well as radioactive decay and radiation will be included. Feynman diagrams will be introduced to descibe e.g. decay of particles. The above parts are then applied to discuss the origin and nature of the universe, including the Big Bang, nucleosynthesis, stellar evolution, and dark matter. Two laboratory exercises will illustrate selected phenomena of the nucleus and of elementary particles in our surrounding environment.

Course literature

To be decided before course start.

Examination

- TEN1 - Examination, 6.5 credits, grading scale: A, B, C, D, E, FX, F
- LAB1 - Laboratory work, 1.0 credits, grading scale: P, F

Based on recommendation from KTH's coordinator for disabilities, the examiner will decide how to adapt an examination for students with documented disability.

The examiner may apply another examination format when re-examining individual students.

If the course is discontinued, students may request to be examined during the following two academic years.

Written exam: TEN1

Laboratory exercises with written reports: LAB1

Ethical approach

- All members of a group are responsible for the group's work.
- In any assessment, every student shall honestly disclose any help received and sources used.
- In an oral assessment, every student shall be able to present and answer questions about the entire assignment and solution.