Faculty of Science

FYSC14, Physics: Particle Physics, Cosmology and Accelerators, 7.5 credits

Fysik: Partikelfysik, kosmologi och acceleratorer, 7,5 högskolepoäng

First Cycle / Grundnivå

Details of approval

The syllabus was approved by Study programmes board, Faculty of Science on 2010-12-15 to be valid from 2010-12-15, spring semester 2011.

General Information

The course is a compulsory course for first-cycle studies for a scientific Bachelor's project in physics.

Language of instruction: English and Swedish

Main field of studies	*Depth of study relative to the degree requirements*
Physics	G2F, First cycle, has at least 60 credits in first-cycle course/s as entry requirements

Learning outcomes

The aim of the course is that students should have acquired the following knowledge and skills on completion of the course:

Knowledge and understanding:

On completion of the course, the student should be able to:

- Describe the structure of matter in terms of quarks and leptons.
- Describe the fundamental interactions in the standard model
- Account for the basic elements in the theories of the strong, electromagnetic and weak interactions
- Account for the basic observations that have led to the standard model
- Be oriented about predicted phenomena beyond the standard model and the current research area in high-energy physics

- Account for the development of universes, above all from the a particle physics point of view
- Account for different particles interaction with matter in detectors
- Account for how one identifies particles and decides their momentum.
- Account for secondary jets of neutrons, muons, pions and photons at t. ESS and at most
- Be oriented about accelerators usage for material studies and medical applications

Skills and abilities:

On completion of the course, the student should be able to:

- illustrate reactions and the decays with Feynman diagram
- Make quantitative calculations on reactions and decays with relativistic kinematics
- Use the method with the four momentum for quantitative kinematic calculations
- Apply conservation laws on reactions and decays
- Connect up an electronic detection system for of muons from the cosmic radiation and measure the decay time.
- By means of MATLAB determine the muon lifetime from the measured values and to generalise lifetime measurements on time scales for weak decays.
- Calculate charged particles movement in electric and magnetic fields

Judgement and approach:

On completion of the course, the student should be able to:

- Evaluate the natural sciences image of the structure of matter based on experiments, modeling and theories.
- Evaluate the natural sciences image of the structure and development of the universe based on observations, modeling and theories.

Course content

The course consists of two parts, particle physics and cosmology, 6 credits (credits) and accelerators and their usage, 1.5 credits.

The student is given an overview of elementary particles and their interaction. Leptons, quarks and composite particles are discussed, as well as the electromagnetic, weak and strong force and its exchange particles. Reactions and decays are represented with Feynman diagram. Especially, the standard model with the electroweak interaction and quantum chromodynamics of the particle physics are introduced. The Higgs-mechanism is introduced and possible theories beyond the standard model are discussed together with an orientation in the research area of high-energy physics. The expansion and development of universe and the cosmology relation to particle physics is discussed. The most important unanswered questions in the cosmology, such as dark matter and the asymmetry between matter and antimatter is introduced.

Methods to identify and measure momentum of particles are explained in the contect of high energy physics experiments. Experimental studies of subatomic systems require particle beams with high energy. Particle accelerators are also used in the

society in general, e.g., for medical applications and for material studies in physics, pharmacology, biology, chemistry. The principles of acceleration in mainly synchrotrons and linear accelerators and storage rings are explained. Examples are taken from the front line of the subatomic physics, LHC at CERN, and from the current material studies at MAX and ESS in Lund In relation to MAX and ESS the generation of secondary beams of photons and neutrons are studied.

Course design

The teaching consists of lectures, laboratory session, calculation exercises and study visit. Participation in the laboratory session and accompanying instructions is compulsory. Participation in study visits is compulsory. Study visit can be associated with some costs for the student but can be substituted by written project.

Assessment

Examination takes place with oral test and with written assignments which, when necessary, can be supplemented by oral presentation of the same,e.g. when the student has not reached minimum number of points to pass. Laboratory session is presented with written laboratory report that is assessed together with the laboratory carrying-out. Study visits are presented with written report that constitutes part of examination. Students who do not pass the regular exam are offered a re-examination shortly after the regular exam.

Subcourses that are part of this course can be found in an appendix at the end of this document.

Grades

Marking scale: Fail, Pass, Pass with distinction.
To pass the entire course, passed oral test, passed written assignments, passed laboratory session with report, presentation of study visit and participation in all compulsory parts are required. To receive the grade Pass with distinction, the material should be submitted within stated period

The final grade is determined by the results in the different parts of the examination.

Entry requirements

For admission to the course, knowledge equivalent to FYSA11 is required, General physics, 30 credits and FYSA21, Scientific thought tools, 30 credits.

Further information

The course can not be counted into higher education qualification in Physics together with FYSA31 Modern physics, 30 credits.

Subcourses in FYSC14, Physics: Particle Physics, Cosmology and Accelerators

Applies from V11

1001 Oral Exam, 5,0 hp
Grading scale: Fail, Pass, Pass with distinction
1002 Laboratory Exercises and Projects, 2,5 hp
Grading scale: Fail, Pass, Pass with distinction
1003 Excursion, 0,0 hp
Grading scale: Fail, Pass