FSH3306 Detection Techniques for Nuclear and Particle Physics 8.0 credits

Detektorteknik för kärn- och partikelfysik

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

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

Establishment

Course syllabus for FSH3306 valid from Autumn 2009

Grading scale

Education cycle

Third cycle

Specific prerequisites

Enrolled as PhD student

Language of instruction

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

Intended learning outcomes

- The interaction of electromagnetic and particle radiation with matter
- Energy loss mechanisms and spectrum formation. Measurement statistics.
- Basic principles of detectors for ionizing radiation
- Semiconductor detectors (and ionization chambers)
- Scintillation detectors, photomultipliers and photodiodes
- Gaseous detectors
- Position sensitive detectors
- Detectors for weakly ionizing radiation
- Detector systems for particle tracking and calorimetry
- High-resolution gamma-ray detector systems
- Monte Carlo simulations as a tool for developing and understanding radiation detectors
- Signal formation, electronic noise and optimization of signal-to-noise ratio

Course contents

The course aims to provide the students with an understanding of basic radiation detection techniques for nuclear and particle physics and their applications in other fields of science, medicine and industry. After completion of the course the student shall be able to:

- Describe the basic interaction mechanisms relevant for radiation detectors and explain their importance for detecting various types of ionizing radiation at different energies.
- Describe the properties of the most common types of detector materials, the working principles behind detectors based on these materials and their characteristic properties with respect to energy resolution, efficiency etc.
- Apply the knowledge about radiation interactions and detector principles to choose the most suitable type of detector for a given detection task.
- Select the appropriate electronics building blocks needed for a certain detector system and explain their function.
- Describe common sources of noise in radiation detection, their origin and how they can be minimized.
- Explain the limiting factors to the energy and time resolution of a detector system.
- Use the standard Monte Carlo simulation package GEANT4 for understanding the performance of radiation detectors.
- Design a radiation detection system, including its basic electronics building blocks, and use it in the laboratory.
- Compile information from own work and from the scientific literature into a written report and an oral presentation.

Examination

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.

Examination by oral or written exam and project report.

Other requirements for final grade

Passed on oral or written exam and project report.

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.