SH2306 Experimentell teknik för kärn- och partikelfysik 8,0 hp

Experimental Techniques for Nuclear and Particle Physics

Fastställande

Betygsskala

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

Utbildningsnivå

Avancerad nivå

Huvudområden

Fysik, Teknisk fysik

Särskild behörighet

Recommended prerequisites: Previous knowledge of basic atomic, nuclear, particle and solid state physics corresponding to 5A1247/SH1009 Modern Physics. The course is intended for students that have completed around 3 years of physics or engineering physics (i.e. are at the Master level) or are engaged in studies at the graduate level.

Undervisningsspråk

Undervisningsspråk anges i kurstillfällesinformationen i kurs- och programkatalogen.

Lärandemål

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.
- 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.

Kursinnehåll

- 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
- Signal Formation, Electronic noise and Optimization of Signal-to-Noise Ratio
- Pulse Processing Electronics, Amplification, Pulse Shaping and Digitization
- Timing and Lifetime Measurements
- Development of a Detector System Concept
- Overview of Applications of Nuclear and Particle Physics
- Radiation Detectors for Medical Imaging

- Nuclear Techniques for Material Analysis
- Systems for Nuclear Safeguards, Public Security and Environmental Monitoring

Kurslitteratur

Glenn F. Knoll, Radiation Detection and Measurement (Wiley)

W.R. Leo; Techniques for Nuclear and Particle Physics Experiments (Springer Verlag)

Examination

- TEN1 - Tentamen, 6,0 hp, betygsskala: A, B, C, D, E, FX, F
- LAB1 - Laborationsuppgift, 2,0 hp, betygsskala: P, F

Examinator beslutar, baserat på rekommendation från KTH:s handläggare av stöd till studenter med funktionsnedsättning, om eventuell anpassad examination för studenter med dokumenterad, varaktig funktionsnedsättning.

Examinator får medge annan examinationsform vid omexamination av enstaka studenter.

När kurs inte längre ges har student möjlighet att examineras under ytterligare två läsår.

Övriga krav för slutbetyg

One written examination (TEN1; 6 university credits).
Laboratory project work with a written report and an oral presentation (LAB1; 2 university credits).

Etiskt förhållningssätt

- Vid grupparbete har alla i gruppen ansvar för gruppens arbete.
- Vid examination ska varje student ärligt redovisa hjälp som erhållits och källor som använts.
- Vid muntlig examination ska varje student kunna redogöra för hela uppgiften och hela lösningen.