Course syllabus

Tillämpad kärnfysik och acceleratorer
Applied Nuclear Physics and Accelerators

FAFF11, 5 credits, G2 (First Cycle)

Valid for: 2023/24
Faculty: Faculty of Engineering, LTH
Decided by: PLED N
Date of Decision: 2023-04-17

General Information

Main field: Technology.
Compulsory for: F2
Language of instruction: The course will be given in Swedish

Aim

The course provides a broad orientation about fundamental and applied nuclear physics, while at the same time including detailed studies of selected topics, e.g. natural and artificial radioactivity. Particular aims are understanding of nuclear physics concepts and phenomena related to abundance, measurement and use of ionizing radiation in society, including phenomena of importance for the energy supply. The course also gives a broad orientation about the principles of different types of accelerators and their application in research, medicine and industry. The course aims to stimulate the interest for further studies in the subject. By highlighting important technical applications, the course aims at illustrating the mutual dependence between technology and basic science.

Learning outcomes

Knowledge and understanding
For a passing grade the student must

- be able to describe the structure of atomic nuclei

- be able to describe different types of radiation, and the interaction between radiation and matter, including human tissue
- be able to describe the biological effects of ionizing radiation
- be able to describe the principles of radiation protection against different types of ionizing radiation
- understand how different radiation detectors operate
- have gained insight about how phenomena related to nuclear physics are of importance to the energy supply
- be able to describe the radiation environment of our society
- be able to describe a few different accelerator types that are used within research, industry and health care
- be able to describe the technology of accelerators, in particular the MAX IV and ESS facilities
- have received a deepened insight into the close and mutual interaction between technology and natural science, and to be aware of and be able to describe typical technical applications of atomic and nuclear physics.

Competences and skills
For a passing grade the student must

- be able to assess, handle and limit radiation risks that may appear in the working life
- be able to choose measurement device for detection of various types of ionizing radiation
- be able to treat measurement data with statistical methods
- be able to apply methods for analysis and estimates in physical problems within the area
- have developed his/her ability to plan, perform and analyse experiments and to present scientific results in writing
- have improved skills for written and oral presentations

Contents

Size, structure and mass of the atomic nucleus. Nuclear models. Strong interaction. Radioactive decay, emission of alpha, beta and gamma radiation. Nuclear reactions. Interaction of ionizing radiation with matter. Biological effects and radiation protection. Nuclear measurement instrumentation. Neutron physics and spallation sources. Accelerators. Fission and fusion. Reactor physics, medical applications, radioactivity in the environment. Methods for analysis and estimates in physical problems within the area.

Examination details

Grading scale: TH - (U,3,4,5) - (Fail, Three, Four, Five)
Assessment: Written exam, passed laboratory work and corresponding written reports.

The examiner, in consultation with Disability Support Services, may deviate from the regular form of examination in order to provide a permanently disabled student with a form of examination equivalent to that of a student without a disability.

Parts
Code: 0121. **Name:** Laboratory Work.
Credits: 2. **Grading scale:** UG. **Assessment:** Approved written laboratory report after each laboratory exercise. **Contents:** Experimental work as laboratory exercises in small groups. Preparation before and reporting after each exercise is mandatory.
Code: 0221. **Name:** Theoretical Part.
Credits: 3. **Grading scale:** TH. **Assessment:** Written examination.

Admission

Assumed prior knowledge: FMSF80 Mathematical statistics, basic course, FAFA55 Concepts in Quantum Physics.
The number of participants is limited to: No
The course overlaps following course/s: FAF270, FAFF10

Reading list

- Lilley, J. S. Nuclear physics: principles and applications (Chichester: Wiley, cop. 2001), ISBN 978-0471979364.

Contact and other information

Course coordinator: Kristina Eriksson Stenström, kristina.stenstrom@nuclear.lu.se
Further information: Some elements may be taught and assessed in English. This includes a maximum of 1.5 hp, in the form of laboratory sessions or written assignments.