

Course syllabus

Modern röntgenfysik - diffraktion och avbildning Modern X-ray Physics - Diffraction and Imaging

EXTQ45, 7,5 credits, A (Second Cycle)

Valid for: 2023/24

Faculty: Faculty of Engineering, LTH

Decided by: PLED N

Date of Decision: 2023-04-17

General Information

Elective for: F4, F4-axn, MFOT1, N4

Language of instruction: The course will be given in English

Aim

The course provides a substantial introduction to the interaction of X-rays with matter and its applications, with an emphasis on diffraction and imaging.

Learning outcomes

Knowledge and understanding

For a passing grade the student must

- be able to explain the interactions of X-rays with matter on an atomic scale
- be able to describe the principles behind X-ray detectors and X-ray optics – and common implementations of these
- be able to explain X-ray scattering in non-crystalline and crystalline materials
- be able to describe the principles for diffraction, and the relation between the direct and reciprocal lattices
- be able to explain how the interaction of X-rays with matter can be utilised for various imaging methods.

Competences and skills

For a passing grade the student must

- be able to calculate absorption and scattering of X-rays in matter
- be able to integrate knowledge acquired from this course in a scientific discussion.

Contents

- X-ray sources
- Scattering and absorption
- Refraction and reflection from interfaces, refractive index
- X-ray optics
- Scattering from non-crystalline material, small angle X-ray scattering (SAXS).
- Scattering from crystalline material: X-ray diffraction (XRD), Fourier transform, reciprocal lattice, Ewald's sphere.
- Scanning X-ray diffraction, surface X-ray diffraction
- Photoelectric absorption, X-ray absorption spectroscopy (XAS/EXAFS)
- X-ray fluorescence (XRF), emission spectroscopy, scanning X-ray fluorescence spectroscopy (XRF)
- X-ray detectors
- X-ray imaging: scanning transmission, tomography
- Coherent X-ray imaging: phase contrast, phase retrieval, holography, ptychography

Examination details

Grading scale: TH - (U,3,4,5) - (Fail, Three, Four, Five)

Assessment: The course consists of lectures, laboratory sessions, Group exercises, and project work. Participation is compulsory in laboratory sessions, project work and associated course components. The assessment is based on a written exam, written assignments, evaluation of the project report and through the compulsory course components.

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.

Admission

Assumed prior knowledge: Basic atomic physics, electromagnetism (especially Maxwell's equations, vector analysis and Fourier transforms) and optics.

The number of participants is limited to: No

The course might be cancelled: If the number of applicants is less than 5.

The course overlaps following course/s: FYST51

Reading list

- Als-Nielsen, J. & McMorrow, D. : Elements of modern X-ray physics, 2nd ed. Wiley, 2011. Available online:
<https://onlinelibrary.wiley.com/doi/book/10.1002/9781119998365>.

Contact and other information

Course coordinator: Jesper Wallentin, jesper.wallentin@sljus.lu.se

Course homepage: <https://canvas.education.lu.se/courses/1997/assignments/syllabus>

Further information: The course is given by the Faculty of Science and does not follow the study period structure.