PHYS-640

Neutron and X-ray Scattering of Quantum Materials

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Cursus	Sem.	Type
Ing.-phys	MA1, MA3	Opt.
Nuclear engineering	MA1	Opt.
Physicien	MA1, MA3	Opt.
Physics		Opt.

Language of teaching	English
Credits	4
Session	Winter
Semester	Fall
Exam	Oral
Workload	120h
Weeks	
Hours	**56 weekly**
Courses	28 weekly
Exercises	28 weekly
Number of positions	

Remark

Next time: Fall

Summary

NNeutron and X-ray scattering are some of the most powerful and versatile experimental methods to study the structure and dynamics of materials on the atomic scale. This course covers basic theory, instrumentation and scientific applications of these experimental methods.

Content

Neutron scattering is one of the most powerful and versatile experimental methods to study the structure and dynamics of materials on the nanometer scale. Its application spans from crystaline matter to bio-materials and engineering, including fields like magnetism and superconductivity. Similar to the vast possibilities with X-rays at synchrotron facilities, neutron scattering is a so-called large scale facility technique with neutron facilities among other at PSI in Switzerland, ILL in Grenoble and a new joint European Spallation Source under construction in Sweden.

The course provides an introduction to the versatile experimental techniques of neutron scattering and covers the following aspects:

1. Theory of the neutron scattering cross section
2. Neutron sources and neutron instrumentation
3. Neutron imaging, neutron reflectivity and neutron small angle scattering
4. Neutron diffraction, crystal structures
5. Inelastic neutron scattering, phonons
6. Magnetic neutron scattering, magnetic structures
7. Inelastic magnetic neutron scattering, magnetic dynamics
8. Resonant Inelastic X-ray Scattering (RIXS) a complementary technique

The course contain lectures and exercise sessions. Exercise sessions will contain deriving relevant formulas, monte-carlo simulation of neutron scattering experiments, and discussion of representative scientific articles using neutron scattering. We use partially flip-class room format for interactive learning.

Keywords

Neutron Scattering, X-ray spectroscopy, diffraction, crystal structures, lattice vibrations, phonons, magnetism, spin waves, magnons, neutron imaging

Learning Prerequisites

Required courses

Solid State Physics 1 and 2; Basic quantum mechanics

Learning Outcomes

By the end of the course, the student must be able to:

- Plan, predict and interpret neutron scattering experiments
- Read and evaluate articles containing neutron scattering results

Assessment methods

Oral

Resources

Bibliography

Lecture notes, example articles

Websites

- http://Lab web page: lqm.epfl.ch

Moodle Link

- https://go.epfl.ch/PHYS-640