PHYS-640

Neutron and X-ray Scattering of Quantum Materials

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

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

Frequency

Every year

Remark

Next time: Fall

Summary

Neutron scattering is one of the most powerful and versatile experimental methods to study the structure and dynamics of materials on the nanometer scale. This course covers basic theory, instrumentation and scientific applications.

Content

The application of the neutron scattering 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.

The course is given every second year, alternating with a course about magnetism in solids.

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

Expected student activities

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

Resources

Bibliography

Lecture notes, example articles

Websites

- http://lqm.epfl.ch