

PSI Masterschool 2017

Introduction photons, neutrons and muons for materials characterization

Lectures description

Room OSGA/UG05

Monday, Sept. 4th

8:30 - 9:15 - *Frithjof Nolting*

Overview of the three large scale facilities. Introduction to the facilities. Science examples of application. Presentation of the program of the two weeks.

9:30 - 10:15 - *Laura Heyderman*

Interaction of photons with matter. Electromagnetic Spectrum. Cross sections. Resonant events.

10:45 - 11:30 - *Laura Heyderman*

Introduction to the synchrotron and free electron laser operation. Radiation properties and production. Energy spectrum and polarization. Types of sources.

11:45 - 12:30 - *Laura Heyderman*

Synchrotron beamlines: optics, monochromators, detectors.

Tuesday, Sept. 5th

8:30 - 9:15 - *Michel Kenzelmann*

Introduction neutron properties, neutron sources, neutron detection, neutron optics.

9:30 - 10:15 - *Michel Kenzelmann*

Neutron scattering length, cross sections, form factors, scattering correlations functions, simple neutron scattering instruments.

10:45 - 11:30 - *Laura Heyderman*

Crystal symmetry, reciprocal lattice, Bragg's law, structure factors.

11:45 - 12:30 - *Michel Kenzelmann*

Diffraction instruments, powder and single crystal (for both neutrons and X-rays), vortex lattice and skyrmions as an example.

Wednesday, Sept. 6th

8:30 - 9:15 - *Frithjof Nolting*

Introduction to electronic and magnetic correlation.

9:30 - 10:15 - *Frithjof Nolting*

Polarization dependent x-ray absorption.

10:45 - 11:30 - *Frithjof Nolting*

X-ray microscopy.

11:45 - 12:30 - *Michel Kenzelmann*

Magnetic structures, cross-sections, types of instruments, short introduction into polarized neutron diffraction.

Thursday, Sept. 7th

8:30 - 9:15 - *Michel Kenzelmann*

Neutron spectroscopy, cross-sections and correlation functions phonons, triple-axis neutron instruments.

9:30 - 10:15 - *Michel Kenzelmann*

Inelastic magnetic neutron scattering, magnons, quantum excitations.

10:45 - 11:30 - *Frithjof Nolting*

Photoemission.

11:45 - 12:30 - *Frithjof Nolting*

Time-resolved X-ray experiments - X-ray pump and probe.

Friday, Sept. 8th

8:30 - 9:15 - *Alex Amato*

What is a muon; What are its relevant properties for solid state/material physicist; How does one produce muons (differences between cosmic and "lab" muons); What kind of muon beams are available (high-energy muons, surface muons and low-energy muons) and their range in matter.

9:30 - 10:15 - *Alex Amato*

What are the basics of the muSR technique; Description of the Zero-Field, Transverse Field and Longitudinal-Field techniques and what kind of information one can extract from them; Difference between LEM and bulk muSR; Short description of the hardware.

10:45 - 11:30 - *Alex Amato*

Application of muSR to study magnetism; Determination of the order parameter and volume fractions; Local field at muon site; Knight shift studies; Examples from LEM and bulk muSR.

11:45 - 12:30 - *Alex Amato*

Application of muSR to study superconducting state; Determination of the absolute value of the penetration depth (and hence superfluid density) from vortex state and/or Meissner state; Determination of the superconducting gap topology; Examples; Interplay magnetism/SC.

Experimental part

Each student will be able to choose a topic. Each topic includes two experiments, each in a different large scale facility. The experiments are performed in groups.

The students should give an oral presentation about one of the experiments. Each experiment should be presented once.

The topics and experiment list will become available around May/2017.

Tuesday, Sept. 12th, 8:30 - 12:00

Lectures of introduction to experiments I and II.

Tuesday, Sept. 12th, 13:30 - Wednesday, Sept. 13th, 12:30

Experiment I

Wednesday, Sept. 13th, 13:30 - Thursday, Sept. 14th, 12:30

Experiment II

Thursday, Sept. 14th, 13:30 - 17:00

Time for the students to prepare their oral presentation.

Friday, Sept. 15th, 8:30 - 12:40

Oral presentations by the student groups about the experiments.