TUT 1: Physics with Neutrons – From Proteins via Polymer Thin Films to Spin Waves (CPP)

New neutron sources (FRM II, ESS, SNS) combined with advanced instrumentation enable the detailed characterization of structural as well as dynamic properties of hard and soft condensed matter. The tutorial covers a few of these methods: Small-angle neutron scattering allows one to investigate mesoscopic structures, e.g. in material and life science. Neutron reflectometry and grazing incidence small angle neutron scattering are used to reveal magnetic structures in thin films and lateral structures at interfaces, for instance. Neutron spectroscopy enables, among others, the investigation of magnetic excitations and is complementary to laboratory based spectroscopy methods.

Organization/Chair: Christine M. Papadakis (TU München)

Time: Sunday 16:00–18:30 Location: HSZ 403

Tutorial TUT 1.1 Sun 16:00 HSZ 403

Neutrons as a sensitive tool to investigate nano- and mesostructured materials — •Stephan Förster — University of Bayreuth, Fakultät für Chemie

Neutrons can be similarly used as x-rays to investigate the structure of nano- and mesoscale synthetic and biological materials. Since, compared to photons, neutrons posses a spin, penetrate deeper into materials, and because the neutron-scattering cross-sections can vary strongly for different isotopes of the same element, they are a much more sensitive and versatile tool.

In the tutorial the basic experiments that can be performed with neutrons, in particular neutron scattering, are described and a number of examples from material and life science are given for illustration. The tutorial also includes practical hints for the application of beam time at neutron facilities.

Tutorial TUT 1.2 Sun 16:45 HSZ 403

Reflectivity and GISAS — •Roland Steitz — Helmholtz-Zentrum Berlin für Materialien und Energie, Berlin, Germany

Current problems in soft and hard matter science often require insight on the nanometer scale. In this contribution we show how surface sensitive scattering of neutrons, namely neutron reflectivity (NR) and grazing incidence small angle neutron scattering (GISANS) can be utilized to reveal details on thin films and stratified systems at solid-gas and solid-liquid interfaces. The first chapter provides a brief revision of the experimental techniques and underlying principles. Successive paragraphs deal with selected examples highlighting various aspects of experimental systems under study. Paragraph two examines polymer films at solid-gas interfaces, paragraph three addresses immobilisation of a protein at solid-liquid interfaces, paragraph four investigates the structure of the boundary of a hydrophobic polymer film and its adjacent water phase. The last two paragraphs concern laterally structured systems at interfaces and magnetic thin films, respectively.

It is noted that in particular neutrons penetrate deeply into matter, which makes them most suitable for studies of buried interfaces. In addition, investigations with neutrons benefit from the negligible impact of neutrons on the sample, i.e. there is no radiation damage, and as long as soft matter samples are considered neutrons can be used to highlight defined areas of interest by partial deuteration of the sample.

15 min. break

Tutorial TUT 1.3 Sun 17:45 HSZ 403

Neutron spectroscopy on solids — •Astrid Schneidewind — Helmholtz-Zentrum Berlin für Materialien und Energie

Neutron scattering is an outstanding and often a unique technique to study the dynamic properties of solids on an atomic scale. The tutorial will give an overview about the opportunities and the constraints of the method. Coming from the understanding of the properties of the neutron and the lattice, the nuclear and magnetic cross-sections for the interaction of the neutron with the lattice will be shown. Typical problems and the results of the required measurements will be presented and used to illustrate the aspects of the different techniques, with focus on three axis spectroscopy and time-of-flight methods. The specific role of neutron scattering in studies on magnetism will be accentuated. Finally, the complementarities to other methods as Raman and infrared spectroscopy, NMR and X-ray scattering will be pointed out.