The IFF Spring School & Scattering Methods in Jülich

The IFF Spring Schools were first brought into being in 1970 by the Jülich “Institute of Solid State Research” (IFF). Since then, the schools have made it possible for students and young scientists to gain a two-week insight into a current topic related to condensed matter physics. In 2011, IFF was dissolved as part of a restructuring process within Forschungszentrum Jülich, and new institutes, namely the “Peter Grünberg Institute” (PGI), the “Jülich Centre for Neutron Science” (JCNS) and the “Institute of Complex Systems” (ICS) were established. Together with the “Institute for Advanced Simulation” (IAS), the three institutes will continue to organize the IFF Spring Schools. The 43rd Spring School 2012 is organized jointly by ICS/1 JCNS/1 “Neutron Scattering” and PGI/4 JCNS/2 “Scattering Methods”.

The Institute for Neutron Scattering conducts neutron research, focusing mainly on soft matter. This term is used to indicate materials which respond strongly to weak forces. Typical examples are rubber materials and emulsions. In addition to their structure, the dynamics of these systems are also of interest. Neutron scattering allows us to investigate both of these aspects simultaneously. The institute has modern chemical laboratories at its disposal in order to produce or alter soft matter. As well as neutron scattering instruments, we make use of various standard methods in order to study and characterize soft matter.

At the Institute for Scattering Methods, work focuses on the investigation of structural and magnetic orders, fluctuations and excitations in complex or nanostructured magnetic systems and highly correlated electron systems with the aid of the most advanced synchrotron X-ray and neutron scattering methods. Our aim is to relate this microscopic information to macroscopic physical properties and functionalities. The systems being investigated have huge potential for future applications in information technology. A further aspect of our work lies in preparing samples and sample characterization.

The development of novel scattering techniques and the construction and continuous improvement of instruments on large scale devices are the main focal points of the work of both institutes that together make up the “Jülich Centre for Neutron Science”. JCNS operates neutron scattering instruments at leading facilities in Europe and the USA, and makes them accessible to external users via a peer-review system.

Scientific Committee (in alphabetic order)

Prof. Dr. Manuel Angst
Prof. Dr. Thomas Brückel
Prof. Dr. Dieter Richter
Dr. Reiner Zorn

Organization

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Registration and Further Information

www.iff-springschool.de

The lecture programme, travelling information, and participant card will be sent in due course to all registered participants.

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Overview

Most of what we know about the structure and dynamics of condensed matter systems on an atomic length- and time-scale stems from X-ray and neutron scattering. The IFF Spring School 2012 comes timely to the centennial anniversary of the discovery of X-ray scattering from single crystals by Max von Laue, Walter Friedrich and Paul Knipping in 1912. Their breakthrough discovery, awarded the Noble prize in 1914, proved both the wave nature of X-rays and the microscopic structure of crystals as being composed of periodic arrangements of atoms. Most of our knowledge on the atomic arrangement in crystalline and amorphous matter is based on the work following Max von Laue employing laboratory sources for X-ray crystallography. With the advent of research reactors 40 years later, neutron scattering came into play with its alternative mechanism and sensitivity to magnetism and collective excitations. Again the Noble prize was awarded to the two pioneers of neutron diffraction and inelastic scattering, Clifford Shull and Bertram Brockhouse, in 1994.

Currently, scattering investigations on condensed matter and life-science systems are an extremely rapidly developing field at synchrotron radiation sources, free electron lasers, neutron research reactors and spallation sources. The unique properties of both radiations, synchrotron and neutron, enable ground-breaking research in a very broad range of research topics in physics, chemistry, life sciences, geoscience, materials science and engineering: The range of materials, structures, phenomena and processes, which can be studied, is nearly unlimited. Experimental methods have been developed that span an incredible range of length- and timescales from picometers to meters and from femtoseconds to hours. Doing experiments at these large-scale facilities is an especially exciting aspect of research for young scientists, who not only obtain unique microscopic information on structure and dynamics of matter, but from the start are familiarised with cutting-edge technology and work in international collaborations. With the projects of the European X-Ray Free Electron Laser XFEL located at DESY (Hamburg) and the European Spallation Source ESS in Lund, the two world-leading pulsed X-ray and neutron sources will be operated in Europe. Together with the large network of national and international sources, these will provide excellent working conditions for users from universities, research organisations and industry.

Scattering methods employed at these sources are ideally suited to provide essential and unique contributions to the grand challenges facing modern society, such as energy supply, health, environment, transport, and information technology. To this end methods and instrumentation are continuously being further refined. This interplay between state-of-the-art method development and modern applications leads to an enormous dynamics of the research field.

Programme

The IFF Spring School 2012 will provide a solid introduction to the basics of scattering methods, starting from the interaction processes of X-rays and neutrons with matter via scattering theory and the application of correlation functions. An overview will be given of our current understanding of the structure of crystals and complex fluids, the dynamics of disordered systems and large molecules, and the collective excitations in crystalline matter. Building on this firm foundation, we will then proceed to introduce sources and instrumentation, present-day synchrotron-radiation sources and reactor-based neutron sources as well as modern and future pulsed sources, such as free electron lasers and neutron spallation sources. The two European flagship projects, XFEL and ESS, will be highlighted. Out of the enormous range of modern scattering techniques, some of the most advanced will be presented in detail. In this block, we will focus on techniques applicable to topical investigation, such as nanostructures, biological or correlated-electron systems. To prepare students for research at these future sources, innovative scattering techniques at pulsed spallation sources or free electron lasers will be introduced. Examples of topical applications in various fields of science will allow the students to connect what they have learned to their own research. We will point out the application of scattering methods for the grand challenges in information technology, energy materials and life sciences. The course will be rounded off by a comparison of scattering methods with complementary techniques, such as real space imaging.

Topics of the lectures include:
- Interaction of X-rays, neutrons and electrons with matter,
- Scattering theory and correlation functions,
- Collective excitations in crystalline matter,
- Dynamics of large molecules,
- Sources and instrumentation for synchrotron and neutron radiation,
- The European projects free electron laser XFEL and the spallation source ESS,
- Innovative scattering techniques at these future sources,
- Application of scattering techniques to study superconductivity, polymer dynamics, nanostructures, protein crystallography, energy materials, ...
- Complementary techniques.

The IFF Spring School is organised in close collaboration with universities, research institutions, and industry. The school offers about 45 hours of lectures plus discussions as well as the opportunity to visit the participating institutes at the Forschungszentrum Jülich. All lectures will be given in English. Each registered participant will be given a copy of the lecture notes (in English), which contain all the material presented during the school.

General Information

Venue: The IFF Spring School will take place at the Auditorium of the Forschungszentrum Jülich March 05 - 16, 2012.

Participation: Participants are expected to have a basic knowledge of condensed matter and/or life sciences.

Registration Deadline

All participants are asked to register via internet at the web-page www.iff-springschool.de before December 09, 2011.

Travel Information

There will be a shuttle service, taking participants to the Forschungszentrum Jülich in the morning and back to their accommodation after the lectures are concluded. The transfer will be free for all registered participants.

Accommodation, Lunch, and Dinner

Low-cost accommodation will be arranged at the youth hostel in Aachen. The accommodation fee of 350 EUR includes breakfast and dinner. Lunch will be provided at the Forschungszentrum Jülich from Monday to Friday.

Arrival: Sunday, March 04, 2012
Begin of lectures: Monday, March 05, 2012
Departure: Friday afternoon, March 16, 2012

Undergraduate students, i.e. students before finishing their diploma or master degree, can apply for financial support from the Forschungszentrum Jülich to cover part of the accommodation costs. To qualify for this support, a valid proof of the Student Status must be supplied. Accommodation for participants from nearby universities can only be provided if there are still places available after the registration deadline.

Payment and Cancellation Policy

Please transfer the accommodation fee to the following account after having received our invoice. Bank: Sparkasse Düren – Owner: Forschungszentrum Jülich – Account No.: 337709 – Bank Code: 395 501 10 – for international transfer: Swift Code (BIC) SDUEDE33XXX and IBAN: DE14 3955 0110 0000 3377 09 – Reference: “Reference Number, SS12” and “participant’s name”. Cancellations must be received before 20th of February, otherwise a payment of € 50.00 is required.

Hotels in Aachen and Jülich

If you would prefer to stay in a hotel in Aachen or Jülich on your own costs, please contact springschool@fz-juelich.de for an accommodation list.