

THE IFF SPRING SCHOOL & SCATTERING METHODS IN JÜLICH

The annual IFF Spring School has a long-standing tradition dating back to 1969 when the *Institut für Festkörperforschung* (IFF) was founded. Since then, the Schools have made it possible for students and young researchers to gain a two-week insight into current topics related to condensed matter research. Since the restructuring in 2011, research in the area of electronic systems and information technology became part of the *Peter Grünberg Institute* (PGI) named after IFF's Nobel Prize winner (Physics in 2007). Biophysics and soft matter research has found a home in the *Institute of Complex Systems* (ICS). Two method-oriented institutes which emerged from the IFF are the *Institute for Advanced Simulation* (IAS), which focuses on applying high-performance computing and the *Jülich Centre for Neutron Science* (JCNS), which is dedicated to the operation of neutron scattering instruments and the application of advanced scattering methods to topical problems in condensed matter science.

2019 marks a special anniversary of the IFF Spring School: for 50 years we will have introduced some 250 students each year to a topical research area in condensed matter science. This anniversary will be celebrated with a special surprise event. It coincides with some anniversaries of groundbreaking scientific discoveries, such as “birthday” of research on magnetism with neutrons. The 50th Spring School 2019 is organized jointly by ICS-1/JCNS-1 for neutron scattering and soft matter and PGI-4/JCNS-2 for quantum materials and collective phenomena. The *Jülich Centre for Neutron Science* develops and operates leading edge instruments at some of the world's best neutron facilities such as the *Heinz-Maier-Leibnitz Zentrum* MLZ in Garching, Germany, the *Institut Laue-Langevin* in Grenoble, France, the *Spallation Neutron Source* SNS in Oak Ridge, USA, or the *European Spallation Source* ESS in Lund, Sweden. JCNS provides these instruments to users from academia and industry through a peer review proposal process. JCNS also undertakes research on functional materials for the energy revolution, and a new *Institute for Neutron Analytics for Energy Research* is being founded.

The IFF Spring School is organized in close collaboration with universities, research institutions, and industry. The school offers about 50 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 form of a hardcover book, which contains all the material presented during the school.

HOW TO FIND US:



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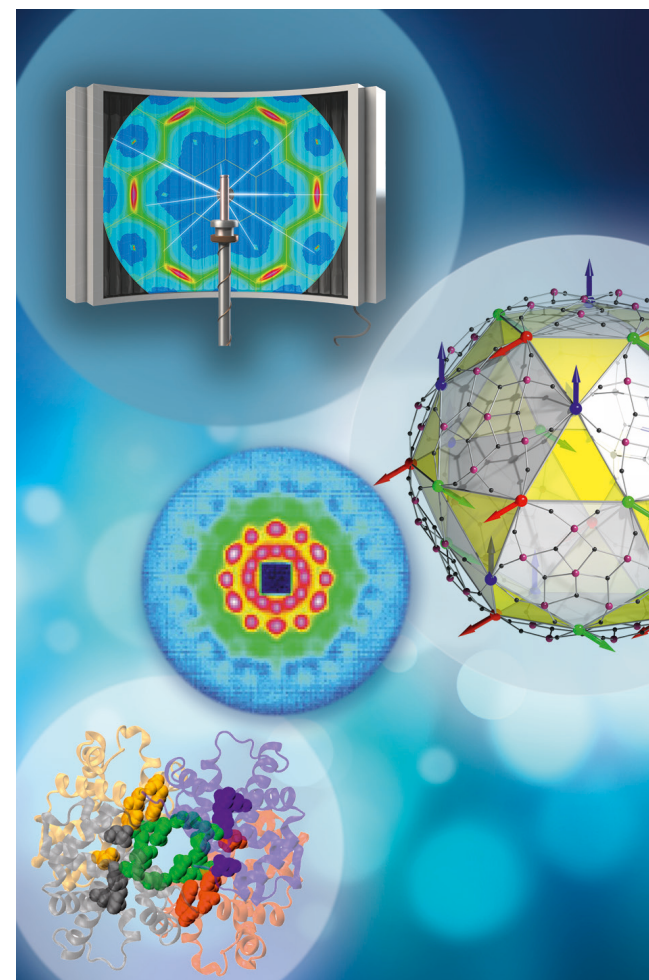
REGISTRATION AND FURTHER INFORMATION:

www.iff-springschool.de



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50th IFF Spring School 2019

SCATTERING!
SOFT, FUNCTIONAL AND QUANTUM MATERIALS

11th March – 22nd March 2019 · Jülich · Germany

Member of the
Helmholtz Association



OVERVIEW

Imagine what we would know – or better: would not know – about the microscopic structure and dynamics of condensed matter if geniuses like Ernest Rutherford (Nobel Prize 1908), Max von Laue (Nobel Prize 1914), son and father William Lawrence and William Henry Bragg (Nobel Prize 1915), Clifford G. Shull (Nobel Prize 1994) and Bertram N. Brookhouse (Nobel Prize 1994) and many others would not have invented scattering as a most powerful tool for condensed matter science. Scattering with x-rays and “neutrons tell us where atoms are and how they move” (C. Shull). Would we be able to build smartphones, produce high-performance plastic materials, modern energy harvesting and energy storage devices or cure diseases with carefully designed pharmaceuticals without the understanding of the microscopic world gained through scattering methods? Much of the amenities we have become accustomed to are based on research with scattering methods. Information on the atomic length scale is provided mainly through x-ray, neutron and electron scattering. To achieve a deeper look into this fascinating microscopic world, large scale facilities have been constructed based on synchrotron x-ray- and neutron radiation sources. With the x-ray free electron laser in Hamburg, Germany, and the European Spallation Source in Lund, Sweden, Europe hosts or will host worldwide leading facilities in this important research field. Groundbreaking research is being performed at such facilities in a very broad range of research areas in physics, chemistry, life science, geoscience, material science and engineering. The range of materials, structures, phenomena, and processes, which can be studied, is unlimited. Experimental methods have been developed which span an incredible range of length- and time-scales from pikometer to meter and from femtoseconds to hours. Doing experiments at these large scale facilities is an especially exciting aspect of research for young scientists. Not only do they obtain unique microscopic information on structure, excitations and dynamics of condensed matter, but from the start they are familiarized with cutting edge technology and with work in an international collaboration.

The goal of the Spring School is to enable students and young researchers to apply the entire tool box of advanced scattering methods to their topical research in order to provide them with microscopic information, which they cannot obtain otherwise. To this end, we will teach the basics of scattering, introduce the various radiation sources with the particular properties of the corresponding radiation, familiarize the students with the appropriate methods and instruments and show how modern

scattering methods can be applied to provide essential and unique contributions to the solution of grand challenges facing our modern societies such as energy supply, health, environment, transport and information technology.

PROGRAMME

The IFF Spring School 2019 will provide a solid introduction into 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 as well as the most advanced development of High Brilliant Compact Neutron Sources, which will provide a new quality of research with neutrons particularly for nanostructured and biological materials. 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 investigations, such as nanostructures, functional biological or quantum materials and 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:

- Scattering Theory
- Structure, Dynamics & Excitations
- Neutron- & Synchrotron Radiation Sources: X-FEL, ESS, HBS
- Experimental Techniques
- Topical Applications in Soft Matter, Life Science, Materials Sciences, Quantum- and Nano-Materials
- Complementary Techniques: Imaging, Microscopies

GENERAL INFORMATION

Venue

The IFF Spring School 2019 will take place in the Auditorium (Building 04.7) of the Forschungszentrum Jülich from 11th March to 22nd March 2019.

Participation

Participants are expected to have a basic knowledge of quantum mechanics and physics or chemistry of condensed matter.

Registration

All participants are asked to register at www.iff-springschool.de during the period 5th November 2018 and 10th January 2019. If you wish to attend **without** booking accommodation, the registration fee is 50 Euro. The full fee including accommodation is 380 Euro, see following section.

Accommodation, Lunch and Dinner

Low-cost accommodation will be arranged at the A & O Youth Hostel in Aachen. The full fee of 380 Euro includes the registration fee, 12 overnight stays from 10. – 22.03.2019 in a four-bed room, breakfast and dinner. Lunch will be provided at Forschungszentrum Jülich from Monday to Friday at your own expense.

Arrival at the hostel: Sunday, 10th March 2019

Start of lectures: Monday, 11th March 2019

End of lectures & departure: Friday afternoon, 22th March 2019

Students who have not yet finished their Master's degree can apply for financial support from Forschungszentrum Jülich to cover part of the accommodation costs. To qualify for this support, valid proof of student status as well as a letter of reference from your supervisor must be supplied upon registration.

Travel Information

A shuttle service will take participants from the A & O Youth Hostel in Aachen to Forschungszentrum Jülich in the morning and back to their accommodation after the lectures are concluded. The daily transfer is free for all registered participants.

Payment and Cancellation Policy

On completing the registration you will receive an email confirmation. Accepted participants will receive an invoice with all relevant information regarding the transfer of the fee in due course. Cancellations must be received before or on 10th February 2019, otherwise a cancellation fee of 50 Euro is required.