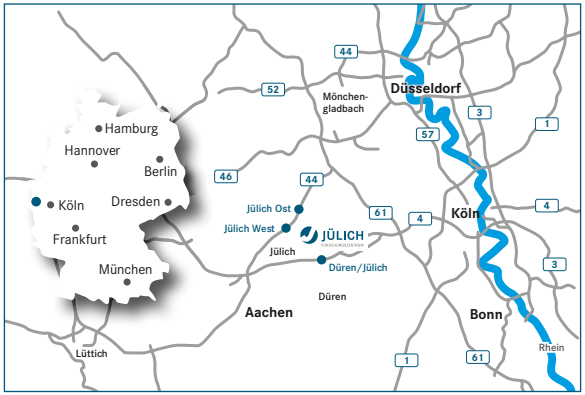
The IFF Spring School & Biophysics Research in Jülich

The annual IFF Spring School is a long-standing tradition of the Institut für Festkörperforschung (IFF) which was founded in 1969. The institute's research topics ranged from electronic and structural properties of solids and nanoelectronics, to the thermal and dynamical behaviour of soft matter. The IFF has organized the Spring School for over 40 years. Since the restructuring in 2011, research in the area of electronic systems, their phenomena, as well as their applications in information technology, became part of the Peter Grünberg Institute (PGI) named after the IFF scientist who received the Nobel Prize in Physics in 2007. Biophysics and soft matter research is now located at the Institute of Complex Systems (ICS). These institutes are linked together and supported by the Institute for Advanced Simulation (IAS), which focuses on developing and applying high-performance computing to understand complex systems, and the Jülich Centre for Neutron Science (JCNS), which is dedicated to the operation of neutron scattering instruments at national and international neutron sources. The IFF Spring School is now organized in turns by PGI and ICS.

The Institute of Complex Systems (ICS) consists of 8 departments: neutron scattering, theoretical soft matter and biophysics, soft matter, cellular biophysics, molecular biophysics, structural biochemistry, biomechanics, and bioelectronics. A major objective of biophysics research is to understand processes far from equilibrium, which distinguishes dead from living matter, and thus to elucidate the structure and function of biological matter and living systems. Examples include biomolecules, such as DNA and various proteins, cells with their complex machinery and functions, tissues which represent a collective organization of cells, and systems biology which concerns intricate interactions between different biological entities starting from single molecules to cells and tissues, right up to organs and whole organisms.

An essential part of the mission of the Institute of Complex Systems is the interdisciplinary education of graduate students at the interface between physics, chemistry and biology. Here, the International Helmholtz Research School on Biophysics and Soft Matter (IHRS BioSoft) provides graduate education and training, with a programme of introductory and advanced lectures, seminars, lab courses, retreats, and transferable skills courses. More information is provided at http://www.ihrs-biosoft.de.

How to find us:



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The lecture programme, travel information, and confirmation of attendance will be sent in due course to all registered participants.

Publication Details

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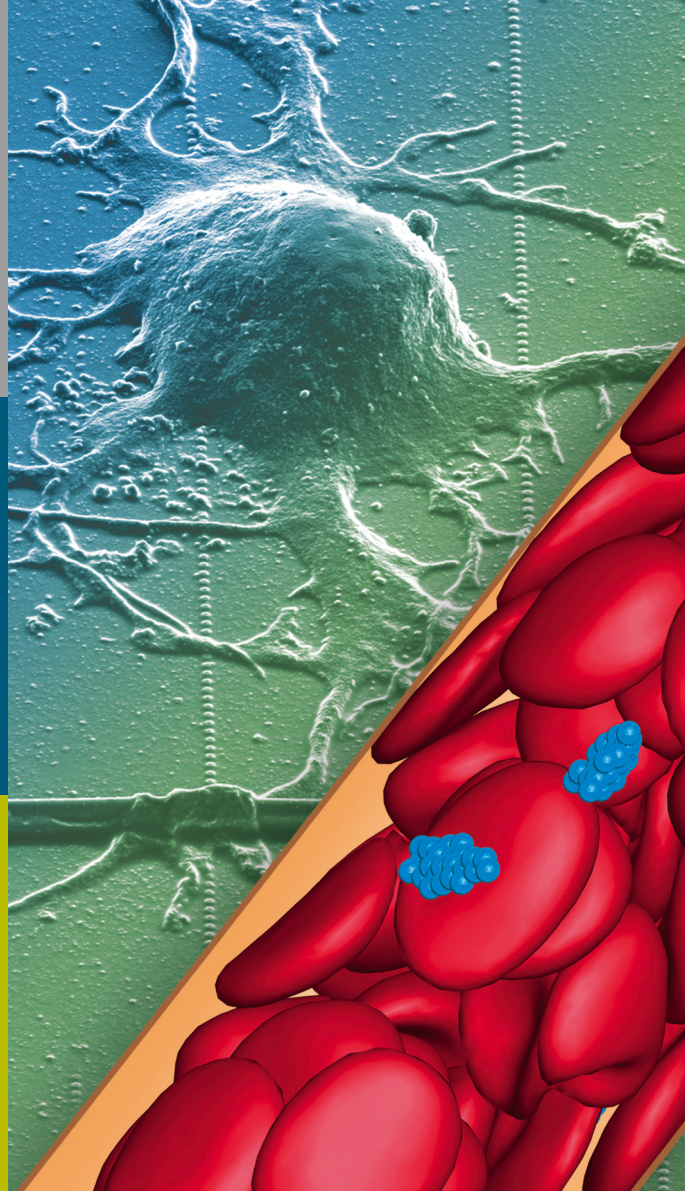

Member of the Helmholtz Association

Physics of Life

49th IFF Spring School 2018
26th February – 9th March 2018
Jülich, Germany

JÜLICH
FORSCHUNGSZENTRUM

Overview

The Spring School will provide an introduction to and an overview of current research topics in biophysics of living systems, with an emphasis on understanding biological structure, dynamics and function. Biomolecules, cells, tissues, and their multiscale interactions are the main building blocks of biological organisms. The physical understanding of their structural and dynamical properties and their organization and synergy is very challenging due to the enormous complexity and non-equilibrium behaviour of these systems. However, this knowledge is essential for linking the structure and dynamics of biosystems to their corresponding functions.

The goal of this Spring School is not only to give an overview of selected topics from biophysics to students and postdocs in physics, chemistry and biology, but also to establish an interdisciplinary connection between these fields. This includes, in particular, the introduction of biologists and chemists to physical experimental methods and theoretical modelling, and the introduction of physicists to the large variety of fascinating biological phenomena.

Introductory lectures will present the basics of biosystems and biophysics. These lectures are intended to establish a common level of basic interdisciplinary knowledge. Subsequent lectures will treat more advanced topics within different disciplines and emphasize interdisciplinary aspects.

Programme

The School provides about 50 hours of lectures, including discussions, and offers the opportunity to visit the participating institutes at Forschungszentrum Jülich. All lectures will be given in English. All registered participants will receive a book of lecture notes, which contains the material presented during the School. The lectures are grouped together in several sections thematically. All sections include an introduction to the fundamental concepts of the field and cover special fields of application and future technologies.

Experimental and Theoretical Methods
The study of biological systems is particularly challenging since very often the macromolecular building blocks are inherently complex and the relevant length and time scales in these systems span many orders of magnitude. Success requires a combination of preparative techniques (synthesis), and the elucidation of structural and dynamical properties by scattering, microscopy, rheology and single molecule techniques. Lectures on experimental methods are complemented by theoretical frameworks of classical statistical mechanics, continuum hydrodynamics, and scaling theory. Furthermore, since many biological phenomena are far too complex to be well-described by an analytical theory, simulation techniques, such as Molecular Dynamics, Monte Carlo, and mesoscale hydrodynamics simulations, are often necessary and will be introduced in the basic lectures.

Basic Building Blocks: Bio-Macromolecules
Bio-macromolecules are the basic building blocks of any biological system. Examples include various proteins, DNA, and lipids, with their properties and mutual molecular interactions inducing the assembly of biomolecules into complex structures with a versatile biological functionality. Bio-macromolecules possess exquisitely designed structures required for fulfilling their specific tasks, and a malfunction in molecular structure or dynamics often leads to the development of disease.

Membranes, Filaments, and Networks
Membranes, filaments, and networks are biomolecular assemblies with distinct functions in the cell. Membranes serve as the main barriers between different cellular compartments and cells, while filaments assemble into cytoskeletal networks defining cellular mechanics, motility, and function. The School will cover various biophysical aspects of lipid membranes, membrane-protein interactions, biological filaments (e.g. actin, microtubules, intermediate filaments), motor proteins, active cytoskeletal networks, and synapses.

Biological Cells
Mechanics and the behaviour of cells determine the development and functionality of various tissues. It is well known that cells may act differently in different environments, a fascinating adaptation which is facilitated by various cell organelles and machinery. Here, the lectures will cover cellular mechanics and adhesion and how these properties and processes are modulated. In addition, cell division, motility, and signalling will be reviewed. Finally, an in-vitro cell model and the bridging of cells and electronics (i.e. bioelectronics) will be discussed.

Multicellular Organization and Collective Behaviour
The next level of biological organization is multicellular assemblies which constitute tissues. Currently, one of the most fascinating research directions is tissue growth and repair, because it opens a variety of avenues for biomedical applications. Other topics will include mechanical properties of tissues and rheology. In addition to multicellular organization, the lectures will touch upon other areas of living matter, such as the collective behaviour of swimming micro-organisms and bacterial biofilms. Finally, current developments in the theoretical description of the collective behaviour of active systems will be discussed.

Systems Biology and Diseases
Systems biology aims to interconnect various biological components, in order to integrate information about specific biocomponents into a comprehensive picture for complex biological systems. Thus, it focuses on complex interactions within biological systems. Often, the malfunctioning or alteration of such interactions leads to different diseases and disorders. Several prominent examples are monogenetic diseases, Alzheimer's and malaria. Finally, the topics of antibiotics resistance, disease spreading, and genetics and evolution will be addressed. Of course, in the end all the different levels and scales must work together, from molecules to information processing. This is illustrated for the important case of neurobiology.

General Information

Venue
The IFF Spring School will take place in the Auditorium (Building 04.7) of Forschungszentrum Jülich from 26th February to 9th March 2018.

Participation
Participants are expected to have a basic knowledge of biophysics.

Registration Deadline
All participants are asked to register at **www.iff-springschool.de** before 20th December 2017. 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 25.02. – 09.03.2018 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, 25th February 2018
Start of lectures: Monday, 26th February 2018
End of lectures & departure: Friday afternoon, 9th March 2018

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. **Accommodation for participants from nearby universities can only be provided if there are still places available after the registration deadline**.

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 26th January 2018, otherwise a cancellation fee of 50 Euro is required.

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