Cycle D: Structure and Function of Macromolecules

Coordinator: Stephan Grzesiek

D1: Interactions and Structures and Dynamics of Soluble Proteins – 12421
(2 hrs/week; 2 CP; Fall 2019)

S. Grzesiek, M. Hennig, T. Maier, **T. Schirmer**

This course will provide an overview of the forces and interactions that stabilize biological macromolecules. The role of these interactions for the structure and stability of peptides, proteins and DNA will be discussed. Topics include molecular geometries, electrostatic interactions, hydrogen bonding, van der Waals interactions, solvation effects, molecular dynamics, and structure prediction.

D2: Molecular Biophysics I – 13160
(2 hrs/week; 2 CP; Spring 2020)

S. Grzesiek, **R. Lim**

Biophysics tackles biological questions by the quantitative analysis of biomolecules and their interactions. The quantitative connection of structure, dynamics and energetics establishes the fundamental link between molecular mechanisms and cellular functionality. With a broad range of topics from single molecule studies to systems biology analyses, this course (spread over two parts) offers life-scientists insight into how contemporary biophysical methodologies address questions and resolve problems at the cutting edge of biology. Individual lectures will cover advanced optical spectroscopy and super-resolution techniques, analytical ultracentrifugation, mass spectrometry, nuclear magnetic resonance, electron paramagnetic resonance, x-ray crystallography, cryo-electron microscopy, surface plasmon resonance, atomic force microscopy and spectroscopy, optical/magnetic tweezers, micro/nanofluidic approaches and other methods.

The two parts of the lecture series D2 and D5 will consist of different selections from these topics, such that they can be attended independently.

D3: Large scale protein production of functional proteins – 17001
(2 hrs/week; 2 CP; Fall 2020)

S. Hiller, **T. Maier**

Large amounts of functionally and structurally intact protein are essential for structural biology and many other fields of biochemistry and biophysics. Such amounts are rarely available from native material. This lecture series will focus on the various approaches for large-scale protein production in prokaryotic and eukaryotic cell lines as well as in vitro systems, their respective advantages and disadvantages, strategies to overcome the various problems inherent to the systems and on the functional recovery of the proteins themselves.

D4: Molecular Structure, Function, and Dynamics of Membranes and Membrane Proteins – 17002
(2 hrs/week; 2 CP; Spring 2021)

S. Hiller, **C. Perez**, T. Schirmer, H. Stahlberg

Biological membranes are composed of proteins and lipids, which can both be glycosylated. Together these molecules form a functional unit. The lecture series leads towards the understanding of the structural and functional aspects of biological membranes. It gives insight into the diversity of membrane constituents and into their structural analysis by x-ray, nuclear magnetic resonance spectroscopy and electron microscopy. Moreover, the thermodynamics and kinetics of lipid-protein interactions monitored by means of different biophysical techniques are discussed.

D5: Molecular Biophysics II – 32793
(2 hrs/week; 2 CP; Spring 2019)

S. Grzesiek, R. Lim, D. Veprintsev

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The two parts of the lecture series D2 and D5 will consist of different selections from these topics, such that they can be attended independently.

D6: Structural Biology and Biophysics I – 22827
(2 hrs/week; 1 CP; Fall 2019)

D7: Structural Biology and Biophysics II – 24284
(2 hrs/week; 1 CP; Spring 2019)

S. Grzesiek, **S. Hiller,** R. Lim, T. Maier, T. Schirmer, H. Stahlberg

International top speakers present highlights from their ongoing research activities. Typical lectures in this series describe applications of advanced structural biology and biophysics methods to solve biological problems. Methods include NMR spectroscopy, X-ray crystallography, cryo-electron microscopy, surface plasmon resonance and atomic force microscopy. Lectures are followed by an informal round-table discussion with the speaker.