Physics Colloquium

18 December 2019 at 16.00
Coffee at 15.45

Campus Limpertsberg
Bâtiment des Sciences – room 2.04

Talk by Prof. Dr. Jörg Enderlein
Georg-August-Universität Göttingen
(invited by: Prof. Anupam Sengupta)

Image Scanning Microscopy and Metal Induced Energy Transfer:
Enhancing Microscopy Resolution in All Directions

Classical fluorescence microscopy is limited in resolution by the wavelength of light (diffraction limit) restricting lateral resolution to ca. 200 nm, and axial resolution to ca. 500 nm (at typical excitation and emission wavelengths around 500 nm). However, recent years have seen a tremendous development in high- and super-resolution techniques of fluorescence microscopy, pushing spatial resolution to its diffraction-dictated limits and much beyond. One of these techniques is Image Scanning Microscopy (ISM), which will be the focus of my talk. In contrast to other super-resolution techniques (e.g., Structured Illumination Microscopy), ISM is conceptually and technically much simpler, is robust to sample imperfections like refractive index variations, and can easily be implemented into any existing laser-scanning confocal microscope. I will also present recent results of combining ISM with two-photon excitation, which is important for deep-tissue imaging of e.g. neuronal tissue, and for performing non-linear coherent microscopy such as second-harmonic generation.

A second method which I will present is concerned with achieving nanometer resolution along the optical axis. It is called Metal Induced Energy Transfer or MIET and is based on the fact that, when placing a fluorescent molecule close to a metal, its fluorescence properties change dramatically. In particular, one observes a strongly modified lifetime of its excited state (Purcell effect). This coupling between an excited emitter and a metal film is strongly dependent on the emitter's distance from the metal. We have used this effect for mapping the basal membrane of live cells with an axial accuracy of ~3 nm. The method is easy to implement and does not require any change to a conventional fluorescence lifetime microscope; it can be applied to any biological system of interest, and is compatible with most other super-resolution microscopy techniques which enhance the lateral resolution of imaging.

About the speaker
Prof. Dr. Jörg Enderlein is Professor of Physics and Director of the Third Institute of Physics (Biophysics) of the Georg August University in Göttingen, Germany. Since April 1st, 2019, Prof. Enderlein serves as the Dean of the Faculty of Physics and is one of the founding speakers of the GGNB doctoral program on the Physics of Biological and Complex Systems, in collaboration with the International Max Planck Research School. His research is focused on Single Molecule Spectroscopy and Super Resolution Microscopy, from fundamentals to applications in soft matter and biological systems.