

## Advanced Experimental Microscopy at the Nanoscale / Super-Resolution Microscopy

Seeing is believing. This sentence is as true as it is tricky. Most cellular components and processes, crucial for the nuanced understanding of (human) life, are not observable by conventional light microscopy since Abbe's Law describes their maximum resolution to roughly half the wavelength of the observed light. This law is literally set in stone in Jena. However, over the past 15 years several ways of cleverly circumventing this diffraction limit were developed and implemented, achieving three-dimensional resolutions down to the nanometer range, resulting in the ever-growing field of optical *super-resolution* microscopy, for which the 2014 Nobel Prize in Chemistry was awarded.

The aim of this projects is to introduce, understand and apply the principles of state of the art fluorescence microscopy techniques, used e.g. in a broad range of modern biomedical and cell-biological research. Students prepare their own, fluorescently labeled, biological samples and will image them on a variety of advanced microscopes with different (resolution) capabilities. The qualitative and quantitative comparison of acquired images will illustrate the advantages and limitations of the respective microscopy technique.

### Goals and Context

- principles and application of advanced fluorescence microscopy techniques
- concept of diffraction-limited and super-resolution
- preparation of fluorescently labeled, biological samples
- 3D & multi-colour imaging at the nanoscale

### Methods

- cell culture and wet lab
- fluorescent labeling
- a selection of advanced fluorescence microscopy techniques from the IOAB toolbox:
  - Confocal Laser Scanning Microscopy
  - Array Scan Microscopy
  - Stimulated Emission Depletion (STED)
  - Structured Illumination Microscopy (SIM)
  - Single-Molecule Localization Microscopy (SMLM)
  - MINFLUX Nanoscopy

### Prerequisites

- An open mind

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Supervisor: Christian Franke

Venue: Microscopy Labs of the IOAB in the ZAF and Abbeanum

**The topic is suitable for two or three students.**