Physikalisches Kolloquium — Physics Colloquium

Einladung — **Invitation**

Monday, 17 July 2023

Lecture Hall N24/H13, at 16:15
Coffee and cookies will be served in front of the lecture hall from 16:00

Superresolution optical microscopy: Basics and applications

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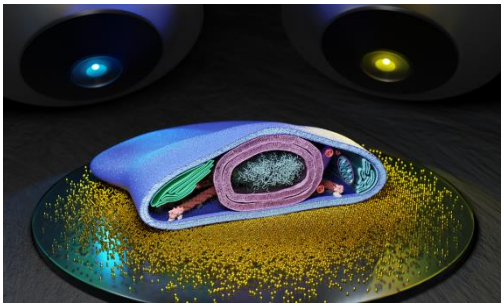
With the advent of super-resolution microscopy, the last ~25 years have seen a revolution in optical microscopy, pushing the spatial resolution capabilities of optical microscopy towards length scales that were typically accessible only by electron microscopy. In my presentation, I will give a short overview of the different principal approaches to super-resolution microscopy. I will briefly discuss the concepts of Structured Illumination Microscopy (SIM), Stimulated Emission Depletion (STED) microscopy, and Single Molecule Localization Microscopy (SMLM). Then, I will focus on two specific techniques where our group has contributed most. The first is Image Scanning Microscopy or ISM [1-3]. This technique uses a simple combination of confocal microscopy with wide-field image detection for doubling the resolution of conventional microscopy. I will explain the physical principals behind ISM, and the various kinds of its implementation. Meanwhile, ISM has found broad and wide applications and lies behind state-of-the-art commercial systems such as the extremely successful AiryScan microscope from Carl Zeiss Jena. The second method is Metal- or Graphene-Induced Energy Transfer imaging or MIET/GIET imaging [4-6]. It addresses the axial resolution in microscopy, which is particularly important for resolving three-dimensional structures. MIET/GIET is based on the intricate electrodynamic interaction of fluorescent emitters with metallic nanostructures, and it allows to achieve Angstrom resolutions in optical microscopy. I will present the basic principles and several applications of this technique.



References

1. Müller, C. B., & Enderlein, J. (2010). Image scanning microscopy. *Phys. Rev. Lett.* **104**, 198101.
2. Schulz, O., Pieper, C., Clever, M., Pfaff, J., Ruhlandt, A., Kehlenbach, R. H., ... & Enderlein, J. (2013). Resolution doubling in fluorescence microscopy with confocal spinning-disk image scanning microscopy. *PNAS* **110**, 21000-21005.
3. Gregor, I., Spiecker, M., Petrovsky, R., Großhans, J., Ros, R., & Enderlein, J. (2017). Rapid nonlinear image scanning microscopy. *Nature Methods* **14**, 1087-1089.
4. Chizhik, A. I., Rother, J., Gregor, I., Janshoff, A., & Enderlein, J. (2014). Metal-induced energy transfer for live cell nanoscopy. *Nature Photonics* **8**, 124-127.
5. Ghosh, A., Chizhik, A. I., Karedla, N., & Enderlein, J. (2021). Graphene-and metal-induced energy transfer for single-molecule imaging and live-cell nanoscopy with (sub)-nanometer axial resolution. *Nature Protocols* **16**, 3695-3715.
6. Ghosh, A., Sharma, A., Chizhik, A. I., Isbaner, S., Ruhlandt, D., Tsukanov, R., ... & Enderlein, J. (2019). Graphene-based metal-induced energy transfer for sub-nanometre optical localization. *Nature Photonics* **13**, 860-865.

Host: Prof. Dr. Kay Gottschalk, Institute of Experimental Physics

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