Joint Department of

BIOMEDICAL ENGINEERING

UNC CHAPEL HILL | NC STATE UNIVERSITY

Coulter Seminar Series Presents

"DNA-based super-resolution microscopy"

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Ralf Jungmann received his Ph.D. in physics from the Technical University Munich in 2010. From 2011 to 2014, he was a postdoctoral fellow at the Wyss Institute at Harvard University. Since 2015, he has been heading an independent research group at the MPI of Biochemistry and the LMU Munich supported by the Emmy Noether Program of the DFG. In 2016, he was appointed as an associate professor at the LMU. In 2017, he was named Allen Distinguished Investigator, in 2018 HFSP Young Investigator. Jungmann received an ERC Starting Grant in 2015 and Consolidator Grant in 2020. His research focuses on the development of DNA-based super-resolution techniques and their application in cell biology.

ABSTRACT

Super-resolution fluorescence microscopy is a powerful tool for biological research. We use the transient binding of short fluorescently labeled oligonucleotides (DNA-PAINT) for easy-to-implement multiplexed super-resolution imaging that technically achieves sub-5-nm spatial resolution.To translate this resolution to cellular imaging, we introduce Slow Off-rate Modified Aptamers (SOMAmers) as efficient and quantitative labeling reagents. We demonstrate the achievable image resolution and specificity by labeling and imaging of transmembrane as well as intracellular targets in fixed and live cell-specimen. Apart from ever increasing spatial resolution, efficient multiplexing strategies for the simultaneous detection of hundreds of molecular species are still elusive. We introduce a new approach to multiplexed super-resolution microscopy by designing the blinking behavior of targets with engineered binding frequency and duration. We assay this kinetic barcoding approach in silico and in vitro using DNA origami structures, show the applicability for multiplexed RNA and protein detection in cells and finally experimentally demonstrate 124-plex super-resolution imaging within minutes. Finally, DNA-PAINT's image acquisition is slow compared to most other approaches. We overcome this limitation by designing optimized DNA sequences and buffer conditions. We demonstrate our approach in vitro with DNA origami and in situ using cell samples, and achieve two orders of magnitude faster imaging speeds without compromising image quality or spatial resolution. This improvement now makes DNA-PAINT applicable to high-throughput studies.

Friday, January 29th
12:00 Noon

Seminar will be presented virtually via Zoom:
https://go.unc.edu/j5W3E