MPI-NAT SEMINAR SERIES

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Nanofluidics-seeing is believing

In this talk, I will introduce a novel method based on liquid-activated quantum emission from native hBN defects for nanofluidic sensing. Liquids confined down to the atomic scale can show radically new properties. However, only indirect and ensemble measurements operate in such extreme confinement, calling for novel optical approaches enabling direct imaging at the molecular level. Using our method, we harness quantum emission originating from native defects in hexagonal boron nitride (hBN) for molecular imaging and sensing in nanometrically confined liquids. We show that defect activation occurs through chemisorption of organic solvent molecules, revealing single-molecule dynamics at the interface through spatially correlated activation of neighboring defects. Defect emission spectra further offer a direct readout of local dielectric properties, unveiling increasing dielectric order under nanometer-scale confinement. Liquid-activated native hBN defects bridge the gap between solid-state nanophotonics and nanofluidics, opening new avenues for nanoscale sensing and optofluidics.

In the second part of my talk, I will describe a novel single-molecule method where we engineer precise spatial and temporal control into the single-molecule experiment. We use a glass nanopore mounted on a 3D nanopositioner to spatially select molecules, deterministically tethered on a glass surface, for controlled translocations. By controlling the distance between the nanopore and the glass surface, we can actively select the region of interest on the molecule and scan it a controlled number of times and at a controlled velocity. Decreasing the velocity and averaging thousands of consecutive readings of the same molecule increases the signal-to-noise ratio (SNR) by two orders of magnitude compared to free translocations. We applied our method to various DNA constructs, achieving down to single nucleotide gap resolution. The spatial multiplexing combined with the sub-nanometer resolution could be used in conjunction with micro-array technologies to enable screening of DNA, improving point-of-care devices, or enabling high-density, addressable DNA data storage.

Tuesday, 22.11.2022, 11:00 am

Host: Grazvydas Lukinavicius

Ludwig Prandtl Hall

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