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 the talk I will introduce two novel types of nanofluidic platforms. The geometry of the first nanofluidic platform combines the benefits of reduced sensing regions typically seen in 2D material nanopores with the asymmetric geometry of capillaries, resulting in ionic selectivity, stability, and scalability. The proposed nature-inspired growing method provides a flexible nanopore platform for various nanofluidic research applications, such as biosensing, energy science, and filtration technologies.

The second nanofluidic platform with a large entrance asymmetry is designed for in-memory processing, which can be mass-produced and behaves as performant memristive charge threshold switches with discontinuous current-voltage characteristics. The device's performance and reliability enabled the building of a logic circuit composed of two interactive ionic channels and an electronic resistor, which opens the way to the design of nanofluidic neural networks for brain-inspired ionic computations.

**Wednesday, August 23rd, 2023 at 2:15 pm**

MPI-DS, Prandtl lecture hall
Am Fassberg 11, Göttingen, and
Zoom Meeting ID: 959 2774 3389
Passcode: 651129, [direct link](#)