



Monday, 15 June 2026

Lecture Hall O25/H2, at 16:15
Coffee and cookies will be served in front of the lecture hall from 16:00

Photonics in flat lands: Engineering interactions at the atomic scale

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<https://www.uni-ulm.de/nawi/institut-fuer-quantenmaterie/>



In recent years, two-dimensional (2D) materials, such as graphene and monolayer transition metal dichalcogenides, have transformed the landscape of photonics and condensed matter physics through their exceptional light-matter interactions and ultrafast carrier dynamics. Controlling these interactions at the atomic scale opens new frontiers for high-precision sensing, novel light sources, and brain-inspired neuromorphic computing.

In this talk, I will focus on van der Waals heterostructures, which can be used to gain fundamental understanding of quasiparticle physics in 2D systems as well as to build future photonic devices. First, I explore a novel electrical excitation mechanism that generates excitons via the near-field coupling of tunneling electrons. This structure allows versatile exciton excitation in systems ranging from two-dimensional magnets to hybrid inorganic-organic perovskites. Extending this concept to complex heterostructures reveals distinct electronic pathways, providing clear evidence of electron tunneling beyond the junction. This phenomenon can then be leveraged to probe electronic band structure parameters within hybridized van der Waals heterostructures. Finally, I focus on emerging sliding ferroelectric devices, which offer promising avenues both for hardware-level neuromorphic computing and for dynamically tuning fundamental excitations in van der Waals materials.

