Kolloquium des Instituts für Angewandte Physik / Quantentechnologien

TECHNISCHE UNIVERSITÄT DARMSTADT

Zeit: **Dienstag 11.11.2025, 16 Uhr**

Ort: Gebäude S2|15, Raum 134 (Handbibliothek)

Quantum geometry and magneto-optical effects in plasmonic metasurfaces

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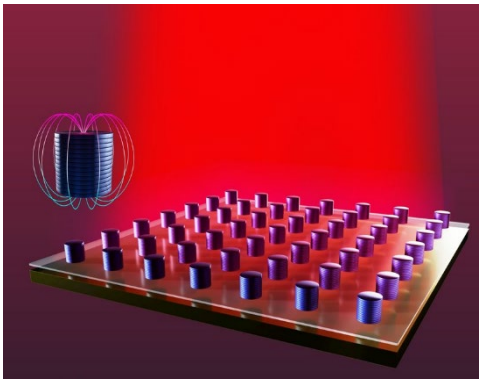
Surface plasmons are collective oscillations arising from the fundamental coupling between photons and conduction electrons at metal/dielectric interfaces. This interaction confines electromagnetic fields to deeply subwavelength regions, resulting in strong field enhancement and pronounced light–matter coupling. In periodic arrays of metallic nanoparticles, plasmonic excitations emerge in the form of extended optical modes with tunable radiative properties. When combined with ensembles of quantum emitters, such *plasmonic metasurfaces* provide versatile platforms for studying lasing and condensation phenomena, as well as their connections to topology, where global features of the optical modes remain robust under continuous deformations.

While the above properties are well-established, our recent work explores new regimes where magnetism, quantum geometry, and collective quantum effects become relevant. In the first part of this talk, I will discuss how the highly dispersive, polarization-dependent band structure of plasmonic lattices gives rise to a non-trivial quantum metric and the pioneering observation of non-Hermitian Berry curvature. Moving on to systems that incorporate quantum emitters, I will show that lattices formed by magnetic nanoparticles exhibit chiral bandgap openings that enable an on–off switching mechanism for controlling lasing emission. Finally, I will discuss emerging signatures of dynamical superradiance in organic materials and their implications for future studies.



In Kooperation mit Prof. R. Walser