SEMINAR: Self-cavity electrodynamics of van der Waals heterostructures

GUNDA KIPP

June 12, 2025
15:00 to 16:00
Seminar Room

Van der Waals (vdW) heterostructures host rich many-body quantum phenomena that are highly tunable via electrostatic gating. Intriguingly, the gates and 2D materials in these structures inherently form plasmonic self-cavities, confining light in standing waves of current density due to finite-size effects. The plasmonic resonances of typical graphite gate fall within the GHz-THz range, aligning with the ?eV- meV energy scale of the phenome a they electrically control in vdW heterostructures. This suggests that the built-in cavity mod s of graphite gates may play a significant role in shaping the low-energy physics of v W heterostructures. However, probing these cavity-coupled electrodynamics is challenging d e to the sub-wavelength scale of the devices relative to the diffraction limit

In this talk, I will present our recent results using advanced on-chip THz spectroscopy t probe the intrinsic cavity conductivity of gate-tunable graphene heterostructures. By tunin the carrier density, we revealultrastrong coupling and hybridization between graphene an graphite plasmonic cavity modes, accompanied by significant spectral weight transfer. T interpret these findings, we introduce an analytical framework and outline design principle for future cavity-engineered vdW systems

Our study demonstrates that intrinsic cavity effects are essential for understanding he low-energy electrodynamics of vdW heterostructures and offer new opportunities or functionality through cavity control.

Hosted by: Prof. Dr. Carmen Rubio-Verdu