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CENTER FOR MULTISCALE THEORY AND COMPUTATION

Institut für Festkörpertheorie
Physikalisches Institut

Seminar – Sondertermin

Ort: Seminarraum 718 (Wilhelm-Klemm-Straße 10)

Zeit: **Montag, 04.09.2017, 14 Uhr c.t.**

Probing plasmon and phonon polaritons using electrons

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Electron energy loss spectroscopy (EELS) and microscopy allow probing of evanescent fields of particle plasmons with nanometer resolution. In EELS swift electrons pass by or through a metallic nanoparticle and lose a tiny fraction of their kinetic energy by exciting particle plasmons. By spectrally analyzing the energy loss and raster-scanning the electron beam over the specimen one can map the plasmon polariton nearfields with sub-eV and nanometer resolution. By a similar token, EELS with extremely high energy resolution of about 10 meV allows investigating nanoscale phonon polariton properties [1], which have recently received tremendous attention in the context of phononics and nearfield heat transport at the nanoscale.

In this talk I will start by discussing our recent efforts to correlate experimental and simulated EELS maps of coupled nanostructures [2,3]. The comparison can be brought to a quantitative level when using the precise 3D geometry of the nanoparticles, reconstructed through electron tomography, as an input for simulation. This work paves the way for detailed investigations of the enhanced fields of realistic and complex plasmonic nanostructures. When additionally using a series of rotated EELS maps, it becomes possible to reconstruct the full 3D photonic environment of the plasmonic nanoparticles [2].

I will also report about our recent EELS studies using a strongly improved energy resolution of about 10 meV, which allowed observation of bulk and surface phonon polariton modes (corner, face, edge) in a single MgO cube with sub-nanometer spatial resolution [1]. This opens the route towards true atomic-resolution phonon spectroscopy in nanostructures and for a detailed understanding of nanoscale energy transport.

[1] M. Lagos *et al.*, Nature 543, 533 (2017).
[2] A. Hörl *et al.*, Nature Commun. 8, 37 (2017).
[3] G. Haberfehlner *et al.*, Nano Lett. 15, 7726 (2015).

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