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 discuss our recent efforts to correlate experimental and simulated EELS maps of single and coupled nanostructures [1-3]. 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 and of their full 3D photonic environment [2,3]. A key feature underlying such tomography is the description of the plasmonic response in terms of resonance modes. I will report about our recent efforts to describe resonance modes within a boundary element method approach [4].