Coupling of light to charges in a metallic nanoparticle leads to hybrid light-matter states, localised surface plasmon polaritons. They are characterised by very strong field intensities in vicinity of the nanoparticle. This field enhancement can be exploited by coupling the nanoparticles to quantum emitters, e.g. molecules or quantum dots.

Many new applications are based on fabrication of arrays of metallic nanoparticles. Significant spatial coherence in such systems is caused by electromagnetic interaction between the nanoparticles. In this work, we study the possibilities of quantum-mechanical description of metallic nanoparticles and the interactions between them.

Using the principles of molecular quantum electrodynamics and quantisation of quasistatic normal modes of charge oscillations, we propose a quantum model of interaction between dipole quasistatic oscillation modes and the electromagnetic field. This model is then applied to estimate how presence of another nanoparticle influences the spontaneous radiative decay rate of dipole charge oscillation mode using the third-order perturbation theory.