## Theoretical study of molecular fluorescence in nonlocal plasmonic environments

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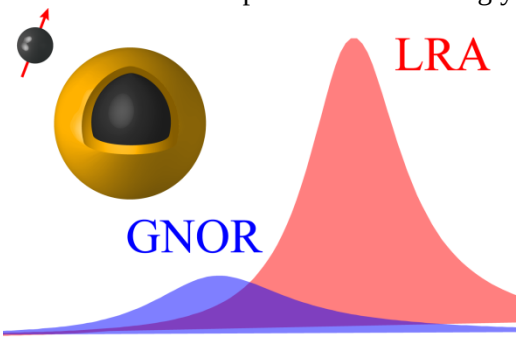
**Project type:** Bachelor or Master

**Project area:** DTU Fotonik, Nanophotonics Cluster, SEM

**Project description:**
The optical response of metallic nanostructures is traditionally evaluated within the framework of classical electrodynamics. However, recent progress in experimental miniaturisation of plasmonic architectures renders inclusion of nonclassical effects essential for a complete theoretical description, and nonlocal screening is one of the widest-range phenomena that needs to be accounted for, in order to understand state-of-the-art experiments [1,2]. While the importance of nonlocality is usually explored through its direct influence on far-field optical spectra, it is still not well understood to what extent it affects quantities that depend indirectly on a plasmonic environment. Along these lines, it has been recently shown [3] that molecular fluorescence enhancement near metallic nanospheres can be strongly reduced when deviating from the local response approximation (LRA), and especially within the Generalized Nonlocal Optical Response theory [4].




The objective of this thesis project is to further explore the importance of nonlocal effects on molecular fluoresce-nce of emitters coupled to plasmonic nanoparticles, for random emitter positions and orientations.

In this project, your tasks could be focused on the following topics:

- Derive analytically, and calculate numerically, the Mie scattering coefficients for local and nonlocal spherical nanoparticles.
- Obtain analytic expressions for the fluorescence, emission, and decay rates of classical dipoles coupled to the nanoparticle.
- Perform ensemble averaging for a large collection of randomly oriented molecules.
- Explore numerically (e.g. with COMSOL) different emitter-plasmon architectures.

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[1] S. Raza et al. – J. Phys.: Condens. Matter **27**, 183204 (2015).
[2] S. Raza et al. – Nature Commun. **6**, 8788 (2015).
[3] C. Tserkezis et al. – *submitted*
[4] N. A. Mortensen et al. – Nature Commun. **5**, 3809 (2014).