Institute of Applied Physics
Friedrich-Schiller-Universität Jena

Theoretical investigation of collective resonances in metallic nano-antennas

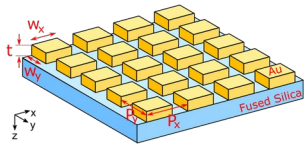
Theme / Problem definition:

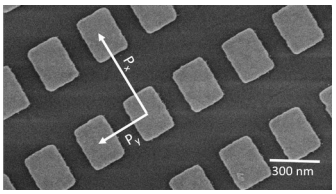
The optical behavior of metals is of primary interest due to some peculiar features. Indeed, the strong coupling between photons and electrons –generating hybrid waves called plasmons- strongly affects the light propagation, yielding both a strong sub-wavelength confinement and a huge field enhancement. In this context, collective resonances involving metallic nano-antennas –dubbed Surface Lattice Resonances (SLRs) - are a novel way to achieve high Q-factor in plasmonic metastructures. The aim is to design new man-made materials with highly tunable characteristics for nonlinear optics, optical sensing, and so on.

Tasks / Aim:

We are looking for a motivated and self-driven candidate who will work in the area of plasmonics. The task is to investigate how SLRs can be enhanced by covering the metallic period structures with a layer of dielectric material.

- Learn to use a commercial numerical solver based upon the Finite Element Method (COMSOL).
- Finding the linear response of a periodic bidimensional lattice made of nano-bars.
- Repeating the computation inserting a dielectric layer on the top of the bars.
- Addressing theoretically the presence of bound states in the continuum and their influence on the observed spectra.





Left Side: sketch of a periodic distribution of metallic nano-antennas (bar shaped) deposited on a transparent substrate. Right side: SEM image of one of the metastructures realized in our laboratories.

- The candidate is expected to have basic knowledge in optics.
- Knowledge in Python or any other programming language is highly desirable.

Contact:

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Literature:

- *Trinh, Q.T., Nguyen, S.K., Nguyen, D.H., Tran, G.K., Le, H.L., Nguyen, H.-S., and Le-Van, Q. 2022. Coexistence of surface lattice resonances and bound states in the continuum in a plasmonic lattice. Optics Letters, 47(6), pp. 1510-1513.*
- *Gour, J., Beer, S., Alberucci, A., Zeitner, U.D., and Nolte, S., 2022. Enhancement of third harmonic generation induced by surface lattice resonances in plasmonic metasurfaces. Optics Letters, 47(22), pp.6025-6028.*
- *Beer, S., Gour, J., Alberucci, A., David, C., Nolte, S., and Zeitner, U.D. , 2022. Second harmonic generation under doubly resonant lattice plasmon excitation. Optics Express, 30(32), pp. 40884-40896.*