

## Second Year PhD Report (XXXIX Cycle)

**Department of Physics, Curriculum Bio-Nanoscience, University of Genova**

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**Ph.D. Supervisors:** Dr. Andrea Toma, Dr. Vincenzo Aglieri

The second year of my PhD has been primarily focused on the fabrication and optical investigation of plasmonic nanostructures, exploring light-matter interactions, mainly through collective lattice resonances. Alongside standard nanostructure layouts, I expanded my study to more complicated architectures, such as circular and triangular holes, thus further extending my fabrication skills towards focused ion beam machining.

I also deepen steady-state optical spectroscopy competences using a custom-made set up to evaluate the impact of structure, surrounding medium, and light polarization on the nanostructure resonances. Within this context, I carried out comprehensive studies on bipartite plasmonic arrays, which permit independent activation of electric and magnetic lattice resonances [1, 2]. My contributions entailed fabricating the nanostructures by electron beam lithography and doing systematic optical characterizations, showing the unique spectral fingerprints associated with this design. The results were collected in a paper currently submitted to an international scientific journal.

Concurrently, my investigation is focusing on the fabrication of plasmon-based platforms for topological photonics and/or for their integration with low dimensional materials, e.g. quantum dots and nanoplatelets, for strong light-matter interaction studies.

Overall, my second-year research has been highlighted by the effective combination of fabrication skills, optical characterization, and experimental analysis of collective resonances excited on plasmonic systems. In line with this, I have established a coherent experimental research path that addresses fundamental questions in light-matter interaction and collective photonics, where significant results that are specifically important for practical application have been demonstrated.

## Attended Courses and Exams

- Biosensing (Exam Given)
- Introduction to Nanophotonics and Nanofabrication
- Design of Superconducting Magnets
- Open Science and Research Data Management (OS&RDM)

## Workshop

- Basic of Scientific Writing (May 19th and 20th 2025 Hack room, CCT-Genova Morego)

## Other activities and collaboration

IIT seminars, invited by supervisor

- **Alejandro Manjavacas** Instituto de Química Física "Blas Cabrera" – CSIC Madrid, Spain “Lattice resonances: a collective response of periodic arrays of nanostructures” (26 March 2025)

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## Reference

1. Alvarez-Serrano, J.J., et al., Normal incidence excitation of out-of-plane lattice resonances in bipartite arrays of metallic nanostructures. ACS photonics, 2023. **11**(1): p. 301-309.
2. Cerdán, L., et al., Perfect Absorption with Independent Electric and Magnetic Lattice Resonances in Metallo-Dielectric Arrays. Advanced Optical Materials, 2024. **12**(13): p. 2302737.