

PhD positions in Classical and Quantum Nanophotonics

The group of Quantum Interactions with Nanoparticles at Macquarie University (Sydney, Australia), led by Prof. Gabriel Molina-Terriza currently has two open positions for bright and highly motivated Ph.D. students. Our group has an extensive track record in the field of nanophotonics and the use of non-classical states of light to address nanostructures.

During the last years, we have extensively contributed to the field of chiral light-matter interactions, showing the major role of the angular momentum of the light. Also, we pioneered the control of electromagnetic helicity in the field of nanophotonics and, more specifically, its role in optical activity. Our new challenges are to apply all these tools to control the interaction of light and matter at the nanoscale. In particular, we are launching a new research line that will enable us to enhance the different response of left and right biomolecules. This project aims to enhance the sensitivity of optical activity to ultra-low molecular concentration samples.

The successful candidates will work in the fields of classical and quantum nanophotonics and chiral light-matter interactions. In our research group, the Ph.D. candidate will study, design and fabricate nanostructures, which preserve the electromagnetic duality. S/he will also learn to control the classical and quantum properties of optical modes of light to experimentally study the optical response of these nanostructures. The successful applicants will also have the chance to collaborate with world-leading theoretical groups and learn the numerical techniques to model the physical phenomena under research. Co-tutelle opportunities with the groups of Prof. Aizpurua (EHU) and Prof. Saenz (DIPC) are also available.

To qualify for the position, applicants must hold a diploma or master degree in physics, electrical engineering or related areas. Interested candidates should send an email to [Ass./Prof. Gabriel Molina-Terriza \(QIRON.Lab@gmail.com\)](mailto:QIRON.Lab@gmail.com) with the Subject "Ph.D. Application". The email should include an updated CV, a short description of research interests, the transcript of their academic performance and the names of up to three potential referees and their relationship to the candidate.

Main related references published by the group:

- 1.- Xavier Vidal, Ivan Fernandez-Corbaton, Alex F. Barbara, and Gabriel Molina-Terriza, "Polarization Properties of Light Scattered Off Solutions of Chiral Molecules in Non-Forward Direction", *Appl. Phys. Lett.* **107**, 211107 (2015).
- 2.- Mikolaj K. Schmidt, Javier Aizpurua, Xavier Zambrana-Puyalto, Xavier Vidal, Gabriel Molina-Terriza, and Juan José Sáenz, "Isotropically Polarized Speckle Patterns", *Phys. Rev. Lett.* **114**, 113902 (2015).
- 3.- Xavier Zambrana-Puyalto, Xavier Vidal, and Gabriel Molina-Terriza, "Angular Momentum-Induced Circular Dichroism in Non-Chiral Nanostructures", *Nature Communications* **5**, 4922 (2014).
- 4.- Nora Tischler, Ivan Fernandez-Corbaton, Xavier Zambrana-Puyalto, Alexander Minovich, Xavier Vidal, Mathieu L. Juan, and Gabriel Molina-Terriza, "Experimental Control of Optical Helicity in Nanophotonics", *Light: Science & Applications* **3**, e183 (2014).
- 5.- Ivan Fernandez-Corbaton, Xavier Zambrana-Puyalto, Nora Tischler, Xavier Vidal, Mathieu L. Juan, and Gabriel Molina-Terriza, "Electromagnetic Duality Symmetry and Helicity Conservation for the Macroscopic Maxwell's Equations", *Phys. Rev. Lett.* **111**, 060401 (2013).

6.- Xavier Zambrana-Puyalto, Xavier Vidal, Mathieu L. Juan, and Gabriel Molina-Terriza, "Dual and Anti-Dual Modes in Dielectric Spheres", *Opt. Express* **21**, 17520 (2013).

7.- Ivan Fernandez-Corbaton, Xavier Vidal, Nora Tischler, and Gabriel Molina-Terriza "Necessary Symmetry Conditions for the Rotation of Light", *J. Chem. Phys.* **138**, 214311 (2013).

8.- Xavier Zambrana-Puyalto, I. Fernandez-Corbaton, M. L. Juan, Xavier Vidal, and Gabriel Molina-Terriza, "Duality Symmetry and Kerker Conditions", *Opt. Lett.* **38**, 1857 (2013).

Other related references published by group members:

9.- Xavier Zambrana-Puyalto, Xavier Vidal, Ivan Fernandez-Corbaton, and Gabriel Molina-Terriza, "Far-Field Measurements of Vortex Beams Interacting with Nanoholes", *Scientific Reports* **6**, 22185 (2016).

10.- Ivan Fernandez-Corbaton, Xavier Zambrana-Puyalto, and Gabriel Molina-Terriza, "On the transformations generated by the electromagnetic spin and orbital angular momentum operators" *JOSA B* **31**, 2136 (2014).

11.- Xavier Vidal, Won Jin Kim, Alexander Baev, Valentyna Tokar, Hongsub Jee, Mark T. Swihart, and Paras N. Prasad, "Coupled Plasmons Induce Broadband Circular Dichroism in Patternable Films of Silver Nanoparticles with Chiral Ligands", *Nanoscale* **5**, 10550 (2013).

12.- Xavier Zambrana-Puyalto, and Gabriel Molina-Terriza, "The role of the angular momentum of light in Mie scattering. Excitation of dielectric spheres with Laguerre–Gaussian modes", *J. Quantitative Spectroscopy and Radiative Transfer* **126**, 50 (2013).

13.- Ivan Fernandez-Corbaton, and Gabriel Molina-Terriza, "Role of duality symmetry in transformation optics", *Phys. Rev. B* **88**, 085111 (2013).

14.- Ivan Fernandez-Corbaton, "Forward and backward helicity scattering coefficients for systems with discrete rotational symmetry", *Optics express* **21**, 29885 (2013).

15.- Xavier Zambrana-Puyalto, Xavier Vidal, and Gabriel Molina-Terriza, "Excitation of Single Multipolar Modes with Engineered Cylindrically Symmetric Fields", *Opt. Express* **20**, 24536 (2012).