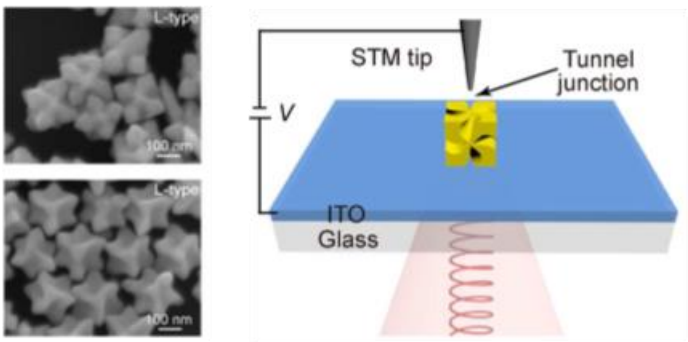
M2/Ph.D. position available (funding already acquired)

Local electrical excitation of a chiral nanoparticle

In this project we will study the tunneling-electron excitation of a chiral plasmonic nanoparticle in order to produce an electrical nanoscale source of circularly polarized light.

Chiral structures, whose initial and mirror structural images cannot be superimposed, interact differently with left-handed and right-handed circularly polarized light. This "chiroptical response" is in general very weak, but is enhanced in gold plasmonic nanoparticles. The goal of this project is thus to explore the near-field electrical excitation of chiral plasmonic nanoparticles in order to understand and exploit this chiroptical enhancement in a polarized nanosource of light.

The chiroptical response of materials and structures is most often studied by optical means, yet in any future optoelectronic nanodevice, a local electronic excitation is necessary. Working with this long-term goal in mind, we will investigate for the first time the *electrical* excitation of a chiral nanoparticle using the tunneling current from a *scanning tunneling microscope* (STM). We will demonstrate that, depending on the "handedness" of the nanoparticle, the emitted light will be either right-handed or left-handedly circularly polarized.



Left: Electron microscope images of chiral plasmonic nanoparticles fabricated by our collaborator (Jianfang Wang at the Chinese University of Hong Kong). Right: Schematic of the experiment; the tunneling current between the STM tip and the plasmonic chiral nanoparticle excites the plasmonic modes of the system. These modes then decay radiatively, leading to the emission of circularly polarized light. The "handedness" of the circularly polarized light depends on the "handedness" of the nanoparticle.

During this internship/thesis, the student will acquire experience in (i) scanning tunneling microscopy and atomic force microscopy (imaging of the chiral structures and excitation), (ii) optical microscopy (detection and analysis of the emitted light) and (iii) the theory of plasmonics. The successful applicant will have a physics background or equivalent, and will have an affinity for optics and nanoscience and a desire to do experiments. Good communication skills in English OR French are required. Note that for a motivated candidate, the project may also include numerical modeling.

Contact: Elizabeth Boer-Duchemin,
elizabeth.boer-duchemin@universite-paris-saclay.fr, 01 69 15 73 52,
Eric Le Moal, **eric.le-moal@universite-paris-saclay.fr, 01 69 15 66 97**
Institut des Sciences Moléculaires d'Orsay, Bât. 520, Université Paris-Saclay

For more information about our work:
https://www.youtube.com/watch?v=nqqpkWicR2k (in French)
https://www.youtube.com/watch?v=bZAs1W25_dQ (in French)
http://www.ismo.u-psud.fr/spip.php?rubrique199 (available in French and English)