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Post-Doctoral research position available at CRPP : *starting in 2023*
Supervisor : Alexandre Baron
Subject : Magnetic emission of light in optical dielectric and plasmonic nanostructures

Light-matter interaction is generally considered to originate exclusively from the interaction of the electric transition dipole of a material and the electric component of the electromagnetic field. But in reality, the interaction Hamiltonian between light and a quantum emitter contains several multipolar components, including the coupling of a magnetic transition dipole with the magnetic field. However, when electric transitions are allowed by symmetry, the electric transition dipole term is several orders of magnitude larger than any. Even when electric dipole transitions are forbidden in high-symmetry electronic wavefunctions, such as in Lanthanide ions to the first order, second-order processes such as ligand-field effects render electric dipole transitions dominant over symmetry-allowed transitions due to magnetic dipoles. For this reason, the engineering of luminescent lanthanide-based materials and organometallic complexes has focused extensively on the design of non-centrosymmetric architectures to factor symmetry-forbidden electric interactions.

The post-doc will join MELODIE, a project that seeks to introduce a paradigm shift in the optimization of luminescence from quantum emitters, featuring high-symmetry electronic wavefunctions. Instead of engineering the surrounding material, the electromagnetic local density of states (LDOS) will be tuned by resorting to resonant dielectric and plasmonic nanostructures to enhance symmetry-allowed magnetic dipole transitions. MELODIE is composed of a consortium of four laboratories with complementary expertise. The post-doc shall join the theoretical and numerical effort to model and design the optical properties of complex nanostructures fabricated and characterized within the consortium. They will work in close collaboration with teams from the ICMCB in Bordeaux, the INSP (Sorbonne University in Paris) and ESPCI in Paris. It will be a great opportunity to meet high-level French experts in the fabrication, modeling and characterization of plasmonic and dielectric resonant nanoparticles in France. They shall work with the finite-element (FEM) based commercial software COMSOL Multiphysics to compute the properties of complex nanostructures that are fabricated within the consortium, as well as with in-house built Matlab and Python Mie scattering codes for the optical properties of individual particles.

Candidates should hold a PhD in Physics or equivalent, have a solid background in Physics simulation and have a very good level of written and spoken English.

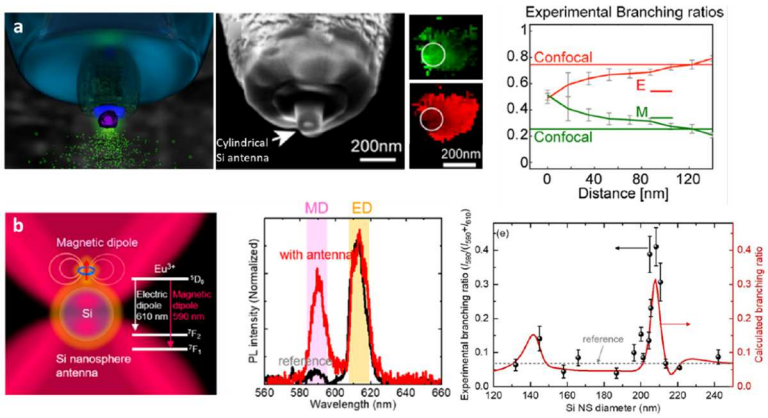

Figure 1 – Magnetic dipole emission enhancement by the Purcell effect. (a) Silicon resonator near europium-doped oxide nanoparticles characterized by scanning-probe microscopy. Adapted from *M. Sanz-Paz et al., Nano Lett. 18, 3481 (2018).* **(b)** Europium-based organo-metallic complexes positioned on the surface of a silicon sphere. Adpated from *H. Sugimoto et al., ACS Photonics 8, 1794 (2021).*