2023-2024

Master and PhD Proposal

Campus Pierre et Marie Curie
Tower 23 – 3rd floor – 23-22
Director: Massimiliano Marangolo

Title: Harvesting the Magnetic Field of Light at the Nanoscale

Keywords: Magnetic Field of Light, Quantum Emitters, Photonic Antennas, Near field Optics

Scientific description:
Light carries both an electric and a magnetic field but light-matter interactions (occurring in photosynthesis or photovoltaics, in our eyes, in quantum technologies and so on), are generally considered to be mediated only by the electric component of light, neglecting its magnetic counterpart.
At the interface between nanophotonics (optics at the nanometer scale) and quantum optics (optics of energy quanta), this master project consists in using metallic and dielectric nanostructures, known as optical nanoantennas, to isolate and enhance the optical magnetic field with respect to its electric counterpart. A luminescent nanoparticle will then be placed, using a near field setup or through synthesis, in the center of the magnetic hot spot, in order to reveal the coupling between the 'magnetic light' and matter (examples in figure 1).
This experimental master project is part of a completely new field of research with high potential both in terms of scientific publications and possible applications.
The master student will work in close collaboration with Mathieu Mivelle and Sébastien Bidault, CNRS Researchers, Benoît Reynier and Pascale Nasr, PhD students, and Eric Charron, Research engineer. **For more information, visit our Webpage**.

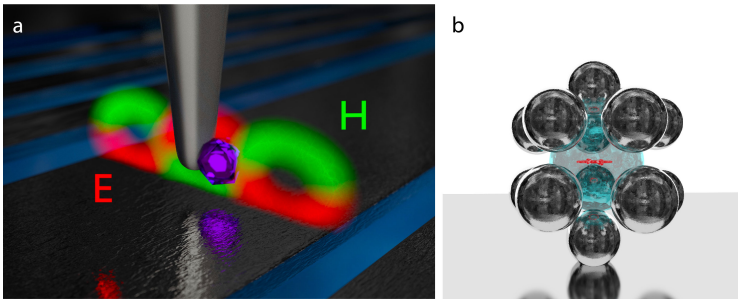

Figure 1. a) *Illustration of a quantum emitter (purple) coupled to the magnetic or electric optical field around a photonic nanostructure. b) A particle containing magnetic transitions is surrounded by silver spheres, significantly increasing the magnetic field in its center, which strongly enhances the coupling between the magnetic component of the light and a quantum emitter.*

Techniques/methods in use: Near Field Optical Microscopy, single particle spectroscopy
Applicant skills: Curiosity, Motivation and Experimental liking & skills
Industrial partnership: No
Internship supervisor: Mivelle Mathieu, mathieu.mivelle@sorbonne-universite.fr, 0144274442, Webpage.
Internship location: Sorbonne Université, INSP, 22-32, fifth floor.
Possibility for a Doctoral thesis: Yes, ERC fellowship.