ESONN'2022 European School On Nanosciences and Nanotechnologies

Practicals

N°10: Nanoscale nonlinear optics with plasmonic antennas

Teachers:
Sanro Mathew (PhD student) and Guillaume Bachelier (associate professor), Néel Institute

Nonlinear nanophotonics is a great opportunity for opening new and promising paths towards a wide range of practical applications in sensors, quantum computers or cryptography. The main challenge lies in the intrinsic weakness of the nonlinear response, which has triggered considerable efforts over the last past years. In this context, plasmonics has a singular position: it provides intrinsic nanoscale localization of the electromagnetic field, breaking the usual diffraction limit, but also large field enhancements associated with the localized plasmonic resonances (SPR).

During the practical, we will investigate two nonlinear processes: the two photon luminescence (TPL) and the second harmonic generation (SHG). In both mechanisms, two low energy photons are converted into a single and more energetic photon. The main difference lies in the nonradiative step, as in any luminescence process, leading to decoherence. Here, we will spectrally and spatially characterize these two non-linear processes on gold nanoantennas, produced in the NanoFab platform (G. Nogues), showing the link between the SPR resonance ant the nonlinear optical properties.

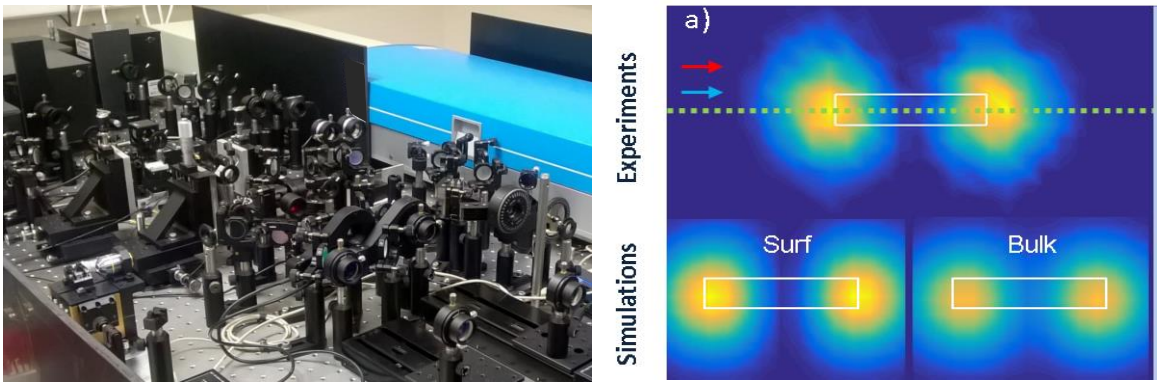

Figure: Optical setup used for the experiments (left) and typical SHG maps obtained with 425 long aluminum antennas excited at 850 nm (right).

The candidate will learn up-to-date techniques ranging from ultra sensitive measurements (a few photon/s noise), nano-positioning (with nm spatial resolution), femtosecond pulses manipulation (100 fs pulse duration oscillator) after a training on optical alignment.