

# MASTER INTERNSHIP M2 PPN (5 months)

2022-2023

**Title of the project:** Inelastic light scattering by chiral metallic nanoparticles

**Supervisor(s):** Lucien Saviot

Laboratory / Department / Team : ICB/Nanosciences

**Collaborations:** CHIRNATIO project (ANR AAPG 2022)

## Summary:

This internship is funded by the CHIRNATIO ANR project [1] whose goal is to develop chiral gold nanoparticles for enantioselective detection. In this context, chiral gold nanoparticles are synthesized and investigated in particular using inelastic light scattering (Raman/Brillouin) by a partner. The goal of this internship is to develop a method to analyze these experimental spectra and interpret the observed experimental features. Inelastic light scattering allow observing acoustic vibrations confined in gold nanoparticles. These vibrations are similar to those of a 1D string [1] but for 3D nano-objects [2]. They depend on the material the nanoparticles are made of, the shape of the nanoparticles, their inner lattice structure and their environment. This makes inelastic light scattering a method of choice to characterize all these parameters. Their frequencies vary as the inverse of the size and fall in the GHz to THz range for sizes between 1 and 100 nm. In the case of metallic nanoparticles, the inelastic light scattering cross-sections become quite large when the excitation is close to the localized surface plasmon resonance (LSPR) of the nanoparticles. The inelastic light scattering mechanisms have been extensively studied. Analytical models exist to calculate the spectra of spherical elastically isotropic nanoparticles. The goal of this internship is to extend these calculations to anisotropic nanoparticles for which no analytic expressions exist to describe the vibrations and/or the surface plasmon resonance. For this purpose, a review of recent works in this domain will be performed. Then a numerical model will be developed using the finite element method or any other suitable numerical approach.

[1] <https://anr.fr/Projet-ANR-22-CE09-0007>

[2] [https://en.wikipedia.org/wiki/String\\_vibration](https://en.wikipedia.org/wiki/String_vibration)

[3] <https://saviot.cnrs.fr/rus/cubic/index.en.html>

**Type of project (theory / experiment):** theory

**Required skills:** basic knowledge of the optical properties of metallic nanoparticles and the finite element method would be appreciated