Stimulated low frequency inelastc light scattering in liquids

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In Cooperation With :	Institut Lumière Matière, luminescence team
Level :	M1 / M2
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Scientific Context :

The study of acoustic vibrations of nanoparticles is of great interest to understand their mechanical properties. Inelastic light scattering spectroscopy at low frequencies (between 10 and 100 GHz) makes it possible to measure their acoustic vibrations when the nanoparticles are embedded in a solid matrix. However, when the nanoparticles are placed in a liquid medium, the measurement of these modes using this technique is a real challenge. The vibrations of the nanoparticles are damped due to the high impedance contrast between the nanoparticles and the liquid. To overcome this difficulty, the objective of the internship would be to demonstrate the possibility of stimulating the vibration of the nanoparticles in order to improve the scattering signal. For this purpose, the objective would be to generate an acoustic wave propagation in the liquid, using two lasers slightly detuned in frequency. The frequency shift will then be scanned to obtain resonance conditions with the vibration of the nanoparticle to improve light scattering by a third laser.

Missions :

The training period will be separated into two main parts. First, the trainee will measure the generation of acoustic waves in different liquids. To do this, he will have to build a simple experimental device combining three different lasers. The first two, in the infrared range, will be used to generate the acoustic wave in the liquid. This wavelength depends on the frequency offset between the two lasers. Then, a third (visible) laser will be used to detect this acoustic wave using a Brillouin spectrometer. A complete study according to the detuning of the laser and the geometry of the experiment will be realized. The final goal of this parts will be to determine the efficiency of the acoustic wave generation as a function of the liquid nature. Once this first step is complete, the student will work on solutions containing large metal particles (100 nm in diameter). Using the preliminary characterization steps, the trainee will configure the configuration specifically for this purpose. The objective would then be to study the effect of size dispersion and damping effect in different types of liquids.
Competences acquired during the internship: Optics, Brillouin and Raman spectroscopy, nanoparticle acoustic vibration, stimulated spectroscopy, electrostriction.

Outlooks :

This internship can be extended to a PhD via an ED-PHAST founding, to study single nanoparticle vibration in liquid