Christophe Galland
École polytechnique fédérale de Lausanne

Quantum Correlations between Light and Mechanical Oscillators

Mechanical oscillators have been identified as new resources for quantum optics and its applications in sensing and information processing. Developing new techniques to prepare non-classical states of mechanical oscillators and engineer their quantum correlations with light fields also promises new insights into the dynamics and decoherence of vibrations in the quantum regime. In this context, I am particularly interested in probing multi-mode mechanical oscillators using pulsed techniques to shed new light on how many-body quantum correlations can be prepared, would evolve and decay in these complex systems.

In this talk, I will present the first experimental milestones achieved with my group over the past 2 years toward this endeavour. In 2018, we established a new ultrafast pump-probe technique to prepare and characterise a single phonon Fock state of THz-frequency internal vibrations in a diamond crystal. In 2019, we performed the first demonstration that Bell correlations between light and vibration can be engineered at room temperature. Our technique enables to watch the decoherence of a vibrational qubit with 200 fs resolution

I will conclude by presenting our other activities in molecular cavity quantum optomechanics, and our collaboration with the startup LakeDiamond toward applications of quantum sensing with NV centres. I will also present my future plans to develop integrated optomechanical platforms operating above 100 GHz, enabling experiments in the quantum regime with standard He cryostats.