Master 2 Internship

Coherent control of nanomechanical resonator motion using surface acoustic waves

Keywords :
Phononics, micro- nano-systems, quantum acoustics, surface acoustic waves, instrumentation.

General Context

The MN2S department of the FEMTO-ST Institute has recently launched a set of activities lying at the merging of Phononics and Nanomechanics. The objective of this work programme is to build an on-chip all-electromechanical signal procesing platform capable to operate in both the classical and quantum regimes. The proposed device is based on the interaction of mechanical resonators exhibiting dimensions in the micron or sub-micron scale and surface acoustic waves (SAW). The SAW can be used to trigger, address and control the resonator system, with the ambition to reach a finest control of the displacement and strain fields at frequencies ranging from a hundred of MHz up to a GHz.

We have recently demonstrated both experimentally and numerically the relevance of merging surface acoustic waves and coupled mechanical resonators to coherently control the resonator motion and manipulate surface acoustic wave propagation at a sub-wavelength scale [1].

Objectives

In the frame of this internship, the candidate will carry on these investigations by focusing on the influence of the excitation conditions on the polarization states of micro- nano-mechanical resonators. These states could indeed constitute one of the building blocks of the all-electromechanical signal processing functions aimed at. The proposed work programme will rely on experimental set-ups, already available, allowing to characterize optically the elastic displacement fields (opical inteferometers); on the technological tools and processes available within the MIMENTO Technology Center of FEMTO-ST and on numerical models based on the finite element method. The successful applicant will most notably be entrusted with the following tasks:

- Lead and plan the experimental investigation, alongside the host team members.
- Contribute to the design and fabrication of the proposed devices,
- Perform numerical simulations using the finite element models provided,
- Use and improve the experimental set-ups used for the characterization of the elastic displacement fields (heterodyne and homodyne optical inteferometers, most notably),
- Analyze the experimental data and present the obtained results,
- Compare the experimental results to numerical simulations.

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Expected Internship Period: 01/03/2020 to 31/08/2020.
Work place : Institut FEMTO-ST, département MN2S.
Supervision : Sarah Benchabane, Abdelkrim Khelif.

[1]L. Raguin *et al.*, Nature Commun. 10, 4583 (2019).