

INTERNSHIP PROPOSAL

(One page maximum)

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Internship location: INSP – Sorbonne Université	
Thesis possibility after internship: YES	
Funding: YES	Type of funding: ANR

Realizing arbitrary quantum operations on a mechanical oscillator

Summary

Quantum optomechanics and electromechanics is a fast growing field with promising applications in quantum information. Recently non-classical mechanical states have been realized. However, full control of a quantum mechanical mode, which is necessary for successful quantum information processing based on electromechanical systems, has yet to be demonstrated. This internship aims to develop a novel quantum electromechanical device capable of obtaining full quantum control of a macroscopic mechanical resonator by integrating a phononic microcavity with a superconducting transmon qubit. We expect to achieve a very strong qubit-phonon coupling coefficient that will allow the realization of any quantum unitary operation on the phononic mode. This will have important applications in quantum information and quantum sensing. In addition this project opens the route to test the relevance of the quantum mechanics to the macroscopic world.

We have several funding grants for this project, including an ANR and a regional funding grant from Île de France.

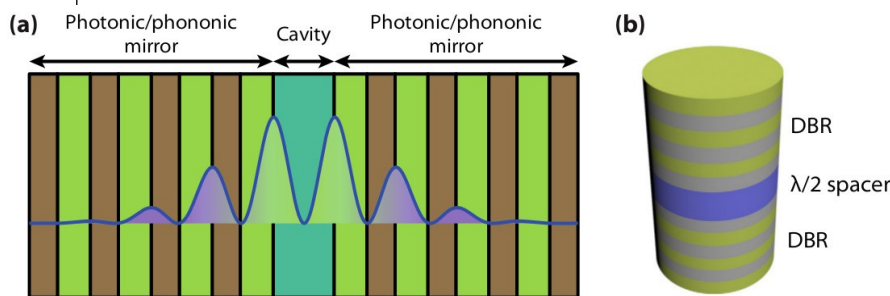
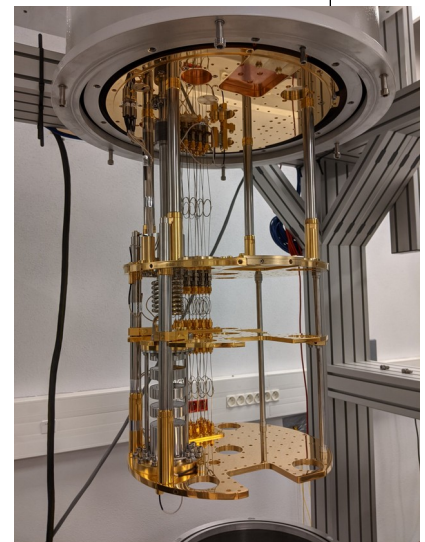


Figure (a) GaAs/AlAs superlattice cavity composed by a $\lambda/2$ GaAs spacer (blue) and two DBRs mirrors made of bilayers of AlGaAs/AlAs (gray/green). (b) After the growth a micropillar can be patterned by dry etching.



Please, indicate which speciality(ies) seem(s) to be more adapted to the subject:

Condensed Matter Physics: YES	Soft Matter and Biological Physics: NO
Quantum Physics: YES	Theoretical Physics: NO