INSTITUT NEEL Grenoble

ERC ULT-NEMS

Ultra-cold Nanomechanics

Context:
Keywords : quantum mechanics, nano-mechanics, non-linear phenomena, low temperatures, ground-state cooling

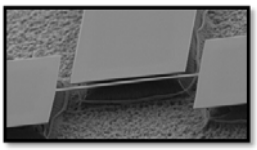
Highly motivated students are sought for an ERC-funded project devoted to fundamental research using nanomechanics cooled down to the lowest possible temperatures. It has two facets: a macroscopic approach concerned with the quantum mechanics behavior of the moving device itself, and a microscopic one concerned with elementary excitations in quantum matter.

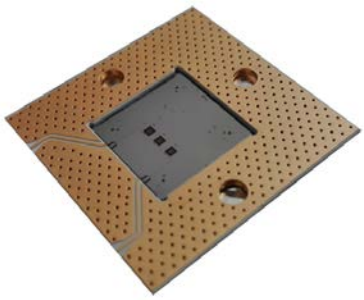
Objectives and means available:

The project is based on the « brute force » cooling of nanomechanical devices down to temperatures around/below 1 mK. For beams resonating around 100 MHz in their first flexure, the collective modes describing the motion are in *their quantum ground states*. Experiments probing mechanical quantum coherence are then possible, on a system which is at equilibrium. These coherence properties are linked to fundamental aspects of quantum theory, with new developments (e.g. stochastic collapse) and old paradoxes (e.g. Schrödinger cat).

Properties of quantum matter are probed by looking at intrinsic mechanical dissipation mechanisms in the constitutive solids, or by immersing the devices in a quantum fluid: superfluid ^{3}He. Intriguing states of matter can then be probed, with e.g. the Tunneling Two-Level Systems of glasses and the elementary excitations of the BCS superfluid.

These experiments rely on cryogenic capabilities of the group: dilution cryostats and nuclear demagnetization cooling down to the 100 µK range. A new and unique platform allying microkelvin temperatures and microwave signals is being built in our group.





Figures: a silicon-nitride high-quality nanomechanical beam coupled to a gate electrode (center), and a microwave cavity setup for quantum-limited readout of the dynamics (right).

Possible collaboration and networking:

This research is carried out at Institut Néel, in collaboration with other researchers from the laboratory. It is performed in the framework of the *European Microkelvin Platform (EMP)*, with contacts to other ultra-low temperature facilities in Europe (UK, Germany, Finland…).

Required profile:

The student should have a strong interest in fundamental research and making challenging measurements at very low temperatures, as well as a thorough understanding of quantum theory at the Master's Degree level.

Foreseen start for the grant : September 2017
Amount : about 1700 €/month gross
Duration : 36 months

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