INSTITUT NEEL Grenoble

Proposition de stage Master 2 - Année universitaire 2019-2020

Glass Nanomechanical Resonators in the Quantum Ground State

Context:

Keywords: Quantum engineering, two-level systems, glass

Highly motivated students are sought for an ERC-funded project devoted to identifying the universal low energy excitations of glass. These excitations, thought to be two level systems (TLSs) formed by atoms or groups of atoms tunneling between nearly equivalent states, will be probed on the individual level for the first time. This will allow us to make a microscopic test of the controversial "tunneling model" of glass.

Objectives and means available:

In order to access individual TLSs, a glass nanomechanical resonator will be cooled to its quantum ground state around 1 mK. Only a few research groups worldwide have succeeded in cooling a mechanical resonator to the ground state, and most of them use active cooling schemes in which only the mechanical mode of interest is cold. In contrast, we will draw on our expertise in ultra-low temperature measurements to cool the entire mechanical resonator to 1 mK.

Ultimately, we are interested in properties of quantum matter. In particular, the identity of the TLSs will be investigated by making the first measurements of individual TLSs inside a mechanical resonator. The quantum state of the resonator will be controlled using a qubit to enable these measurements. First we will look for a signature of an individual TLS in spectroscopic measurements of the ground-state glass resonator. Then we will use quantum control of the mechanical resonator to in turn control and measure the quantum state of the TLS. This will yield information about the TLS and a test of the "tunneling model" mentioned above.

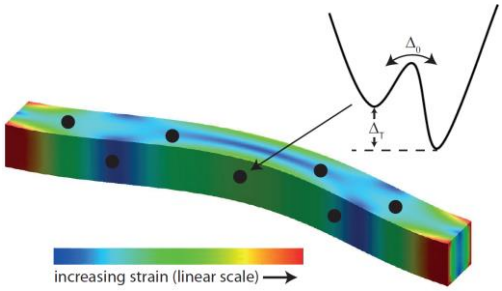

Figure: Intrinsic tunneling two level systems (TLSs) inside a glass nanomechanical resonator. The mechanical resonator will be cooled to the quantum ground state to enable measurements of the individual TLSs.

Possible collaborations and networking:

This work may involve collaboration and interactions with researchers at the Institut Néel, elsewhere in Europe and in the United States.

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.

This internship may be followed by a funded PhD position.

Starting Date : Flexible

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Plus d'informations sur : http://uni-glass.eu