Glass Nanomechanical Resonators in the Quantum Ground State

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Openings for a postdoc and a PhD student are available in an ERC-funded project devoted to identifying the universal low energy excitations of glass.[1] These excitations, thought to be two level systems (TLSs) formed by atoms tunneling between nearly equivalent states, will be probed on the individual level for the first time in mechanical systems. This will allow us to make a microscopic test of the controversial "tunneling model" of glass.[2]

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.[3] In contrast, we will draw on our expertise in ultra-low temperature measurements to realize good thermal coupling of the mechanical resonator to the sub-mK cold plate of the cryostat. Our progress towards this goal is reported in Ref. 4.

Once the ground state is reached, we will look for a signature of an individual TLS in spectroscopic measurements of the glass resonator. We will ultimately use a qubit to control the quantum state of the mechanical mode and TLS.

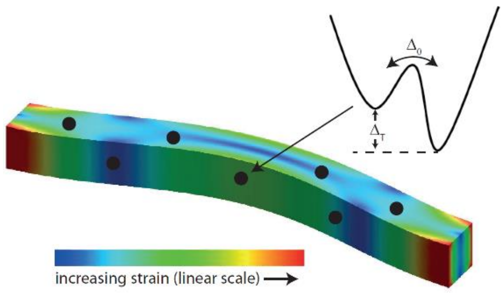

Figure: Intrinsic tunneling two level systems (TLSs) inside a glass nanomechanical resonator. The mechanical resonator will be cooled to the quantum ground state to enable measurements of the individual TLSs.

For more information, please contact Andrew Fefferman, the PI of the project (andrew.fefferman@neel.cnrs.fr).

References:

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2. P. W. Anderson *et al. Phil. Mag.* **25**, 1 (1972); W. A. Phillips *JLTP* **7**, 351 (1972).
3. O'Connell *et al.*, *Nature* **464**, 697 (2010); Teufel *et al.*, *Nature* **475**, 359 (2011); Chan *et al. Nature* **478**, 89 (2011).
4. X. Zhou *et al.* "On-chip thermometry for microwave optomechanics implemented in a nuclear demagnetization cryostat," *Physical Review Applied* **12**, 044066 (2019).