

Quantum paraelectrics : hot, cool, and active

Quantum fluctuations prevent the phase transition of quantum paraelectrics toward a long-range (ferroelectric) state where all dipoles align. Such an effect prevails at very low temperatures. As a consequence, these materials are known to exhibit extraordinarily high permittivity (larger than 10,000). However, they are also of interest as model materials for their multi-physics properties, e.g. magnetic-free solid-state cooling through the electro-caloric effect, superior cryogenic actuation through an original electro-mechanical coupling which is neither piezoelectric nor electrostrictive, etc. The theoretical framework for these materials is incomplete and requires specific experimental measurements at cryogenic temperatures. The internship will consist of carrying out measurements down to 10K to determine the temperature range over which the quantum fluctuations prevail, depending on the respective energies of the classical and quantum phases. The



electro-caloric and electro-mechanical properties will subsequently be measured in the quantum phase, and the influence of the quantum fluctuations will be derived by extending existing models. This internship can be extended to a full PhD thesis.

The SPMS lab is world-renowned for its research on functional materials, especially ferroelectrics. It is equipped with state-of-the-art experimental setups maintained by highly skilled scientific and technical staff and provides access to supercomputers for numerical simulations. It hosts many PhD students and young, enthusiastic researchers, providing an inclusive and multinational work environment.

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