Quantum acoustics with spin qubits

**Context:** Acoustic and nanomechanical systems have recently emerged as a powerful quantum technology: these mechanical oscillators have applications ranging from quantum sensing to quantum memories. Using tools from quantum acoustics/nanomechanics now appears as a promising strategy to detect and manipulate solid-state spin qubits. With the prospect of large-scale quantum computing, finding efficient ways to readout, control and couple distant spin qubits is the source of an intense research effort worldwide. To perform quantum acoustics with spin qubits and achieve highly coherent interactions between single spins and single phonons, a central goal is now to push the development of mechanical oscillators with both high frequency and strong quantum fluctuations.

**Research topic and facilities available:** During this project, the student will first learn how to design, fabricate and operate devices based on quantum acoustics and nanomechanical oscillators. These devices will be engineered with the goal to enhance interactions with isolated spin qubits hosted in single molecules. This platform will then be used to explore interactions between single spins and single phonons, and exploit them to readout and coherently manipulate spin qubits.

The fabrication will take place in the clean room of the Néel institute, using state-of-the-art nano-fabrication techniques and high performance materials (such as LiNbO₃). The microwave measurements (GHz frequencies) will be performed at cryogenic temperatures (20 mK) using a dedicated dilution refrigerator.

**Possible collaboration and networking:** The quantECA team is involved in many national and international collaborations. This project benefits in particular from collaborations with F. Balestro (Néel Institute) and W. Wernsdorfer (KIT, Germany).

**Possible extension as a PhD:** Yes

**Required skills:** We are looking for a motivated student, willing to be part of a project involving both technical and fundamental challenges, and wanting to learn a variety of skills in experimental condensed matter physics.

**Starting date:** Flexible

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