Coherent dynamics of single spins coupled to diamond mechanical oscillators

P. Maletinsky

University of Basel

A single spin coupled to a mechanical oscillator forms a prototypical hybrid quantum system. With a strong and robust coupling mechanism, such devices could yield high-performance nanoscale sensors, be applied for quantum information processing tasks or ultimately be used to study macroscopic objects in the quantum regime. In this talk, I will present our recent experiments where we established a novel type of such a hybrid spin-oscillator system. Specifically, we implemented for the first time diamond nanomechanical resonators, which are coupled to embedded Nitrogen-Vacancy centre electronic spins through crystalline strain. This strain coupling is highly robust, potentially strong and it leads to interesting dynamics due to the nontrivial strain coupling Hamiltonian. I will illustrate these aspects though our recent experimental results, which include the first quantitative determination of the strain coupling strengths and the demonstration of resolved sideband operation in our devices. I will also discuss preliminary data which show the intriguing quantum dynamics that our strain-coupled spin-oscillator system can undergo. Our results demonstrate first essential steps towards further experiments in the quantum regime, such as spin-based oscillator sideband cooling or the recently proposed generation of spin-squeezing in nanomechanical oscillators.