MAR15-2014-020225
Abstract for an Invited Paper
for the MAR15 Meeting of
the American Physical Society

Dynamics of a strain-coupled, hybrid spin-oscillator system

JEAN TEISSIER, 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 (NV) centre electronic spins through crystalline strain. This strain coupling mechanism is highly robust, potentially strong and 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 relevant strain coupling constants and the demonstration of resolved sideband operation in our devices. I will also discuss recent experiments in which we demonstrated coherent driving of NV spins through time-varying strain fields and studied the resulting intriguing dynamics of the strain-driven NV spin system. Our results constitute first essential steps towards future experiments of our hybrid system in the quantum regime. Examples for these include spin-based oscillator sideband cooling or the recently proposed generation of spin-squeezing in nanomechanical oscillators.