Quantum Spin-Mechanics with Color Centers in Diamond

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Quantum acoustics is an emerging field focusing on interactions between acoustic waves and artificial atoms that can be exploited in quantum science. Acoustic waves propagate at a speed that is five orders of magnitude slower than the speed of light and couple to artificial atoms through mechanical processes, thereby enabling a new paradigm for on-chip quantum operation and communication. The extensive technologies developed for micro-electro-mechanical systems (MEMS) can also be adapted for quantum acoustics.

Among the various artificial atoms or qubits that have been explored, nitrogen vacancy (NV) color centers in diamond are of special interest because of their robust spin coherence and the ease with which these qubits can be measured and controlled. In this talk, I will discuss our recent experimental advance in coupling NV centers to surface acoustic waves (SAWs). By exploiting strain coupling to orbital degrees of freedom, we are able to induce strong and coherent spin-mechanical interactions with SAW amplitudes at only a fraction of a picometer. This platform opens a new avenue for experimental exploration of spin-based quantum acoustics.