Coherent Magnonics for Quantum Information Science with NV Spins

Michael E. Flatté

Department of Physics and Astronomy, University of Iowa, Iowa City, IA 52242
Department of Applied Physics, Eindhoven University of Technology, Eindhoven, The Netherlands

The current revolution in quantum technologies relies on coherently linking quantum objects like quantum bits ("qubits"). Coherent magnonic excitations of low-loss magnetic materials can wire together these qubits for sensing, memory, and computing. Although nitrogen-vacancy (NV) centers in diamond provide a promising qubit platform, developing scalable two-qubit gates remains a well-known challenge. To this end, magnon-mediated entanglement proposals have attracted attention due to their long-range spin-coherent propagation. I will describe predictions of strong long-distance (> μm) NV-NV coupling via magnon modes with cooperativities exceeding unity in ferromagnetic bar and waveguide structures. These coherent magnonic properties have also motivated studies of quantum transduction from "stationary" NV spin systems to "flying" magnons, and applications to quantum memory. This work was supported by the U.S. Department of Energy, Office of Science, Basic Energy Sciences, under Award Number DE-SC0019250.