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Efficient coherent driving of NV centers in a YIG-nanodiamond hybrid platform[1] PAOLO ANDRICH, CHARLES F. DE LAS CASAS, XIAOYING LIU, HOPE L. BRETSCHER, PAUL F. NEALEY, DAVID D. AWSCHALOM, Institute for Molecular Engineering, University of Chicago, Chicago, IL 60637, USA, F. JOSEPH HEREMANS, Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439, USA — The nitrogen-vacancy (NV) center in diamond is an ideal candidate for room temperature quantum computing and sensing applications. These schemes rely on magnetic dipolar interactions between the NV centers and other paramagnetic centers, imposing a stringent limit on the spin-to-spin separation. For instance, creating multi-qubit entanglement requires two NV centers to be within a few nanometers of each other, limiting the possibility for individual optical and microwave (MW) control. Moreover, to sense spins external to the diamond lattice the NV centers need to be within few nanometers from the surface, where their coherence properties are strongly reduced. In this work, we address these limitations using a hybrid YIG-nanodiamond platform where propagating spin-waves (SWs) are used to mediate the interaction between a MW source and a NV center ensemble, thereby relaxing the requirements imposed by dipolar interactions. In particular, we show that SWs can be used to amplify a MW signal detected by the NV centers by more than two orders of magnitude, allowing us to obtain ultra-low energy SW-driven coherent control of the NV centers. These results demonstrate the potentials of YIG-ND hybrid systems for the realization of enhanced quantum sensing and scalable computing devices.

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