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Exploring magnetic excitations in the condensed matter using single electron spins TOENO VAN DER SAR, Harvard University, FRANCESCO CASOLA, RONALD WALSWORTH, Harvard-Smithsonian Center for Astrophysics, AMIR YACOBY, Harvard University — Pushing the frontiers of condensed-matter magnetism requires tools to probe magnetic excitations on the nanometer scale. We have developed a new approach to exploring magnetic excitations in correlated-electron systems [1], using magnetometry based on single electron spins in diamond. We demonstrate the power of this approach by detecting spin-wave excitations in a ferromagnetic microdisc with nanoscale spatial sensitivity over a broad range of frequencies and magnetic fields. In addition, we show how spin-wave resonances can be exploited for on-chip amplification of microwave magnetic fields, allowing strongly increased spin manipulation rates and single-spin magnetometry with enhanced sensitivity. These results can be directly applied to nanoscale magnetic imaging of spin-wave propagation and magnetic vortex/skyrmion dynamics, and open the way towards spin-spin coupling via ferromagnets.

[1] T. van der Sar, F. Casola, R. Walsworth, and A. Yacoby, arXiv:1410.6423 (2014).

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