Abstract Submitted for the DAMOP15 Meeting of The American Physical Society

Nanometer-scale probing of spin waves using single electron spins TOENO VAN DER SAR, Department of Physics, Harvard University, 17 Oxford St., Cambridge, MA 02138, USA., FRANCESCO CASOLA, RONALD WALSWORTH, Harvard-Smithsonian Center for Astrophysics, 60 Garden St., Cambridge, MA 02138, USA., AMIR YACOBY, Department of Physics, Harvard University, 17 Oxford St., Cambridge, MA 02138, USA. — We have developed a new approach to exploring magnetic excitations in correlated-electron systems [1], based on single electronic spins in atom-like defects diamond known as nitrogen-vacancy (NV) color centers. 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. 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. Finally, we show the possibility to detect the magnetic spin noise produced by a thin ( $\sim 30 \text{ nm}$ ) layer of a patterned ferromagnet. For the interpretation of our results, we develop a general framework describing single-spin stray field detection in terms of a filter function sensitive mostly to spin fluctuations with wavevector  $\sim 1/d$ , where d is the NV-ferromagnet distance. Our results pave the way towards quantitative and non-perturbative detection of spectral properties in nanomagnets, establishing NV center magnetometry as an emergent probe of collective spin dynamics in condensed matter.

[1] arXiv:1410.6423v2 (2014).

Francesco Casola Harvard-Smithsonian CFA

Date submitted: 30 Jan 2015

Electronic form version 1.4