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Single spin relaxometry of spin noise from a ferromagnet FRANCESCO CASOLA, 1) Harvard-Smithsonian Center for Astrophysics, 60 Garden St., Cambridge, MA 02138, USA, 2) Department of Physics, Harvard University, TOENO VAN DER SAR, Department of Physics, Harvard University, 17 Oxford St., Cambridge, MA 02138, USA, RONALD WALSWORTH, 1) Harvard-Smithsonian Center for Astrophysics, 60 Garden St., Cambridge, MA 02138, USA, 2) Department of Physics, Harvard University, AMIR YACOBY, Department of Physics, Harvard University, 17 Oxford St., Cambridge, MA 02138, USA — The introduction of new schemes for the measurement of spatially resolved dynamic magnetic properties of strongly correlated electrons is essential for the study of condensed matter magnetism and the development of novel spintronic devices. Here we show the possibility to detect the magnetic spin noise produced by a thin (~ 30 nm) layer of a patterned micro-sized ferromagnet ($Ni_{81}Fe_{19}$) by optical initialization and readout of the single spin state of a nearby nitrogen vacancy center (NV) in diamond. 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].

[1] T. van der Sar, F. Casola, R. Walsworth, and A. Yacoby, arXiv:1410.6423v2 (2014).

Francesco Casola
Harvard-Smithsonian Center for Astrophysics;
Department of Physics, Harvard University

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