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Field noise near ferromagnetic films. ROBERT MCMICHAEL, HAUJIAN LIU, NIST Center for Nanoscale Science and Technology, SEUNGHA YOON, NIST Center for Nanoscale Science and Technology and Maryland Nanocenter, University of Maryland — Thermally driven magnetization fluctuations can be viewed as a nuisance noise source or as interesting physics. For example, mag noise in a field sensor may set the minimum detectable field of that sensor. On the other hand, the field noise spectrum reflects the dynamics of the magnetic components, which are essential for device operation. Here, we model the field noise spectrum near the surface of a magnetic film due to thermal spin waves, and we calculate its effect on the T_1 relaxation rate of a nearby nitrogen-vacancy (NV) center spin[1]. The model incorporates four components: the spin wave dispersion of the magnetization in a finite-thickness film, thermal excitation of spin waves, the coupling geometry between waves in the film and an external point dipole and finally, the relaxation dynamics of the NV spin. At a distance of 100 nm above a 50 nm thick permalloy film, we find that the strongest stray fields are along the film normal and parallel to the magnetization, on the order of 1 mA m^{-1} $Hz^{-1/2}$ or 1 nT $Hz^{-1/2}$, yielding relaxation times on the order of 10 μs. The spin wave field noise can dominate the intrinsic relaxation, ($T_1 \approx 1$ ms) of the NV center spin. [1] T. van der Sar, et al., Nat. Commun. 6, 7886 (2015).

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