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Simulating narrow nonlinear resonance features for magnetometry in compact cold atom systems DAVID MEYER, JENN ROBINSON, PAUL KUNZ, QUDSIA QURAISHI, U.S. Army Research Laboratory — We are investigating cold atom magnetometry applications and have developed a numeric model of Electromagnetically Induced Absorption (EIA) and Nonlinear Magneto-Optical Rotation (NMOR) for degenerate two-level systems. While most EIA and NMOR research is done in warm vapors, cold atoms avoid Doppler broadening and better isolate the various optical pumping mechanisms involved. Our model focuses on the effect of transverse magnetic fields on both EIA and NMOR features and shows that critical points of both yield quantitative measures of the magnitude and direction of the transverse field. This dependence reveals the underlying optical pumping mechanisms and makes possible a single, in-situ measurement of the background magnetic field zero to the sub-milligauss level, reducing background fields to enhance sub-Doppler cooling and collectively-enhanced neutral-atom quantum memory lifetimes. Separately, we are pursuing experimental measurements on the relationship between EIA and NMOR in a compact cold atom apparatus. To improve the system's capabilities we are designing our next-generation atom chip to reduce system size and employ versatile geometries enabling multi-site trapping.

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