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Electromagnetically Induced Absorption (EIA) and a "Twist" on Nonlinear Magneto-optical Rotation (NMOR) with Cold Atoms PAUL KUNZ, DAVID MEYER, QUDSIA QURAISHI, US Army Research Laboratory — Within the class of nonlinear optical effects that exhibit sub-natural linewidth features, electromagnetically induced transparency (EIT) and nonlinear magneto-optical rotation (NMOR) stand out as having made dramatic impacts on various applications including atomic clocks, magnetometry, and single photon storage. A related effect, known as electromagnetically induced absorption (EIA), has received less attention in the literature. Here, we report on the first observation of EIA in cold atoms using the Hanle configuration, where a single laser beam is used to both pump and probe the atoms while sweeping a magnetic field through zero along the beam direction. We find that, associated with the EIA peak, a "twist" appears in the corresponding NMOR signal. A similar twist has been previously noted by Budker et al., in the context of warm vapor optical magnetometry [1], and was ascribed to optical pumping through nearby hyperfine levels. By studying this feature through numerical simulations and cold atom experiments, thus rendering the hyperfine levels well resolved, we enhance the understanding of the optical pumping mechanism behind it, and elucidate its relation to EIA. Finally, we demonstrate a useful application of these studies through a simple and rapid method for nulling background magnetic fields within our atom chip apparatus.

[1] D. Budker, et al. *PRL*, vol. 81, no. 26, pp. 5788–5791, Dec. 1998.

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