Imaging magnetic fields by fluorescence-detected magnetic resonance in polarized atoms

I. Fescenko[1,2] and A. Weis[1]

[1] *Physics Department, University of Fribourg, Switzerland*
[2] *Institute of Atomic Physics and Spectroscopy, University of Latvia, Riga, Latvia*

Presenting Author: iliafes@gmail.com

Spin polarization created in an alkali vapor by optical pumping represents—in general–a so-called dark state, characterized by strongly reduced fluorescence emission. The polarization, stabilized by a static magnetic field $\vec{B}_0$, can be destroyed by a transverse magnetic field oscillating at $\omega_L \propto B_0$, thus leading to an increased fluorescence. We have developed a magnetic field imaging system based on these properties [1]. A thin sheet of laser light tuned to the $D_1(4-3)$ transition prepares a 2D-layer of spin-oriented atoms in a cubic Cs vapor cell containing Ar/Ne buffer gas (left graph). When exposed to an inhomogeneous magnetic field, a frequency comb of weak oscillating magnetic fields depolarizes the medium at specific spatial positions. The CCD recording of the fluorescence emitted by the Cs layer shows the depolarized regions as bright lines that represent iso-B_0 lines. The middle and right graphs of the figure show an experimental recording of field lines from a quadrupole coil, and the corresponding algebraic modeling. The spatial and magnetometric resolution obtained in a magnetically unshielded environment are 1 mm and 2 nT, respectively. We currently implement the method in a magnetic shield, anticipating a strongly increased performance.

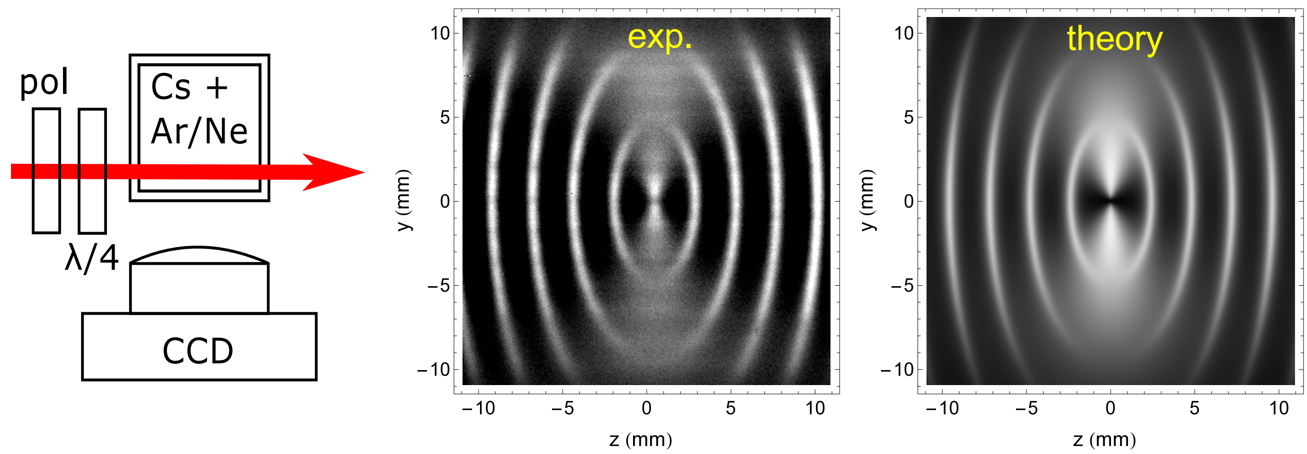

Figure 1: *Left: Principle of the experiment. Experimental recording (middle) and anticipated lines of constant* $|\vec{B}_0|$ *(right) produced by a quadrupole (anti-Hemholtz) coil. The elliptical lines (from inside to outside) represent field values* B_0 *of 19, 37.5, 56, 74.5, 93* μT.

References

[1] I. Fescenko and A. Weis, J. Phys. D: Appl. Phys, **47**, 235001 (2014).