Quantum Imaging of Magnetic Field Contours with Yb Atoms

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With a relatively simple experimental system we observe and measure contours of constant magnetic field using fluorescence spectroscopy. This new atomic magnetometer is based on the Zeeman splitting in the (6s6p) 3P1 state of Yb. In the presence of a magnetic field gradient, we observed prominent dark stripes (visible by eye or camera) in the fluorescence (556 nm) when a thermal Yb atomic beam is excited with modulated resonance laser light. The 1S0-3P1 transition forms a "V" system where two laser sidebands interact simultaneously with two 3P1 Zeeman sublevels. The dark lines are consistent with theoretical models that include two (or more) optical fields and four quantum levels. This new magnetometer has compelling capabilities that include good accuracy, determination of B-vector orientation in 2D or 3D, wide dynamic range, and rapid response times – imaging magnetic field structure at video frame rates.