Abstract Submitted
for the MAR05 Meeting of
The American Physical Society

Imaging Electron Spin Flows in Semiconductors in the Presence of Electric, Magnetic, and Strain Fields DARRYL SMITH, SCOTT CROOKER, Los Alamos National Laboratory — Using methods for scanning Kerr microscopy, we directly acquire two-dimensional images of spin-polarized electrons flowing laterally in bulk epilayers of n:GaAs [1]. Optical injection provides a local dc source of polarized electrons, whose subsequent drift and/or diffusion is controlled with electric, magnetic, and -in particular- strain fields. The acquired spatial maps directly reveal how flows of polarized electron spins respond to these three fields when applied individually or in combination. Spin precession induced by controlled uniaxial stress along the $\langle 110 \rangle$ axes demonstrates the direct $|\vec{k}|$-linear spin-orbit coupling of electron spin to the shear (off-diagonal) components of the strain tensor ϵ, through a Hamiltonian of the form $c_3(\sigma_x \epsilon_{xy} k_y - \sigma_y \epsilon_{yx} k_x)$. The $|\vec{k}|$- linear nature of the strain-induced "internal" magnetic field ($\vec{B}_\epsilon$) leads to a spatial coherence of dc spin flows that is preserved over much greater distances as compared with spin flows manipulated by external magnetic fields. $\vec{B}_\epsilon$ is shown to be in-plane and orthogonal to $\vec{k}$, and therefore chiral for radially- diffusing spins. Lastly, the spatial period of strain-induced spin precession is explicitly shown to be independent of applied electrical bias, of possible benefit to future spintronic devices. [1] S. A. Crooker and D. L. Smith, cond-mat/0411461

Scott Crooker
Los Alamos National Laboratory

Date submitted: 30 Nov 2004 Electronic form version 1.4