Abstract Submitted
for the MAR06 Meeting of
The American Physical Society

Ballistic-diffusive crossover in spin propagation and precession
CHRIS WEBER, JOE ORENSTEIN, JASON STEPHENS, DAVID AWSCHALOM, University of California, Berkeley — In the transient spin grating (TSG) technique, electron spins are optically oriented in a standing wave ("grating") of spin polarization with wavevector q. TSG measures spin propagation through the time-dependence of the grating amplitude. We have shown[1] that for GaAs 2DEGs diffusive spin motion at low mobility μ crosses over at high μ to motion that is ballistic on length-scale of the grating—the mean free path exceeds q^{-1}. The ballistic regime is characterized by oscillations in the spin-grating amplitude with frequency $\omega \approx v_F q$. In this talk we present data from TSG and time-resolved Kerr rotation measurements on n-doped GaAs quantum wells. We explore the crossover between ballistic and diffusive behavior as a function of temperature and of disorder. We also explore a second, distinct crossover in the spin dynamics that occurs as $v_F q$ is tuned through the spin-orbit precession frequency, $\Omega_{SO} \approx 0.2$ THz.
[1] C. P. Weber *et al. Nature* **437** p. 1330 (2005).

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Date submitted: 02 Dec 2005 Electronic form version 1.4