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Search for the Persistent Spin Helix in a 2-Dimensional Electron Gas[1] J.D. KORALEK, C.P. WEBER, J. ORENSTEIN, Lawrence Berkeley National Laboratory, B.A. BERNEVIG, S.-C. ZHANG, Stanford University, S. MACK, J. STEPHENS, D.D. AWSCHALOM, Center for Spintronics and Quantum Computation, University of California, Santa Barbara, CA 93106 — The persistent spin helix is an infinitely long-lived helical spin density wave that is predicted to occur in 2-dimensional electron systems with equal-strength Rashba and Dresselhaus spin-orbit coupling [Bernevig *et al.*, cond-mat/0606196]. The infinite lifetime of the helix would result from the combined effects of diffusion and precession in the spin-orbit effective field. These effects would also greatly enhance the lifetime of spin excitations at the helix wave vector in systems where Rashba $\neq$ Dresselhaus. We use the transient spin grating technique to search for this effect in GaAs quantum wells. In these experiments, two non-collinear, orthogonally polarized pump pulses from a Ti:Sapphire oscillator generate a holographic spin grating in the interference region on the sample. The subsequent decay of the spin grating is monitored by diffraction of a time-delayed probe pulse. The wave vector of the spin grating can be tuned by varying the angle between the interfering pump beams, making this technique ideally suited for observing the persistent spin helix.

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