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Emergence of the persistent spin helix in semiconductor quantum wells[1]

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The persistent spin helix is a collective spin excitation of 2D electron systems that emerges as a new conserved quantity when the spin-orbit interaction is tuned to recover SU(2) symmetry in the spin Hamiltonian. The spin helix has great potential for application to spintronics, where it would allow rapid gate control of the spin lifetime over several orders of magnitude in devices with both high electron density and high mobility. We observe the persistent spin helix in semiconductor quantum wells using transient grating spectroscopy. This technique uses femtosecond pulses of light to generate spatially non-uniform spin (or charge) patterns in the sample. Studying the decay of spin patterns of varying periodicity allows quantitative characterization of the diffusion properties of the material. Additionally, we have developed a phase-resolved version of the transient grating technique which has enabled us to observe the spin helix moving in an electric field with unprecedented spatial resolution. Supported by DMSE office of BES-DOE, NSF, MARCO, ASEE and CNID.

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