Abstract: An electron propagating through a solid carries both charge and spin. While today’s logic devices are based on charge, spin-based devices offer potential advantages in dissipation, size, and speed. To a great extent, their chance for success depends on the ability to control the spin state of electrons using electric rather than magnetic fields. One of the few ways to accomplish this is to exploit the spin-orbit interaction, which takes an especially simple form in the two-dimensional electron gas in semiconductor quantum well. In these systems, spin-orbit coupling acts as an effective, in-plane magnetic field whose magnitude and direction depend on the momentum of the electron. The resulting coupling of motion in spin and configuration space leads to theoretical predictions of very unusual spin dynamics. In this talk I describe some recent measurements that allow us to test these theories by measuring spin dynamics in real time. This is accomplished by writing, and subsequently reading, spin patterns in the semiconductor using holographic techniques.