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**Spin Transport in Spin Orbit Coupled Bose Einstein Condensates** ROBERT NIFFENEGGER, ABRAHAM OLSON, CHUAN-HSUN LI, YONG CHEN, Purdue University, QUANTUM MATTER AND DEVICES TEAM — We study spin transport induced by synthetic spin-dependent electric fields in spin-orbit coupled (SOC) Bose Einstein Condensates (BECs). The 1D SOC is created with counter propagating Raman lasers which couple hyperfine spins ($m_F = -1$ and 0, of F=1) and momentum states of $^{87}Rb$, allowing us to engineer spin dependent vector potentials. Quickly lowering the Raman laser intensity (spin-orbit Raman coupling) splits the spin vector potentials in opposite directions and applies opposite synthetic electric fields to the two dressed spin BECs. We allow them to oscillate in opposite directions within the optical trap (exhibiting a spin dipole mode) and measure their momentum after time of flight. The oscillations damp when the spin BECs collide and the damping increases as the Raman coupling is increased, possibly related to the Raman coupling dressing and increasing the effective spin interactions. Over longer time scales, thermalization accompanies the damping of the bare spins' oscillations. However, with Raman coupling, the overdamped dressed spins' oscillations are accompanied by rich excitations in the BEC but less thermalization. Our experiments may provide new insights for understanding and controlling spin transport and spin decoherence in atomtronic or spintronic devices.

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