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Optical control of topological spin and charge transport in semiconductors WANG YAO, ALLAN MACDONALD, QIAN NIU, The University of Texas at Austin — In n-doped semiconductors, the strong spin-orbit coupling in valance band can be utilized through the band renormalization by optical field off-resonantly coupled to the interband transitions. The adiabatic electronic ground state is thus reactively controlled by optical pulses, exhibiting an anomalous spin-dependent Hall conductivity. Light-matter interaction is exploited here in a unique way, i.e. light does not induce real excitations in the system but act as a control knob for switching on/off novel material properties, in contrast to most previous use of light. With the control by linearly polarized light, a pure spin Hall current of electrons can be driven by an in-plane DC electric field, which results in net spin accumulations at the edges of the optical excitation area. Effectively, one has created a spin battery powered by optical pulses together with DC electric field, or equivalently, an optically gated spin transistor. As conduction band spin-orbit coupling is not needed, the resultant electron spin accumulations can have long lifetime when control light is adiabatically switched off. In addition, circularly polarized light breaks the time reversal symmetry and can result in spin polarized anomalous Hall conductance.

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