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Spin Hall effects in diffusive normal metals. ROMAN SHCHELUSHKIN, ARNE BRATAAS — We study transport in normal metals in an external magnetic field. We employ the Keldysh formalism to find transport equations in the presence of the spin-orbit interaction, interaction with magnetic impurities, and nonmagnetic impurity scattering. This system exhibits an interplay between a transverse spin imbalance (spin Hall effect) caused by the spin-orbit interaction, a Hall effect via the Lorentz force, and spin precession due to the Zeeman effect. The spin and charge accumulations are computed numerically in experimentally relevant thin film geometries. The out-of-plane spin Hall potential is suppressed when the Larmor frequency is larger than the spin-flip scattering rate. The in-plane spin Hall potential vanishes at a zero magnetic field and attains its maximum at a finite magnetic field before spin precession starts to dominate. Spin injection via ferromagnetic contacts creates a transverse charge Hall effect that decays in a finite magnetic field due to spin precession.

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