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Spin Hall effect in p-type semiconductors in magnetic fields
MEHDI ZAREA, SERGIO ULLOA, Ohio University — We calculate the spin Hall conductivity driven by Rashba spin-orbit interaction in p-type two-dimensional semiconductors in the presence of a perpendicular magnetic field. For a highly confined quantum well the eigenstates and eigenvalues of the system, described by a k-cubic Rashba term for heavy holes, can be described by Landau spinor states, as in the k-linear case [1]. The contribution of the interband transitions to the Kubo-Greenwood formula gives the density-dependent *conventional* spin Hall conductivity, which approaches its universal value $\sigma_{xy}^{z} = 9e/8\pi$ for weak spin-orbit coupling and low Fermi energies, in agreement with previous work. However, two intraband contribution terms cancel this effect, resulting in *zero* conventional spin Hall conductivity. Adding the torque dipole contribution to the definition of spin current, we also study the *effective* spin conductivity. This is shown to be proportional to the total magnetization plus surface terms which exactly cancel it for small spin-orbit coupling. The fact that both effective and conventional spin Hall conductivities vanish is unexpected, especially as one expects the intraband transitions to evolve into vertex corrections for low magnetic fields. Supported by NSF-NIRT. [1] M. Zarea and S. E. Ulloa Phys. Rev. B 72, 085342 (2005).

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