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Spin Hall Effect in Doped Semiconductor Structures[1] WANG-KONG TSE, SANKAR DAS SARMA, University of Maryland — We present a microscopic theory of the extrinsic spin Hall effect based on the diagrammatic perturbation theory. Side-jump (SJ) and skew-scattering (SS) contributions are explicitly taken into account to calculate the spin Hall conductivity, and we show their effects scale as $\sigma_{xy}^{SJ}/\sigma_{xy}^{SS} \sim (\hbar/\tau)/\varepsilon_F$, where τ being the transport relaxation time. Motivated by recent experimental work we apply our theory to n-doped and p-doped 3D and 2D GaAs structures, obtaining analytical formulas for the SJ and SS contributions. Moreover, the ratio of the spin Hall conductivity to longitudinal conductivity is found as $\sigma_s/\sigma_c \sim 10^{-3} - 10^{-4}$, in reasonable agreement with the recent experimental results of Kato *et al.* [Science 306, 1910 (2004)] in n-doped 3D GaAs system.

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