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Collective Spin-Hall Effect for Electron-Hole Gratings[1] GIOVANNI VIGNALE, KA SHEN, Department of Physics, University of Missouri, Columbia MO 65211 — We study the coupled spin-density transport in a periodically modulated electron gas in a GaAs quantum well. We show that an electric field parallel to the wavefronts of an electron-hole grating generates, via the electronic spin Hall effect, a spin grating of the same wave vector. We refer to this phenomenon as "collective spin Hall effect". In our calculation, we include not only the intrinsic but also the extrinsic spin Hall mechanisms. In the extrinsic mechanism we include both skew scattering and side jump. A detailed study of the coupled-spin charge dynamics for quantum wells grown in different directions reveals rich features in the time evolution of the induced spin density. For example, in the symmetric (110) quantum well the amplitude of the induced spin density is controlled solely by skew scattering and can be as large as 1% of that of the initial density modulation.Similarly, the collective spin Hall effect in (001) QWs with identical Rashba and Dresselhaus SOC strengths is also entirely controlled by skew scattering. In this case, the skew scattering generates a spiral spin density wave when the wave vector of the initial grating matches the wave vector of the spin-orbit coupling. Ref: Ka Shen and G. Vignale, PRL 111, 136602 (2013).

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Ka Shen
University of Missouri-Columbia

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