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Two-Dimensional Spin Transport with Two-Particle Spin-Orbit Coupling[1] KAMIL WALCZAK, STEFAN BADESCU, THOMAS REINECKE, Naval Research Laboratory, Washington, DC 20375 — We examine new spin-orbit effects on the quasi-particle properties in electron Fermi liquids in semiconductor quantum wells. These effects are independent of the structure asymmetry and come from the coupling of spins to their relative motion. We focus on the low-temperature, impurity-free and phonon scattering-free regime where the decoherence of spin transport is determined by the intrinsic spin-dependent interactions and Coulomb scattering between carriers. Quasiparticle parameters are obtained within the Random Phase Approximation for the Coulomb screening and by taking into account spin-dependent interactions to second perturbative order. The dependences of lifetime and effective mass on density and the quasiparticle energy are compared to previous results for Fermi Liquids obtained with only single-particle spin-orbit coupling (Rashba or Dresselhaus). We identify regimes where the spin-relative orbit coupling dominates, and we discuss cross-terms when both single-particle and spin-relative orbit interactions are present. These results are relevant for Spin-Hall and Spin-Coulomb Drag effects.

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Kamil Walczak
Naval Research Laboratory, Washington, DC 20375

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