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Spin-orbit coupling in strongly correlated two-dimensional systems undergoing MIT[1] JIAN HUANG, Wayne State University, LOREN PFEIFFER, KEN WEST, Princeton University — Experimental studies of the spin-orbit coupling (SOC) often utilize systems that lack inversion symmetries, i.e. 2D hole systems in p-GaAs heterostructures, where SOC is known to drive both classical and quantum effects. They are usually perturbations in weakly interacting systems. However, in a strongly correlated system, the effects due to the SOC-interaction interplay are more profound in relation to the exchange interaction, i.e. it leads to diverging density of states in the limit of low carrier densities. Adopting ultra-clean 2D holes in undoped GaAs/AlGaAs field-effect-transistors, we have measured the magnetoresistance (MR) for a large r_s range of 20-60 (or carrier densities from $2x10^{10}$ down to $2x10^9 cm^{-2}$). Two unique behaviors directly linked to SOC are reported. First, in correspondence to the zero-field MIT, the sign of the MR switches, from being positive in the metallic regime to being negative in the insulating regime, when the density is lowered across the critical density of MIT (at r_s~39). Second, in the close vicinity of the critical density, a nonmonotonic density-dependence due to SOC results in a substantial correction to the MR beyond perturbation. This peculiar behavior echoes with a trend of delocalization long suspected for the SOC-interaction interplay.

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