Experimental Evidence of Spin-Incoherent Luttinger Liquid State in Semiconductor Quantum wires

MUSTAFA MUHAMMAD, University of Cincinnati, Cincinnati, Ohio 45221, STEVEN HERBERT, Xavier University, Cincinnati, Ohio 45207, RICHARD NEWROCK, PHILIPPE DEBRAY, University of Cincinnati, Cincinnati, Ohio 45221 — We have measured the Coulomb drag between two spatially separated parallel quantum wires in the absence of tunneling to experimentally probe the recently proposed spin-incoherent Luttinger liquid (SILL) state. This new state is considered to exist in one-dimensional electron systems when the electron density is sufficiently low and the electron-electron interaction is strong, leading to $J < T << E_F$, where $J$ is the exchange coupling of spins and $E_F$ the Fermi energy. The measured drag resistance in the strictly one-dimensional (1D) transport regime is found to follow a power-law temperature dependence with a negative exponent (-0.65) in the temperature range 70mK – 1.2K, in excellent agreement with the prediction of SILL theory for $4k_F$ backscattering. The drag resistance is also found to decay exponentially with wire separation confirming the backscattering nature of the momentum transfer process.

This work is supported by the National Science Foundation under grant DMR-0244489