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Temperature Limited Spectroscopy of the Quantum Hall Liquid
O.E. DIAL, R.C. ASHOORI, MIT, L.N. PFEIFFER, K.W. WEST, Bell Laboratories, Lucent Technologies — We present spectra of the tunneling density states of a two dimensional electron gas (2DEG) in GaAs over a range of 30 meV centered about the Fermi surface, revealing the beautiful structure present in these systems far from the Fermi energy. Using these measurements, we examine the dependence of the exchange-enhanced spin-gap on electron density (0-4×10^{11} cm^{-2}) and magnetic field, observe induced spin splittings in Landau levels away from the Fermi energy, and compare measured linewidths to the expected lifetime broadening from interactions. The measurements are performed using time domain capacitance spectroscopy which uses short pulses to drive electrons perpendicularly between the 2DEG and a bulk electrode while monitoring the induced image charge on an isolated electrode. Using a very low duty cycle maintains a 100 mK electron temperature even when injecting electrons at energies 1000 times larger than k_bT, while the absence of in-plane current allows us to continue to measure when the 2DEG is fully depleted or has vanishing in-plane conductivity.

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