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Determining the Location of Charged Background Impurities in High Mobility AlGaAs/GaAs 2DEG Structures JERRY LEE, KIRK BALDWIN, KEN WEST, LOREN PFEIFFER, Princeton University — The two main Coulomb scattering contributions to the scattering rate $1/\tau$ in the modulation-doped AlGaAs/GaAs two-dimensional electron gas (2DEG) system are scattering from unintentional background charged impurities present in the GaAs and AlGaAs materials, and scattering by the intentional dopants in the doped layer. Theoretical studies [1] indicate that for structures dominated by scattering from unintentional background charged impurities in the conducting channel, a carrier mobility μ versus 2DEG density n relationship of $\mu \approx n^{0.8}$ is anticipated. On the other hand, in structures where the dominant scattering mechanism is due to charged impurities or dopants in the nearby AlGaAs barriers, a relationship of $\mu \approx n^{1.8}$ is expected. Using high-mobility heterostructure insulated-gate field-effect transistors (HIGFETs) fabricated by molecular beam epitaxy (MBE) and lithography, we demonstrate a technique for determining the location of the mobility limiting charged impurities. We intentionally introduce charged impurities into either the barrier or the quantum well of our HIGFETs and measure the slope of μ versus n. We find a dependence of $\mu \approx n^{0.7}$ when the dopants are inserted into the quantum well. In contrast, we measure a dependence of $\mu \approx n^{1.8}$ when impurities are introduced into the barrier. Our results are in excellent agreement with theoretical predictions and pave the way towards utilizing these relationships to diagnose the exact location of impurities in high-mobility structures for FQHE applications. [1] A. Gold, Appl. Phys. Lett. **54**, 2100 (1989).

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