The 2d Kondo effect in p-type Quantum Wells in GaAs

THEODORE CASTNER, University of Rochester — Two groups [Huang et al. [1] and Hamilton et al. [2]] have observed minima in the resistivity $\rho(T)$ at very low T well below $\rho_{max}$ at $T_{max}$ in metallic samples ($p>p_c$). Minima in [1] were found at 32 mK for $p \sim 2.1 \, p_c$, 25 mK for $p \sim 1.76 \, p_c$, while no minimum was observed down to 0.5 mK for $p \sim 1.24 \, p_c$. Both groups have interpreted their results in terms of a crossover to insulating (nonmetallic) behavior for $T < T_m$ where $d\rho/dT < 0$. An alternative explanation arises from a 2d Kondo effect. Using the Hamann function [3] for the magnetic scattering contribution from localized magnetic moments and a term $\rho(0)C_T/T_F$ from screening (interactions) one obtains an expression for $T_m(p)$ which is very close to the Kondo temperature $T_K(p)$ given by $(E_F/k)x \exp(-1/N(E_F\text{abs}J))$. The very strong $p$-dependence of $T_m(p)$ and $T_K(p)$ is dominated by $N(E_F)$ which is shown to approach zero as $p$ approaches $p_c$ because of the pseudogap in the DOS. Good agreement is obtained $T_m(p)$ for both [1] and [2]. The data in [1] supports metallic behavior down to 0.5 mK. The implications for a true 2d MIT as a QPT are discussed. 1) J. Huang et al. Phys.Rev.Lett.98, 226801 (2007); 2) A. R. Hamilton et al. Phys.Rev.Lett.82, 1542 (1999); D. R. Hamann, Phys.Rev.158, 570 (1967).