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Strongly Temperature-dependent Compressibility of Dilute 2D Holes near the Metal-Insulator Transition XUAN GAO, Case Western Reserve Univ, NAOTO MASUHARA, GREG BOEBINGER, National High Magnetic Field Lab, LOREN PFEIFFER, Bell Labs, Alcatel-Lucent — We used the capacitance measurement to study the compressibility of dilute 2D holes in a 10nm wide GaAs quantum well for T=0.01-0.7K. The sample exhibits the B=0 metal-insulator transition (MIT) at a critical density $p_c \sim 1.0 \times 10^{10}/\mathrm{cm}^2$. Deep in the metallic state, the sample capacitance decreases slowly as hole density p increases, due to the (negative) exchange contribution to the compressibility of an interacting 2D system. As p is reduced below p_c at low-T, the capacitance of sample diminishes rapidly as a result of the incompressible nature of the insulator state, similar to previous studies (Dultz and Jiang, PRL 84, 4689 (2000); Allison et al., PRL 96, 216407 (2006)). On the other hand, we found that temperature has a strong effect near the MIT, in contrast to literature. In our system, the compressibility of insulator state increases with T and remains positive, while the behavior of metallic phase is more complex. Notably, for metallic phase with p slightly above p_c, the sign of compressibility can change from positive to negative as T increases. This strongly T-dependent compressibility is possibly related to the competition between two phases with distinctive compressibility in our system, which is more strongly interacting than samples studied previously.

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