Coulomb-Frustrated Phase Separation in a Magnetically-Doped 2DEG

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Abstract. The basic physical processes that drive the metal-insulator transition (MIT) in a two-dimensional electron gas (2DEG) remain a subject of much controversy and debate. While much recent progressed focused on the interplay of the interactions and disorder in the Fermi liquid context, some experimental findings seem to be dominated by the correlation effects that are found even in the clean limit. In particular, several scenarios have recently been proposed that relate to the approach to Wigner crystallization. An interesting possibility proposed in this context involves a possible role of an inherent tendency to local phase separation leading to inhomogeneous phases in the intermediate regime between the Fermi liquid metal and the Wigner-Mott insulator. While no direct evidence exists that this possibility is realized in the clean electron gas, very recent experiments have provided evidence that such "stripe-glass" phases can emerge by additional manganese doping of the 2DEG. As a result, the system seems to display the phenomenon of Coulomb-frustrated phase separation, leading to colossal magneto-resistance (CMR). In this talk, we discuss a simple theoretical picture which explains how such phase separation can be driven by the double-exchange interactions between the manganese spins and the conduction electrons. We argue that such inhomogeneous phases generically form on the metallic side, but only close to where the 2D-MIT is found in absence of manganese doping.