Heat Capacity Measurements of 2D ^{3}He on Graphite with Excess Particle Densities near the Mott Localization

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Monolayers of ^{3}He atoms on graphite are ideal experimental systems for studying strongly correlated two dimensional fermions. In the case of second layer ^{3}He adsorbed on ^{4}He-preplated graphite, the 4/7 commensurate phase is stabilized due to the potential corrugations of the underlayer ^{4}He. The 4/7 phase is a Mott localized phase [1, 2] with the magnetic ground state of the gapless spin liquid [3]. In the density region higher than the 4/7 phase density ($\rho_{4/7}$), we have discovered three different quantum phases with a variety of distinct properties from heat capacity and NMR [4] measurements as follows.

At densities just above $\rho_{4/7}$ (**region-IIIa**), a heavy ^{3}He fluid seems to exist over the second layer 4/7 phase. The degeneracy temperature is estimated to be very low (< 1 mK) from temperature dependences of the excess heat capacities (C_{ex}) and magnetization. As density increases (**region-IIIb**), C_{ex} starts to have a rounded peak at 5 mK. Here, the heavy fluid is supposed to be weak-ferromagnetic (WF) from the NMR measurements. With further increasing density (**region-IV**), the rounded peak at 1 mK of the 4/7 phase suddenly disappears, and a new rounded WF peak grows at 3 mK. The transition from the region IIIb to IV is of the first order where a structural change from the 4/7 phase to perhaps an incommensurate phase or a phase with some kind of domain wall structure takes place in the second layer.

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