Solidification of Second Atomic Layer of ^{4}He Film Adsorbed on Graphite

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^{3}He and ^{4}He films adsorbed on graphite surfaces are almost ideal two-dimensional (2D) Fermi and Bose systems, respectively. The second atomic layer of ^{3}He film is believed to solidify and form a commensurate phase, the so-called "4/7" phase, with increasing areal density from the fluid phase. The second atomic layer of ^{4}He film has also been thought to form the 4/7 phase for a long time according to the heat capacity measurements by Greywall.[1] However, the recent theoretical study by Corboz *et al.* has revealed that there is no commensurate phase in the second layer of ^{4}He film.[2]
Heat capacities of second layer $^3\mathrm{He}_{1-x}$-$^4\mathrm{He}_x$ mixture films have been measured in the temperature range 1-80 mK, where x is the areal density ratio to the 4/7 phase and the first atomic layer consists of ^{4}He. At $x = 0.25$ and $x = 0.5$ the results indicate that the films are solid, while at $x = 0.75$ the results exhibit 2D Fermi fluid behavior although the total areal densities are the same. These results strongly suggest that pure ^{4}He film does not solidify into the 4/7 phase. Preliminary measurements of heat capacities of $^3\mathrm{He}_{0.03}$-$^4\mathrm{He}_x$ films also suggest that ^{4}He film does not solidify up to much higher areal density than that of the 4/7 phase. These coincide with the prediction by Corboz *et al.*

[1] D. S. Greywall, *Phys. Rev. B* **47**, 309 (1993).
[2] P. Corboz, M. Boninsegni, L. Pollet, and M Troyer, *Phys. Rev. B* **78**, 245414 (2008).