Magnetism of Two-Dimensional Films of $^3$He on Highly Oriented Graphite

H.M. Bozler, Jinshan Zhang, Lei Guo, Yuliang Du, and C.M. Gould

Dept. of Physics and Astronomy, Univ. of Southern California, Los Angeles, CA 90089-0484, USA

What is the effect of the structural length scale on the ordering of $^3$He films? NMR experiments on the magnetism of second layer $^3$He on Grafoil in the low field limit found ferromagnetic ordering for coverages over 20 atoms/nm$^2$. Finite temperature phase transitions are prohibited in 2D when only Heisenberg interactions are present. However ordering of a two-dimensional magnetic film can be a result of a phase transition caused by weak anisotropy and/or dipolar interactions, or could be a less interesting manifestation of finite size effects. By replacing Grafoil with ZYX grade highly oriented graphite we can study the magnetism of two-dimensional films with a substantially increased structural coherence length and test the importance of finite size effects. Our new experiments find a region of coverages where the second layer $^3$He films become ferromagnetic at temperatures above 1 mK, with no evidence for an increased suppression of the ordering due to increasing the coherence length. We show the results for the magnetism at a wide range of coverages as well as the effect of varying the magnetic field in the ferromagnetic cases. Our results support the interpretation in terms of a phase transition occurring at finite temperature.

*Supported by NSF through grant DMR-0307382

Sorting category: Ad Quantum gases, fluids and solids

Keywords: magnetism, NMR, He-3, 2-D

LT1265