Session 22aA

Properties of Two-dimensional ^{3}He in ^{3}He - ^{4}He Mixture Films **22aA1**

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^{3}He atoms on a superfluid ^{4}He film provide a unique example of an interacting two-dimensional Fermi system. NMR and specific heat experiments on this system reveal a number of its detailed properties and these will be described. For low ^{3}He coverage, changes in the ^{4}He substrate coverage allow the ^{3}He energetics to be determined and a localization transition is seen. As the ^{3}He coverage is increased, the two-dimensional system evolves from a very dilute Fermi fluid to an interacting two-dimensional Fermi liquid. A combination of NMR and specific heat measurements results in a determination of the two lowest order Landau Fermi liquid parameters F_0^A and F_1^S. Further increases in ^{3}He coverage result in the occupation of a second two-dimensional quantum state. The subject will be surveyed with an emphasis on recent work.

2D ^{3}He : from a pure spin-liquid phase to ferromagnetic clusters **22aA2**

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Using ^{4}He and the ”pushing gas” technique we have been able to tune the exchange constants of a solid ^{3}He film (in the second layer of helium adsorbed on graphite) and to investigate this system by NMR techniques in a large temperature range, down to 100 microkelvins. We show that Dirac multi-spin exchange gives rise at low densities to a very stable gapped spin-liquid phase due to quantum frustration. As the ^{4}He spreading pressure is increased we observe an evolution towards the well known ferromagnetic phase of 2D ^{3}He, modified here by the nanometric size of the ^{3}He two-dimensional clusters. This behavior is in agreement with recent theoretical calculations.

22aA3 Evidence for Ferromagnetic Ordering of ^{3}He Films on Graphite

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Recent experiments at USC have shown that two-dimensional films of ^{3}He on graphite order ferromagnetically at finite temperatures ($T > 0$) for densities above 20 atoms/nm^2. These results, obtained by measuring NMR on these films in the zero field limit, appear to contradict several studies which concluded that there is no spontaneous order by measuring magnetic susceptibility through conventional NMR in finite magnetic fields, and heat capacity in zero field. The low field limit is important in understanding these two-dimensional magnetic systems. At higher temperatures and/or fields, these films have been described in terms of the multiple spin exchange model. However, two-dimensional systems are extremely sensitive to anisotropies such as nuclear dipole interactions, even when they are several orders of magnitude less than the dominant exchange mechanism. Supported by the NSF DMR-9973255.

22aA4 Phonon velocity of ^{4}He Bose fluids formed in one-dimensional 18Å-pores

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We have studied ^{4}He adsorbed on straight pores of 18Å in diameter by heat capacity and vapor pressure measurements. The second layer atoms adsorbed on the first solid layer become the Bose fluid that forms a tube of the diameter about 11Å. T-linear heat capacity of the fluid below about 0.2K is attributed to one-dimensional (1D) phonon excitations along the tube. Since the motion in the cross section is believed to be in the ground state, the ^{4}He fluid is a true 1D Bose fluid. The phonon velocity v_C derived from the phonon heat capacity almost agrees with v_P deduced from the coverage dependence of the vapor pressure. The velocities indicate correlations in the 1D ^{4}He Bose fluid.