Session 23AP

NMR Study of Diffusional Processes in Solid ^{3}He - ^{4}He Mixtures near the BCC-HCP Transition **23AP1**

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The spin diffusion coefficient of a dilute solution of ^{3}He in ^{4}He is measured in the vicinity of the BCC-HCP transition. The spin echo technique does allow to distinguish the contributions from all of coexisting phases. In addition to well known diffusion in BCC, HCP, and bulk liquid phases the new fast diffusional process is observed. It is shown that the diffusion coefficient of this process is closed to that in liquid being dependent on the time between the NMR pulses. The possible reason for such bounded diffusion may be connected with formation of liquid droplets during the BCC-HCP transition.

Clusters of Pure ^{4}He around Vacancies in Solid Mixtures of ^{4}He in ^{3}He **23AP2**

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The properties of vacancy clusters in phase-separated solid mixtures of ^{4}He in ^{3}He are investigated by precise pressure measurements. Such clusters are formed during homogenization of the two-phase crystal and are resulted from the quantum nature of the vacancies in solid helium. They consist of only ^{4}He atoms and are arranged within the unordered matrix of the ^{3}He - ^{4}He mixtures. It is shown that the homogenization mixtures on their heating occurs in two steps. The first step corresponds to decreasing the cluster size, and the second one is determined by the diffusion establishment of a new concentration. A more correct calculation of the cluster size is made with taking into account the temperature and concentration influence. The calculated data are found to be agreement with the experiment.

23AP3 Neutron Scattering on Solid ^{3}He

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Multiple spin exchange leads, according to present understanding, to a variety of magnetically ordered states in solid ^{3}He, depending on pressure and applied magnetic field. We report the status of experiments to directly determine these structures by neutron scattering. The large neutron absorption cross section, and associated sample heating, impose severe experimental demands on the design of the sample cell. We report on our proposed solution, including details of the sintered heat exchanger necessary to cool the sample, as well as the $PrNi_5$ nuclear demagnetization stage and neutron spectrometer. The use of NMR in parallel experiments to characterise growth of the solid sample within the sinter is also discussed.

23AP4 Pulsed NMR in the Nuclear Spin Ordered Phases of Solid ^{3}He in a Ag Sinter

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To obtain the exact spin structure of the nuclear magnetically ordered phases of solid ^{3}He, in the bcc lattice called U2D2 and high field phase, both occurring below about 1 mK, we started a project of neutron scattering at the Hahn-Meitner-Institut, Berlin. This experiment faces three main difficulties: to cool the solid to temperatures below 1 mK (or even much lower in the case of the hcp lattice), to keep it there under neutron flux, and to grow a single crystal within the sintered material needed for this purpose. As a first step we have performed pulsed NMR measurements in the ordered phases of solid ^{3}He in a silver sinter of 700 Å particle size down to temperatures of 600 μK at various molar volumes. The samples remained in the ordered state for about 140 h.
Work funded by EU project HPRN-CT-2000-00166

23AP5 Magnetic properties of ^{3}He nanoclusters embedded in hcp ^{4}He

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The magnetic properties of ^{3}He nanoclusters in phase-separated solid ^{3}He-^{4}He mixture were investigated for samples with pressures between 3.71 and 2.64 MPa and temperatures between 10 and 0.6 mK. From pulse NMR at 250 to 62 kHz, it was found that there are two components with different spin-spin relaxation times. For the samples of intermediate pressure, the component with longer T_2 showed large downward deviation from Curie law or decrease of magnetization at about 1.1 mK which was larger for lower field. The component with shorter T_2 showed ferromagnetic tendency down to the lowest temperature for all samples. The solid-like fraction was obtained from the relative magnitudes of magnetization and it shows a sharp increase with pressure at P $\approx$ 2.95 MPa.

About nuclear spin kinetics in solid ^{3}He in magnetic field **23AP6**

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The kinetics of nuclear spin system in solid ^{3}He is investigated at low temperatures and in external magnetic field for both cases: bulk crystal and solid 2D film. It is shown that the high spin polarized state of bulk solid He-3 can be reached at a rather moderate magnetic field by using non-resonant saturation of NMR line. In the case of solid 2D films the unique information about the validity of the taking into account different orders of multiple-spin exchange interaction can be obtained form the analysis of temperature and magnetic field dependencies of nuclear spin relaxation times.

Spin ordering and coherent atomic motion in bcc solid ^{3}He **23AP7**

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We propose a new model to describe the ordering of nuclear magnetism of bcc ^{3}He. According to this model, in bcc ^{3}He there is correlated zero-point motion of the nuclei, which gives rise to electric and magnetic polarizations of the electronic cloud. Our model describes the resulting modification of the phonon spectra and predicts new localized modes, which have been observed during the last year. The polarization of the electronic cloud leads to hyperfine magnetic interactions with the nuclear spin. Magnetic ordering results from an indirect spin-spin interaction. The model predicts correctly both the u2d2 symmetry of the ordered phase and the volume dependence of the magnetic interaction. We further predict the excitation branches (spin waves) of the ordered phase.

Effect of Domain Wall on Thermal Conductivity of Solid ^{3}He in U2D2 Phase **23AP8**

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We calculate the thermal conductivity of solid ^{3}He in U2D2 phase. In our previous work, we assume the magnetic plane defects in the single domain crystal have an influence on the thermal conductivity, and we show that our model is able to explain the temperature dependence of that at low temperatures qualitatively. Now, we are interested in the effect of the domain wall. In U2D2 phase, it is well known that there are three domains characterized by the anisotropic axes. The static structure of the domain wall was investigated by Tsubota *et al.* and it is reported that this structure is consistent with the recent experimental data. Therefore, we apply the same method of our previous work to this system, and calculate the thermal conductivity. we estimate the effect of external magnetic field because there is strong magnetic field in the experiment.

23AP9 Matrix isolation by solid helium

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The new technique for embedding micro-impurities into solid helium, based on impurity-helium gas jet sedimentation on the top surface of He solid continuously moved down by helium exhaust from the bottom, has been elaborated. The guest species density of 3-10^{19} per cc (as small clusters) and 10^{16} per cc (as solitary molecules) and doped crystal growth rate of 1 mm per 20 s were achieved. The promises of this novel approach for matrix isolation spectroscopy as well as for quantum crystal studies are discussed.

23AP10 Magnetic and electric properties of alkali atoms trapped in solid helium

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The magnetic properties of alkali atoms implanted in crystalline ^{4}He matrices are extremely sensitive to the symmetry of the local trapping sites. For Cs atoms trapped in the body-centered-cubic phase of ^{4}He spin relaxation times up to 1 s have been observed. In the hexagonal-closed-packed phase on the other hand the Cs spins are readily depolarized and a number of phenomena specific for this phase, such as zero field magnetic resonance spectra, forbidden transitions and anomalous hyperfine shifts have been observed in magnetic resonance experiments with optical detection.
Our present interest focuses on spin perturbations of implanted Cs atoms by strong (30 kV/cm) external electric fields. These perturbations are measured as shifts of the magnetic resonance lines using a phase-sensitive optical magnetic resonance technique.

23AP11 Charge Centers and Small Polarons in the Molecular Cryocrystals

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The conditions of formation of the static polaron and quasipolaron states (charge center, small polaron for electron or hole and quasipolaron for muon) due to the rotational degrees of freedom in molecular cryocrystals are theoretically investigated. It is shown the two types of behavior are realized for the two groups of the nearest to the carrier molecules in dependence on the parameter G (the ratio of amplifiers of the anisotropic parts of the molecule interaction energy with the carrier electric field and the molecular field): smooth reorientation of the molecule with G growth; keeping of the orientation , free rotation; kicking of the molecules. The small polaron energy are evaluated for the cryocrystals H2, D2, T2, N2, CO2 and compared to the experimental data.

CARS study of D_2 molecules isolated by solid helium **23AP12**

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By using the new technique of doped helium crystal growth the impurity molecules can be stabilized as small clusters, oligomers, or solitary particles. Due to large shifts of Raman scatterling lines in the parent matrix these states can be distinguished by Coherent Antistokes Raman Scattering Spectra. The results of D_2 CARS study detected at different guest molecular densities in solid helium are presented.

Delocalized p excitations of atoms in cryocrystals **23AP13**

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It was theoretically established that atoms of cryocrystals, considered as quantum particles, can undergo quantum transitions in their own potential wells. At low temperatures, interaction of atoms with phonon modes results in quantum transitions of atoms from the ground state to an excited p state. Due to translational symmetry of the crystal and interaction of an atom with neighbors, the p excitation propagates through the crystal, creating a wide enough energy band. The bottom of the band is separated from the ground state by a gap of about 15–20 K. As temperature increases, the concentration of excitations rises exponentially, but the free path of the excitation decreases as T^{-7}. This effect explains existence of a maximum of the heat conductivity observed in cryocrystals at 15–20 K.

Anomalous Reduction of the Debye-Waller Factors of Quantum Crystals **23AP14**

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The ratio of $6(1/2m)(E_0/c)^2$ of 12.9meV at E_0=4keV to$k_B\Theta_D$ of 2.27meV for $hcp{-}^4$He in the exponent $2M = \left[6(1/2m)(E_0/c)^2/k_B\Theta_D\right]\Phi(t)\sin^2\theta_B$of the Debye-Waller (D-W) factor D=exp(-2M) becomes 5.7, because of the small atomic mass m and the low Debye temperature Θ_D. Conversely, that of the heavy atom crystals becomes smaller than 1. An experiment on $hcp{-}^4$He at low temperature limit of $\Phi(t) \cong 1$ reveals that not only the maximum value of D is reduced below 0.249(=$e^{-1.395}$) but also the values of D for all other Laue spots except our observed six spots are crowded into a range of D¡0.05.It turned out that the large reduction of the D-W factor is one of characeristics in hydrogen and helium and the recoil fraction of the diffuse scattering by 1-D increases as a major part of the total scattering.

23AP15 Quantum Effects in Thermal Conductivity of Solid $Kr - CH_4$ Solutions

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The dynamic interaction of a quantum rotor with its crystalline environment has been studied by measurements of the thermal conductivity of a solid solutions of $Kr_{1-x}(CH_4)_x$ at $x = 0.05 - 0.75$ in the temperature region from 2 up to 40K. The thermal resistance of the solutions was mainly determined by the resonant scattering of phonons by CH_4 molecules with the nuclear spin $I = 1$ (the nuclear spin of T-species). The influence of the nuclear spin conversion on the temperature dependence of the thermal conductivity $K(T)$ was found: a clearly defined minimum on $K(T)$, its temperature position depends on the CH_4 concentration. It was shown, that the anisotropy molecular field does not increased monotonously with the CH_4 concentration. A compensation effect in the mutual orientation arrangement of the neighboring rotors is observed at $x > 0.5$.

23AP16 Thermal Expansion of Solid Solutions Kr-CH_4 at Low Temperatures

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Thermal expansion was studied of solid solutions Kr+0.76; 5.2; 10.5%CH_4 in the temperature range 2 to 22K. The temperature dependence of the thermal expansion of solid solutions of equilibrium composition of nuclear spin species of CH_4 is measured. A negative contribution of the CH_4 impurity to the thermal expansion of the solution has been revealed in dilatometric studies on this solid solutions. A connection between the negative contribution in thermal expansion of solid solutions of impurities molecules of CH_4 and conversion processes is elucidated experimentally, in a qualitative consistency with the basic theoretical conclusions by T. Yamamoto et al. It is shown, that the negative contribution results from changes in the occupancy of the ground state of the A-modifications of isolated CH_4 molecules.

23AP17 High Resolution Coherent Raman Spectroscopy of Vibron in Solid Parahydrogen

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Coherent Raman spectroscopy was carried out for the vibron of solid parahydrogen crystal with a spectral resolution higher than 1 MHz. The Raman width and shift were measured for the temperature from 2K to 13 K. It is shown that the Raman width is extremely narrow, narrower than 5 MHz hwhm at temperature lower than 5 K, and that the Raman shift and width increase with the increase of the temperature. The observed behaviors are well reproduced through a theoretical model based on vibron-phonon interaction, leading to an effective parameter that consistently describes both the Raman shift and width.

Antiferromagnetic Spin Waves in High Field Ordered Phase of Bcc ^{3}He **23AP18**

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We studied thermodynamic properties of the high field nuclear-spin ordered phase of bcc ^{3}He by measuring the melting pressure at temperatures well below T_c in high magnetic fields up to 15 T. The spin-wave velocity (v) extracted from the data below 0.6 T_c increases linearly with increasing field and saturates above 10 T. This behaviour is consistent qualitatively with the linearized spin wave theory which assumes the canted antiferromagnetic spin structure with two sublattices and multiple spin exchange parameters suggested by the path integral Monte Carlo calculation. However, the theory gives a factor of five too large v at low fields (≈ 0.45 T) than the experiment, which gives rise to a new puzzle.

Nuclear Spin Orderings in Bcc ^{3}He in High Magnetic Fields **23AP19**

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Nuclear spin ordering temperatures (T_c) of bcc ^{3}He were determined in magnetic fields (B) between 2 and 15 T from melting pressure measurements. We found that the phase line, $T_c(B)$, at the melting density has a reentrant shape with a maximum (= 3.4 mK) at 10 T for the first time. From the $T = 0$ magnetization curve derived from the present data, we estimated the upper critical field, B_{c2}(0), which is important to determine the multiple spin exchange (MSE) parameters, as 21.5 $\pm$ 0.4 T. Although the phase line below 15 T seems to scale to that at 22.69 cm^3/mol with a Grüneisen parameter (Γ) of about 18, B_{c2}(0) does with $\Gamma \approx 20$, indicating different Γ values for different MSEs.

Recovering time of the dislocation network pinning in the solid ^{3}He **23AP20**

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We have measured the shear modulus and the dissipation of bcc solid ^{3}He using the high-Q torsional oscillator technique. After large amplitude driving of the oscillator, the relaxation of the shear modulus and the dissipation were observed. And the relaxation time were strongly dependent on the temperature. These relaxation effect is explained by the recovering of the pinning nodes of the dislocation network in bcc solid ^{3}He.

23AP21 Water-Helium Condensate (Watergel) in Liquid Helium

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The water-helium condensate is formed in He-II cooled below 1.5 K as a result of condensation of the gas flow of ^{4}He with the water impurity at the surface of superfluid liquid. The experimental results indicate that the total content of water molecules in bulk of the gel samples is less than 10^{20} molecules/cm^3 and that their density is a few percents higher than the density of surrounding liquid only. The heating of the gel samples (compact icebergs) in liquid helium inhibits its rearrangement to the more stable structure (an ice powder) at T_{decay} = 2.5 K when the outer pressure P is equal to 0.2 atm and at T_{decay}=4 K, when P = 1 atm. In He gas atmosphere at SVP the "dry" icebergs start to decay at T = 1.8 K.

23AP22 A-B Transition of Superfluid ^{3}He in Aerogel Under Magnetic Field

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A-B phase transition of superfluid ^{3}He in aerogel under magnetic field is discussed using the homogeneous impurity model. The A-B transition temperature $T_{\rm AB}$ is calculated in the whole temperature range as a function of the magnetic field. It is shown that the GL result is correct only in the vicinity of the transition temperature $T_{\rm CA}$ of the liquid ^{3}He in aerogel.

23AP23 The Observation of Coherent Magnetization Precession of ^{3}He in Aerogel.

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We have observed the formation of the Domain with Homogeneously Precession Magnetization (HPD) in superfluid ^{3}He in aerogel covered by solid monolayers of ^{4}He. The signal of HPD have been observed by pulsaed NMR and by CW NMR. By playing with the magnetic field gradient we were able to distinguish the spatial position of the HPD as well as to determine the long scale inhomogenity of the order parameter. The observation definitely shows the B phase like nature of the order parameter of superfluid ^{3}he in aerogel.

Novel sound phenomena in impure superfluids **23AP24**

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Last decade new techniques for producing impure superfluids (ISF) with unique properties (superfluid helium confined to aerogel (Cornell, Lancaster, Manchester, Northwestern), He II with different impurities (D_2, N_2, Ne, Kr) (Cornell), superfluids in Vycor glasses, and watergel - a frozen water lattice in HeII (Chernogolovka)) have been developed. These new systems exhibit very unusual properties including unexpected acoustic features. We discuss the sound properties of these systems and show that sound phenomena in ISF are modified from those in pure superfluids.

Heat Capacity and Torsional Oscillator Measurements of ^{3}He in Aerogel **23AP25**

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Simultaneous torsional oscillator and heat capacity measurements of pure ^{3}He in low-density aerogel have been performed at a pressure of 22.5 bar. A correction is made to remove the bulk-liquid contribution to the total heat capacity; the remaining heat capacity has a fermi-liquid form above the aerogel transition (i.e. linear in temperature). The heat capacity shows a peak with approximately ten percent rounding coincident with the aerogel superfluid transition. The observed value of $\Delta C/C$ is 1.06.

Ultrasound Velocity and Attenuation of Liquid ^{4}He in Aerogel **23AP26**

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The ultrasound velocity and attenuation of liquid ^{4}He in various porosity aerogels were measured for a frequency of 10 MHz. Temperature dependence of the sound velocity was similar to that of bulk. The superfluid transition temperature was suppressed about 5 mK in aerogel. Sound velocity in this composite system depended seriously on the aerogel porosity. An aerogel-^{4}He composite model, in which normal fluid was clamped to aerogel strand gave almost satisfactory temperature and aerogel density dependence of the sound velocity. The sound attenuation in aerogel was considerably larger than that in bulk liquid and became constant in the lower temperature region. The attenuation peak ascribed to roton-phonon interaction was not observed in aerogel-^{4}He system.

23AP27 Transverse sound in aerogel with liquid ^{4}He

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We present measurements of transverse sound resonances in a square slab of aerogel filled with liquid ^{4}He. A number of sound modes were observed both in the superfluid and normal phase. The dynamics of the system was modeled by combining the equations of two-fluid hydrodynamics of helium with those of elasticity of aerogel.

23AP28 Acoustic resonance experiments on ^{3}He – ^{4}He mixtures in aerogels

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When superfluid, either ^{4}He, ^{3}He or isotopic mixtures of the two, are adsorbed in a compliant porous medium such as an aerogel, first and second sound modes both have significant pressure and temperature components. This makes it possible to excite and detect both modes using broadband piezoelectric transducers which in turn makes resonant acoustic spectroscopy an extremely convenient technique to study the behavior of superfluid/porous solid composites. We report a comprehensive investigation of the acoustics of superfluid mixtures in aerogels.

23AP29 Spin Diffusion in normalfluid ^{3}He in 97% porous Silica-Aerogel

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Spin relaxation and spin diffusion were investigated in a liquid ^{3}He sample in contact with solid ^{3}He which was adsorbed on the SiO_2 strands of an aerogel. NMR experiments at 950 kHz were performed at pressures and temperatures ranging from 0-20 bar and from 0.2 to 100 mK, respectively. The solid contribution to the NMR signal could be separated from the liquid signal by time delayed multi-pulse sequences due to the different spin-spin relaxation times in the liquid (T_2=110 ms) and solid layer (T_2=3 ms). The results for the diffusion coefficient $D_\perp$ are not only influenced by the effective mean-free path in the aerogel but also by the solid-layer magnetization. For T$<$3mK a diffusion coefficient $D_\perp \sim$T has been observed which might be caused by spin-scattering processes associated with the polarization in the sample.

Acoustic properties of 97% porous Silica-Aerogel at Low Temperatures **23AP30**

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Sound transmission techniques were used to investigate sound velocities and attenuation in an aerogel sample of 3 mm length and 3 mm diameter. This sample was squeezed in between 10MHz transmitter and receiver quartzes. Pulsed measurements were performed during several cool down cycles (300K to 0.7 K) in vacuum as well as while filling the aerogel with gaseous and liquid ^{3}He up to 29bar. The striking features of all experiments were that a) a profound change of the sound mode in the ^{3}He-filled aerogel occurs around 5 and 12 bar, and b) neither sound velocity nor absorption in the aerogel has been found very reproducible from cooldown to cooldown. These results might shed light on some inconsistencies reported earlier for high frequency sound transmission where no suppression of T_c could be seen.

Low Frequency Sound Propagation of ^{3}He in Aerogel **23AP31**

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Low frequency sound has proved to be a powerful tool for investigation of ^{3}He confined within the aerogel matrix. We have constructed an acoustic cell to investigate ^{3}He properties in the superfluid state. Two sound modes were observed in this apparatus i.e. the first sound like mode (fast mode) and the slow mode which is a combination of a Helmholtz resonance and the second sound mode of ^{3}He in aerogel. By focusing on the temperature dependence of the slow mode/Helmholtz mode combination we hope to examine aspects of the phase diagram including the onset of superfluidity at low pressure and transitions within the superfluid phase.
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Characterization of fractal materials with an adsorbed superfluid film **23AP32**

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The tortuosity of a film of superfluid ^{4}He adsorbed on 91%-porous silica aerogel has been measured with transverse sound as a function of helium coverage. This is a new technique for the evaluation of the fractal dimension of the substrate. Complementary data from ^{4}He adsorption isotherms and small-angle X-ray scattering have also been used for substrate characterization. Scaling models of adsorption, dominated by capillary condensation, are used for analysis.

23AP33 Acoustic Study of the Liquid-Vapor Critical Point of Neon and Helium in Aerogel

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We have used low frequency acoustic resonators to study the liquid-vapor coexistence curve and critical behavior of simple fluids in low density silica aerogels. Resonators provide direct measurements of sound speed at low frequency. Sound speeds exhibit sharp kinks at the liquid-vapor phase boundary that allow us to map out coexistence curves near the critical point. Our previous measurements showed that neon in 95% aerogel exhibits a narrowed coexistence curve shifted to higher fluid density, but were complicated by a significant quantity of bulk neon present in the cell. We discuss results from our current experiments on two different fluids (neon and helium) and on two different porosities of aerogel (95% and 98% porous). Results are compared to our earlier measurements and to studies by other groups.

23AP34 Adsorption and Desorption of Helium in Aerogels

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We have studied the adsorption and desorption of helium in a 95% porosity aerogel. The helium density in the aerogel was directly measured with a capacitive technique, while the pressure and bulk helium density were measured with in situ capacitive gauges. Thermal response is slow in aerogels, so we used a thin sample to minimize the time constant. The combination of high resolution and rapid equilibration allowed us to study the capillary condensation of helium, which in aerogels occurs very close to the bulk saturation pressure. We saw hysteresis between filling and emptying of the pores, even for very slow rates. The hysteresis becomes smaller as the critical temperature is approached. We discuss whether true two phase coexistence can be observed in the helium-aerogel system.

23AP35 The Thermal Boundary Resistance between Bulk Superfluid ^{3}He and Liquid ^{3}He confined in Aerogel at Ultralow Temperatures

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We present the first measurements of the thermal boundary resistance between bulk superfluid and liquid ^{3}He confined in aerogel. An aerogel layer is placed in a bulk superfluid-filled channel. The measurements are made by monitoring the temperature in the bulk superfluid on each side of the aerogel while a heat current is flowing. At the lowest temperatures the thermal resistance is dominated by the boundary resistance at the aerogel surfaces and is unaffected by the superfluid transition of the ^{3}He in the aerogel. While in conventional Kapitza resistance the boundary conductance is limited by acoustic mismatch, here the conductance is limited by an energy mismatch, since quasiparticles with energies above the bulk B-phase gap may freely cross the interface, while those with lower energies are confined to the aerogel.

Transport Properties of ^{3}He in Aerogel **23AP36**

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We report theoretical calculations of the thermal conductivity, spin diffusion coefficient and magnetic susceptibility of ^{3}He impregnated into high-porosity aerogel. In the normal state, elastic collisions of ^{3}He quasiparticles off the aerogel strands leads to a saturation of the spin diffusion coefficient at low temperatures. The effect of a magnetic field on thermal transport and spin diffusion is investigated. In the superfluid state, scattering off the aerogel matrix leads to the existence of gapless quasiparticle states near the Fermi level. These states determine the temperature-dependence of the thermal conductivity in the superfluid at very low temperatures. Gapless excitations also lead to a substantial increase in the low-temperature susceptibility of the BW-state for this system. We describe our theoretical results and compare them with available experimental data.

Observation of Superfluidity of ^{3}He in Aerogel by 4th Sound Technique **23AP37**

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The transition temperature and superfluid density of superfluid ^{3}He in aerogel are revealed to be largely suppressed with respect to those of bulk liquid. We have studied superfluidity of ^{3}He in aerogel of nominal porosity of 98.5, 98.0 and 97.5 % by 4th sound technique. The superfluid density and the superfluid transition temperature $T_c{}^{aero}$ were suppressed as previous experiments. $T_c{}^{aero}$ has been recognized by sharp change of quality value (Q value) of the sound resonance with changing temperatures. Unexpectedly we observed the sound signal from the 4th sound resonator between $T_c{}^{aero}$ and bulk transition temperature. This sound mode continuously changes to the 4th sound mode with decreasing temperatures. The loss of 4th sound was independent of temperature at the lowest temperature.

Liquid ^{3}He Quasiparticle Free-Path Distribution Function in Simulated Aerogels **23AP38**

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Conflicting results between different laboratories of measurements of the phase diagram of superfluid ^{3}He when immersed in aerogel, even with nominally identical aerogels, suggests that details of the aerogels other than the porosity are important in determining superfluid properties. We have simulated the growth of small clusters ($N \sim 10^5$) by off-lattice single-particle Diffusion Limited Aggregation (DLA). Measurements of the free-path distribution function of ^{3}He quasiparticles scattered by these clusters — truncated and repeated to simulate experimental conditions — show significant differences from uncorrelated scatterers at the same density, which differences may be significant for superfluid properties.
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23AP39 Experiments on A-like to B phase transition of ^3He confined in aerogel

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We have studied the transition from overcooled A-like to B phase in superfluid ^3He confined within aerogel at a pressure of 25.5 bar in magnetic fields of 284 Oe and 1 kOe. The kinetics of the transition was found to be different for pure ^3He in aerogel and for the cell preplated with ^4He. In the first case the phase transition rate depends strongly on temperature and changes from $>$10 hours at $T \approx 0.68T_c$ down to several minutes at temperature $\approx 0.6T_c$ (T_c is the superfluid transition temperature in the bulk ^3He). In case of ^4He preplated cell we see a stable coexistence of A-like and B phases over a broad range of temperatures down to $T \approx 0.54T_c$.

23AP40 Measurements of Longitudinal and Transverse Magnetic Relaxation in Superfluid ^3He Confined to Aerogel

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We present results of pulsed NMR measurements of magnetic relaxation in liquid ^3He in aerogel. It was found that the temperature of the superfluid transition of ^3He in aerogel (T_c^a) is clearly seen on temperature dependencies of both longitudinal and transverse relaxation times. Below T_c^a the longitudinal relaxation is faster and depends on the initial tipping angle. The experiments have been done for the case of aerogel preplated with a few monolayers of ^4He as well as for pure ^3He in aerogel.

23AP41 Homogeneous Spin Precession in Superfluid ^3He-B Confined to Aerogel

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We report on systematic studies of creation and relaxation of a macroscopic region of homogeneous spin precession (*homogeneously precessing domain, HPD*) in B-like phase of ^3He in aerogel. It was created in CW NMR experiments in the same way as in the bulk ^3He-B and in recent experiments with aerogel performed in Grenoble. Long lived free induction decay signal has been observed after the filling up the whole cell with the HPD and switching off the CW radiofrequency field. Characteristics of CW NMR and free induction decay signals were found to be similar to those known for bulk ^3He-B. Our results show that spin supercurrents can play an important role in spin dynamics of superfluid ^3He in aerogel.

Heat Capacity Measurement of ^{3}He in Aerogel **23AP42**

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Liquid ^{3}He in aerogel is known as a dirty p-wave superfluid system that has attracted interest from numerous experimental and theoretical points of view. The heat capacity of ^{3}He in a silica aerogel with 98 % porosity has been measured in both the normal and superfluid phases at a pressure of 20 bar down to 1 mK with the adiabatic method. The results indicate a sharp peak at $T_c^a = 1.8$ mK with $\Delta\ C_a/C = 1.0$. The shape of the peak is slightly broader than that of bulk ^{3}He which coexists in a region outside of the aerogel sample and which was observed simultaneously. The value of $\Delta\ C_a/C$ for superfluid ^{3}He in aerogel is smaller than that for bulk ^{3}He $(= 1.8)$ directly indicating supression of the amplitude of the order parameter. Further results and discussion will be presented. NSF Grant #DMR-0072350.

Nucleation and Interfacial Coupling between Pure and Dirty Superfluid 3He **23AP43**

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The nucleation of 3He-B from 3He-A is remarkable since it requires a seed of the order of a micron. We have studied the nucleation between the A and B-phases of 3He confined to 98% porous aerogel. This dirty (aerogel) superfluid behaves in a manner similar to the bulk superfluid, i.e. extensive primary supercooling is observed over a wide range of pressures and fields. Secondary nucleation of the aerogel B-phase shows however, unlike the bulk, no memory effect. At the interface between the pure and dirty superfluids, we find that the proximity effect is insufficient to nucleate the B-phase in either superfluid. We suggest an explanation in terms of decoherence of the order parameter on the length scale of the critical radius for nucleation. Grant #DMR-0072350. Ref: Phys. Rev. Lett.88, 045505 (2002).