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precision secondary thermometer calibrated against the susceptibility of Lanthanum diluted Cerium Magnesium Nitrate.

We discuss these measurements and interpret some systematic differences between these and previous measurements[1,2].

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* Supported by the NSF through Grant #DMR-78-02655 and indirectly through Grant #DMR-76-81083A02 to the Cornell Materials Science Center.

1 Alvesalo, Haavasoja, Main, Manninen, Ray and Reyn, Phys. Rev. Lett. 43, 1509 (1979).

2 Webb, Greytak, Johnson, and Wheatley, Phys. Rev. Lett. 30, 210 (1973).

AL 7 Zero Sound and the Viscoelasticity of Liquid ^{3}He.* ISADORE RUDNICK, University of California, Los Angeles.--Simple acoustic dispersion and attenuation relations which apply for all values of $\omega\tau<<1$ are obtained for liquid ^{3}He. They are found to agree extremely well with published results on longitudinal zero sound. A unique feature of a zero sound experiment is that it yields all the information necessary to obtain the non-magnetic and non-heat conductive parameters of the normal ^{3}He as $T\to 0$.

*Supported by ONR Contract N00014-75-C-0246 and NSF Contract DMR 76-22306.

AL 8 The Vapor Pressure of He^3 At High Magnetic Fields. J. BROOKS, G.O. ZIMMERMAN, Boston U. and R.H. MESERVEY† and P.M. TEDROW,† M.I.T., F. Bitter National Magnet Laboratory†--Preliminary measurements of the vapor pressure of He^3 in magnetic fields of up to 18T at a temperature of 1.2K indicate that the vapor pressure change has an approxiamtely linear dependence on H and is 0.3 ± .09 Pa/T. This value is in line with one of the theoretical predictions[1] and is too large to be accounted for by the diamagnetic contribution of He^3. Further results will be presented and discussed.

†Supported by the National Science Foundation.
[1]C. Lhuillier and F. Laloë, J. Phys. (Paris), 40, 439, (1979).

AL 9 A Technique for Surface Ion Mobility Measurements.* JOE THEOBALD and GARY A. WILLIAMS†, Univ. of California, Los Angeles.-- A technique has been developed for measuring the mobility of ions at the surface of liquid helium. The method uses a capacitance-conductance bridge to measure the surface conductance of the charge layer. The system has been used to determine mobilities ranging between 10^{-1} to 10^7 cm^2/V-sec. Preliminary results for ions just under the liquid surface will be presented.

*Work supported by the NSF, Contract DMR 78-17049.
†Alfred P. Sloan Research Fellow.

AL 10 Reflectivity for ^{4}He Atoms at Glancing Incidence to the Surface of Liquid ^{4}He. V. U. NAYAK, and D. O. EDWARDS, Ohio State U.*--Measurements will be presented for the elastic scattering probability (reflectivity) for ^{4}He atoms at glancing incidence to the surface of liquid ^{4}He. The reflectivity $R(k,\theta)$ is measured with the surface at low temperature (T<0.04K) as a function of the momentum $\hbar k$ and the angle of incidence θ of the incoming atom. The experiments are being carried out at glancing incidence (θ near 90°) in order to test the inference from earlier work[1] that $R(k,\theta)\to 1$ as $k\cos\theta\to 0$. The apparatus is similar to that used previously[2] but it has greater angular resolution. Preliminary data agree with earlier measurements at $\theta=70°$ and confirm that $R(k,\theta)$ increases at larger values of θ.

*Supported by NSF grant DMR 79-01073.
[1]D. O. Edwards and W. F. Saam, Prog. Low Temperature Phys. Vol. 7A (ed, by D. F. Brewer) (North Holland, Amsterdam, 1978), p. 283.
[2]D. O. Edwards, et.al., Phys. Rev. Lett. 34, 1153 (1975)

AL 11 Structure Factor Measurements in ^{4}He in the Vicinity of the Lambda Line*, D.A. Ewen, P.D. Lepell and R.B. Hallock, Univ. of Mass., Amherst and H.N. Robkoff, Mt. Holyoke College - X-ray scattering techniques have been used to determine the static structure factor, S(k), of ^{4}He in the vicinity of the λ-line at constant density. The results show a clear loss of spatial order on cooling from $T > T_\lambda$. Studies at different density reveal[1] that the onset of this loss of spatial order on cooling is closely associated with T_λ. Results of experiments presently underway will be presented. The theory of Cummings et.al.[2] allows a determination of the condensate fraction from the data. The suitability of the Cummings theory will be discussed as will other points of view.[3]

*Supported by the National Science Foundation through DMR 79-09248
[1]H.N. Robkoff, D.A. Ewen and R.B. Hallock, Phys. Rev. Letters 43, 2006 (1979)
[2]F.W. Cummings, G.J. Hyland and G. Rowlands, Phys. Kondens. Materie 12, 90 (1970)
[3]C. deMichelis, G.L. Masserini and L. Reatto, Phys. Lett. 66A, 484 (1978).

AL 12 Scattering of Ripplons by ^{3}He on the Surface of Superfluid ^{4}He. I.B. MANTZ, D.O. EDWARDS, and V.U. NAYAK, Ohio State Univ.*--A gradient in the concentration of adsorbed ^{3}He, produced by a current of ripplons, has been observed in heat conduction measurements on the surface of superfluid ^{4}He. The experiments were made on a saturated film, 100A thick, and at T<0.3K, so that conduction by phonons and evaporation are negligible. The heat is carried by a hydrodynamic flow of ripplons on the surface, and the thermal conductivity is reduced by the addition of adsorbed ^{3}He. The ^{3}He spreading pressure, and the ^{3}He-ripplon collision rate have been determined from the data. The collision rate agrees well with a theoretical calculation by Saam.[1]

*Supported by U.S. National Science Foundation grant DMR 79-01073.
[1]W.F. Saam, private communication (1979).

AL 13 Relaxation times in liquid He^3-He^4 mixtures.* R.P. BEHRINGER, Wesleyan U., G. RUPPEINER and H. MEYER, Duke U.--We report measurements of relaxation times $\tau(\nabla X)$ and $\tau(\nabla T)$ characterizing the establishment (or decay) of the concentration gradient ∇X and the temperature gradient ∇T in several He^3-He^4 mixtures, as caused by a vertical heat flux that is switched on (or off). These times represent the diffusive modes that are predicted by solving the differential hydrodynamic equations. When the modes are strongly coupled, i.e. when the thermal diffusion ratio k_T is large enough, $\tau(\nabla T)\simeq\tau(\nabla X)$. This situation is realized in the superfluid phase and up to a temperature slightly above $T_\lambda(X)$. Above that temperature the modes become uncoupled. A complete solution for the problem, including the boundary conditions has been obtained. Using the transport properties determined in other experiments, we have calculated $\tau(\nabla X)$ and $\tau(\nabla T)$ for mixtures near the tricritical point and found reasonable agreement with our measurements. Near T_λ we have deduced absolute values for the diffusion coefficient, D.

*Work supported by a grant from the National Science Foundation.

AL 14 Ultrasonic propagation in He^3-He^4 mixtures near the liquid-vapor critical point† T. DOIRON,* D. GESTRICH and H. MEYER, Duke U.--We present results on the critical sound attenuation and the dispersion of two He^3-He^4 mixtures at frequencies of 1, 3, and 5 MHz taken along the critical isochore. The He^3 concentration was respectively X_3=0.80 and 0.45. Furthermore, control measurements were made for pure He^3 and He^4 and these were found to agree with previous published results.[1] The singular part of the attenuation and the dispersion in the mixtures were found to be equal to those in the pure fluids within experimental error. The results are discussed in terms of the singular contributions from the sions in a Pomeranchuk cell in high magnetic fields. At 25 kG and at compression rates significantly higher than those used by the Florida group, the pressure vs. time curves become qualitatively different from those published[1]. Simultaneous zero sound attenuation measurements have also been carried out and there appears to be a feature in the sound attenuation associated with the pressure back-step.

* Supported by NSF through Grant #DMR-78-10901 and indirectly through the Cornell Materials Science Center through Grant #DMR-76-81083.

1 E.A. Schuberth, D.M. Bakalyar and E.D. Adams, Phys. Rev. Lett. 42 (1979).

EL 6 NMR Relaxation Studies in Liquid ^{3}He. L.J. FRIEDMAN, and R.C. RICHARDSON, Cornell U.*--We have studied the relaxation of nuclei in liquid ^{3}He in the presence of large surface areas. When 90 Å carbon particles are prepared with a monolayer coating of N_2 gas, the relaxation rate of the ^{3}He is found to have anomalous behavior at the precession frequencies 3.25 MHz and 6.50 MHz. At these frequencies the rate is 25% more rapid that that found at frequencies 100 kHz on each side of the anomalies. When we studied the ^{3}He relaxation on "bare" carbon particles we found that the relaxation rate decreased linearly with increasing frequency and that the anomalies were absent. The results with the "bare" particles reproduce Kelly's earlier observations[1].

*Supported by NSF through the Cornell Materials Science Center, Grant #DMR-76-81083A02.

1J.F. Kelly, Ph.D. Thesis (unpublished), Cornell University, 1974.

EL 7 Thermal Vacancies in Solid ^{3}He-^{4}He Mixtures.* R. O. SIMMONS and B. A. FRAASS†, University of Illinois, Urbana-Champaign--Concentrations of thermal vacancies in crystals of ^{3}He-^{4}He mixtures have been measured directly with x-ray diffraction. Crystals with ^{3}He concentrations of 99, 51, 28, 12 and 0% have been studied in the pressure range 3.0 to 7.8 MPa. A new x-ray diffractometer-position sensitive detector system is used which allows precise study of the detailed temperature dependence of the vacancy concentration. Vacancy concentrations as large as 5% are found in low pressure mixed crystals. In such crystals, the vacancies account for up to 30% of the internal pressure of the crystal. The temperature dependence of the vacancy concentration is qualitatively different for different mixtures.

*Supported by DOE Contract EY-76-C-02-1198.
†Present address: National Cancer Institute, National Institutes of Health, Bethesda, MD.

EL 8 X-ray Study of Phase Separation in Solid Helium Mixtures.* B. A. FRAASS† and R. O. SIMMONS, University of Illinois, Urbana-Champaign-- A microscopic study of phase separation in solid ^{3}He-^{4}He mixtures has been made using x-ray diffraction. Mixtures with ^{3}He concentration x = 51, 28, and 12%, respectively, have been studied in the pressure range 3.0 to 6.2 MPa. Accurate phase separation temperatures T_{ps} are obtained from shape changes in Bragg diffraction peaks. Regular solution theory accurately describes the relationship of T_{ps} to the critical temperature T_c for the 28 and 51% mixtures. T_c is linear in pressure from 3.0 to 6.2 MPa for both 28 and 51% mixtures. dT_c/dP is -34mdeg/MPa. Thus the excess volume of mixing is $-0.57x(1-x)$ cm^3/mol. Data obtained on warming are found to be unreliable; doubts are therefore raised about data in the literature which have been obtained by warming. Lattice parameters of both separated components are measured as a function of temperature, and some speculations about the phase diagrams are encouraged.

*Supported by DOE EY-76-C-02-1198.
†Present Address: National Cancer Institute, National Institutes of Health, Bethesda, MD.

EL 9 Visual Observation of Solidification and Melting of ^{4}He in the kbar Range. J. P. FRANCK*, Univ. of Delaware†.--Solidification and melting of ^{4}He at constant volume was visually observed at pressures between 4 and 7 kbar. Optical resolution was about 5μ. During solidification dendritic growth is observed at large cooling rates, and facetted growth for small cooling rates. At the end of the solidification interval highly faulted regions appear, some of which remain in the formed solid. Melting starts at the faulted regions, which increase dramatically as the melting process continues.

*Permanent address: University of Alberta

†Supported by NSF Grant DMR 78-01-307.

EL 10 Pressure Transitions in Solid H_2.* D. G. HAASE, J. O. SEARS, and R. A. ORBAN, North Carolina State Univ. We have measured the pressure changes due to orthohydrogen held at constant temperatures below 0.5°K. The samples were initially cooled to the measurement temperatures at orthohydrogen concentrations X>0.6, in the ordered fcc phase, and observed until X≤0.50. We noted abrupt pressure transitions, similar to those previously observed for the high temperature fcc to hcp transition, at X≃0.53 and sample temperatures down to 0.23°K. The gradual pressure change, $(\partial P/\partial X)_T$, also decreased by 20 to 50% after the transitions occurred. These results will be compared with other measurements of the solid H_2 phase diagram in this concentration-temperature range.

* Supported by the Research Corporation and the Office of Naval Research.

EL 11 Possible Long-range Order in hcp Solid Hydrogen. STEPHEN PATE and MARJORIE KLENIN, North Carolina State University.--We have obtained the energy surfaces for systems of classical quadrupoles arranged in the one-sublattice, two-sublattice, four-sublattice, and eight-sublattice structures possible on an hcp lattice. Multiple, mutually accessible minima are found to occur. These represent states of the system in which a local symmetry is broken, and their existence suggests that hcp solid hydrogen may provide an example of a "fully frustrated orientational glass". Mean-field estimates of ordering temperatures and of various thermodynamic quantities are made, and the limitations of these estimates are discussed.

EL 12 Computer Studies of Orientational Ordering in the Hexagonal Phase of Solid Hydrogen. MARJORIE KLENIN and STEPHEN PATE, North Carolina State University.--We present preliminary results of Monte Carlo calculations designed to model a purely classical quadrupolar interaction between molecules on hexagonal lattices, with quadrupolar "spin" concentrations varying between the percolation limit and 100%. The stability of possible one-sublattice, four-sublattice, and eight-sublattice structures is investigated, as a function of both temperature and concentration, through determination of a local "order parameter" and susceptibility. The low-temperature specific heat and relaxation-time phenomena are also described, and implications for the picture of solid hydrogen as a "quadrupolar glass" are discussed.

EL 13 Susceptibility and relaxation Measurements on Frozen Saturated H_2O Cerium Magnesium Nitrate Solution. B.W. HOLMES† and C.O. ZIMMERMAN†, BOSTON U.--We have measured the susceptibility and relaxation times of a glasslike[1] H_2O-CMN solution between 1K and 4K. We find that the solution obeys Curie's Law and it appears that the g-factor is isotropic unlike crystalline CMN. The relaxation times are much faster than those of the crystal and can be analyzed in terms of direct and Raman relaxation. No Orbach[2] relaxation is observed. The relaxation times of CMN imperfect crystals will also be discussed.

†Supported by NSF Grant No. DMR 7719582
[1]J.M. Colwell, J. Low Temp. Phys. 14, 53, (1974).
[2]C.B.P. Finn, R. Orbach and W. P. Wolf, Proc. Phis. Soc. 77, 261, (1961).

*Although this paper deals with a paramagnetic substance since the substance is relevant to the low temperature measurements of liquid He^3, it should appear in the quantum fluids and solids section where it will encounter a more interested audience.

BUSINESS MEETING OF THE DIVISION OF NUCLEAR PHYSICS
Tuesday afternoon, 29 April 1980
Washington Room, Sheraton Washington Hotel at 4:15 P.M.

NUCLEAR SCIENCE ADVISORY COMMITTEE REPORTS
Tuesday afternoon, 29 April 1980
Washington Room, Sheraton Washington Hotel at 4:30 P.M.

NO HOST COCKTAIL PARTY
Tuesday evening, 29 April 1980
Blue Room, Shoreham-Americana Hotel at 5:30 P.M.

SESSION FA: SYMPOSIUM OF THE FORUM ON PHYSICS AND SOCIETY: PRIZE SESSION
Tuesday evening, 29 April 1980; Palladium Room, Shoreham-Americana Hotel at 8:00 P.M.; Paul Horwitz, presiding

FA 1 Presentation of the Leo Szilard Award to SIDNEY D. DRELL, *Stanford Linear Accelerator Center.*

FA 2 Response of the Prize Winner. (30 min.)

FA 3 Presentation of the APS Forum Award to WILLIAM A. SHURCLIFF, *Cambridge Electron Accelerator.*

FA 4 Response of the Prize Winner (30 min.)

SESSION GA: SYMPOSIUM OF THE DIVISION OF NUCLEAR PHYSICS: GENERAL INTEREST—NUCLEAR PHYSICS I
Wednesday morning, 30 April 1980; Washington Room, Sheraton Washington Hotel at 9:00 A.M.; G.L. Rogosa, presiding

GA 1 Proton Radiative Capture at Intermediate Energies: Is There a "Nuclear Balmer Series"?
S.L. BLATT, *Ohio State University.* (30 min.)

Recent experiments on (p,γ) reactions at energies up to 100 MeV reveal strong capture to highly excited nuclear states.[1] The dominant final states appear to have simple single-particle configurations, in agreement with subsequent theoretical analyses.[2] Further experimental results reinforce these findings and suggest the existence of a series of simple excitations involving single protons in high-lying major shells. Radiative transitions between these configurations would produce a spectrum analogous to that of a single-electron atom. Such a simple picture appears to describe the major features of the data.

*Work supported in part by the National Science Foundation.
[1]M.A. Kovash, S.L. Blatt, R.N. Boyd, T.R. Donoghue, H.J. Hausman, and A.D. Bacher, Phys. Rev. Lett. 42, 700 (1979).
[2]L.G. Arnold, Phys. Rev. Lett. 42, 1253 (1979); S.F. Tsai and J.T. Londergan, Phys. Rev. Lett. 43, 576 (1979); D. Halderson and R.J. Philpott, to be published.

GA 2 Resonant Behavior of the $^{24}Mg(^{16}O, ^{12}C)^{28}Si$ Reaction.
S.J. SANDERS, *Argonne National Laboratory, Argonne, Ill.** (30 min.)

Studies of several light heavy-ion systems have revealed the presence of resonance-like structures in the excitation functions of a number of outgoing channels. For heavier nuclei, these features were first identified in backward angle elastic and inelastic scattering and have been found subsequently in 'alpha-transfer' reactions. The results of an extensive series of measurements on the $^{24}Mg(^{16}O,^{12}C)^{28}Si$ reaction will be presented. These measurements include numerous angular distributions, as well as 0°, 90° and 180° excitation functions for 26 MeV $\le E_{cm} \le$ 38 MeV. The data are analyzed in the context of Breit-Wigner resonances added to a direct reaction background. Spin assignments are suggested for prominent structures in the 0° excitation function. Additional measurements for other decay channels of the ^{40}Ca compound system will be presented.

*Work performed under the auspices of the U. S. Department of Energy.

GA 3 Test of the Interacting Boson Model with Two-Neutron Transfer.*
J.A. CIZEWSKI, *Los Alamos Scientific Laboratory.* (30 min.)

Extensive investigations of two-particle transfer reactions have been performed on medium and heavy mass nuclei. Unfortunately, except for nuclei near closed shells, the wealth of information concerning two particle transfer strengths has not been examined with existing nuclear models. Recently, the Interacting Boson Model (IBM)[1)] has been formulated by Iachello, Arima, and their coworkers with the aim of unifying the understanding of collective excitations in medium and heavy mass nuclei, especially away from closed shells. Several levels of sophistication for the IBM have been explored, from the phenomenological one-boson IBM I, to the two-boson (neutron and proton bosons) IBM II and current attempts at understanding the microscopic structure[2)] of the bosons. In all of these approaches the ability to predict two particle transfer strengths[3,4)] in non-magic nuclei exists.
This talk will summarize some of the important theoretical aspects of the Interacting Boson Model, especially aspects which are relevant to two-particle transfer studies. Various types of IBM