Session 22bA

Molar-Volume Dependence of the Isentropic Pressure of Solid ^{3}He **22bA1**

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We have measured the pressure of bcc solid ^{3}He during adiabatic demagnetization at practically zero entropy. The upper critical field shows a $V^{19.7\pm0.2}$ dependence for molar volumes V between 20.02 cm^3/mol and 21.73 cm^3/mol. The lower critical field has been completely mapped out for molar volumes between 20.02 cm^3/mol and 23.99 cm^3/mol, showing a $V^{15.6\pm0.2}$ dependence. The results are in agreement with those reported by the Tokyo group for molar volumes above 22.45 cm^3/mol. The magnetic-field dependence of the pressure is qualitatively similar at all molar volumes, indicating that the natures of the two antiferromagnetically ordered phases are independent of the molarvolume.

Observation of a New Excitation in bcc ^{4}He by Inelastic Neutron Scattering **22bA2**

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In a classical cubic crystal with one atom per unit cell, the only allowed excitations are 3 acoustic phonon branches. Recently, it was predicted that in a quantum crystal another, optic-like excitation branch can exist. This additional excitation arises from the assumption that atomic zero point motion in the crystal can be correlated. Here, we describe a neutron scattering experiment aiming to detect this excitation in bcc ^{4}He. In addition to the three phonon branches, we indeed observed a weakly dispersive, optic-like excitation branch along the [110] direction. One possible interpretation is that the new excitation is a quantum analogue of a point defect.

22bA3 Sound velocity and attenuation in nuclear-ordered U2D2 solid ^{3}He

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We observed sound properties in nuclear-ordered U2D2 solid ^{3}He crystal with a single magnetic domain along the melting curve. We observed temperature dependences of both sound velocities and attenuations for a longitudinal and two transverse sounds between 3 and 50 MHz below the nuclear-ordered transition temperature T_N. The velocity, v, changed as $\Delta v/v = a(T/T_N)^4$ and the attenuation, α, approximately $\Delta\alpha = b\omega^3(T/T_N)^9$. The coefficients a and b depended on crystal orientations and sound modes. Assuming a tetragonal symmetry of U2D2 crystal, we determined 6-independent elastic constants of nuclear spin system from data of $\Delta v/v$.

22bA4 Magnetic Resonance Studies of Hydrogen Isotopes in Impurity-Helium Solids.

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Investigations of Impurity- Helium (Im-He) solids have been performed with electron spin resonance (ESR) and nuclear magnetic resonance (NMR) techniques. Structural changes in porous Im-He solids have been observed for D_2 impurities as samples were heated above T_λ. Tunneling exchange chemical reactions were studied in Im-He solids containing D, H, D_2, H_2 and HD impurities. The D and H concentrations varied with time as determined by ESR measurements on the atomic H and D free radicals. Satellite ESR lines associated with dipolar coupling of H or D atoms to the nuclear moments of hydrogen nuclei found in neighboring molecules have been observed. The forbidden transition involving the mutual spin flips of electrons and protons in hydrogen atoms has also been studied.