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Session EE. Physical Acoustics V: Mechanical Wave Propagation in Condensed Matter Physics

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Chairman's Introduction—8:00

Invited Papers

8:05

EE1. Ultrasonic absorption in the magnetic superconducting system $Er_{1-x}Ho_xRh_4B_4$. Keun J. Sun (NASA–Langley Research Center, Mail Stop 231, Hampton, VA 23665)

Ultrasonic attenuation measurements as a function of temperature at constant magnetic fields and as a function of magnetic field at constant temperatures in $Er_{1-x}Ho_xRh_4B_4$ show interesting behavior at low temperatures. The enhanced attenuation observed in the superconducting state and the sharp change in attenuation at magnetic phase transition for the superconductors in this system are attributed to spin–phonon interaction. The peculiar dependence of attenuation on orientation of magnetic field with respect to sound wave propagation direction evidences indirectly the coexistence of magnetic order and superconductivity. A two-level model of phonon–phonon interaction is proposed to elucidate the occurrence of relaxation type attenuation maxima observed in the temperature-dependent attenuation curves of all the samples. Furthermore, the attenuation behavior at low temperatures in high magnetic fields may also manifest the occurrence of a new magnetoelastic coupling effect.

8:35

EE2. Ultrasonic attenuation measurements on the heavy fermion superconductor UPt_3. B. K. Sarma, M. Levy, A. Schenstrom, Y-J. Qian, M.-F. Xu (Department of Physics, University of Wisconsin–Milwaukee, Milwaukee, WI 53201), S. Adenwalla, J. B. Ketterson, Z. Zhao (Department of Physics, Northwestern University, Evanston, IL 60208), and D. Hinks (MST, Argonne National Laboratory, Argonne, IL 60439)

The superconducting pairing mechanism in the heavy fermion superconductor UPt_3 is unconventional, as evidenced from any of its low-temperature properties. Recent ultrasonic absorption, heat capacity, and magnetization measurements show a multiplicity of phases in the H–T plane, suggesting an exotic order parameter. The experimental results will be reviewed. [Work supported by ONR and NSF.]

9:05

EE3. Ultrasonic studies of collective modes in superfluid ^{3}He. John B. Ketterson (Department of Physics and Astronomy, Northwestern University, Evanston, IL 60201)

Liquid ^{3}He undergoes a transition at a temperature of 2×10^{-3} K into a superfluid state. The state is related to the paired-electron state of the BCS theory of superconductivity but differs in that the ^{3}He atoms are paired in an $L=1$ (p wave), $S=1$ (triplet) state [rather than the $L=0$ (s wave), $S=0$ (singlet) state of conventional superconductivity]. Various excited states of the superfluid exist, which are referred to as excitonic or collective modes, and, loosely, they correspond to various values of the total angular momentum $J=L+S$. Some of these modes couple strongly with ultrasound. A brief review is presented of these collective modes and of the ultrasonic experiments performed to date, which probe their behavior as a function of temperature and magnetic field.