

should be proportional to $k^{3/2}$, because the spin-wave frequency is believed to vary as $\xi^{-1/2} k$ in the macroscopic region below T_c .

The Brookhaven experiment was done by H. Y. Lau, Lester Corliss, A. Delapalme, Julius Hastings, Robert Nathans and A. Tucciarone (*Phys. Rev. Lett.* **23**, 1225, 1969). The experimenters used a simple "fruit-fly" type of material, rubidium manganese fluoride: the manganese atoms sit on a simple cubic lattice; the exchange interaction is very closely of the form $S_1 \cdot S_2$, where S_1 and S_2 are atomic spins; the interactions lead to antiferromagnetic ordering at a temperature T_N of 83 K.

A beam of neutrons strikes the sample, and the experimenters measure the energy and momentum of the inelastic magnetically scattered neutrons. The momentum dependence yields information on the spatial extent of the correlated regions, and the en-

ergy dependence yields information on their time dependence.

The Brookhaven group was able to determine the characteristic frequency for k approximately equal to zero as a function of temperature (or ξ) and for $T = T_N$ ($\xi^{-1} = 0$) as a function of k . Comparing the behavior in these two regions, they find good quantitative agreement with the prediction of dynamic scaling. —GBL

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Panel Suggests New Uses for Accelerators of 6 MeV or Less

A National Academy of Sciences report, "New Uses for Low-Energy Accelerators," suggests a variety of experiments for nuclear astrophysicists, atomic and solid-state physicists. The 173-page report, prepared by an ad hoc panel chaired by William A. Fowler, discusses many uses for machines with energies of 6 MeV or less. Comments from the report include:

- Thermonuclear-reaction studies provide the most useful application of these accelerators to nuclear astrophysics. One can study nonresonant charged-particle, resonant and neutron-induced reactions and photonuclear rates.

- With beam-foil spectroscopy the atomic physicist can study the level structure of monatomic ions. The atomic lifetimes of the highly charged ions produced in the foil experiments are determined by measuring the decrease either in the transition rate or in the brightness of the emerging ions.

- Among the experiments of interest to solid-state physicists are those dealing with energy loss and with penetration of keV to MeV particles into amorphous and crystalline solids. Channeling (anisotropic-penetration) studies can be performed on crystals to locate foreign atoms, determine precise crystal orientation and study lattice damage. One can possibly tailor

solid-state materials by adding atoms dynamically (ion implantation) rather than by conventional doping techniques.

- Solid-state and nuclear physicists might profitably cooperate in studies of the interaction of nuclear moments with solid-state environments. Measurements of magnetic and electric fields in solids interacting with the magnetic and electric moments of the nuclei could be used to study either the fields or the moments.

Doppler Shift Is Used to Study Superfluid Currents

At the December APS meeting in Los Angeles, a group from UCLA reported on a new method of studying persistent currents in superfluid helium in which they observe the Doppler shift of a sound wave in the medium.¹ This method has also been used by a Texas A & M group.²

In the UCLA work, Isadore Rudnick, H. Kojima, Wolfgang Veith and Reynold S. Kagiwada place liquid helium in a container packed with powder of very fine (about 17 to 32.5 nanometers) grain size. They rotate the cylinder as it is cooled below the critical temperature and then stop the rotation. Because of the viscosity of the normal fluid, it is trapped by the

powder pores while the superfluid component is free to move.

When a resonant sound wave is induced in the cavity it propagates only in the superfluid, a mode of propagation known as "fourth sound". Because fourth sound faces infinite resistance in the normal fluid and zero resistance in the superfluid there is no power loss.

The motion of the superfluid causes the fourth-sound resonance to be split into a doublet whose frequency difference measures the angular momentum of the superfluid. The mean frequency is proportional to the superfluid density, and Rudnick believes that the constant of proportionality, which depends on a scattering correction for the grains of the powder, is empirically well determined. Other studies of persistent currents,^{3,4} which depend on the gyroscopic effects associated with the rotation, also measure the angular momentum but are able to determine only temperature dependence of superfluid density.

Rudnick and his colleagues plan to investigate not only the persistent-current velocity but also the superfluid density, which is a function of temperature, coherence length and pore size of the powder.⁵ Because the density goes to zero on the boundary of the pore, the average density is less than the density in the bulk, especially for small pore sizes. By comparing the measurements of the density of superfluids on the free surface of a film¹ to the UCLA measurements of the density on bound surfaces, one should obtain interesting information about the boundary conditions on superfluids.

So far the UCLA team has only preliminary data. They hope to obtain greater accuracy by replacing the present dipole-source transducer with one that will consist of n segments, each one $2\pi/n$ out of phase with its neighbor. For a given direction of phase difference this transducer would excite only one of the two resonant frequencies. —BGL

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