(1, 2, and 3 in the figure), we can independently determine, in addition to the value of μ, the values of the quantities Δ and μ_0, which is an additional check of the validity of the interpretation of the measured absorption spectrum. Thus, for the value of Δ we obtained $(1.9 \pm 0.2) \times 10^{-7}$ ev, which is in good agreement with the value obtained from the absorption spectrum in the absence of a magnetic field, and the value of μ_0 was found to be $-(1.1 \pm 0.3)$ nuclear magnetons in agreement with the available data. For the magnetic moment of the 23.8-kev excited state of Sn^{119} we found a value $\mu = +(1.9 \pm 0.4)$ nuclear magnetons. This value considerably exceeds the value predicted by the single-particle model (Schmidt lines), which shows that the 23.8-kev level in Sn^{119} in not a pure single-particle level. Such a conclusion is confirmed by the fact that the M1 transition with energy 23.8-kev is l-forbidden.

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THE DETERMINATION OF THE COEFFICIENTS OF DIFFUSION AND OF HEAT CONDUCTIVITY OF WEAK SOLUTION OF He^3 *IN HELIUM II*

T. P. PTUKHA

Institute for Physics Problems, Academy of Sciences, U.S.S.R.

Submitted to JETP editor July 13, 1960

J. Exptl. Theoret. Phys. (U.S.S.R.) **39**, 896-898 (September, 1960)

IF one wall of a reservoir containing a weak mixture of the isotopes He^3-He^4 is kept cold while heat is given out at the other, He^3 will be carried along by the thermal excitations and accumulate at the cold end. Diffusion and heat conductivity will cause a concentration gradient and a temperature gradient ∇T. By measuring the temperature gradient in the direction of the heat current in the steady state, and knowing the magnitude of this heat current, we can find the effective heat conductivity, κ_{eff}, which characterizes the processes of diffusion, thermal diffusion, and heat conductivity in the mixture.

To measure ∇T, four 35-μ phosphor-bronze wire resistance thermometers were used. The thermometers were made in such a way that their coils lay in one plane. The heat current was produced by a constantan heater with bifilar winding in the form of a flat disk. The lowest temperatures were obtained by pumping off He^3 vapor. The temperature of the He^3 bath was controlled by a temperature regulator[1] and kept constant to 10^{-4} °K.

Figure 1 shows the dependence of κ_{eff} on T. The circles and crosses correspond to results obtained with two different devices. The theoretical curves (dashed) calculated by Khalatnikov and Zharkov[2] are shown for comparison.

They determined the unknown constant for the interaction of an impurity with a roton, which is necessary for this calculation, from the experimental value of the diffusion coefficient found by Beenakker et al.[3] at T = 1.5° K. The existence of a minimum in the $\kappa_{eff}(T)$ curve indicates the existence of two heat transfer mechanisms in weak He^3-He^4 mixtures: heat transport due to the motion of thermal excitations, limited by the presence of He^3 (He^3 acts as a resistance to the propagation of heat), and heat transport by thermal conductivity (the diffusion of thermal excitations).

Values of the diffusion coefficient D in the temperature range from the λ point to T = 1.5° K were derived from the values of κ_{eff} for a concentration C = 0.1%. The results are shown in Fig. 2. The theoretical curve obtained from the equation[2]

$$D = \frac{kTt_{ip}}{m_3}\left(\frac{\rho_{n_0}}{\rho_n}\right)^2, \qquad (1)$$

is shown for comparison. Here k is Boltzmann's constant, ρ_{n_0} is the part of the normal density (ρ_n) of the mixture associated with the thermal excitations, and t_{ip} is the time characterizing the scattering of an impurity on a roton.

To determine t_{ip}, we normalized κ_{eff} to the experimental value at T = 1.6° K. The experimental values of the diffusion coefficient, taken from

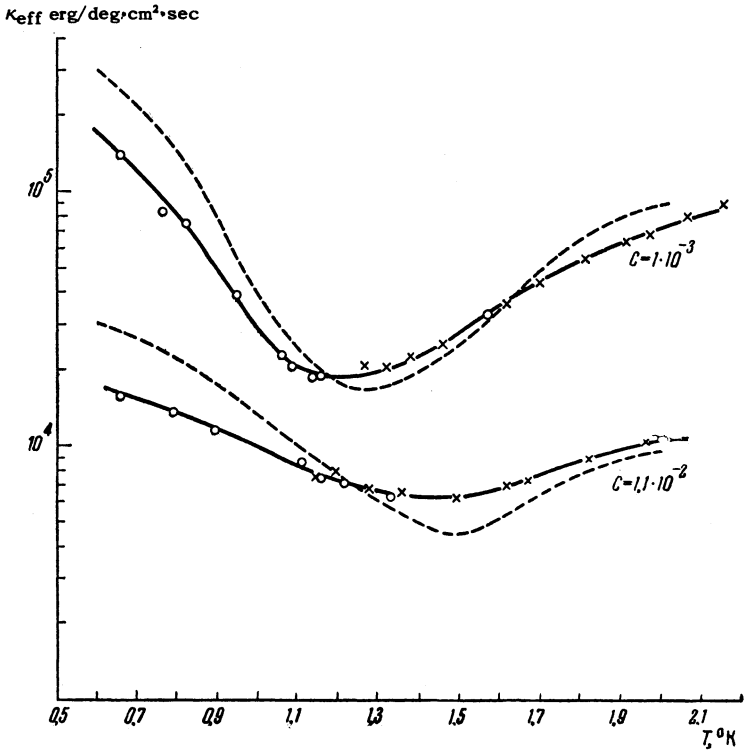

FIG. 1. Temperature dependence of the effective heat conductivity of mixtures with He^3 concentrations C = 0.1 and 1.1%. ($C = N_3m_3 \times (N_3m_3 + N_4m_4)^{-1}$, where N_3 and N_4 are the numbers of He^3 and He^4 atoms per unit volume and m_3 and m_4 are the masses of He^3 and He^4 atoms).

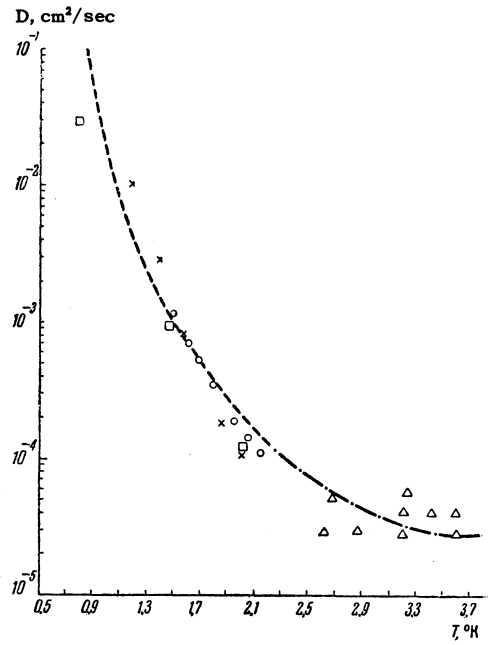

FIG. 2. Temperature dependence of the diffusion coefficient; o – results of the present work, x – reference 3, Δ – references 4 and 5, □ – reference 6.

the work of Careri et al.[4,5] and of Beenakker et al.[3] are shown in Fig. 2. Since in the latter work there was an error in calculating the results, the values of D shown in Fig. 2 have been recalculated with the correct entropies of pure helium II, taken from the work of Kramers et al.[6] The values of D obtained by the spin-echo method by Garvin and Reich[7] are also included on the graph. Since they measured the diffusion coefficient under pressure,

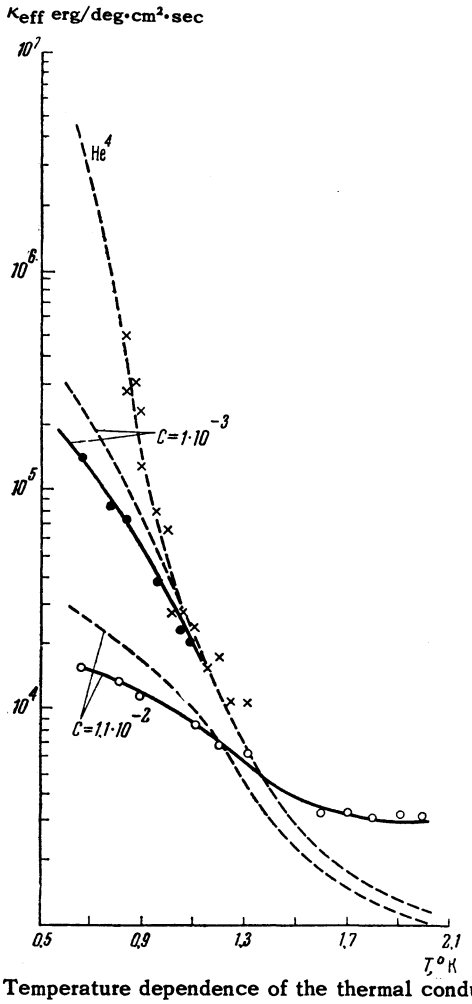

FIG. 3. Temperature dependence of the thermal conductivity, κ, of mixtures; o – results of the present work, x – from reference 8.

the values of D have been extrapolated roughly to the saturation vapor pressure.

Figure 3 shows the dependence of the thermal conductivity κ on T. For comparison, the thermal conductivity of He^4, obtained by Zinov'eva[8] from measurements of the attenuation of second sound, are shown. The dashed curves are theoretical, calculated from the results of Khalatnikov and Zharkov.[2] In this calculation the energy gap between the ground state of helium II and the lowest roton level was taken as $\Delta = 8.5°$ K. It can be seen from Fig. 3 that the thermal conductivity of weak solutions is little dependent on concentration in the temperature region between the λ point and 1.1° K. The curves for pure He^4 and for a mixture with C = 0.1% He^3 in He^4 diverge below 1.1° K. In this temperature region impurities influence the conductivity mechanism appreciably, reducing the mean free paths of rotons and phonons.

A more detailed discussion of the results and of the method, and the results of extending the measurements to lower concentrations will be published in the near future.

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PARAMAGNETIC RESONANCE IN SINGLE-CRYSTAL TIN

M. S. KHAĬKIN

Institute for Physics Problems, Academy of Sciences, U.S.S.R.

Submitted to JETP editor June 14, 1960

J. Exptl. Theoret. Phys. (U.S.S.R.) **39**, 899-901 (September, 1960)

THE paramagnetic resonance of conduction electrons in metals has been investigated by Feher and Kip[1] on small particles and thin films of lithium, sodium, and beryllium, and was noted also in potassium. The theory of the effect was worked out by Dyson,[2] Azbel', Gerasimenko, and Lifshitz.[3,4] Experiments on paramagnetic resonance of large single crystals of metal have not yet been described in the literature.

In the present work, electron paramagnetic resonance was observed on a single crystal of very pure tin with $< 6 \times 10^{-5}$% of impurities.[5] The single crystal had dimensions of 11 × 6 × 1 mm and served as the inner conductor of a strip-type resonator tuned to 9.35×10^9 cps. The measurements were carried out at a specimen temperature of 2.3° K by the frequency-modulation method.[6,7]

The results of the experiment are plotted in Fig. 1, in which are seen three paramagnetic-resonance signals. The copper parts of the resonator, prepared from copper of technical purity, give the wide line 1. The narrow symmetrical line 2 is the signal from $\sim 10^{-10}$ mole of crystalline diphenyl picryl hydrazyl, placed in the resonator for calibration. Line 3 is the paramagnetic resonance of the tin sample.

Rotation of the constant magnetic field in the plane perpendicular to the high-frequency magnetic field permits the observation of an apparent small anisotropy of the effect: the peak of the resonance moves by an amount which is of the order of its width. The significant change of the amplitude of the peak, which occurs during rotation of the field, is possibly explained[4] by a change of the angle of inclination of the field with respect to the sample surface. However, these aspects of the phenomenon are still not sufficiently clear from the experimental point of view.

In Fig. 2 is shown, on a larger scale, a record of the paramagnetic resonance of the electrons of tin (right-side peak) and of the calibration signal. The values of the constant magnetic field were recorded by a proton magnetometer (as in Fig. 1). From this graph it is possible to find the difference between the factor g_{Sn} for conduction electrons in tin and the factor $g_d = 2.0036$ for diphenyl