

γ rays. The latter strongly interfered with the counts at the detector disposed in the direction of the field, since in this case part of the detector was screened by the pole of the magnet. Apparently, one can thus explain the fact that the ratio of the change in counts along the field to the change in counts across the field was not equal to two (see figure). The accuracy of the results presented will be increased in further experiments.

In our previous communication¹ we thought that the presence of an intrinsic magnetic moment at the gold atoms was needed to form the strong magnetic field at the Au^{198} nuclei in the Au-Fe alloy. However, it now appears highly probable that a large (or basic) contribution to this field arises in the conduction electrons. This possibility was first pointed out to us by E. K. Zavoiskii. Recently Marshall⁴ proposed a mechanism for the creation of a "contact" field at the nucleus of a ferromagnetic atom. Apparently this mechanism also applies in our case, with the difference that the conduction electrons are polarized close to the neighboring atoms of iron and pass to the impurity atoms without change of orientation. Unfortunately, existing calculations of the magnetic field created by the conduction electrons in a ferromagnet are still only estimates. We hope to obtain more definite data on the origin of this field in further experiments (in particular by the study of the magnetic field at In and Au nuclei in In-Ni and Au-Ni alloys).

From the results we have obtained it would seem that the method of polarizing nuclei of weakly-magnetic atoms by introducing them into ferromagnets is of general applicability and allows a relatively high degree of polarization to be obtained.

The authors express their deep gratitude to E. K. Zavoiskii for much valuable advice, to L. D. Puzikov for assistance in calculating the γ -ray angular distributions and to L. V. Groshev, V. M. Galitskii, and D. P. Grechukhin for discussion of results.

*The errors in temperature determination are associated both with the inaccuracy of measuring the thermodynamic temperature of the salt itself and with the difference in the temperatures of salt and specimen (due to the short time elapsing after the demagnetization of the salt).

¹Samoilov, Sklyarevskii, and Stepanov, J. Exptl. Theoret. Phys. (U.S.S.R.) **36**, 644 (1959), Soviet Phys. JETP **9**, 448 (1959).

²H. A. Tolhoek and J. A. M. Cox, Physica **19**, 101, 673 (1953).

³Strominger, Hollander, and Seaborg, Revs. Modern Phys. **30**, 585 (1958).

⁴W. Marshall, Phys. Rev. **110**, 1280 (1958).

Translated by K. F. Hulme
395

LIFETIMES OF THE FIRST EXCITED STATES OF Rb^{85} AND Pr^{141}

N. A. BURGOV, A. V. DAVYDOV, and G. R. KARTASHOV

Institute for Theoretical and Experimental Physics, Academy of Sciences, U.S.S.R.

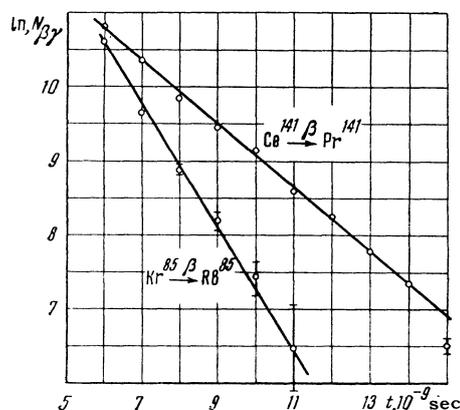
Submitted to JETP editor March 13, 1959

J. Exptl. Theoret. Phys. (U.S.S.R.) **36**, 1946-1947 (June, 1959)

WE have measured the lifetimes of the 150-kev level of Rb^{85} and of the 142-kev level of Pr^{141} by the method of delayed β - γ coincidences. The apparatus consisted of two scintillation counters with diphenyl acetylene crystals and FEU-33 photomultipliers and of a coincidence circuit with a resolving time of $2\tau_0 = 4.5 \times 10^{-9}$ sec. It was possible to insert calibrated sections of 200-ohm coaxial cable as delay lines into either channel.

As sources we used Kr^{85} and Ce^{141} , produced by exposure of natural krypton and cerium in a reactor. The gaseous radioactive krypton was contained at an absolute pressure of 3 atmos in a brass cylinder, 15 mm in length and diameter. The faces of the cylinder, through which the electrons and γ rays escaped, were covered with a 1 mg/cm² nylon film. The cerium source was a thin layer of cerium oxide powder mounted on aluminum foil.

The number $N_{\beta\gamma}$ of β - γ coincidences is related to the delay t in the channel of the β



counter by the formula $N_{\beta\gamma} = N_0 \exp(-t/\tau_\gamma)$ if $t \gg \tau_0$. Here τ_γ is the mean life of the excited nuclear state with respect to γ emission. The data obtained are shown in the figure. Treatment of the data by the method of least squares yields

$$\begin{aligned}\tau_\gamma(\text{Rb}^{85}) &= (1.14 \pm 0.12) \cdot 10^{-9} \text{ sec}, \\ \tau_\gamma(\text{Pr}^{141}) &= (2.32 \pm 0.17) \cdot 10^{-9} \text{ sec}.\end{aligned}$$

The value of τ_γ for Pr^{141} agrees with the result of de Waard and Gerholm.¹

The ratios of the experimentally determined lifetime to that calculated for single-particle transitions from the formulas of Moszkowski² are 210 and 230 for Rb^{85} and Pr^{141} , respectively.

¹H. de Waard and T. R. Gerholm, *Nuclear Physics* **1**, 281 (1956).

²S. A. Moszkowski, *Beta- and Gamma-Ray Spectroscopy*, p. 391, ed. Kai Siegbahn, North-Holland Publ. Co., Amsterdam 1955.

Translated by J. Heberle
396

ON THE PROBLEM OF THERMAL CONDUCTIVITY AND ABSORPTION OF SOUND IN SUPERCONDUCTORS

V. Z. KRESIN

Moscow State Pedagogical Institute

Submitted to JETP editor March 19, 1959

J. Exptl. Theoret. Phys. (U.S.S.R.) **36**, 1947-1948
(June, 1959)

IN the present note we consider the absorption of sound in superconductors for the case where $\omega\tau \ll 1$ (ω is the sound frequency and τ the relaxation time). If such a sound field is present, the electron finds itself in a lattice with a slightly altered lattice constant. The absorption of sound energy occurs when we take into account the irreversibility of the process of deforming the lattice.

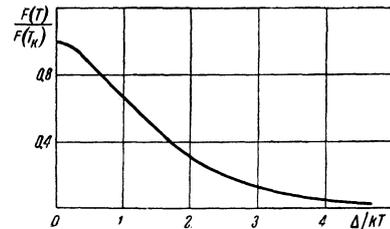
The solution of the transport equation for the distribution function of the electronic excitations of the superconductor which interact with the phonons, and the subsequent evaluation of the dissipative function which determines the absorption of the sound energy, leads to the following result for the coefficient for the absorption of sound:

$$\gamma_s = 4\gamma_n (e^b + 1)^{-2} F(T_k) / F(T). \quad (1)$$

Here $\gamma_n = \text{const} \cdot T^{-5}$ is the coefficient for the absorption of sound in the normal metal, evaluated by Akhiezer in reference 1; $b = \Delta/kT$; Δ is the gap in the energy spectrum;

$$\begin{aligned}F(T) &= 96\zeta(4) \ln(1 + e^{-b}) \\ &+ \sum_{s=1}^{\infty} s^{-6} e^{-2bs} (80b^4 s^4 + 160b^3 s^3 + 240b^2 s^2 + 240bs + 120) \\ &- \ln(e^b + 1) \sum_{s=1}^{\infty} s^{-4} e^{-2bs} (64b^3 s^3 + 96b^2 s^2 + 96bs + 48)\end{aligned}$$

($\zeta(s)$ is the zeta-function). We have given a graph of $F(T)/F(T_k)$ in the figure.



We can consider the problem of the influence of the electron-phonon interaction on the electronic thermal conductivity of superconductors in a similar way. This interaction, as was already noted by Geilikman² must be taken into account at temperatures close to T_k . We get in this case for the coefficient of thermal conductivity

$$\begin{aligned}\kappa_s &= \kappa_n \frac{12F(T_k)}{\pi^2 F(T)} \left[\sum_{s=1}^{\infty} \frac{(-1)^{s+1}}{s^2} e^{-bs} \right. \\ &\left. + b \ln(1 + e^{-b}) - \frac{b^2}{2(e^b + 1)} \right]^2, \quad (2)\end{aligned}$$

$\kappa_n = \text{const} \cdot T^{-2}$ is the thermal conductivity in the normal state considered by Landau and Pomeranchuk in reference 3.

We give here some values of κ_s/κ_n :

$\Delta/kT = 0$	0.25	0.5	0.75	1
$\kappa_s/\kappa_n = 1$	0.81	0.72	0.58	0.46

In conclusion I express my sincere thanks to B. T. Geilikman for suggesting this subject and for valuable advice.

¹A. I. Akhiezer, *J. Exptl. Theoret. Phys. (U.S.S.R.)* **8**, 1331 (1938).

²B. T. Geilikman, *J. Exptl. Theoret. Phys. (U.S.S.R.)* **34**, 1042 (1958), *Soviet Phys. JETP* **7**, 721 (1958).

³L. D. Landau and I. Ya. Pomeranchuk, *J. Exptl. Theoret. Phys. (U.S.S.R.)* **7**, 379 (1937).

Translated by D. ter Haar
397