it is possible to produce a medium with an easily controlled number of free electrons.

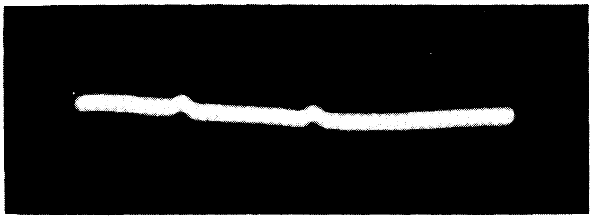


FIG. 2. Oscillogram of electronic resonance of a frozen solution.

The concentration of electrons can readily be determined from the intensity of the electronic resonance line.

We believe that the electronic resonance method described above may prove useful in determining the nature of different solutions.

[1]C. A. Hutchison, Phys. Rev. 75, 1769 (1949).

[2]A. Clyde and J. Hutchison, J. Phys. Chem. 57, 546 (1953).

[3]C. A. Kraus, J. Frankl. Inst., 212, 537 (1931).

[4]B. E. Gordon and V. L. Broude, Zhur. fiz. khim. 24, 409 (1950).

Translated by E. J. Rosen
309

Discontinuous Attenuation of Current In a Superconducting Ring

A. A. GALKIN, IA. S. KAN AND B.G. LAZAREV
Physico-Technical Institute, Academy of Sciences, Ukrainian SSR

(Submitted to JETP editor March 13, 1957)
J. Exptl. Theoret. Phys. (U.S.S.R.) 32, 1582 (June, 1957)

IN AN EARLIER INVESTIGATION, devoted to the kinetics of the transition from the normal state to the superconducting one, it was shown that the resistance of the specimen is a non-monotonic function of the temperature and fluctuates between zero and the normal value as the temperature is gradually decreased.[1,2] These fluctuations of resistance were related, in particular, with the kinetics of formation of an intermediate state arising in the process of destruction of the superconductivity by the current. It was assumed that an analogous but reverse effect might be observed during transition of a superconducting ring in which a current was induced to the normal state, *i.e.*, that the current would attenuate in jumps with gradually increasing temperature.

The experiments described herein were set up for the purpose of investigating the process. The apparatus consisted of a 10 mm radius lead ring made of 1 mm diameter wire and a coil of 8000 turns of copper wire mounted coaxially with the ring. By means of this coil it was possible to measure both the full current in the ring (by turning the coil about an axis in the plane of the ring) and the change in current ΔI (from the change in the induced emf produced by ΔI). In the first case the coil was connected to a ballistic galvanometer, in the second to a short-period galvanometer.

The coil and ring were enclosed in a copper cup immersed in liquid helium. By filling the cup with gaseous helium at a pressure of 1–2 mm Hg, the system could be cooled to the temperature of the helium bath. By applying a magnetic field $H > H_k$ and then cutting it off, a current $I = I_k$ was induced in the ring. After this the helium was pumped out of the cup to a residual pressure of $10^{-6} - 10^{-7}$ mm Hg and the ring slowly and gradually warmed. The rate of heating could be regulated and in most cases was $10^{-4} - 10^{-5}$ degrees/sec.

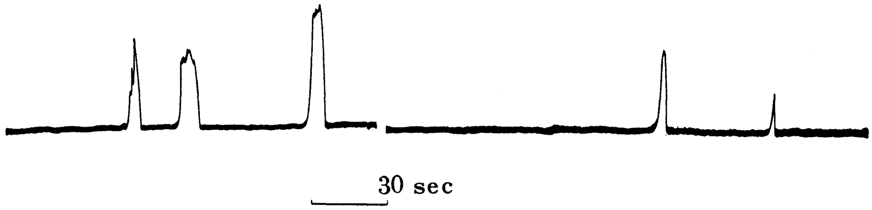
Part of the curve characterizing the variation with time of the emf in the measurement coil while the ring with the initially induced current was heated is shown in the accompanying figure. It will be seen that the current in the ring does not attenuate gradually, but falls off in jumps of several seconds duration; in the intervals between jumps the emf equals zero, *i.e.*, the current does not change during the interval.

From the $E(t)$ curves one can determine the relative change in current $\Delta I/I$ occurring during each jump. In the vicinity of 4.2° K the average value of $\Delta I/I$ for the lead ring is 10^{-4}.

Knowing $\Delta I/I$, the self-inductance of the ring, $L \approx 40$ cm, and the current attenuation time τ, one can evaluate the effective resistance responsible for the damping:

$$R_{\mathrm{eff}} = (\Delta I/I)\,L/\tau \approx 10^{-11}\ \mathrm{ohm}.$$

Inasmuch as the total resistance of the ring in the normal state was $\sim 10^{-7}$ ohm, we can say that, re-



gardless of the specific character of the intermediate state during the attenuation of the current, only an insignificant part of the volume of the superconductor is in the normal state.

[1] A. A. Galkin and B. G. Lazarev, Dokl. Akad. Nauk. SSSR 59, 1017 (1948).

[2] Galkin, Kan, and Lazarev, J. Exptl. Theoret. Phys. (U.S.S.R.) 20, 865 (1950).

Translated by E. J. Rosen
310

Calculation of the Polarization of Neutrons on the Basis of the Diffused Edge Nuclear Model

P. E. NEMIROVSKII AND IU. P. ELAGIN
Academy of Sciences, U.S.S.R.

(Submitted to JETP editor March 16, 1957)
J. Exptl. Theoret. Phys. (U.S.S.R.) 32, 1583 (June, 1957)

THE RESULTS OF EXPERIMENTS on the polarization of 400-kev neutrons have been examined by Adair[1] on the basis of the optical nuclear model with a rectangular potential well. In the examination the spin-orbit potential was assumed to be constant inside the nucleus. However, this examination does not take into account the basic properties of spin-orbit interaction which must actually exist only on the surface of the nucleus, as may be concluded from analogy with electromagnetic interaction.

In view of the above it is logical to assume that the spin-orbit interaction is proportional to

$$\frac{1}{r}\frac{dV}{dr}(\mathbf{l}\boldsymbol{\sigma}), \qquad (1)$$

where V is the depth of the potential well inside the nucleus. In this case, as can readily be seen, the magnitude of the spin-orbit interaction depends on the dimensions of the nucleus; this circumstance could not be taken into account in Adair's calculations.

In our calculations the selected form of the potential was

$$\begin{aligned} V &= V_0(1+i\zeta) = \text{const} \quad \text{for} \quad r \leqslant r_0, \\ V &= V_0 e^{-\alpha(r-r_0)}(1 + c\alpha/r_0) \quad \text{for} \quad r \geqslant r_0. \end{aligned} \qquad (2)$$

With this choice of potential there is a small discontinuity at $r = r_0$; this however is unimportant inasmuch as $c\alpha/r_0 < 1$. For the purpose of simplifying the solution, the factor $1/r$ in (1) was replaced by the constant $1/r_0$, which is a satisfactory approximation for heavy nuclei in which the thickness of the boundary layer is $d \ll r_0$. This substitution greatly facilitates calculations, since it makes it possible to use the procedure developed in Ref. 2.

The spin-orbit coupling coefficient c was assumed equal to 3.3×10^{-27} cm^2 in accordance with the data of Levintov[3] obtained in investigating light nuclei.

The polarization was computed according to familiar formulas which were derived on the assumption that the spin of the target nucleus is zero. It was assumed that the cross section for elastic scattering is due to optical elastic scattering and resonance elastic scattering. The latter makes no contribution to the polarization since the individual levels with different values of l do not interfere with each other.

The calculations were carried out on the assumption that only the s- and p-phases differ from zero. Inasmuch as we considered nuclei close to the maximum of the p-wave ($A \sim 100$), the d-phase in this region had a minimum as a function of A and, according to the calculations of one of the present authors, was close to zero.

In the calculations we assumed the following parameters:

$$r_0 = 1.28\,A^{1/3},\ V_0 = 42 \text{ Mev};\ \zeta = 0.05 \text{ and } \zeta = 0.1;$$
$$1/\alpha = 0.7 \cdot 10^{-13} \text{ cm}.$$

We investigated polarization with scattering at an angle of 90° to the direction of the incident beam.