mately 90,000, but is considerably less for any other pair of isotopes.

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The Mass Difference $Ni^{59}-Co^{59}$

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We have measured the threshold for $Co^{59}(p, n)Ni^{59}$, using protons from the Rockefeller electrostatic generator.[1]

The target was a freshly evaporated film of spectroscopically pure cobalt about 0.3μ thick, on a 2.5-inch disk of 10-mil tantalum. To avoid possible contaminations, we mounted the disk on a target holder that was hitherto unused. The neutron detector was a cadmium-clad long counter about an inch from the target, the axis of the counter being perpendicular to the proton beam.

Half an hour before the run with cobalt, the $Li^7(p, n)Be^7$ threshold was located, using a fresh lithium target.

The yield curves for the two targets are shown in Fig. 1. The ordinate scale for Li is about 10 times as large as the ordinate scale for Co. At low yields, the two curves lie so close together as to suggest that the yield from the Co target might be caused by Li contamination. This suspicion can be set at rest by noting the difference in the slopes of the curves. Furthermore, recent improvements in the Rockefeller generator have virtually eliminated the possibility of such a large shift in calibration. Nevertheless, we repeated the experiment with fresh targets some weeks later, and made background measurements with a clean Ta target. The threshold obtained was the same as before, but the uncertainty was greater because of a higher background.

The threshold for the $Co^{59}(p, n)Ni^{59}$ reaction is 7 ± 2 kilovolts above the $Li^7(p, n)Be^7$ threshold at 1882 ± 2 kev.[2] The Co^{59} threshold is therefore at 1889 ± 3 kev, and the Q-value is 1857 kev.

The decay of Ni^{59} to Co^{59} by β^+ emission has not been observed, and hence the mass difference $N^{59}-Co^{59}$ cannot be determined by a β-spectrum end point. When combined with the value 782 ± 1 kev[3] for the $n-H^1$ mass difference, the present measurement gives 0.001155 ± 0.000003 amu for the mass difference $Ni^{59}-Co^{59}$.

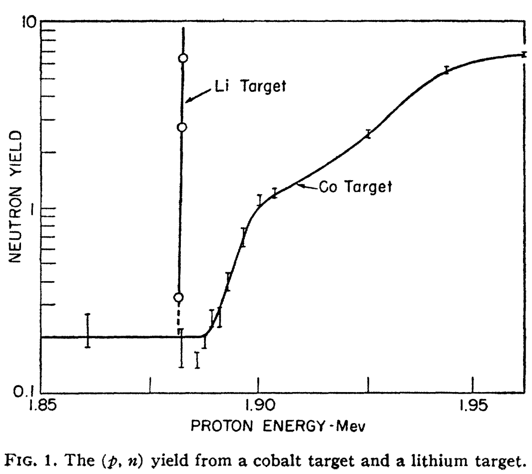

FIG. 1. The (p, n) yield from a cobalt target and a lithium target.

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Thermal Conductivity of Superconducting Lead in the Intermediate State

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A previous study of the thermal conductivity of pure-metal superconductors in the intermediate state reports[1] the transitions of lead cylinders in transverse magnetic fields at temperatures in the vicinity of 4° to 5°K. This investigation showed a small, field-independent thermal conductivity in the superconducting state ($H<\frac{1}{2}H_c$, where H_c is the critical magnetic field), an approximately linear increase of the conductivity as the field was raised through the intermediate state ($\frac{1}{2}H_c<H<H_c$), and a large, nearly field-independent thermal conductivity in the normal state ($H>H_c$). These results are consistent with the explanation[2] that in the superconducting state the majority of free electrons have entered into a state of zero-point energy where they are unable to contribute to the heat transport by exchanging energy with the lattice.

We have recently repeated and extended this experiment, using a solid cylinder and a hollow cylinder of highly pure lead (Johnson and Matthey, 99.998 percent). The outside dimensions of these cylinders were approximately 10 cm long by 0.5 cm in diameter. The wall thickness of the hollow cylinder was 0.15 cm. The temperature drop, measured by two carbon-composition thermometers on each specimen, was approximately 0.15°K.

The isothermal transition of the solid cylinder in a transverse magnetic field at 2.5°K is shown in Fig. 1. It is seen that in the intermediate state the thermal resistivity (w) is markedly higher than that of either the normal or the superconducting metal. The dashed curve indicates the hysteresis occurring on reducing the applied field to zero.

This anomaly is strongly temperature dependent as is shown in reduced coordinates in Fig. 2. Here the initial transition shown in

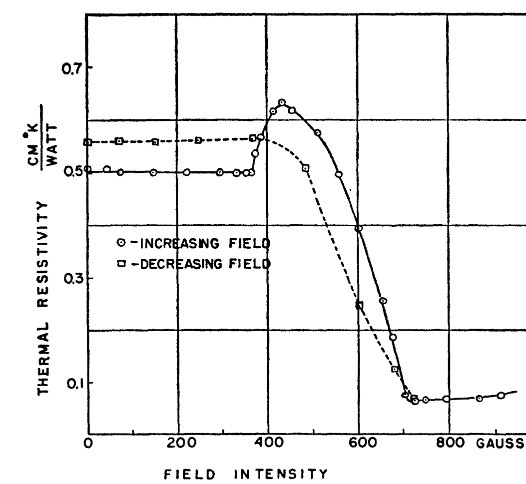

FIG. 1. Thermal resistivity of a solid lead cylinder in a transverse magnetic field at 2.5°K.

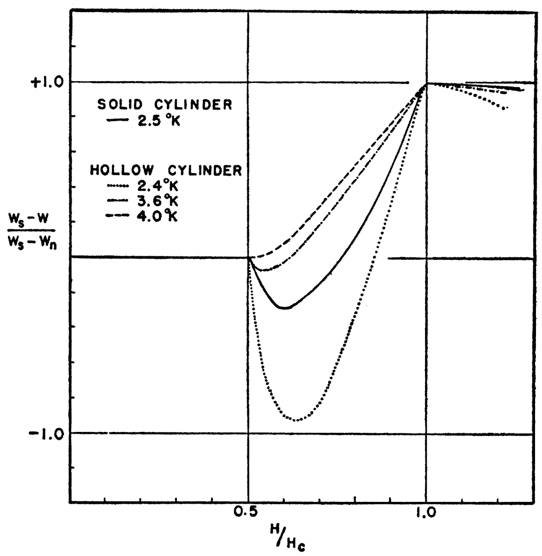

FIG. 2. Temperature dependence of the reduced thermal resistivity, $(w_s-w)/(w_s-w_n)$, of lead cylinders in a transverse magnetic field. w_s is the thermal resistivity in zero field and w_n is the thermal resistivity in critical field.

Fig. 1 appears as the solid curve. The remaining curves of this figure are transitions of the hollow cylinder on initial magnetization (the specimen was warmed above the transition temperature between each set of data).

A similar effect has been observed in niobium and in the alloy Pb-Bi (0.1 percent) by Mendelssohn and Olsen.[3] The anomaly in the intermediate state was taken as further evidence for a circulation mechanism leading to a thermal conductivity of alloy-type superconductors in the pure superconducting state that was relatively large as compared to their normal state conductivity.

The anomalously high thermal resistance in the intermediate state, as shown in Figs. 1 and 2 may be caused by:

(1) A circulation of superconducting and normal electrons, similar to that hypothesized in the case of alloys,[3] yielding a large contribution to the thermal conductivity of the superconducting state.

(2) A large thermal conduction by the lattice in the superconducting state.[4] This lattice conduction is largely quenched in the intermediate state due to the suddenly increased number of free electrons which act to scatter the phonons.

(3) A scattering of the normal electrons by the numerous surfaces bounding the laminations[5] of superconducting metal in the intermediate state.

Marked size dependencies should be observed in the second and third possible mechanisms mentioned above. Measurement of this dependency together with a more complete determination of the temperature dependence should permit a more complete understanding of the origin of this phenomenon.

Further work on this problem is in progress.

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Evidence for the Decay of a Negative π-Meson in a Photographic Emulsion*

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ILFORD C-2 200-micron plates were exposed in a spiral orbit spectrometer[1] to the Berkeley cyclotron. Positive and negative π-mesons entered the emulsion from opposite surfaces. While continuing the search for short μ-meson tracks from positive π-meson decays,[2] an unusual π—μ decay was found. The π-meson entered the emulsion from such a direction as to indicate that the meson was negatively charged. The π-meson track is about 120 microns long and ends near the middle of the emulsion. The grain density near the end of the π-meson track is saturated, indicating that the π-meson was traveling with a low velocity. The μ-meson

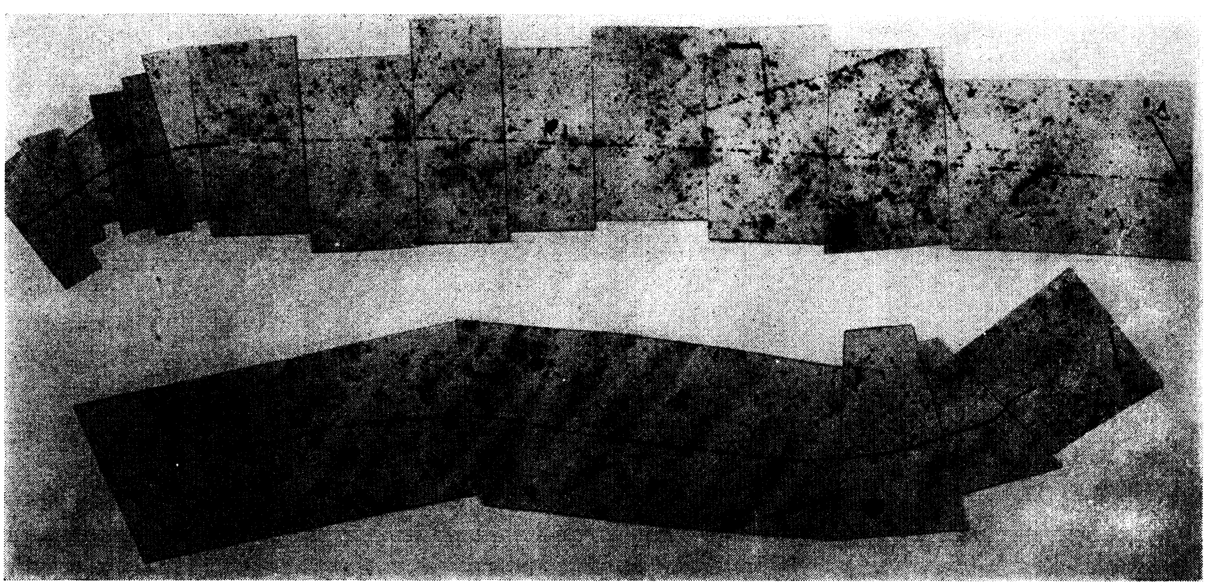

FIG. 1. A photomicrograph of the decay of a negative π-meson in a photographic emulsion. The π-meson track is near the top and to the left of the mosaic. The segments of the μ-meson track should be joined at the point indicated by the two arrows. The μ-meson track is 828 microns long.