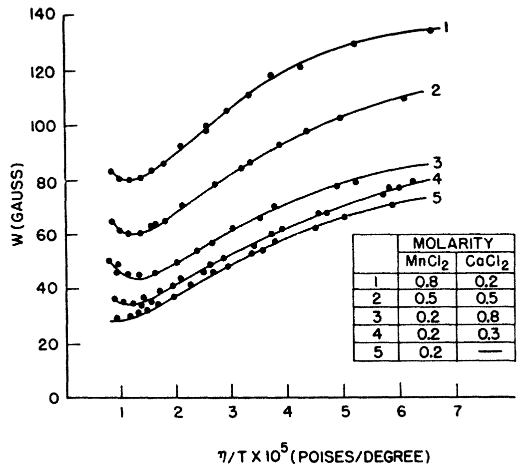

FIG. 2. Line width W as a function at η/T.

below 30 gauss. This corresponds to a relaxation time of about 4×10^{-9} second.

Other measurements have been made at room temperature to test the dependence of the width W on ionic concentrations. It was found that W is very nearly a linear function of Mn^{++} ion concentration when total ionic strength is constant, and also of total ionic concentration when a solution of a nonmagnetic salt was added, holding the Mn^{++} ion concentration constant. To test the effect of the anion, line widths were measured with 0.15-M solutions of $MnCl_2$, $MnBr_2$, $Mn(NO_3)_2$, $Mn(C_2H_3O_2)_2$, and $MnSO_4$. The first three widths were all 43 gauss within experimental error. The width in the acetate was 60 gauss and that in the sulfate was 64 gauss. These results can be interpreted in terms of the effect of ionic size on τ_c and the effect of ionic charge on the magnitude of the perturbation.

Further work on liquids is in progress.

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Order of Gamma-Ray Emission in the Decay of In^{111} *

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THE identification of the 247-kev gamma-ray emitted following orbital electron capture in In^{111} with a 0.08-μsec excited state in Cd^{111} at 247 kev seems to have been well established indirectly by several methods. One of these methods[1] depends upon noting that only the 247-kev gamma-ray is common to the activities of In^{111} and Cd^{111m}. Thus the order of emission of the gamma-rays following the decay of In^{111} can be inferred, the 0.08-μsec level found by Deutsch and Stevenson[2] giving rise to the 247-kev gamma-ray. These conclusions have been substantiated in another way by Engelkemeir,[3] who has shown the existence of a beta-ray group in Ag^{111} which feeds a 0.1-μsec level in Cd^{111}. The present work shows the assignment is correct by demonstrating that the 247-kev gamma-ray following the decay of In^{111} is delayed with respect to the 172-kev gamma-ray associated with the same decay.

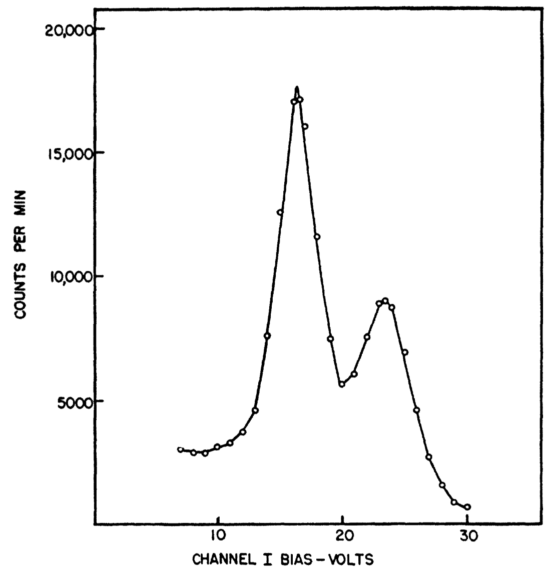

FIG. 1. Single-crystal pulse-height distribution for In^{111} obtained in channel I. The two photoelectron peaks are caused by gamma-rays at 172 and 247 kev.

In this experiment two scintillation spectrometers were used in coincidence. Each channel consisted of a $\frac{3}{4}$-inch NaI(Tl) cube mounted on a RCA 5819 photomultiplier, a cathode follower preamplifier, an Atomic Instruments Model 204-B linear amplifier, and a conventional differential discriminator of variable slit width. The discriminator outputs were mixed in a coincidence circuit of approximately 0.2-μsec resolving time. Delays in the form of RG 65/U cable were introduced in either channel between the linear amplifier and the differential discriminator. Attenuation of pulse height caused by the delay line was completely compensated

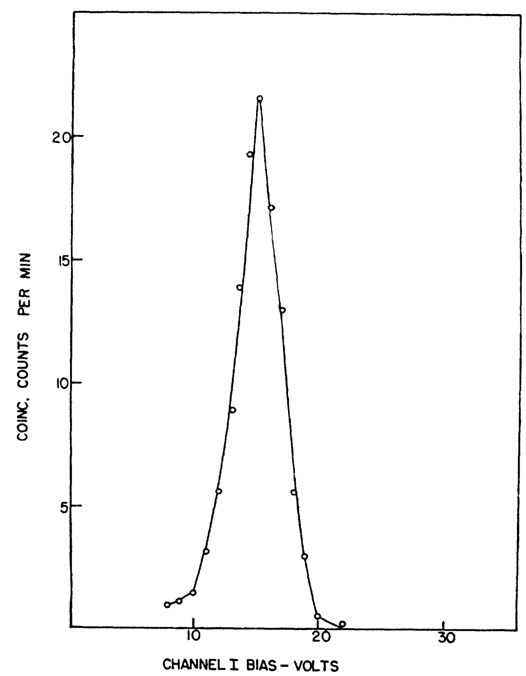

FIG. 2. Coincidence spectrum obtained when channel II transmits only the 247-kev peak while channel I surveys the whole spectrum. No delay has been introduced into either channel.

for by varying the amplifier gain. Lead shielding between the two counters minimized scattering between the crystals.

Figure 1 shows the single-crystal pulse-height distribution obtained in channel I for In^{111}. The two photoelectron peaks are associated with the 172- and 247-kev gamma-rays. Figure 2 shows the zero-delay coincidence spectrum obtained when channel II was adjusted to transmit only the 247-kev peak with a large slit width and channel I ranged over the entire spectrum. A coincidence peak is seen at the position of the 172-kev gamma-ray since the time resolution of the coincidence circuit is insufficient to prevent true coincidences at zero delay. The ratio of true to chance coincidences at the peak is about thirty to one. The introduction of a 0.1-μsec delay in channel I alone increased the coincidence rate by a factor of two, whereas the same delay introduced only in channel II practically eliminated true coincidences. This shows that the 247-kev gamma-ray is delayed with respect to the lower energy one and establishes directly the correspondence between the Cd^{111} 247-kev level and the 247-kev gamma-ray associated with the decay of In^{111}.

* This work was assisted by the joint program of the ONR and AEC.
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Zenithal Distribution of Low Energy Mesons

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It is well known that the zenithal distribution of the integral meson spectrum at sea level obeys the empirical law $I_\theta = I_0 \cos^\lambda\theta$, where I_θ is the intensity of cosmic-rays making an angle θ with the zenith. The value of λ is approximately two. It has been shown,[1] however, that this law does not apply for the differential spectrum, in particular, in the momentum range 300–410 Mev/c.

In the present experiments a limited band in the spectrum was obtained by an arrangement of counters and absorbers such that the particles which stop in a block of lead are detected. In Fig. 1 the counters ABC define a beam which has passed through ababsorbers P_1, P_2, and P_3. P_2 and P_3 are each 5 cm thick. By observing the particles which are registered in ABC but not in D, a band of the spectrum is selected which is fixed in position by $P_1+P_2+P_3$ and in width by the thickness of Q_1. At the same time a second band of longer range and of width fixed by Q_2 can be studied by observing particles which register in coincidence in $ABCD$ but not in E. A group of counters G was included to exclude showers.

The whole apparatus was mounted in a steel frame that could be rotated about a horizontal axis. For the results described here $P_1+P_2+P_3=15$ cm of lead and Q_1 and Q_2 were each 7.5 cm thick.

The results were corrected for the background and for the scattering in the absorber. These corrections will be described when a detailed account of the experiment is published.

Table I shows the counting rate $\Delta I_{\theta D}$ for particles stopped in the absorber Q_1 and $\Delta I_{\theta E}$ for particles stopped in Q_2. Table II shows the values of λ calculated from $\log r/\log\cos\theta$, where $r=\Delta I_\theta/\Delta I_0$. Since the values of λ are far from constant, the $\cos^2\theta$ law is not applicable. A much better fit is obtained if a function of the form

$$r=(1-a\sin^b\theta)$$

is assumed. If $\log(1-r)$ is plotted against $\log\sin\theta$, the points fall on a straight line. The constants a and b have the following values: $a=0.98\pm0.02$, $b=1.47\pm0.12$, for the spectral band 300 to 410 Mev/c; $a=1.03\pm0.03$, $b=1.61\pm0.15$, for the spectral band 410 to 510 Mev/c.

TABLE I. Counting rates at various zenithal angles θ: $\Delta I_\theta D$ represents mesons with momenta between 300 and 410 Mev/c. $\Delta I_\theta E$ represents mesons with momenta between 410 and 510 Mev/c.

θ	0°	30°	60°	75°	80°
$\Delta I_{\theta D}$	3.59±0.10	2.33±0.18	0.75±0.03	0.19±0.02	0.18±0.02
$\Delta I_{\theta E}$	3.62±0.10	2.36±0.11	0.60±0.03	0.13±0.01	0.09±0.01

The measurements were extended to angles greater than 90° in an effort to detect particles coming upward from the earth. Upward moving particles are difficult to distinguish from particles scattered into the ABC telescope from the high flux of downward particles in Q_1 or into $ABCD$ from Q_2. Measurements with one or

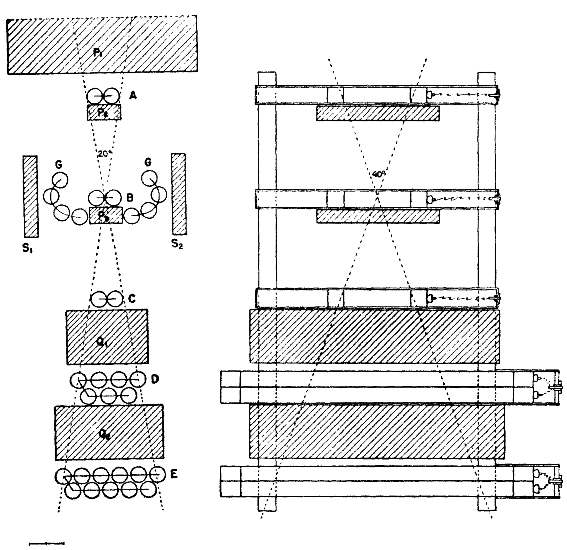

FIG. 1. Arrangements of counters and absorbers to measure the zenithal distribution.

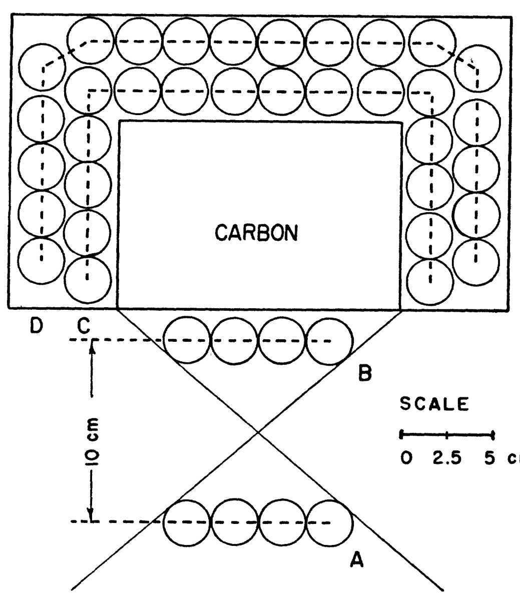

FIG. 2. Arrangement of counters and absorber to detect the upward flux of mesons.