correlation between the decay electrons and the α-particles from the subsequent break-up of Be^8.

This letter reports measurements which have been made on the angular correlation with a β-ray spectrometer,[2] to select electrons from the high energy part of the spectrum. The α-particles were detected with a thin-window proportional counter which could be rotated about the source.

Li^8 was produced by bombarding natural Li with 530-kev deuterons. The beam was interrupted periodically by deflecting it off the target by means of a 50-cps rectangular voltage wave applied to deflecting plates. The signals from the counters were passed through electronic gates which were opened only when the beam was off the target. The random coincidence rate was continuously monitored by counting delayed coincidences.

The spectrometer resolution was set at about 7 percent, and two sets of measurements were made, with the coil current set to select electrons of 9.8 Mev and 7.5 Mev, corresponding to 0.8 and 0.6 of the end-point energy of the β-spectrum, respectively. Measurements were made at five angles from 90° to 175°, and the results were fitted by least squares to the expression $(1+A\cos^2\theta)$. The values of A found in the two cases were, respectively (0.04 ± 0.2) and (0.12 ± 0.09).

These results are substantially in agreement with the recent measurements by Class and Hanna.[3]

An attempt was made to compute the theoretical angular correlation from the results of Falkoff and Uhlenbeck.[4] However, the results are uncertain, owing to the uncertainty as to the form of interaction involved in β-decay. This and the rather large experimental error make it impossible to arrive at any definite conclusion at present. The calculations of Gardner[5] for the angular correlation in this case appear to be in error. The above results can, however, be taken as confirming the nonzero spin of the 3-Mev level in Be^8, while they also rule out the possibility that the Li^8 β-decay is allowed.

A search was also made for γ-rays in coincidence with decay electrons of Li^8, since there is known to be a γ-ray emitting level at 4.9 Mev in Be^8.[6] In order to reduce as much as possible the effects of bremsstrahlung, the target was deposited at the end of a thin-walled aluminium tube, and the β-counter, which was also of very light construction, was placed as close to the target as possible. Two γ-counters were placed one on each side of the target, and glass walled β-counters, connected in anticoincidence with the other counters, were placed between the target and the γ-counters, to avoid spurious coincidences due to bremsstrahlung produced in the lead surrounding the latter. Bombardment and counting were carried out alternately, as described above, and the background coincidence rate was measured after each run of six minutes. The result obtained was that an upper limit of (0.8 ± 0.3) percent could be placed on the number of disintegrations leading to the 4.9-Mev level in Be^8. This is somewhat lower than the result of Vendryes[7] who obtained (2 ± 1) percent after making a correction for bremsstrahlung. If we take the spin of this level as one,[6] it is difficult to reconcile the above results with a spin of less than three for Li^8.

In the course of this work the half-life of Li^8 was also remeasured. The result obtained was (0.89 ± 0.01) sec, which is not in agreement with the recent measurement of Rall and McNeill[8] who obtained (0.825 ± 0.02) sec, but is in agreement with earlier measurements.[9–11]

The writer is indebted to Professor S. Devons for his interest and encouragement. He also wishes to thank the Senate of the University of London for a postgraduate studentship.

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An Unusual Example of V^0 Decay*

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THE object of this note is to report in detail a rather unusual V^0 decay recently observed in the new magnetic chamber.[1] Event R-118 is shown in Fig. 1. The V^0 particle, occurring with a penetrating shower, decays after traversing about one-eighth of the illuminated height of the chamber. The decay takes place

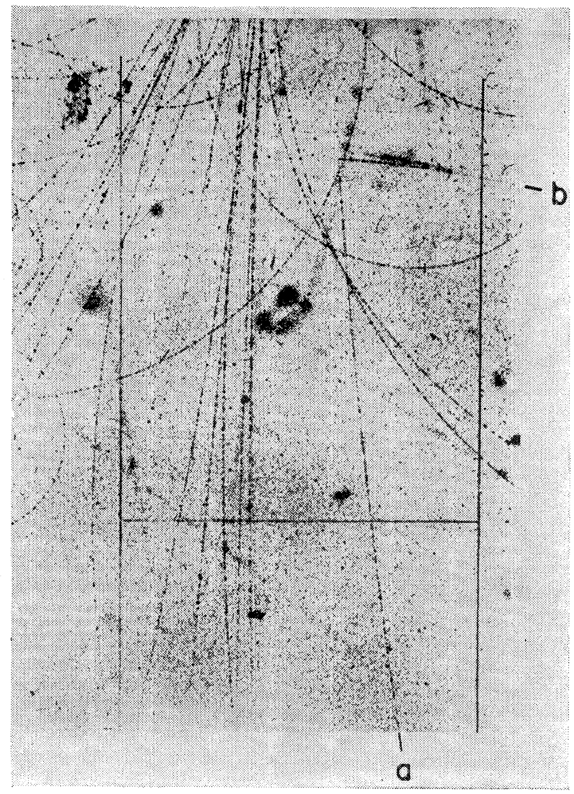

FIG. 1. Event R-118. The upper ⅜ of the chamber is shown. The obscuration of track b, by an unrelated old track, is less in the other two stereoscopic views.

very near the center of the illuminated depth; the positive fragment (track a) is projected almost vertically down, and the negative fragment (track b) almost horizontally to the right.

The track of the positive fragment is 43 cm long and is well illuminated throughout its entire length. The comparator plot for the left eye is shown in Fig. 2. The corrected momentum, derived from the three eyes, is 0.67 ± 0.02 Bev/c, and the ionization is indistinguishable from that of electronic tracks nearby. A proton of this momentum would be heavily ionizing by a factor 2.3, which it is believed would not easily escape detection under these conditions. Thus it is probable that the positive fragment is lighter than a proton, which means that the disintegration is not of the type $V_1^0 \rightarrow p+\pi$.

The track of the negative fragment, although relatively short, is highly curved and distinctly heavily ionizing. The track makes an angle of 26° with the plane of the chamber and crosses the front boundary of the illuminated depth near the right side of the chamber, as evidenced by the fading of track b in Fig. 1. The comparator plot for the left eye is shown in Fig. 2. The momentum is 0.094 ± 0.008 Bev/c, and the track is heavily ionizing by an estimated factor of 2 or 3. A pion of this momentum would be heavily ionizing by a factor 2.5; and a muon by a factor 1.8; thus it is likely that the negative fragment is a pion or nuon. A τ-meson of this momentum would be heavily ionizing by a factor in the neighborhood of 15 and would not easily escape detection. We thus consider it unlikely that this event represents a decay of the type suggested by the California Institute of Technology group,[2] namely $V_3{}^0 \rightarrow (\tau^-$ or $\kappa^-) + \pi^+ + 60$ Mev.

The corrected angle between the tracks is $79.2° \pm 0.4°$, the relatively large error arising primarily from the shortness of the negative track. Although the orientation of the event with respect to the associated shower suggests that it represents the decay of a neutral V particle (the angle of decay being so large), the possibility that the event is grossly misinterpreted must not be overlooked. The possibility that the event represents the decay of a charged particle (track b) which enters the chamber from the right can be excluded on energetic grounds since the total energy indicated by track b is considerably less than the kinetic energy of track a. The possibility that the event represents the decay of a charged particle (track a) which enters the chamber from below is a possible but relatively improbable interpretation.

The $Q(\pi, \pi)$ value is 215 ± 7. The next most accurate cases[1] R-32 and R-39 give 212 ± 10 and 216 ± 7, and a recent unpublished event (R-151) gives 219 ± 15. Confirmation of individual $Q(\pi, \pi)$ values in the neighborhood of 214 Mev has not been forthcoming

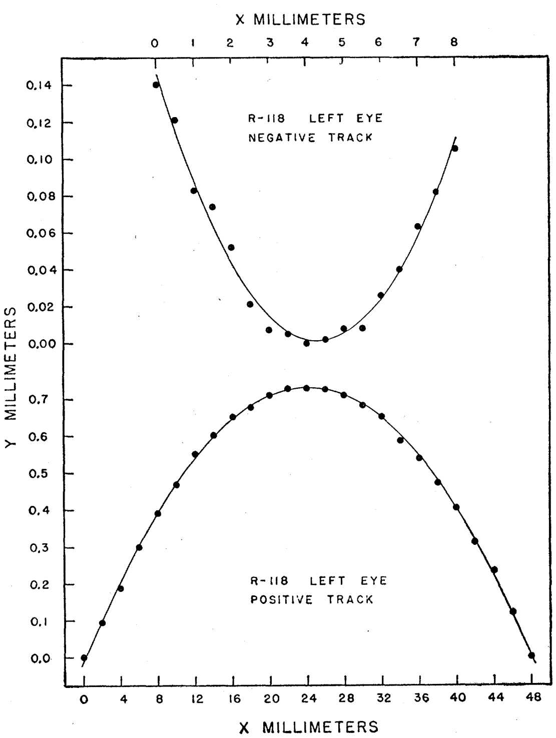

FIG. 2. Comparator plots of R-118 for the left eye. The plots for the other two stereoscopic views are of the same quality.

from other groups, and there is certainly no indication therefrom for the existence of either a line or a pronounced maximum in that neighborhood. We are inclined to consider that the values in the neighborhood of 214 determined as described above are incompatible with a value of 170 Mev,[3] limits of 115–185 Mev,[4] or a range of 100–130 Mev,[2] so that the present observations appear to be distinct from those of other investigators.

It may be that the experimental arrangement has biased[5] our observations in favor of a different type[6] of neutral V particle, $V_4{}^0 \rightarrow (\pi^+$ or $\mu^+) + (\pi^-$ or $\mu^-) + Q$, where $Q(\pi, \pi) = 214 \pm 5$ Mev.[7,8] In view of the limited statistics (7 cases of $V_4{}^0$), we cannot, of course, exclude a splitting of the $V_4{}^0$ structure in the Q-curve plot,[1] or a three-body decay. The latter might account for part of the differences with the results of other investigators, and for events[1] 328 and R65B.

* Assisted by the U. S. Office of Ordnance Research and by grant of the Frederick Gardner Cottrell Fund of the Research Corporation.

[1] Proceedings of the Third Rochester Conference. See Thompson, Buskirk, Etter, Karzmark, and Rediker, Phys. Rev. **90**, 329 (1953).

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[3] We are indebted to Dr. Butler for recently informing us that the Manchester data has been remeasured to give $Q(\pi, \pi)$ values in the neighborhood of 170 Mev instead of 122 Mev as previously reported.

[4] We are indebted to Dr. Bridge for sending us a preprint of a forthcoming paper of the Massachusetts Institute of Technology group.

[5] With the new magnetic chamber, we find roughly equal numbers of $V_1{}^0$ and $V_4{}^0$ (see below).

[6] The Manchester group and the Massachusetts Institute of Technology group use the symbol $V_2{}^0$ to indicate the class of all neutral V particles other than $V_1{}^0 \rightarrow p + \pi$. In that usage, the $V_2{}^0$ symbol seems inappropriate here, in view of the large variety of decay schemes in that class which have been reported (see reference 2), but which we have not as yet observed.

[7] In case one or both fragments are muons, slight modification of the Q value would be necessary.

[8] The kinetic energy per pion in the c.m. system would be 107 Mev, very near $E_\pi = 115 \pm 10$ Mev for the χ-decay. See the excellent review paper of D. H. Perkins in the *Proceedings of the Third Annual Rochester Conference on High Energy Physics* (Interscience Publishing Company, New York, 1953).

The O^{14} β-Decay and the Fermi Interaction

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IN view of the results of the angular correlation measurements[1] in the He^6 decay it now appears that the Gamow-Teller (GT) part of the β-interaction is tensor or almost wholly so. It is clear that a measurement of the angular correlation or recoil momentum spectrum for an allowed transition with $\Delta J = 0$ could, in principle, provide corresponding information concerning the composition of the Fermi (F) interaction.[2,3] However, the analysis of transitions other than $J = 0 \rightarrow J = 0$ cases is complicated by the necessity of an accurate knowledge of the relative values of GT and F matrix elements and also by the fact that the He^6 angular correlation measurements, together with β-energy spectra of GT transitions, does not distinguish between pure tensor and an interaction containing an admixture of axial vector coupling. Specifically, if the GT interaction is $\mathcal{H}_{GT} = g(C_T\mathcal{H}_T + C_A\mathcal{H}_A)$ one can conclude only that $|C_A/C_T| \lesssim 0.1$.

In view of these remarks, the C^{10} and O^{14} decays become more interesting. Since the C^{10} decay is a 2 percent branch and is followed by two gamma-rays, the correlation or recoil experiment would be very difficult to carry out and interpret. In the O^{14} decay there is only the 2.31-Mev gamma-ray to consider. This does not interfere with the possibility of carrying out either of the experiments in question, since the recoil due to the gamma-ray is easily taken into account, as shown below.

It has been suggested[3] that the gamma-recoil can be taken into account by observing triple coincidences between the photon, positron, and recoil N^{14}. While this does serve the useful purpose of better definition of the effective source volume, it entails a severe reduction of intensity. It seems preferable to take the gamma-recoil into consideration by a direct and simple calculation. We have considered the recoil experiment since this involves the detection of only one particle. However, the difficulties of this experiment are recognized and similar considerations to those described below can be applied to the angular correlation experiment.

The nuclear recoil momentum is $\mathbf{P} = -(\mathbf{p}+\mathbf{q}+\mathbf{k}) = -(\mathbf{Q}+\mathbf{k})$, where $\mathbf{p}$, $\mathbf{q}$, and $\mathbf{k}$ are the momenta of positron, neutrino, and photon, respectively. Since the photon is isotropic with respect to $\mathbf{p}$ and $\mathbf{q}$, the distribution $N(P)dP$ of recoils with momentum between P and $P+dP$ is obtained essentially by integrating the spectrum of β-recoils (distribution in Q) over the appropriate Q limits. The analytic form of the result depends upon whether or

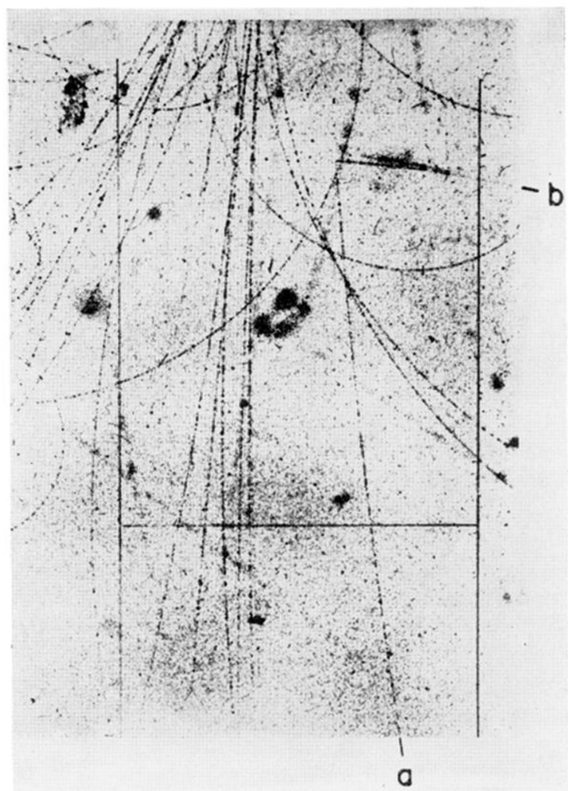

FIG. 1. Event R-118. The upper $\frac{2}{3}$ of the chamber is shown. The obscuration of track b, by an unrelated old track, is less in the other two stereoscopic views.