Using pulse-height selectors in both channels, we have investigated the directional correlations of the different cascades separately and report here on the 1.7–0.6-Mev and the 2.06–0.6-Mev cascades.

After a correction for angular resolution, the data on the 1.7–0.6-Mev cascade can be fitted with a distribution $W(\Theta)=1-0.094\times\cos^2\Theta$.

If one assumes spin 0+ for the ground state of the even-even Te^{124} nucleus, the 0.6-Mev excited state has spin 2+.[2] The possible spin combinations are, therefore, 0–2–0, 1–2–0, 2–2–0, 3–2–0, and 4–2–0, all higher spins being excluded by conversion measurements.[3] The assignment 1–2–0 is improbable in view of the absence of a strong crossover transition to the ground state of Te^{124}. A comparison of the theoretical correlations with the experimental points (Fig. 1) eliminates all spin combinations with

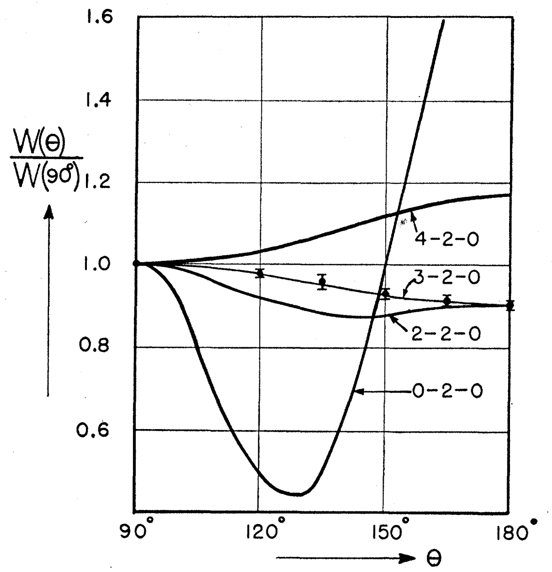

FIG. 1. Directional correlation of the 1.7–0.6-Mev cascade of Te^{124}. The theoretical correlations expected for different spins of the 2.3-Mev state are drawn in for comparison. For the 3–2–0 and 2–2–0 combinations the dipole-quadrupole mixtures were adjusted to fit the experimental $W(180°)/W(90°)$ ratio. For 0–2–0 and 4–2–0 the pure quadrupole-quadrupole correlations are plotted. No mixture is possible for 0–2–0 and only very small admixtures can be expected for 4–2–0.

the exception of 3–2–0. The spin of the 2.3-Mev excited state of Te^{124} is, therefore, taken as 3.

The correlation coefficient $A_2=-0.094\pm0.010$ allows an admixture of at most 10^{-3} parts of quadrupole to the 3–2 dipole transition. In comparison with recently measured $E2$-$M1$ mixtures[4] this $E2/M1$ ratio is off by factors of 10^2 to 10^3. One is therefore inclined to assume that the 3–2 transition in Te^{124} is not $M1$-$E2$, but involves a parity change and is almost pure $E1$. In Sr^{88}, which exhibits a very similar angular correlation, the 3–2 transition is indeed $E1$, as shown by conversion measurements.[5]

Recently a group at Princeton[6] has determined the number of 1.7-Mev conversion electrons to be 1/30 of the number of 0.6-Mev conversion electrons. From measurements with calibrated converters, we estimate the ratio of the intensities of the 1.7-Mev and 0.6-Mev gamma-rays as 0.55 ± 0.12. Combining these, one arrives at a conversion coefficient of $(2.6\pm0.7)\times10^{-4}$ for the 1.7-Mev transition. This has to be compared with theoretical values[7] of 2.2×10^{-4} for $E1$ and 5.8×10^{-4} for $M1+10^{-3}E2$. It is therefore concluded that the 1.7-Mev transition in Te^{124} is almost pure $E1$ and that the 2.3-Mev excited state of Te^{124} has spin 3, odd parity.

When measuring the 1.7−0.6-Mev coincidences, one has to accept a contribution of about ten percent from the 2.06−0.6-Mev cascade. In order to insure that the 2.06−0.6-Mev cascade does not alter the 1.7−0.6-Mev data considerably, we investigated the 2.06−0.6-Mev cascade for itself, accepting in one channel only the photoelectron peak of the 2.06-Mev gamma-ray. Although the counting rates were low, it was possible to establish that the 2.06−0.6-Mev cascade shows a correlation of the form $1-0.09\times\cos^2\Theta$ which is practically identical with the 1.7−0.6-Mev correlation. From this, one can conclude that the 2.06−0.6-Mev cascade will not affect the 1.7−0.6-Mev data, and one can furthermore assign spin 3 to the 2.66-Mev level in Te^{124}. In view of the low intensity of the 2.06-Mev transition, no conversion information is available. However, the similarity of the ft values of the two beta-transitions suggests that both states have the same parity, i.e., both are 3 odd.

The assignment of 3− to the two highly excited states in Te^{124} gives some indication as to the spin of the ground state of Sb^{124}, a spin which has been the subject of some speculation in connection with the strong $\beta-\gamma$ correlation observed in Sb^{124}. Recently Morita and Yamada[8] have investigated the consequences of the measured $\beta-\gamma$ correlation and of the shape of the 2.3-Mev beta-spectrum of Sb^{124}. These authors arrived at 3− as the most probable total angular momentum for the Sb^{124} ground state. The next probable value, 4+, was excluded on the grounds of the relatively low ft value.

If the ground state of Sb^{124} were 3−, the beta-transition to the 2.3-Mev excited state of Te^{124} with 3− would be allowed. The experimental logft value, however, is 7.7, which corresponds to a first forbidden transition. It cannot be denied that a logft value of 7.7 could be attributed to an allowed transition ("L forbidden") but this seems at least as artificial as the exclusion of spin 4+ based on a low logft value. The number of observed second forbidden transitions is still very small, and the grouping of the ft values is therefore very uncertain. It might be added that the logft value for the second forbidden beta-transition in Fe^{59} [9] is 10.9, i.e., very close to the value 10.3 for Sb^{124}.

Based on these considerations, we are inclined to make the assignment 4+ rather than 3− to the ground state of Sb^{124}.

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The Disintegration of V^0 Particles*†

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MANY V^0 particles appear to decay into a proton and a negative pion with a Q value in the neighborhood of 35 Mev.[1-5] However, it has been apparent for some time that there are cases in which the positive fragment is considerably less massive than a proton.[1,2] Various conjectures as to the decay scheme in such cases have been made: the one ($V^0\rightarrow\pi+\pi$) most frequently discussed having been introduced[1,2,6] in the nature of a simplifying assumption. The California Institute of Technology group reports a few cases which may be so interpreted.[7]

The object of this note is to report preliminary results obtained with a new magnet chamber at sea level. The chamber has a field of 7000 gauss over an illuminated volume 22 in. high, 11 in. wide, and 5 in. deep and is actuated by penetrating showers. Measurements of no field tracks indicate that the maximum detectable momentum for long tracks is well in excess of 10^{10} ev/c.

To date, 24 cases of V^0 decay have been observed in the new chamber, of which 12 have sufficiently long track lengths in the illuminated volume that the momentum determination is not likely to be in large error. The average momentum of these latter cases is rather high, so that relatively little direct information concerning the masses of the fragments is available. It is therefore necessary to analyze these events by a method which does not depend on assumption as to the character of the fragments.

Consider the decay in flight, as in Fig. 1, of a particle of mass M and velocity β into two fragments of masses m_+ and m_- and momentum p' in the c.m. system. Resolve p' into components p_x' and p_y' along the x' and y' axes, where x' corresponds to the direction of motion β. Since p_y' is invariant, it is equal to the so-called transverse component of momentum p_T observed in the laboratory frame of reference. Express p_x' in terms of the Manchester parameter α:

$$p_x'=\frac{(\alpha-\bar{\alpha})}{(2/\beta M)},$$

where

$$\alpha=(p_+^2-p_-^2)/P^2, \quad \bar{\alpha}=(m_+^2-m_-^2)/M^2.$$

Then, since $p_x'^2+p_y'^2=p'^2$, we have

$$\frac{(\alpha-\bar{\alpha})^2}{(2p'/\beta M)^2}+\frac{p_T^2}{p'^2}=1.$$

For a given velocity β, this is the equation of a family of ellipses in the variables α and p_T. In the new results to be described below, the average value of β is very near unity, so that the results may for convenience be represented in the (α, p_T) plane for which $\beta=1$, although it is clear that a three-dimensional representation is required, in general. The Q curves have a very simple physical significance in terms of the sphere S', on which lie the terminal points of $\mathbf{p}'$ in the c.m. system.

If a neutral particle is produced (three-body decay), then the observed points in the (α, p_T) plane scatter but all lie within the ellipse which corresponds to zero kinetic energy for the neutral particle in the true c.m. system.

The new data are plotted as rectangles in Fig. 2 and the data obtained with the 12-in. magnet[2] as circles. Solid points indicate a heavily ionizing positive fragment near protonic mass. A number of the points cluster on or near the curve $V_1^0\rightarrow p+\pi$ $(\bar{\alpha}=0.69)$ and give an average Q value of 37 Mev, in good agreement with the value 36 Mev previously reported by one of us[8] and with the best earlier value of 31 Mev.[2]

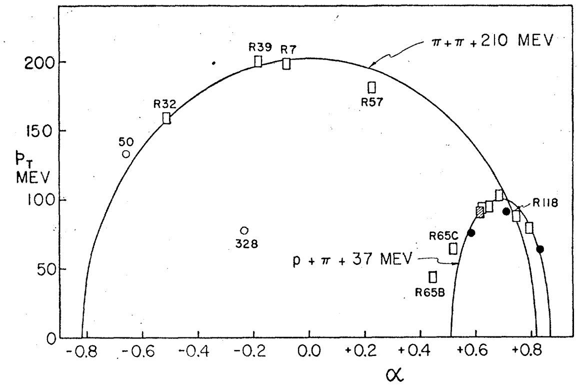

FIG. 2. Q curve plot of the V^0 disintegration data. In order to represent the decay of slowly moving V^0 particles in this diagram the values of α have been adjusted according to the decay scheme assignments in the text. Stereoscopic photographs of a three-dimensional model will be published in a forthcoming paper.

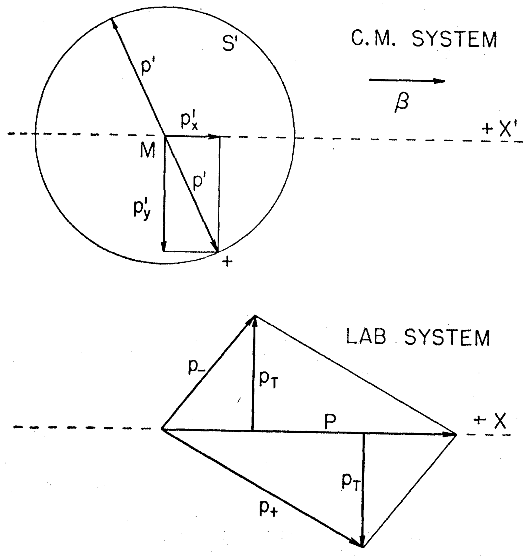

FIG. 1. Vector diagram of a V^0 disintegration.

The remaining events[9] suggest the existence of a relatively large structure in the (α, p_T) plane with approximate height $p_T=200$ Mev/c and center near the origin.

Events 50, R-32, R-39, R-7, R-57, and R-118 can be fitted with a single ellipse corresponding to the decay scheme $V^0\rightarrow\pi+\pi+210$ Mev[10,11] for which $M=962$ m_e,[12] in agreement with the published[2] value for event 50 of 1020 m_e or $Q=240$ Mev for (π, π) decay.

However, if events 328[13] and R-65B represent the same disintegration process as the events just listed, a three-body decay may be indicated with a true Q value probably in excess of 210 Mev.

* Assisted by the U. S. Office of Ordnance Research and by grant of the Frederick Gardner Cottrell Fund of the Research Corporation.
† The essential conclusions of this note were reported at the Third Rochester Conference, the proceedings of which are in the process of publication by Interscience Press.

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9 Event R-118 is included since the positive fragment is apparently less massive than a proton. The negative fragment is heavily ionizing and is probably a pion or muon. This unusual event will be described in detail in a forthcoming publication.
10 A comparable fit is obtained with one or both fragments assumed to be muons.
11 We are indebted to Dr. Butler for recently informing us that the Manchester V_2^0 data have been re-analyzed to give a Q value in the neighborhood of 170 Mev instead of 122 Mev as previously reported.
12 It would be premature to more than note the similarity of this figure to the τ-mass.
13 Event 328 is an unpublished case of intermediate quality obtained with the 12-in. chamber. In R-65B both fragments traverse essentially the full height of the chamber with relatively high curvature, so that it is felt this point is probably distinct from the V_1^0 curve as drawn. However, the errors in R-65C are several times larger, and the event is not considered incompatible with the V_1^0 curve.

The Beta-Spectrum of Mg^{28}†

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THE beta-spectrum of Mg^{28} has been measured using the double magnetic lens spectrometer of Agnew and Anderson.[1] This isotope has been recently reported by Sheline[2] and also by