Disintegration of Ir^{192} and Ir^{194}

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The energies and intensities of 20 gamma rays of Ir^{192} and 16 gamma rays of Ir^{194} have been measured by studying their external conversion spectra with a high resolution beta-ray spectrometer. A Fermi analysis of the beta spectrum of Ir^{194} reveals four components with the following end-points and intensities: 2236 kev (70 percent), 1905 kev (16 percent), 975 kev (9 percent) and 430 kev (2.8 percent). The observed beta and gamma radiations are consistently accounted for in terms of transitions to the following levels of Pt^{194}: 0.0, 328.1, 621, 1265, 1477, 1665, 1794, 1802, 1836, 1946, and 2048 kev. The $Ir^{194}-Pt^{194}$ energy difference is 2236 ± 10 kev. The Ir^{192} gamma-ray energies are classified in terms of levels at 0.0, 283, 485, 690, and 1064 kev in Os^{192} and 0.0, 316, 612, 784, 921, 1155, 1201, and 1359 kev in Pt^{192}. The results for Ir^{192} serve chiefly as confirmation of earlier investigations.

I. INTRODUCTION

THE n-γ reaction in iridium leads to 70-day Ir^{192} and 19-hr Ir^{194}. With an 18-hr irradiation period the initial Ir^{194} activity is about fifteen times that of Ir^{192} and conditions remain favorable for a study of the short-lived nuclide for about 80 hours thereafter.

Ir^{192} has been studied extensively[1-5] and the main features of its decay scheme are known. However, the information available concerning Ir^{194} is quite incomplete[1,2] and it seemed worthwhile to examine its beta and gamma radiations with a high resolution beta-ray spectrometer. The results presented in this paper show that there is a rich spectrum of weak gamma rays accompanying the decay of Ir^{194}. In order to study these radiations it was necessary to re-examine the complex background caused by the decay of the Ir^{192}. Our observations concerning the latter spectrum serve mainly to confirm the findings of other workers.

Since the decay of Au^{192} and Au^{194} leads to excited states of Pt^{192} and Pt^{194} respectively, the data available for these nuclides[6,7] are also pertinent to this study.

II. APPARATUS AND METHOD

Six sources of "spec-pure" iridium powder, sealed in quartz, were irradiated in the Brookhaven reactor and studied in a high resolution beta-ray spectrometer[8] by examining the external conversion spectrum produced in uranium and gold radiators of thicknesses ranging from one to fifty mg/cm^2. Photoelectron peaks from twenty gamma rays in Ir^{192} and sixteen in Ir^{194} were observed. The decay of each of the latter peaks was followed for at least forty hours and found to be consistent with a 19-hr half-life. Since none of the radiations which might be expected from the possible impurities were found, it is felt certain that all of these gamma rays do occur in the decay of Ir^{194}. A 3-curie Ir^{192} source was used to examine the weak high-energy spectrum of the lighter isotope.

Most of the measurements were made with uranium radiators of thickness 1.85, 10.3, and 20.1 mg/cm^2 and area 3.0×0.8 cm prepared according to the technique described by Dodson.[9] The spectrometer was adjusted to give a resolution of 0.65 percent in momentum (full width at half-maximum) on the thorium F line. The external conversion peaks with these radiators ranged from 0.8 to 2 percent in width, depending on the choice of radiator and the electron energy under study. These photoelectron peaks all possess a characteristic shape, marked by a steep, high-energy profile which rises from the base line to the peak in a momentum change of about 0.3 percent and a low-energy profile whose slope depends on both the electron energy and radiator thickness. In any region the peaks have a clearly defined shape and width; any marked change in this shape indicates the presence of an unresolved doublet.

The electron momentum was obtained by measuring the magnetic field strength corresponding to the point of inflection of the high-energy edge of the peak. This point was found to be quite independent of radiator thickness, providing the latter was great enough to give a peak wider than 1 percent, and it was also found to be relatively independent of the manner in which the underlying Compton distribution was drawn in. Measurements of the field were made with a flip coil and galvanometer, using the external conversion peak of the Co^{60} radiation at 1.3325 Mev[10] as a standard. Calibration runs were made on this line, the external conversion line of the Cs^{137} radiation[3] and the thorium F and X internal conversion lines.[3,11] For the internal conversion lines the peak position was used rather than the point of inflection. In addition, the very precise measurements of Muller *et al.*[3] provided

[1] *Nuclear Data*, National Bureau of Standards Circular No. 499 (U. S. Government Printing Office, Washington, D. C., 1950), p. 224.
[2] J. M. Cork *et al.*, Phys. Rev. **82**, 258 (1951).
[3] D. E. Muller *et al.*, Phys. Rev. **88**, 775 (1952).
[4] K. I. Roulston and R. W. Pringle, Phys. Rev. **87**, 930 (1952).
[5] Pringle, Turchinetz, and Taylor, Phys. Rev. **95**, 115 (1954).
[6] G. T. Ewan and A. L. Thompson, Trans. Roy. Soc. Can. **47**, 126 (1953).
[7] Steffen, Huber, and Humbel, Helv. Phys. Acta **22**, 167 (1949).
[8] Johns, Waterman, and Cox, Can. J. Phys. **31**, 225 (1953).
[9] A. C. Graves and D. K. Froman, *Miscellaneous Physical and Chemical Techniques of the Los Alamos Project* (McGraw-Hill Book Company, New York, 1952), National Nuclear Energy Series, Plutonium Project Record, Vol. 3, Div. V.
[10] Lind, Brown, and DuMond, Phys. Rev. **76**, 591 (1949).
[11] W. Brown, Phys. Rev. **83**, 271 (1951).

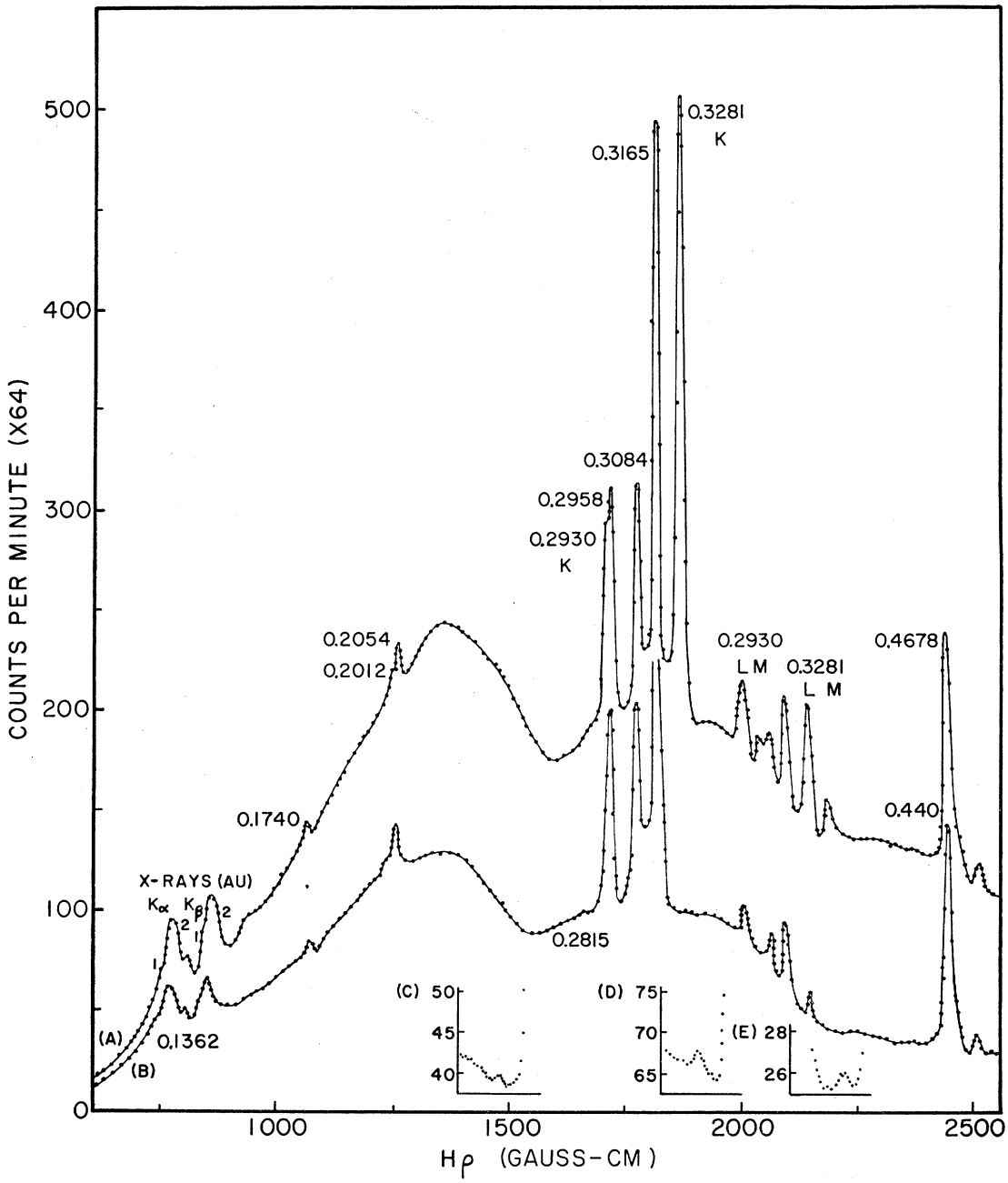

FIG. 1. The external conversion spectrum below 0.490 Mev. Curves A and B were obtained with a 1.2-mg/cm² Au radiator; C, D, and E with a 1.8 mg/cm² U radiator. A presents the total spectrum 12 hours after irradiation and B the Ir^{192} component 10 days later. C shows the weak 0.281-Mev K peak just below the 0.296-Mev K peak, D presents the 0.374-Mev K peak which falls just below the 0.296-Mev L peak and E shows the weak 0.440-Mev K peak between the 0.316-Mev M and the 0.467-Mev K peaks.

excellent internal standards up to 600 kev. These standards were used to draw a correction curve for any lack of linearity in the galvanometer scale. The corrections applied were never greater than 0.3 percent over the range of $H\rho$ from 500 to 9000. Peak positions were reproducible to 0.1 percent in any given run, but systematic errors of about twice this amount appeared over the fifteen months during which measurements were made.

The intensities were calculated using a modification of the formula given by Deutsch, Elliott, and Evans.[12] Following their argument, one can write:

$$N=K[n/p\beta^3\tau]\cdot[(R p\beta^3/t)^2+k^2]^{\frac{1}{2}},$$

[12] Deutsch, Elliott, and Evans, Rev. Sci. Instr. **15**, 178 (1944).

in which N is the intensity of the gamma ray, n the height of the photoelectron peak of momentum p, β is v/c, R the instrumental resolution, t the radiator thickness, τ the photoelectric cross section, and K a constant, depending on the source-radiator geometry and the instrumental transmission. The quantity k, which may be expected to vary slowly with energy, was evaluated semi-empirically using Bohr's theory and the data given by White and Millington.[13] It was found that gamma-ray intensities computed by this means were practically independent of the chemical composition or thickness of the radiator. Values for τ were obtained either directly or by extrapolation, from the data given by Davisson and Evans.[14] It is felt that in the region from 200 to 1800 kev, intensity measurements made in this way can be relied on to within 20 percent for well-defined peaks.

The iridium for preparation of beta sources was dissolved by a method suggested by Yaffe.[15] A quartz vial containing 1 mg of irradiated metal was placed in a porcelain crucible and crushed under ether to keep the active powder under control. The ether was allowed to evaporate, equal parts of potassium hydroxide and potassium nitrate were added and the mixture heated strongly until the iridium dissolved in the melt. The flux was allowed to cool and was then leached with concentrated hydrochloric acid. The iridium came out as a deep blue solution of iridium tetrahydroxide. To remove the large quantities of potassium salts and silica from the solution, the iridium was precipitated as

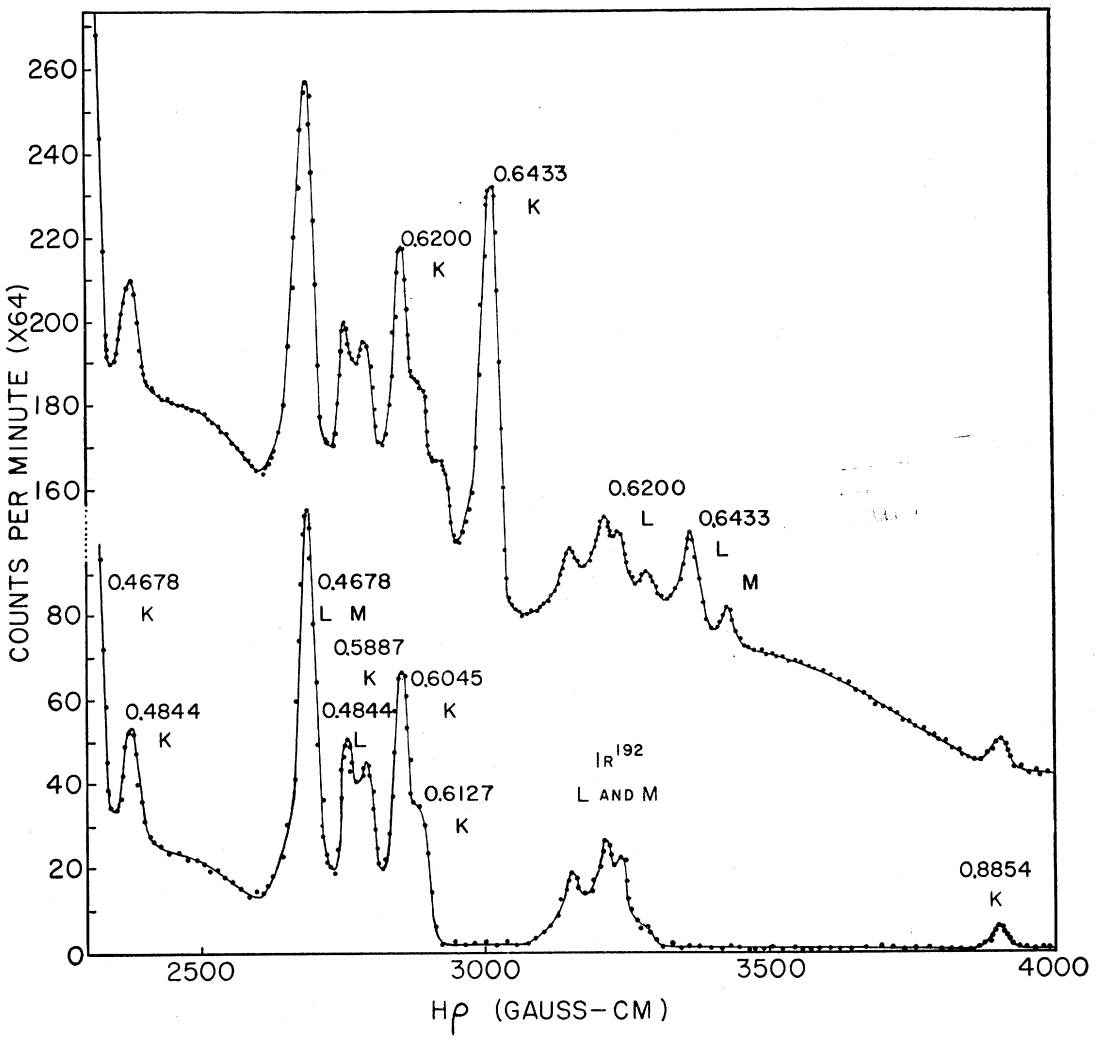

FIG. 2. The external conversion spectrum from 0.470 Mev to 0.900 Mev obtained with a 10-mg/cm² U radiator. The Ir^{194} peaks are identified on the upper curve, obtained about 12 hours after irradiation and the Ir^{192} peaks are shown on the lower curve, taken after the short-lived activity had disappeared.

[13] Rutherford, Chadwick, and Ellis, *Radiations from Radioactive Substances* (Cambridge University Press, London, 1930), p. 430.
[14] C. M. Davisson and R. D. Evans, Revs. Modern Phys. **24**, 79 (1952).
[15] L. Yaffe, McGill University, Montreal, P. Q. (private communication).

iridium thiocyanate by adding ammonium thiocyanate and then dissolved in ethyl acetate. The resulting solution when deposited on a thin film gave strong sources whose Fermi plots were well behaved to energies as low as 125 kev.

III. EXPERIMENTAL RESULTS

(a) Gamma-Ray Measurements

Composites of the external conversion spectra of both Ir^{192} and Ir^{194} from $H\rho=500$ to 8000 are shown in Figs. 1 to 3. In addition, the weak high-energy spectrum of Ir^{192} obtained with the 3-curie source is shown in Fig. 4. The gamma-ray energies and intensities are presented in Tables I and II. The energies of most of the radiations were measured at least ten times and the limits of error quoted represent twice the standard deviation of the mean. These limits include at least 80 percent of the individual measurements. For each of the weak, high-energy radiations, the Compton contribution in the absence of the radiator was also observed as a check on the reality of the photoelectron peaks. The intensities are given as quanta per disintegration. These will be correct as relative values even if the decay scheme on which they are based proves to be incomplete.

(b) Beta Spectra

Three separate beta sources were analyzed. Since the irradiation periods were too short to give good Ir^{192} specific activity, no attempt was made to study the Ir^{192} beta spectrum in detail. Its end point was found to be 0.672 Mev in good agreement with Levy's value of 670 ± 13 kev.[16] The Fermi plot for one of the three Ir^{194} sources is presented in Fig. 5. All three

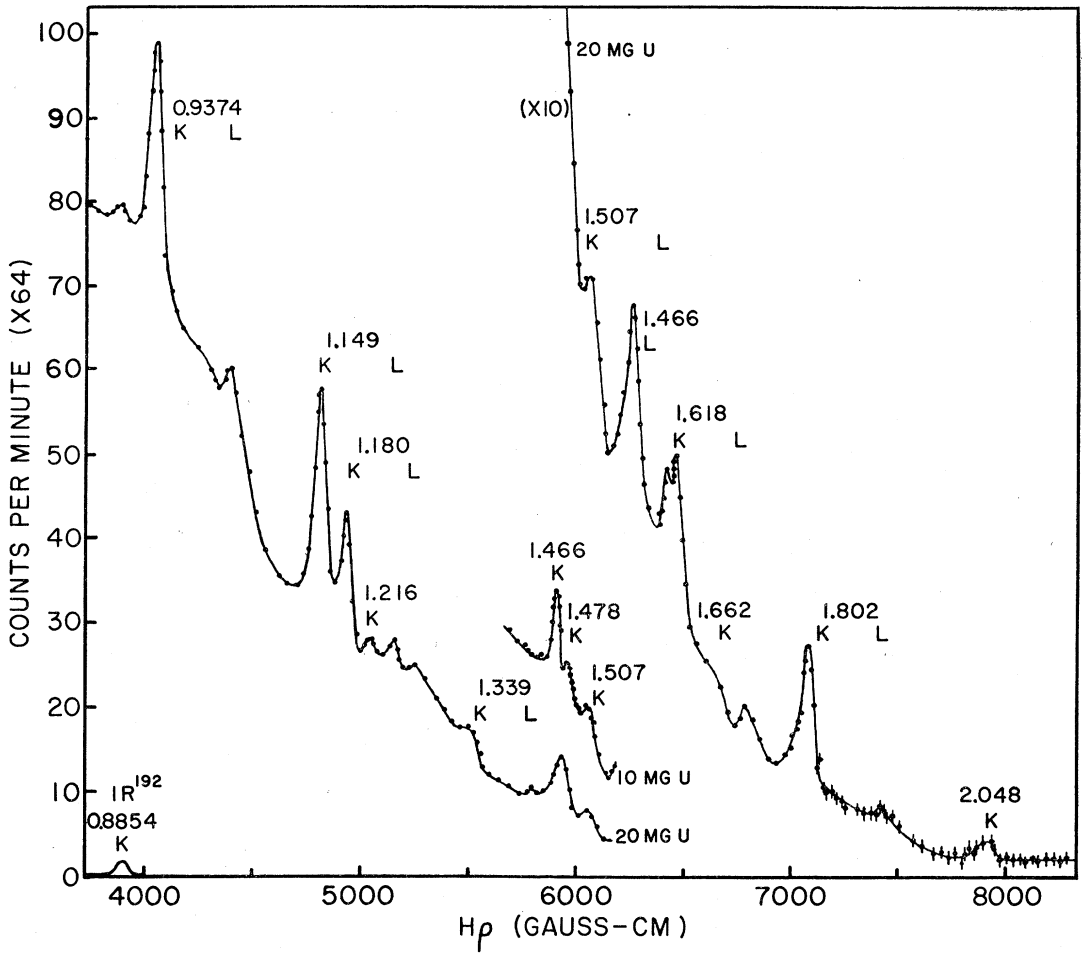

FIG. 3. The Ir^{194} high-energy external conversion spectrum obtained with a 20.1-mg/cm² U radiator. The insert shows the profile of the 1.466—1.478 Mev doublet observed with a 10-mg/cm² U radiator. This doublet is not resolved with a 20-mg/cm² radiator but the high-energy profile of the peak obtained does not seem to be steep enough for a normal peak of this height. The unresolved peak corresponds to an energy of 1.467 Mev.

[16] P. W. Levy, Phys. Rev. **72**, 352 (1947).

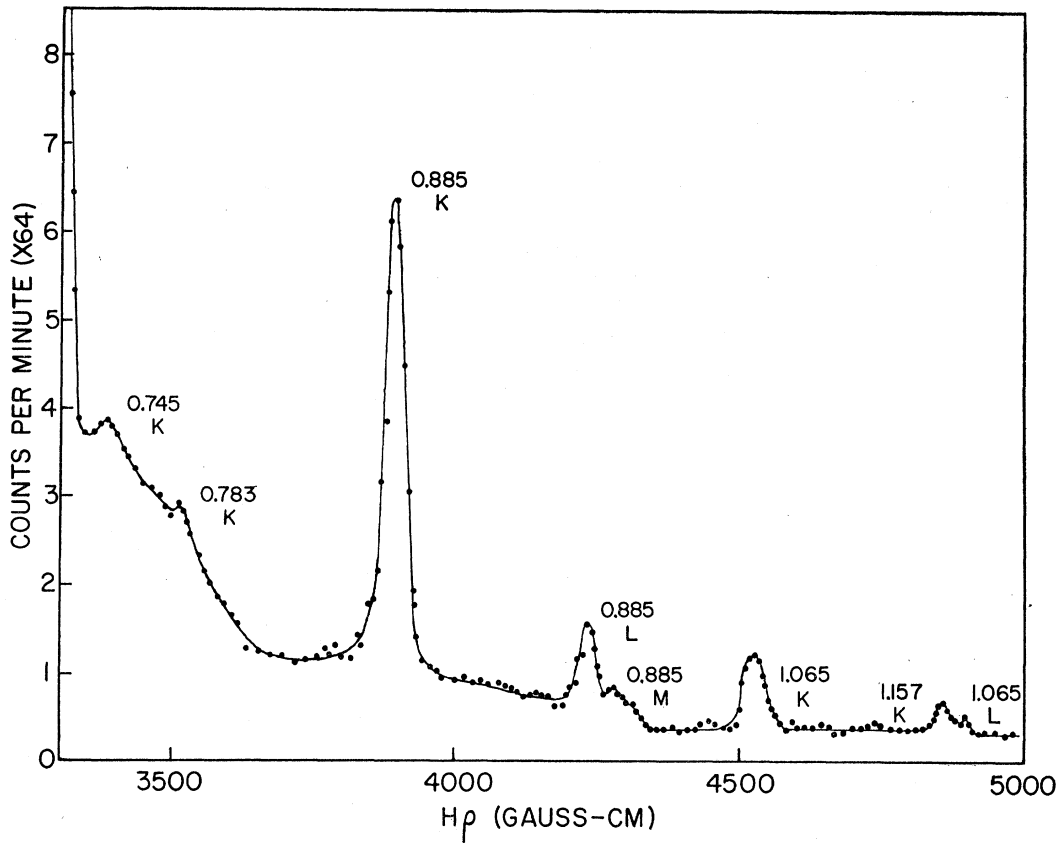

FIG. 4. The high-energy external conversion spectrum of Ir^{192} obtained with a 10-mg/cm² U radiator.

sources showed the presence of four well-defined components with the following end-point energies and relative intensities (average values): 2236±10 kev (66 percent); 1905 kev (15 percent); 975 kev (9.7 percent); and 430 kev (~8 percent). In drawing the Fermi plot, the end point of the high-energy component was determined from the data above 1900 kev, while the other end points were adjusted to correspond with that expected from the decay scheme already proposed on the basis of the gamma measurements alone. These slight adjustments ($\leq$10 kev) were made in order that the relative intensities of the beta groups might be more accurately determined. The relative intensities of the first three beta groups were found to be quite reproducible. The yield and end point of the low-energy group are much more uncertain because of the effects of source thickness and the difficulties in subtracting the Ir^{192} background with its strong conversion lines.

The intensities of the beta transitions can also be found by combining the gamma-ray intensities with the relative intensities of the 2236- and 1905-kev beta groups found from the Fermi analysis. The distortion of the gamma-ray intensities caused by ignoring the effect of internal conversion is negligible, except for the strong 293- and 328-kev radiations. Even for these the distortion is quite insensitive to the values of the total conversion coefficient chosen. The $E2$ character of the 328-kev radiation has been established by Mihelich[17] from its K/L ratio so that a value of 0.075 for its internal conversion coefficient seems appropriate. The nature of the 293-kev radiation is not known, but for these intensity calculations an arbitrary value of 0.2 has been chosen for its total conversion coefficient. Using these values, a straightforward calculation leads to the following intensities: 2236 (70 percent); 1905 (16 percent); 975 (9 percent); and 430 kev (2.8 percent). All other beta transitions should amount to less than 3 percent. These values are in good agreement with those obtained from the beta analysis, except for the low-energy component.

IV. DISCUSSION

(a) Ir^{192}

A comparison of the energy values obtained in this investigation with those of Cork[2] and Muller[3] for Ir^{192} and those of Ewan and Thompson[6] for Au^{192} is presented in Table I. Since Cork's energies were computed from the internal conversion spectrum, he was unable to decide whether the weaker lines were converted in the

[17] J. W. Mihelich (private communication), quoted by F. Scharff-Goldhaber, Phys. Rev. **90**, 587 (1953).

TABLE I. Gamma rays of Ir^{192}.

Intensity	Gamma-ray energy (kev) Present work	Cork[a]	Muller[b]	Au^{192} [c]	Nucleus	Assignment Transition	ΔE(kev)
2.6	136.2±0.3	135.9	136.33	136.5	Pt	4→3	+0.2
		156		157.7	Pt	7→6	+1
0.8	174.0±0.4	173		173.4	Pt	3→2	−2
0.8	201.2±0.3	201.1	201.31		Os	*C*→*B*	+0.1
3.5	205.4±0.2	205.7	205.74	205.4	Os	*D*→*C*	+0.3
					Pt	7→5	−1
1.0	281.5±0.5			281.8	Pt	6→4	−1.5
		283			Os	*B*→*A*	+0.4
26	295.8±0.1	294.9	295.94	295.7	Pt	2→1	+0.2
28	308.4±0.1	307.7	308.45	308.1	Pt	4→2	0.0
77	316.5±0.1	316.1	316.46	316.0	Pt	1→*O*	0.0
0.5	374 ±2[d]				Os[f]	*E*→*D*	0
	e	400		401	Pt		
	e	415.1		415.5	Pt	6→3	+1.3
0.5	440 ±2	438		435.5	Pt	7→4	−2
57	467.8±0.1	467.4	467.98	467	Pt	3→1	+0.2
5.2	484.4±0.2	484	484.75		Os	*C*→*A*	+0.3
6.4	588.7±0.3	588.6	588.40	588	Pt	6→2	−0.3
10	604.5±0.3	603.7	604.53		Pt	4→1	−0.1
7.7	612.7±0.2	611.2	612.87	612	Pt	2→0	−0.2
0.05	745 ±3				Pt[f]	7→2	+1.5
0.05	783 ±2[g]			783	Pt	3→0	+1.5
0.9	885.4±1.0[g]				Pt[f]	6→1	−1.0
0.15	1065 ±2[g]				Os[f]	*E*→*A*	−1
0.08	1157 ±2			1158	Pt	5→0	−2

[a] See reference 2.
[b] See reference 3.
[c] Ewan and Thompson (see reference 6) and private communication.
[d] Falls on the *L* peaks of the 295–316 triplet when converted in Pt, Au, or Pb; observed in U.
[e] Falls on the *L* peaks of the 295–316 triplet when converted in U; not seen in Au.
[f] Assigned on the basis of energy alone.
[g] Obtained by Pringle *et al.*

osmium or platinum branch. On the other hand, all the Au^{192} data refer to transitions in platinum. By comparing the four columns it is nearly always possible to assign each gamma ray uniquely to one branch of the decay scheme, as shown in Table I.

Since Cork assigns the 205-kev radiation to osmium on the basis of its *K* and *L* internal conversion peaks and Ewan and Thompson find it clearly in Au^{192}, radiation of this energy must appear in both branches of the decay scheme, with the stronger probably belonging in osmium. The situation with respect to the much weaker 281-kev radiation is similar but not so clearly defined. Its presence in platinum is indicated by Ewan and Thompson, while Cork's value of 283 kev is based on internal conversion in osmium. Cork's corresponding energy for internal conversion in platinum would have been 288 kev; there is no other evidence for the existence of a 288-kev radiation, though admittedly it would be very difficult to detect by external conversion, since its *K* peak would fall on the low-energy edge of the strong 295-kev *K* peak. For four of the weakest lines the decision as to the branch in which they belong has been made purely from their position in the decay scheme. Confirmation for most of the weak, high-energy lines reported is found in the coincidence and scintillation spectrometer studies of Pringle *et al.*[4,5]

All but one of the radiations given in Table I can be accounted for as transitions between the energy levels shown in Fig. 6. In calculating these energy levels from the data, Muller's energy values have been used wherever possible. The last three columns of Table I show the assignment of each radiation and the difference between the expected value and that observed in this work. The scheme is essentially that suggested by Cork's group and extended by Pringle

TABLE II. Gamma-rays of Ir^{194}.

Intensity	Gamma-ray Energy (kev)	Assignment	ΔE (kev)
5.1	293.0±0.3[a]	2→1	0.1
27	328.1±0.2[a]	1→0	0.0
<3	466[ab]	9→4	+3
1.7	620.0±1.0	2→0	+1.0
6.2	643.3±0.6	3→2	+0.7
2.9	937.4±0.4	3→1	−0.5
2.9	1149.2±0.6	4→1	−0.2
1.7	1180 ±1	7→2	+1
0.4	1216 ±1	8→2	−1
0.3	1339 ±2	5→1	−2
0.8	1466 ±1[a]	6→1	0
0.2	1478 ±1[c]	4→0	−1
		or	
		7→1	−4
0.3	1507 ±2	8→1	+1
0.3	1618 ±2	9→1	0
0.2	1662 ±3	5→0	+3
0.3	1802 ±2	7→0	0
0.05	2048 ±4[a]	10→0	0

[a] Observed by Steffen *et al.* (see reference 7) in the decay of Au^{194}.
[b] Falls underneath the strong 468-kev peak in Ir^{192}. The upper limit for its intensity is set by observing the decay of the Ir^{192} peak intensity.
[c] Appears as a partially resolved peak between the 1466- and 1507-kev peaks when studied with a 10-mg/cm² uranium radiator.

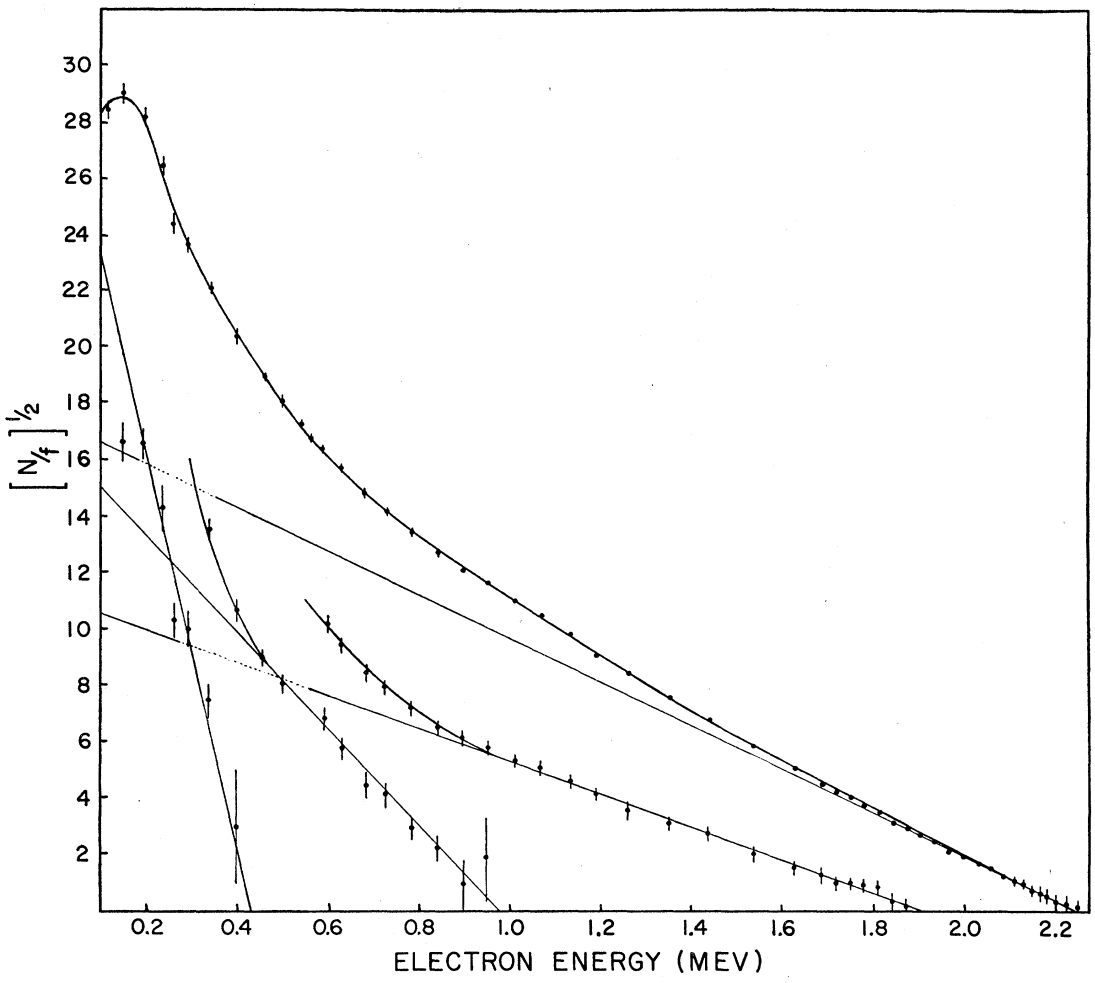

FIG. 5. Fermi plot of the beta spectrum of Ir^{194}.

and his colleagues. Slight modifications of the energies of the upper levels have been made necessary by the more accurate data presented here. The evidence for the 1156-kev level is based on two weak lines, while the 1359-kev level is based on four weak lines. The level at 1064 kev in osmium, suggested by Pringle, is rather insecurely established.

On the basis of the beta-ray end-point energy of 672 kev and Pringle's value of 1490 ± 20 kev for the $Ir^{192}-Pt^{192}$ mass difference, it would appear that the highest-energy beta group feeds the 784-kev level and that no direct transitions from Ir^{192} pass to the three lowest-lying levels. Support for this view is given by the gamma-ray intensities, which indicate that very few beta rays can proceed to either the 316- or 612-kev levels. The gamma-ray intensity measurements also indicate that roughly 50 percent of the beta rays go to the 784-kev level, 35 percent to the 921-kev level, 8 percent to the 1200-kev level, and 1 percent to the 1359-kev level. K capture occurs in 6 percent of the disintegrations, with most of the transitions proceeding to the 485- and 690-kev levels. These estimates are admittedly rather rough, since the internal conversion coefficients of the gamma rays are not known.

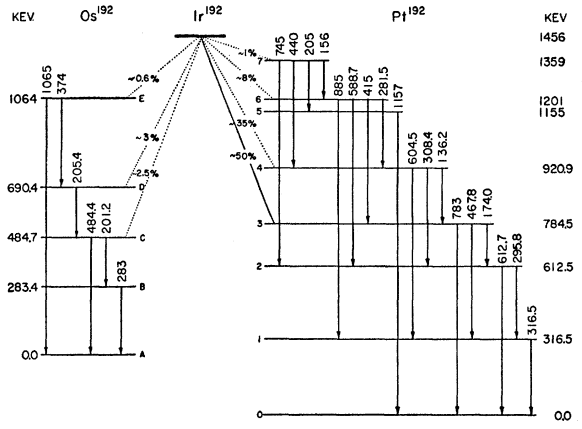

FIG. 6. Disintegration scheme of Ir^{192}.

(b) Ir^{194} Results

The results presented in Sec. III and Table II may be consistently accounted for in terms of the levels presented in the decay scheme of Fig. 7. The classification of each gamma ray and the agreement between the values predicted by this scheme and the observed measurements are shown in Table II.

The levels at 328, 621, and 1265 kev may be regarded as well established on the basis of evidence from both the beta and gamma spectra. The levels above 1265 kev are much less certain since the cross-over transitions expected are too weak to show on the strong Compton background of higher-energy gamma rays. The level at 1793 kev is based on only one line, the relatively strong 1466-kev line which Steffen and his co-workers[7] found to be in cascade with the 328-kev radiation in their study of Au^{194}. On the basis of our expected errors, it is impossible to identify this level with the one at 1802 kev, which is established by two well defined gamma rays and the doubtful 1478-kev radiation.

Coincidence experiments carried out by Ian Williams of this laboratory, using two NaI(Tl) gamma-ray scintillation spectrometers, offer good support for the proposed decay scheme up to 1265 kev above the ground state, but the more difficult experiments arranged to test the levels above 1265 kev have so far proven inconclusive.

(c) General

The data presented here, together with the information available for the decay of Au^{196} [7] provide an interesting comparison of the positions of energy levels in the three even-even isotopes, Pt^{192}, Pt^{194}, and Pt^{196}. The positions of the first excited states for these three nuclides are 316, 328, and 358 kev respectively above the ground states; the second excited states lie at 611, 621, and 688 kev above the same reference levels. In both cases the regular change in level position with increasing neutron number is in agreement with expectation and removes an anomaly in the literature[18] which states that the second excited state in Pt^{194} falls at 1.8 Mev above the ground state.

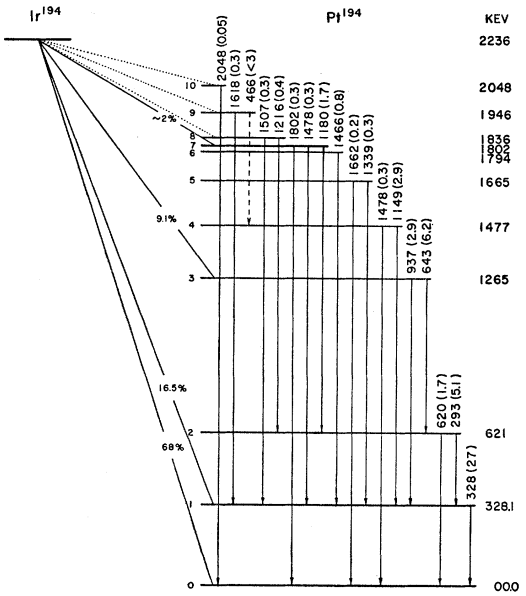

FIG. 7. Disintegration scheme of Ir^{194}. Beta transitions shown as solid lines were obtained in the Fermi analysis; the others are deduced from gamma-ray intensities.

The difference in intensity of the ground-state beta transitions of Ir^{192} and Ir^{194} is very striking. Using the measured beta- and gamma-ray intensities and making the assumption that transitions to the 0, 316, or 612 kev levels of Pt^{192} would have been observed if their intensities were larger than 1 percent of the 670-kev beta group, one can calculate the $\log(f_0t)$ values for transitions to each of the levels given in Figs. 6 and 7. For Ir^{192} this calculation leads to the following values: (0)$>$11.2, (1)$>$11.0, (2)$>$10.4, (3)8.3 (4)8.2, (5)10, (6)8.0, and (7)7.9. For Ir^{194} the values are (0)8.3, (1)8.7, (2)$>$9, (3)7.8, (4)7.9, (5)8.3, (6)7.8, (7)7.3, (8)7.6, (9)6.7, and (10)6.9. Such a calculation is not possible for the transitions to Os^{192} without a knowledge of the $Ir^{192}-Os^{192}$ energy difference. If one assumes that the $\log(f_0t)$ values for transitions to levels D and E in Os^{192} are also approximately 8, consideration of the gamma intensities in the K-capture branch leads to a value of 1.3 ± 0.2 Mev for the $Ir^{192}-Os^{192}$ energy difference.

The $\log(f_0t)$ values for the observed beta transitions in both Ir^{192} and Ir^{194} are close to those of the first forbidden transitions for other odd-odd nuclei in this mass range; for example, Re^{186} has values ranging from 7.7 to 8.2, Re^{188} from 8.2 to 8.9,[19] and Au^{198} values of 7.4 and 7.6.

On the basis of these $\log(f_0t)$ values and the observed pattern of gamma-ray intensities, it seems necessary to describe the Ir^{192} ground state as 4^- and the Ir^{194} ground state as 1^- or 2^-, with the former choice preferred since there was no evidence of departure from the allowed shape in the analysis of the 2.236-kev beta spectrum.

According to shell theory[20] the ground state of the Ir^{192} nucleus is described as a $(6h_{11/2})^{12}(4d_{3/2})^1$; $(7i_{13/2})^8(4p_{3/2})^1$ configuration. That of Ir^{194} should possess the same configuration with the addition of two neutrons to the $7i_{13/2}$ subshell. Such a configuration leads readily to the desired 1^- state for Ir^{194}, but it is not easy to see how a 4^- state for Ir^{192} can be achieved. However, the difference in stability between the $6h_{11/2}$ and $4d_{3/2}$ shells is very small and it may be that in Ir^{192} the odd proton is in the $6h_{11/2}$ shell. Support for

[18] Gertrude Scharff-Goldhaber, Phys. Rev. **90**, 587 (1953).
[19] C. C. McMullen, Ph.D. thesis, McMaster University, Hamilton (unpublished).
[20] P. F. A. Klinkenberg, Revs. Modern Phys. **24**, 63 (1952).

this view is provided by the existence of a 1.5 min isomer of Ir^{192}.[1]

It would be expected that the first excited state of each of the three nuclides Os^{192}, Pt^{192}, and Pt^{194} has spin 2 and even parity. Experimental evidence for this exists from the K/L ratio of the 328-kev line in Ir^{194}.[17] Moreover, angular correlation studies[21,22] indicate that some of the higher levels in the Ir^{194} decay scheme also have spin 2, but at the time these experiments were performed the complex nature of the spectrum was not realized, so that the interpretation of these experiments is open to question.

[21] C. E. Whittle and P. S. Jastram, Phys. Rev. **87**, 203 (1952).
[22] J. J. Krauschaar and M. Goldhaber, Phys. Rev. **89**, 1081 (1953).

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Internal Conversion in Ne^{22}†

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The internal conversion coefficient of the 1.28-Mev γ ray in Ne^{22} has been measured to determine its multipole character. It has been found to be $E2$. The spin and parity assignments to the Ne^{22} excited state and the Na^{22} ground state are discussed.

THE internal conversion coefficient of the 1.28-Mev gamma ray of Ne^{22} has been measured in order to determine the spin and parity of the 1.28-Mev excited state. Two methods were used to find the total conversion coefficient. One way, the least accurate, was to compare the area under the conversion peak with the area under the continuous spectrum. The second way was to compare the conversion coefficient of the neon gamma ray with that[1] of the 1.33-Mev gamma ray of Ni^{60}.

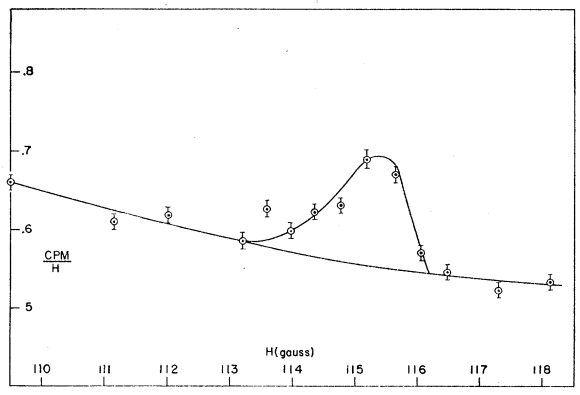

FIG. 1. Internal conversion peak of 1277-kev γ ray in Ne^{22}, source I.

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The source used in method one (source I) was prepared from cyclotron produced Na^{22} obtained from Oak Ridge in the form of NaCl. The NaCl was deposited on a zapon film covered by a 0.1-mg/cm² layer of silver. The average thickness of the source was 4 mg/cm² but was not very uniform; the total source area was 10 cm² and the source strength one millicurie.

The data taken on the conversion peak are shown in Fig. 1. Actually several runs were made, but only the data with the best statistics are included in the plot. The curve drawn indicates a somewhat poorer resolution than is usual for the counter and baffle arrangement used. The line was broadened by the thick source. A

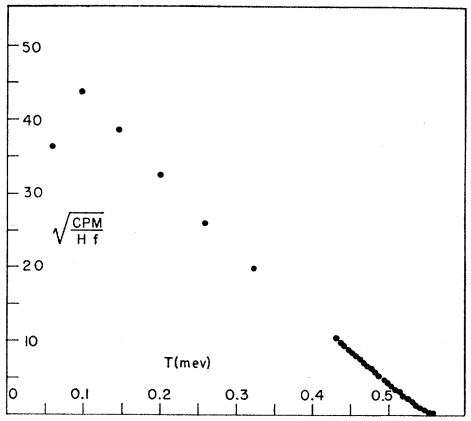

FIG. 2. Kurie plot of positrons from the decay of Na^{22}, source I, 4 mg/cm².