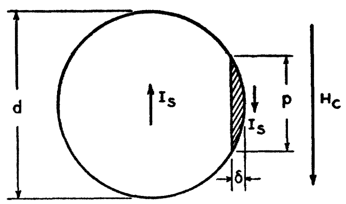

FIG. 2. Initial stage of magnetization reversal by formation of Bloch transition wall of width δ.

Here γ is the surface energy density of a Bloch wall, p is the wall diameter, and δ is the wall thickness; V is the volume of the sphere. The term on the left approximates the energy of formation of the wall; the first term on the right approximates the magnetic energy of the wall material in the applied field H_c, while the second term on the right is a crude estimate on dimensional grounds of the change in the magnetic self-energy of the sphere.

Using the geometrical relation $p^2=4\delta d$, we may write Eq. (2) in the form

$$H_c/H_c^\infty=1-(d/d_0), \tag{3}$$

where $H_c^\infty=2\gamma/\delta I_s$ and $d_0=24\gamma/I_s^2$. Now, from the theory of the Bloch wall, $\gamma\simeq(KkT_c/a)^{\frac{1}{2}}$ and $\delta\simeq(kT_c/Ka)^{\frac{1}{2}}$, so that $H_c^\infty\simeq 2K/I_s$, in agreement with the value obtained from domain rotation. For MnBi, we calculate $H_c^\infty=40{,}000$ and $d_0\sim 7\times 10^{-3}$ cm. The estimated value of d_0 is uncertain by an order of magnitude, because of the crudeness of the estimate of the change in self-energy of the sphere. The theoretical curve plotted in Fig. 1 was fitted to the data using $H_c^\infty=20{,}000$ and $d_0=9\times 10^{-3}$ cm.

The present theory may be regarded as setting an approximate *lower limit* to the coercive force as a function of particle size—a lower limit because it is not clear without very detailed calculation that the situation pictured in Fig. 2 actually corresponds to the maximum energy barrier for wall formation.

[1] J. Frenkel and J. Dorfman, Nature **126**, 274 (1930).
[2] C. Kittel, Phys. Rev. **70**, 965 (1946).
[3] C. Guillaud, Thesis, Strasbourg, 1943.
[4] L. Néel, Comptes Rendus **24**, 1550 (1947); E. C. Stoner and E. P. Wohlfahrt, Nature **160**, 650 (1947).

The Beta-Spectrum of Au^{198}

D. SAXON
Argonne National Laboratory, Chicago, Illinois
February 23, 1948

THE 180° β-spectrometer, previously used by V. A. Nedzel,[1] has been placed in operation again. The absolute field calibration is made with a G.E. fluxmeter; at the end point of Au^{198} the error is $\sim$0.3 percent. As a check on this the spectrum of P^{32} was run, and the end point found agreed to within 1 percent with that of Siegbahn.[2] The spectrum shape was also found to match his down to 0.3 Mev.

An organic Au solution was irradiated in the Argonne heavy water pile. Simultaneously, with the measurement in the spectrometer, the decay was followed to detect impurities. The linear plot of Fig. 1 gives half-life $T_{\frac{1}{2}}=(2.66\pm 0.01)$ days, and indicates no detectable impurity of $T_{\frac{1}{2}}$ different from this. The half-life given in the literature is $T_{\frac{1}{2}}=2.7$ days.[3] In the spectrometer the detector is a G-M counter used with scaling circuit and recorder. The filling of the counter was a mixture of argon and amyl acetate, with sufficient pressure (8 cm of Hg) to insure $\sim$100 percent counting efficiency over the entire spectrum measured. The counter window was a sheet of Nylon, 0.3 mg/cm². The source of weight 0.4 mg/cm² was deposited on a Nylon backing of 0.54 mg/cm². The resolution $\Delta H\rho/H\rho$, was 1 percent.

The spectrum shape is shown in Fig. 2, while Fig. 3 is the Kurie plot for the Fermi theory. The value of the end point from the extrapolated Kurie plot is 0.960 ± 0.005 Mev.

Using a thick source of 40 mg/cm², Siegbahn obtained a value of 0.92 ± 0.01.[4] This difference, outside of the error limits, is difficult to reconcile, but it should be pointed out that Siegbahn used a very thick source and extrapolated the Kurie plot from 0.8 Mev. The present Kurie plot is linear back to 0.2 Mev, thus indicating an allowed spectrum shape.

Konopinski[5] gives Au^{198} as empirically second forbidden with ft. $=0.1\times 10^8$. Using the new end point, $W_0=2.88$, ft. is changed to 0.18×10^8. This still leaves Au^{198} in the second forbidden empirical classification. However, from the linearity of the Kurie plot, the total forbidden correction factor must be constant. There seems to be no simple way in which the theory can reconcile this difficulty. If the ft. value of Au^{198} were $\sim$0.1 the actual value, it would fall in the first forbidden group. In this case the theory will give an allowed shape for all the interactions, $\Delta J=0$, ± 1, for heavy elements like Au.[6] With the vector and tensor interactions, this is possible even for light elements.

One possible explanation is that the observed allowed shape is the sum of two or more forbidden spectra. However, recent coincidence measurements on Au^{198} give no γ-γ coincidences, and the ratio of β-γ coincidences to β's, constant up to 0.7 Mev.[7] This would verify the simple spectrum shape found.

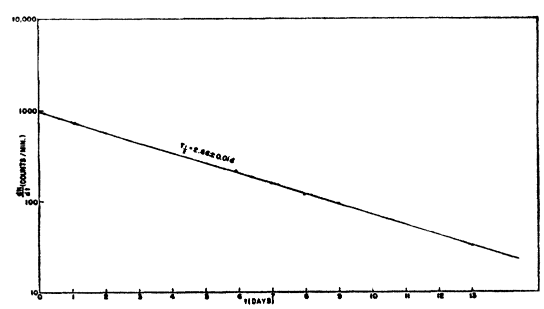

FIG. 1.

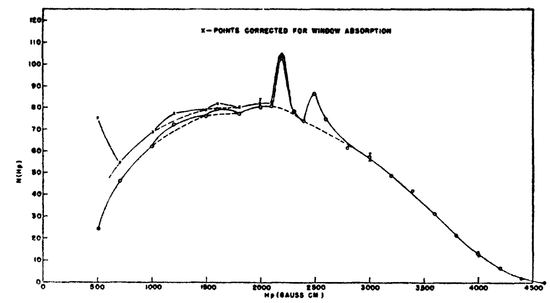

FIG. 2.

From the probable errors in the Kurie plot data near the end point, an upper limit on the neutrino mass can be made.[8] The present data give $\nu \leq 15$ kev, or $\nu \leq 0.03$ the electron mass.

No systematic search for internal conversion lines was made; the K and L peaks found give a γ-energy of ~ 0.40 Mev. The rough conversion coefficients are ~ 1 percent.

The recent work on the radiation from Au^{198} by Levy and Grueling[9] gives 0.97 ± 0.010 Mev for the β-end point, in very close agreement with the present data. However, the interpretation of the spectrum as complex, with ~ 15 percent of a 0.605-Mev β, and γ's of 0.157 and 0.208 Mev in parallel with the 0.97-Mev β cannot be supported by the present work. There is no indication of the inflection at 0.6 Mev in Fig. 3.

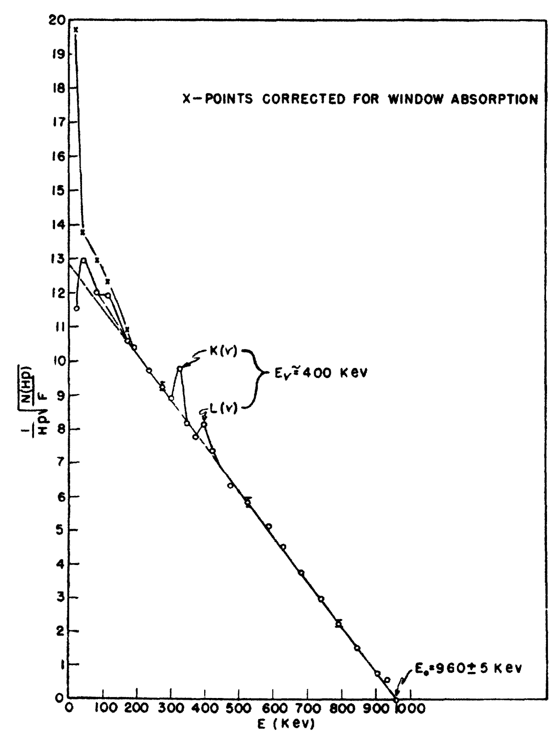

FIG. 3.

Wiedenbeck and Chu[10] have found $N\beta\gamma/N\beta$ independent of β-energy, indicating a simple spectrum. They find low energy γ's and γ-γ coincidences,[11] explainable as in cascade on the simple spectrum model.

The present work is part of a survey of the heavy elements. The author wishes to thank Professor Donald J. Hughes for his helpful supervision.

[1] Unpublished Plutonium Project Reports.
[2] K. Siegbahn, Phys. Rev. **70**, 127 (1946).
[3] E. Amaldi, O. d'Agostina, E. Fermi, B. Pontecorvo, F. Rossetti, and E. Segrè, Proc. Roy. Soc. **A149**, 522 (1935).
[4] K. Siegbahn, Proc. Roy. Soc. **A189**, 527 (1947).
[5] E. J. Konopinski, Rev. Mod. Phys. **15**, 209 (1943).
[6] E. J. Konopinski and G. E. Uhlenbeck, Phys. Rev. **60**, 308 (1941).
[7] E. T. Jurney and M. R. Keck, Bull. Am. Phys. Soc. **22**, No. 6 (1947).
[8] O. Kofoed-Hansen, Phys. Rev. **71**, 451 (1947).
[9] P. W. Levy and E. Grueling, Phys. Rev. **73**, 83 (1948).
[10] M. L. Wiedenbeck and K. Y. Chu, Phys. Rev. **72**, 1164 (1947).
[11] M. L. Wiedenbeck and K. Y. Chu, Phys. Rev. **72**, 1171 (1947).

Internal Conversion Electrons from 70-Day Ir^{192}

R. D. HILL AND W. E. MEYERHOF
Physics Department, University of Illinois, Urbana, Illinois

February 20, 1948

THE internal conversion electron spectrum of long-lived Ir^{192} has been investigated recently by P. W. Levy[1] and J. M. Cork.[2] Both workers reported a large number of lines in the energy region up to approximately 600 kev, but the agreement between their results was not very satisfactory.

Using a high dispersion 180° photographic beta-ray spectrograph, we have studied the Ir^{192} spectrum up to approximately 300 kev. These results, together with those of the above two workers, are given in Table I. According to the present work, the energies of the converted gamma-rays in the region investigated are:

$$\gamma_1 = 137,\ \gamma_2 = 208,\ \gamma_3 = 296,\ \gamma_4 = 308,\ \gamma_5 = 317 \text{ kev.}$$

TABLE I. Internal conversion lines of 70-day Ir^{192}.

Intensity of line	Energy of line (kev) (present workers)	Energy of line (kev) (Levy)	Energy of line (kev) (Cork)
Weak	58(γ_1-K)	—	—
—		121(γ_1-K)	—
Weak	124(γ_1-L_I)	124(γ_2-K)	—
Weak	126.5(γ_1-L_{III})	128(γ_3-K)	—
Medium	131(γ_2-K)	131(γ_4-K)	129.8(?)
	—	—	162.5(?)
Weak	193(γ_2-L_I)	193(γ_3-L)	190.9(γ_1-K)
Weak	195(γ_2-L_{III})	194(γ_4-L)	—
Weak	203(γ_2-M)	202(γ_4-M)	—
Weak	205(γ_2-N)	—	—
Strong	217.5(γ_3-K)	217(γ_5-K)	214.9(γ_2-K)
Strong	230(γ_4-K)	229(γ_6-K)	227.9(γ_3-K)
V. strong	238(γ_5-K)	237(γ_7-K)	236.2(γ_4-K)
	—	—	254.5(γ_1-L)
Medium	282(γ_3-L_I)	281(γ_5-L_I)	280.5(γ_2-L)
Weak	284(γ_3-L_{III})	284(γ_5-L_{III})	—
Weak	293(γ_3-M)	293(γ_5-M)	—
Weak	295.5(γ_3-N) and/or (γ_4-L_I)	295(γ_6-L_I)	292.5(γ_3-L)