74.2-kev I.T. and the 129-kev γ-ray of the daughter activity, and find it is $\lesssim 10$. If the I.T. were $M3$, by using the threshold K-conversion coefficient of Spinrad and Keller[4] for the 74.2-kev I.T., our measured K-conversion coefficient of the 129-kev γ-ray ($\alpha_K = 2.0$), and the decay scheme,[1] this ratio R should be >260 and probably ~ 2600, depending on the K/L ratio assumed. (3) The L_{II} conversion is actually more intense than would be expected for an $M3$ I.T.

However, the L subshell conversion ratios are not those expected for an $E3$ transition, on the basis of empirical results obtained for a 130-kev $E3$ I.T. in Au^{197m}.[5] We wish to suggest the following explanation of our results. The transition occurs between the $p_{\frac{1}{2}}$ level and the $7/2+$ ground state and consists of 90 percent $E3$ plus 10 percent $M4$ γ-radiation, (that is, after considering conversion, 73 percent total $E3$ transitions and 27 percent total $M4$ transitions). This assumption makes the L subshell conversion data consistent, as is shown by the analysis in Table I. The theoretical and empirical conversion coefficients are only very approximate, but are probably sufficiently good to establish the need for mixing the magnetic and electric radiation.

TABLE I. Theoretical and experimental conversion data on the I.T. in Os^{191m}.

	K	L_{tot}	L_I	L_{II}	L_{III}
		Theoretical conversion coefficients.			
$E3$	1.6[a]	177[b]	6	114	57[d]
$M4$	215[a]	5300[c]	1710	170	3420[e]
		Relative intensities			
0.73 $E3$+0.27 $M4$[f] (theor.)			45	28	100
Observed[g]	small	large	42	25	100

[a] See reference 4.
[b] M. H. Hebb and E. Nelson, Phys. Rev. **58**, 486 (1940).
[c] Using reference 4 and extrapolating K/L ratio to large Z^2/E.
[d] Estimates of relative L-shell conversion obtained from empirical evidence (see references 2 and 5).
[e] Estimated from N. Tralli and I. S. Lowen, Phys. Rev. **76**, 1541 (1949) and empirical results of reference 2.
[f] Normalized to intensity of $L_{III}=100$.
[g] See reference 1.

Assuming that 27 percent of the I.T. are $M4$, using the conversion data in Table I, and assuming that $M+N$ conversion is $\frac{1}{3}$ of L conversion, the value of $\tau_\gamma(M4) = 2\times 10^9$ sec is obtained. This is in reasonable agreement with the theoretical value[6] (taking the initial spin $=\frac{1}{2}$)[7] of 8×10^9 sec. The observed value of $\tau_\gamma(E3)$ for the 73 percent $E3$ branch is $\sim 10^3$ times the average observed value for $\Delta I = 3$ transitions of this energy.[7] This apparent mixture is made possible by the slowness of the odd neutron $E3$ I.T. to the compound $7/2+$ level, and is made conspicuous by the extremely large L and M conversion coefficients for an $M4$ I.T. of this energy.

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† Permanent address: University of Illinois, Urbana, Illinois.
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Observation of the $(\gamma,2n)$ Reaction in Ta†

E. A. WHALIN AND A. O. HANSON
Department of Physics, University of Illinois, Urbana, Illinois
(Received November 19, 1952)

LEVINGER and Bethe[1] and later Eyges[2] pointed out that the sharp drop off in the cross section for the (γ,n) reaction in heavy elements as well as the higher neutron yields as measured by Price and Kerst could be quite adequately explained by competition from the $(\gamma,2n)$ reaction. A direct measurement of the $(\gamma,2n)$ reaction in heavy elements has not been made since it has been difficult to find reactions which give satisfactory radioactivities. This report presents the result of measurements in which both the total neutron yield and the (γ,n) radioactivity are measured under the same conditions. The $(\gamma,2n)$ yield is obtained from the difference between the two excitation curves.

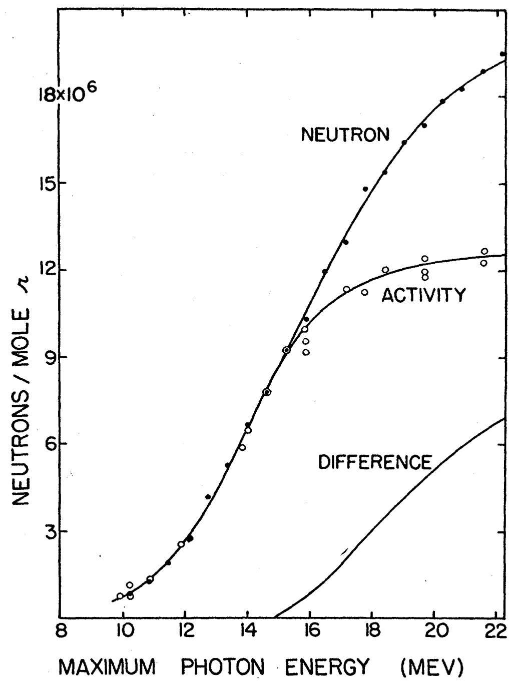

FIG. 1. Ta activation curves.

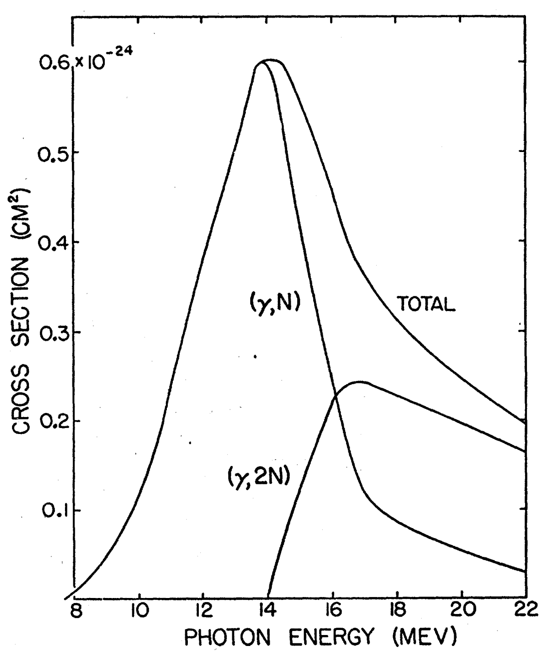

FIG. 2. Ta cross-section curves.

In the present experiment a collimated beam of x-rays from the 22-Mev betatron was used to irradiate a target made up of a stack of 25 Ta foils, each 0.010 inch thick. The Ta target was in the center of a 10-inch cubic cavity in a large pile of boxes of borax. A long BF_3 proportional counter with its axis perpendicular to the beam was surrounded by paraffin, and it closed one side of the cavity. This counter arrangement was designed to have a uniform sensitivity to neutrons in the energy range expected from the Ta. After each irradiation the activity of the middle Ta foil was measured in an arbitrary geometry by a Geiger counter.

The neutron yield and the Ta^{180} activity as a function of the maximum betatron energy are shown in Fig. 1. The neutron yield is normalized using the absolute neutron yield values of Price and Kerst.[3] At low energies the Ta^{180} activation curve is normalized to coincide with the neutron yield curve. The excitation function for the excess neutrons shown in Fig. 1 is obtained by subtracting the smoothed Ta^{180} activation curve from the smoothed neutron yield curve.

Figure 2 shows the cross sections obtained from the smoothed curves of Fig. 1 by the photon difference method of Katz and Cameron. The high energy portions of the cross sections are not very reliable as they are sensitive to the exact shape of the activation curve.[4] The thresholds used are 7.7 Mev for the (γ,n) reaction, and 14.0 Mev for the $(\gamma,2n)$ reaction.

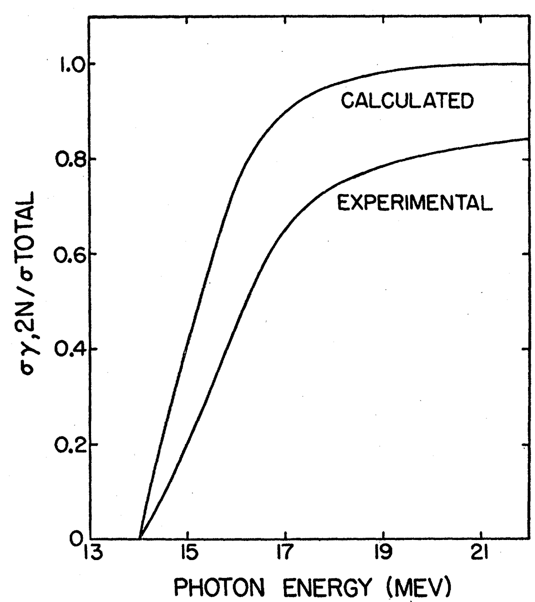

FIG. 3. Fraction of excited Ta nuclei decaying by emission of $2n$, as measured and as calculated by the statistical theory of the compound nucleus.

Figure 3 shows the theoretical and experimental values of the ratio of the $(\gamma,2n)$ to the total cross section. The theoretical values for this ratio were calculated using the statistical model of the nucleus as given by Feld *et al.*[5] where the level density parameter (a) for the Ta^{180} nucleus was taken as 11 Mev^{-1}. Since the experimental determination of this ratio must be considered to have a large error arising from the uncertainty in the (γ,n) cross section at high energies, it can be concluded that the statistical model of the compound nucleus is sufficient to explain the present observations. Since the threshold for the $(\gamma,3n)$ reaction is 22.2 Mev, which is just beyond the maximum energy used, this reaction can have no effect on this work.

The tail of the curve for the total cross section is somewhat higher than that expected by Eyges. If it is correct as shown, the principal effect of the $(\gamma,2n)$ reaction is to increase the width of the curve for the total cross section. It does not appear that this reaction does very much to affect the position of the maximum. Further work is in progress at this laboratory to study these processes more accurately.

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A Li^9 Disintegration in a Photographic Emulsion

W. F. FRY
Department of Physics, University of Wisconsin, Madison, Wisconsin
(Received November 18, 1952)

A GROUP of Ilford C-2 and electron-sensitive G-5 plates were exposed behind absorbers to the negative μ-meson beam of the University of Chicago cyclotron. Among many typical μ-meson stars,[1] a meson-induced star was observed where a low energy fragment caused a small secondary star. A projection drawing of the event is shown in Fig. 1.

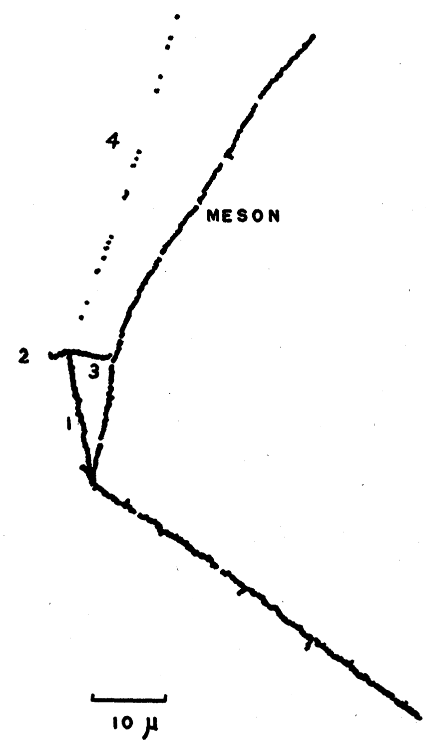

FIG. 1. A projection drawing of an event which was found in a G-5 plate exposed to negative μ-mesons. Track 1 is probably the result of a $_3Li^9$ fragment which disintegrated into an electron, track 4; two α-particles, tracks 2 and 3, and a neutron.

Track 1 is 18 microns long. Tracks 2 and 3 are 2.3 and 5.7 microns long, respectively. Track 4 leaves the emulsion after 1460 microns, is minimum ionizing, and exhibits a large amount of small-angle scattering. From the multiple scattering along track 4, the $p\beta$ of the particle was found to be 7.7 ± 2 Mev/c. Since the particle was minimum ionizing, the track most probably was produced by an electron of 7.7 ± 2-Mev energy. The event is very similar to the conventional "hammer" tracks caused by the disintegrations of $_3Li^8$. However, there is an essential difference between a $_3Li^8$ disintegration and the event shown in Fig. 1, in that tracks 2 and 3 (presumably α-particles) are not co-linear and do not have the same range. The residual momentum of the particles which produced tracks 2, 3, and 4 is 69 ± 5 Mev/c. The