dependence of gamma-transition lifetime on nucleon configuration. The data presented in Fig. 1 show that there is, in fact, some evidence to this effect.

In Fig. 1, the values of the matrix elements $|M|^2$ for all the evaluable $E3$ transitions of the $7/2+\rightleftarrows p_{\frac{1}{2}}$ type are plotted against a number n, representing the complexity of the nucleon configuration. For odd-proton nuclei (open circle points), n is the number of protons coupling to form the 7/2+state, and for odd-neutron nuclei (full circle points) n is the number of neutron holes in the configuration forming the 7/2+state. Reasonable estimates of n can be arrived at in the case of $g_{9/2}$ proton and neutron configurations by consideration of the energy systematics of the 7/2 +levels.[4] For the cases of Os^{191}, W^{183}, and W^{185}, however, the n-values for the $i_{13/2}$ holes can be regarded as no more than judicious shell-theory guesses. It is apparent from the plot that $|M|^2$ increases steeply with n and at approximately the same rate for odd protons of the $g_{9/2}$ shell, and for odd neutrons of both the $g_{9/2}$ and $i_{13/2}$ sub-shells. To indicate the odd-proton variation, the Rh^{105} and Ag^{107} points have been joined by a line because these isomers have equal neutron numbers. There appears to be some evidence from the plot that there is a systematic effect of adding pairs of neutrons and protons. The departure of Kr^{79} from the general trend may be due to experimental inaccuracy.

Since the factors involved in the estimates[2] of transition probabilities are the same for both odd-proton and odd-neutron transitions and since the single nucleon $p_{\frac{1}{2}}$ states are common to all transitions, the differences of $|M|^2$ should be attributed to the differences of nucleon electric moment of the 7/2+states. It is not surprising that the electric moment of the odd-proton 7/2 states should increase with increasing numbers of protons in the outer-shell configurations. It is also reasonable to expect that an increasing number of neutrons in the outer shell configurations should tend to crowd protons into the core, thus affecting the electric moment in an inverse manner to the odd-proton states. This is equivalent to saying that for odd-neutron states the electric moment should increase with the number of neutron holes in the configuration.

If the argument for the variation of $|M|^2$ with configuration complexity be accepted for the $E3$ transitions, it may be conversely argued that the constancy of $|M|^2$ for the $M4$ transitions also indicates relatively pure configurations. Analysis of the $M4$ cases makes this indeed appear so, for there are only two cases (Ag^{110} and In^{110}) which have $|M|^2$ values departing significantly from the mean, and these configurations are, in fact, the only ones which are not describable in terms of a single nucleon. It may well be, therefore, that large departures of $|M|^2$ values from the mean value for a particular multipole transition are associated either with departures of one or both of the states from single nucleon configurations or alternatively with actual mixing of multipole radiations as, for example, in the case of $M1$ and $E2$ transitions.

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The Inherent Half-Width of *K*-Conversion Lines

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IN 1951, one of us[1] found that the well-known F line (which is a K-conversion line) in the beta-spectrum of ThB was broader than the I line (L_I line). The half-widths in momentum were 0.14 and 0.10 percent. respectively. The observation was made in the semicircular beta-spectrometer constructed by Lindström and confirmed with the double focusing spectrometer.

Later, one of us measured the broadening effect in his permanent magnet beta-ray spectrometer of high resolving power[2]

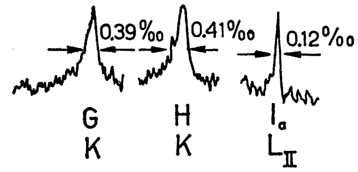

FIG. 1. Broadening effect of the K lines in the beta-spectrum of ThB. The relative half-widths are given in parts per thousand.

(half-width of the I_a line, which is an L_{II} line, only 1.2 parts in 10,000). The difference in half-width between the K and L lines was now found to be 3 parts in 10,000. In addition, the G and H lines, which also are K lines, were found to be 3 parts in 10,000 broader than the I_a line (Fig. 1). This broadening effect in momentum corresponds to about 80 ev in energy, and seems to be the same for all observed K-conversion lines in the β-spectrum of ThB.

Professor Kai Siegbahn has suggested the following explanation of the observed inherent line width of conversion lines: The fact that all the K-conversion lines investigated so far in the ThB spectrum have the same width indicates that the line broadening is essentially independent of the particular nuclear configuration of the states between which the transition takes place. The refilling of the empty place in the K shell, which occurs within a time which is very short compared to the life-time of the nuclear state, is accompanied mainly by the emission of $K\alpha$-radiation. The width of this radiation must, therefore, be expected to show up also in the width of the emitted K-electron line. An inspection of existing data[3] on $K\alpha$-line widths gives quantitative support to this view. For $Z=20$ to 40 the $K\alpha$-line widths increase from 1.7 to 6.8 ev. At $Z=74$ (W) the $K\alpha$-line width is already 42.5 ev, and a reasonable extrapolation to $Z=83$ yields here a line width of 70 ± 5 ev, in remarkably good agreement with the widths of the K-conversion lines reported above. The widths of the L-conversion lines should be expected to be about 10 ev, which is just too small to be observed at present.

The authors are indebted to Professor K. Siegbahn and Professor L. Hulthén for valuable discussions.

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Activation Energy for Fission*

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THE rate of spontaneous fission for even-even nuclides has a simple exponential dependence [1-3] on Z^2/A, and a plot of the logarithm of the "half-life" for this process *vs* Z^2/A (Fig. 1 of references 1 and 3) yields the relationship

$$T=10^{-21}\times10^{178-3.75Z^2/A}\text{ sec.} \qquad (1)$$

It is the purpose of this note to point out how this information can be related to the activation energy for fission and, hence, be correlated with the known information on slow neutron and photofission of heavy nuclides.

The barrier penetration probability for spontaneous fission has been shown to have the general form $10^{-k\Delta E}$, where ΔE is the energy deficit at the saddle point.[4,5] In particular Frankel and Metropolis[5] have derived for the liquid drop model the relationship

$$T=10^{-21}\times10^{7.85\Delta E}\text{ sec,} \qquad (2)$$

where ΔE is in Mev. On the assumption that their treatment for the rate process is essentially correct so that the general form of (2) is valid, even though the calculation of ΔE is not, as evidenced from the failure to account for experimental spontaneous fission