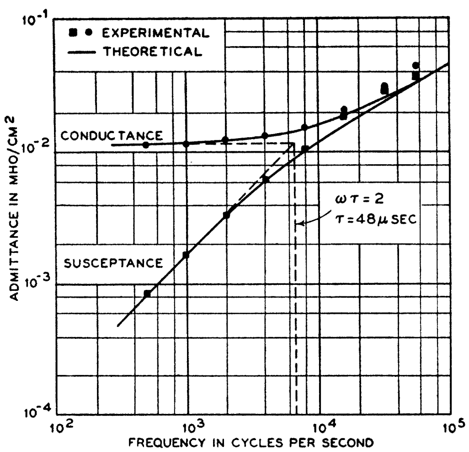

FIG. 3. Admittance of $p-n$ junction vs frequency.

A further check of the lifetime results was obtained from the impedance characteristic at zero bias, Fig. 3, which is in good agreement with the theoretical form based on diffusion theory.[2]

For reverse biases, the diffusion term is suppressed and a capacity corresponding to a concentration gradient in the transition region was found. From Eq. (2.46) of reference 2 a value of 10^{18} cm^{-4} was obtained.

The dependence of admittance on bias for intermediate biases has also been found to be in agreement with theory as has the effect of temperature. The dependence of the photo-response on wavelength has been used for the study of surface recombination, which is more important at the short wavelengths which do not penetrate deeply.

We are indebted to W. L. Bond and H. R. Moore for aid with the experimental techniques, and to J. A. Morton for encouragement in connection with the germanium single-crystal program.

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On the Isomerism of Kr^{83} and Xe^{133}

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IN previous communications[1,2] we have reported β-spectrometer investigations on electromagnetically separated Kr^{83m} and Xe^{133m} obtained in fission. By improvements in the experimental technique used we have obtained some new results which will be reported here.

Kr^{83m}.—Previously we had found[1] that only one γ-ray of energy 32.7 kev is associated with the isomeric transition in Kr^{83}. By the use of a thinner G-M window in the β-spectrometer (cutoff $\sim$5.0 kev) four additional electron lines of energies 7.3, 9.0, 10.5, and 12.1 kev were found (Fig. 1). All six electron lines have the same half-life $\sim$114 min. The first two lines are interpreted as the L and M lines of a γ-ray of energy 9.3 kev. The 10.5- and 12.2-kev lines have energies in agreement with the Auger lines K–$2L$ and K–L–M of Kr.

The $K2$ and $L2+M2$ lines of energies 17.7 and 30.5 kev are hardly absorbed in the G-M window. After making the window

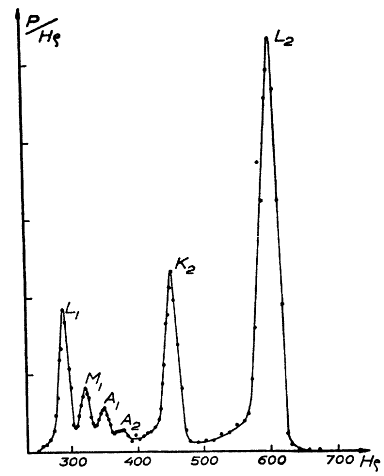

FIG. 1. β-spectrum of electromagnetically separated Kr^{83m} obtained in fission. Resolving power of the β-spectrometer $\sim$5 percent.

absorption correction, we obtain the following intensity relations:

$$N_{L1}/N_{M1}\sim 3, \tag{1}$$

$$N_{K2}/(N_{L2}+N_{M2})=0.35, \tag{2}$$

$$(N_{L1}+N_{M1})/(N_{K2}+N_{L2}+N_{M2})\sim 0.8. \tag{3}$$

From Eqs. (1) and (2) it must be concluded that the 32.2-kev (new energy value) γ-ray is responsible for the isomeric transition. Siegbahn and Thulin[3] have found a γ-ray of energy 27 kev in a separated Kr^{88} sample for which $N_K/(N_L+N_M)\sim 8$. This γ-ray, however, is not associated with an isomeric transition.

Because of the low energy both γ-rays should be almost completely converted. The intensity relation[3] is then in accordance with the assumption that the two soft γ-rays in Kr^{83m} are emitted in cascade.

The half-life 114±2 min (measured with the $L2+M2$ lines in the β-spectrometer) and the energy are consistent with the multipole order 4. The spin of the ground state of Kr^{83} is 9/2. It seems hard to explain the experiments without associating the lowest excited level in Kr^{83} with the spin 7/2 and the isomeric state with the spin $\frac{1}{2}$. Both the multipole order $l=4$ and the spin 7/2 are, however, in contradiction to the spin-orbit coupling nuclear theory. Because of the soft γ-energy 9.3 kev, the first excited state in Kr^{83} is most probably delayed. Delayed coincidence measurements

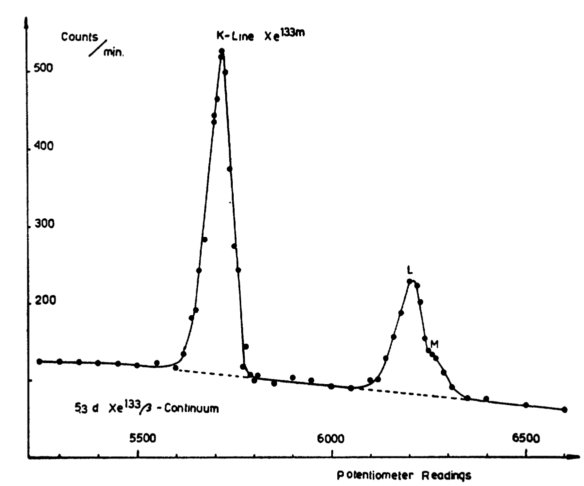

FIG. 2. Conversion lines of Xe^{133m} produced by neutron irradiation. Resolving power of the β-spectrometer $\sim$1 percent.

must be performed before it is possible to assign spins and parities unambiguously to the levels in Kr^{83}.

Xe^{133m}.—We have given previously[2] a tentative decay scheme of Xe^{133m} based on the fact that the half-life of the β-spectrum was of the same order as that of the conversion lines of a γ-ray of energy 232 kev associated with the isomeric transition. Recently, however, Ketelle, *et al.*,[4] have shown that the half-life of the conversion lines of the 232-kev γ-ray is about 2 days, which partly contradicts our decay scheme.

When Xe was irradiated in the Harwell pile, the intensity of Xe^{133m} was so strong even after electromagnetic separation that it was possible to investigate the sample with a resolving power of 1 percent in the double-focusing β-spectrometer.[5] In this way it was possible to obtain a rather accurate value of the half-life of Xe^{133m}, which was not possible in our previous investigation. The ratio of the intensities of Xe^{133m} and Xe^{133} was also larger in this irradiation than was the case in the fission sample. The half-life of Xe^{133m} was found to be 2.30 ± 0.08 days. Figure 2 shows the conversion lines of Xe^{133m}. The γ-energy of the isomeric transition is 232.8 ± 0.4 kev. Because of larger intensity and higher resolving power we can now give a more accurate value of N_K/N_L, which was found to be 2.90 ± 0.20.

On basis of the results of Ketelle, *et al.*, and of those obtained by us, it can be concluded that the β-spectrum of I^{133} is complex. I^{133} decays partly to the ground state of Xe^{133}, which decays with a half-life of 5.3 days to an 81-kev excited level in Cs^{133}. A smaller fraction of I^{133} decays to the 2.3-day isomeric state in Xe^{133}. With slow neutrons both the ground state and the isomeric state of Xe^{133} are produced.

The Xe sample was flown from England and was electromagnetically separated 14 hours after the pile irradiations were stopped. We wish to express our thanks to the Isotope Division at Harwell for their excellent service, which made the measurements on Xe^{133m} possible.

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Window Correction Curves and the Shape of Beta-Spectra*

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IN a recent letter on the beta-spectrum of Th^{233}, Bunker, Langer, and Moffat[1] conclude that their observed deficiency of low energy electrons cannot be due to source or counter window effects. The possibility of low energy defocusing in the spectrometer is suggested instead. However, it is the present writer's strong opinion that most, if not all, of the observed deficiency is due to the counter window alone. The argument follows.

The counter window used was 3.6 mg/cm² mica. This weight corresponds in total range to an energy[2] of only about 40 kev, yet as a half-thickness this same weight would correspond to about 200 kev. Further, for a window effect of only 10 percent the corresponding energy could be as high as 500 kev. All these conditions are compatible with the observed results.

To show the argument more quantitatively, we can assume that the entire deficiency below a linear Fermi plot is due to the counter window. From the observed Fermi plot, the window correction for the momentum distribution can then be estimated. This is shown by the broken curve in Fig. 1. The twelve solid curves have been taken both from the literature and from the author's unpublished work.[3] In general, the curves were determined by adding additional absorbers to some initial thickness of counter window; however, a few of the points for the thinner windows have been determined from observed deficiencies of low

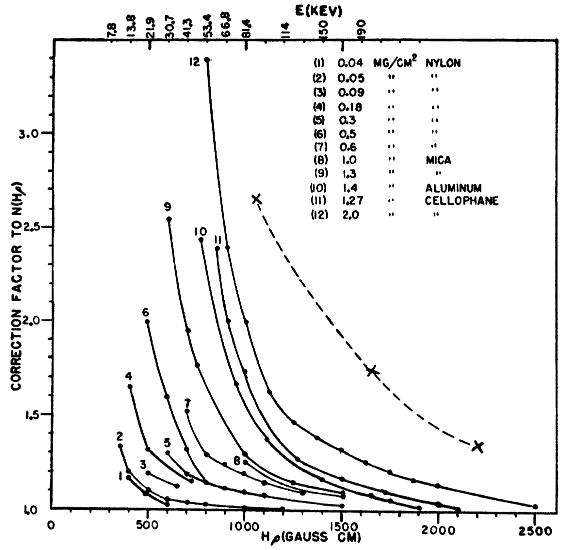

FIG. 1. The correction factors to $N(H\rho)$, the momentum plot, for various counter windows as indicated in the twelve solid curves. These results do not apply to corrections for effective source thicknesses, the scattering-in effects of the source having no analog in the counter window geometry.

energy electrons such as concern the present discussion. In view of the possibility of widely differing geometries for the various curves, they form a fairly consistent family.

Returning to the point in question, the broken line for the 3.6-mg/cm² mica window falls about where it should, relative to the thinner windows and the known range-energy relationships. There seems to be a lack of upward curvature at the low energy end. This can be interpreted as meaning that the assumption of a linear Fermi spectrum at low energies is incorrect; that, in fact, the spectrum of Th^{233} as measured, has an excess of low energy electrons instead of a deficiency. This conclusion is expected from the source thicknesses used, 16 and 0.6 mg/cm².

For more recent work on thin window corrections one can consult the work of Sturcken, Heller, and Weber,[4] and Cook and Chang.[5]

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The Change of Cosmic-Ray Neutron Intensity Following Solar Disturbances†*

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MEASUREMENTS of the changes of fast neutron intensity at 30,000 feet pressure altitude (312 g-cm^{-2} air) as a function of latitude have been obtained following the occurrence of solar disturbances. Though the results are preliminary, they may be significant. The neutron detectors were BF_3 proportional counters surrounded by paraffin and were transported by B-29 aircraft over the range of magnetic latitudes 40°N to 65°N. Flares were reported of importance 1, 2, and 3 during the period 25 to 31 October.[1] None of the flares occurred when the aircraft was in