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.

[1] Bergström, Thulin, and Andersson, Phys. Rev. **77**, 851 (1950).
[2] I. Bergström and S. Thulin, Phys. Rev. **79**, 538 (1950).
[3] K. Siegbahn and S. Thulin, Ark. Fysik. **2**, No. 22, 212 (1950).
[4] Ketelle, Brosi, and Zeldes, Phys. Rev. **80**, 485 (1950).
[5] Hedgran, Siegbahn and Svartholm, Proc. Roy. Soc. (London) **63**, 960 (1950).

Window Correction Curves and the Shape of Beta-Spectra*

D. SAXON
University of Wisconsin, Madison, Wisconsin
December 11, 1950

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

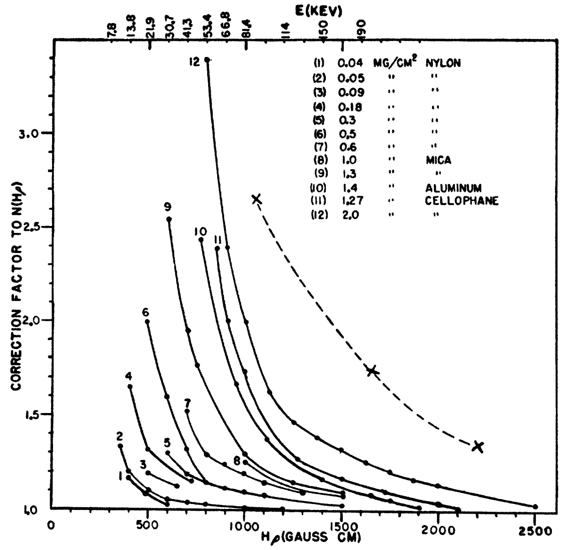

FIG. 1. The correction factors to $N(H\rho)$, the momentum plot, for various counter windows as indicated in the twelve solid curves. These results do not apply to corrections for effective source thicknesses, the scattering-in effects of the source having no analog in the counter window geometry.

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]

* This work was supported by the AEC and the Wisconsin Alumni Research Foundation.
[1] Bunker, Langer, and Moffat, Phys. Rev. **80**, 468 (1950).
[2] L. E. Glendenin, Nucleonics **2**, 12 (1948).
[3] Curves 1, 3, 4, 6, 7: D. Saxon (unpublished work). Curve 2: D. Saxon, Phys. Rev. **74**, 849 (1948). Curve 5: D. Saxon, Phys. Rev. **73**, 811 (1948). Curve 8: G. J. Neary, Proc. Roy. Soc. (London) **A175**, 71 (1940). T. H. Martin and A. A. Townsend, Proc. Roy. Soc. (London) **A170**, 190 (1939). Curve 9: Feather, Kyles, and Pringle, Proc. Phys. Soc. (London) **A61**, 466 (1948). Curve 10: A. Flammersfeld, Z. Physik **112**, 727 (1939). Curv 11: E. Haggstrom, Phys. Rev. **62**, 144 (1942). Curve 12: V. A. Nedzel (unpublished work).
[4] Sturcken, Heller, and Weber, Phys. Rev. **78**, 327 (1950).
[5] C. S. Cook and C. Chang, Phys. Rev. **79**, 244 (1950).

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

J. A. SIMPSON, JR.
Institute for Nuclear Studies, University of Chicago, Chicago, Illinois
December 18, 1950

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 the air. Some of the flares were followed by minor but distinct magnetic storms. For example, a flare of importance 2 occurred at 0002 local time October 26 and was followed by a magnetic storm with sudden commencement at 0430 local time October 27.[1,2] The flight course covered only a small range of longitudes, and corrections were made for this from earlier measurements of the longitude effect. (At $\lambda=40°$ this correction is -8.3 counts per minute per degree longitude near 112° W.)

The results of the measurements are shown in Fig. 1 with

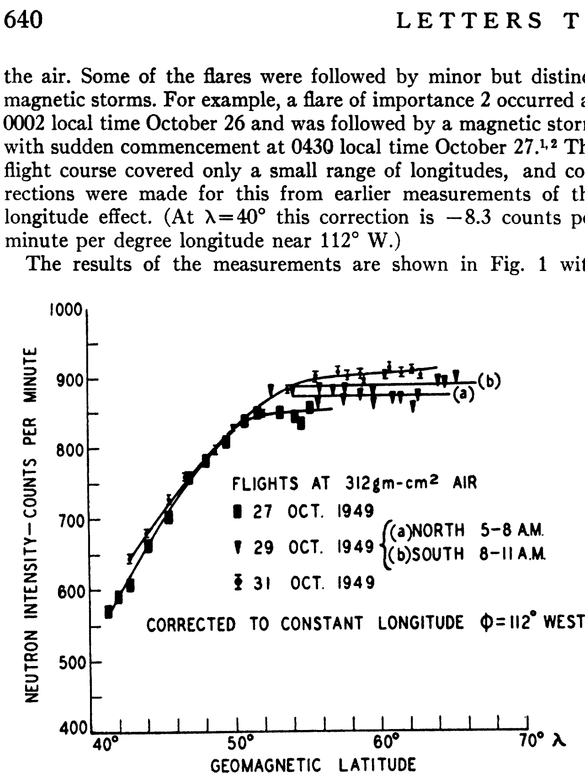

FIG. 1. The change of fast neutron intensity with geomagnetic latitude during solar activity and a magnetic storm. The maximum intensity on a quiet day is 660 events per minute. Counting rates for both quiet and disturbed day values were normalized at the geomagnetic equator.

standard deviations indicated for each point. These fast neutron intensity curves have five characteristics which are of interest in relation to the solar activity:

(1) The measured intensities above $\lambda=53°$ are all approximately 30 percent above the intensity of 660 events per minute observed on undisturbed days.[3] Also, the intensity increases with time during the period of the flights. Thus, the observations represent a continuing increase above normal quiet day intensity and not the recovery of the cosmic-ray intensity to normal which commonly occurs during a magnetic storm.

(2) If the "knee" of the latitude curve is arbitrarily defined as the intersection of the tangents to the approximately straight line portions of the latitude curve, it is seen that a northward shift of the knee takes place between October 27 and 31. This shift is 3° and lies outside the experimental errors. On undisturbed days this knee[3] is located at $\sim 50°$.

(3) Below $\lambda=51°$ there is no change or, at most, only a negligible change of intensity during the time interval 27 to 31 October. Due to the nature of the longitude corrections, the difference of intensity shown in the region of 42° may not be real.

(4) Above $\lambda=51°$ the intensity curves still appear to have positive slopes.

(5) Any assumed diurnal effect at 30,000 feet during the four day period was negligible, since in Fig. 1, (a) represents measurements in the local time interval 0500 to 0730 and (b) represents measurements from 0900 to 1130 local time.

The use of the neutron component as a sensitive indicator of changes in primary particle intensity and a comparison of neutron and charged particle intensity measurements will be published later.

The measurements in Fig. 1 show that beginning on October 27, additional primary particles with momenta lower than permitted by the apparent quiet day cut-off value at $\lambda \approx 50°$ arrive at the top of the atmosphere and that by October 31, particles, if singly charged, arrive with momenta as low as ~ 1 Bev/c corresponding to a cut off at $\lambda=56°$.

Either: (*I*) These low energy primaries are normally part of the cosmic radiation spectrum and a geo- or heliomagnetic field decreased during the period following solar activity to admit these particles, or (*II*) the low energy particles are added to the normal cosmic-ray flux during the disturbed period and are produced in the solar system.

The present measurements do not distinguish between these extreme alternatives. However, the absence of a pronounced shift in neutron intensity observed for $\lambda<50°$ N with time and the recent evidence against a strong helio dipole field make it difficult to support alternative (I). On the other hand, the approximate 30 percent increase of intensity above normal and the shift of the knee of the latitude curve northward are evidence for alternative (II).

The absence of a significant diurnal effect at 30,000 feet and the observed latitude dependence for the low energy primary particles arriving between $\lambda=51°$ and $\lambda=56°$ indicate that these low energy particles may be approximately isotropically distributed in space and are mostly charged particles.

The writer wishes to thank E. Hungerford for recording the data and to thank Major W. Gustafson, the officers, and crew of the Air Forces B-29 for their cooperation and skill in flying the aircraft.

† Reported at meeting Am. Phys. Soc. June, 1950, Phys. Rev. 80, 135 (1950).

* Assisted by the joint program of the ONR and AEC.

[1] Data kindly compiled and supplied by A. H. Shapley of the Central Radio Propagation Laboratory, National Bureau of Standards.

[2] J. Geophys. Research 55, 94 (1950).

[3] J. A. Simpson, Jr., Proc. of the Echo Lake Conference on Cosmic Rays, 1949.

The High Energy Beta-Spectrum of Sc^{46}

FRED T. PORTER AND C. SHARP COOK
Physics Department, Washington University, St. Louis, Missouri*
December 26, 1950

In a recent study[1] of the disintegration of Ti^{45} a small amount of Sc^{46} was found as an impurity. A cloud-chamber histogram of the beta-particle radiations from this impurity clearly showed the lower energy group but failed to identify the higher energy group previously reported by Peacock and Wilkinson.[2] This has led to the further investigation of the disintegration of Sc^{46} herein described.

For this study three beta-ray spectrometer sources were prepared from an Oak Ridge sample of Sc^{46}. One was prepared as received with no further chemical separation. The second was separated chemically in accordance with the procedures outlined by Noyes and Bray[3] with special precautions being made to remove the scandium from any possible phosphorus or strontium

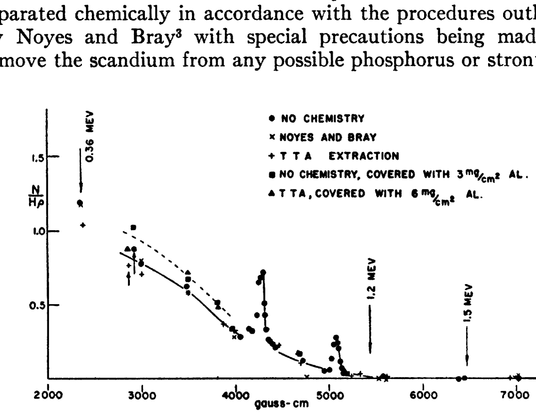

FIG. 1. Momentum spectrum of electrons, from sources of Sc^{46}, whose energies lie in the region higher than the high intensity, low energy beta-ray group. The solid line represents the best fit for the bare sources. Dashed line represents best fit when sources are covered with an aluminum foil whose surface density (in mg/cm²) is approximately equal to that of the source. The significance of this experiment is discussed in the text. The two peaks are the internal conversion lines for the 0.89- and the 1.12-Mev gamma-rays.