A striking change in intensity was observed for the band identified as CO when the solar spectrum was observed on different days. On April 25, May 26, and May 31, 1948 this band was intense; for example, the line noted R_3 by Lagemann, Nielsen, and Dickey[1] had a central absorption of about 50 percent on a spectrogram taken at 4 P.M. on May 31. On records obtained on June 16 and 17, 1948 the CO band was weak; for example, the central absorption of R_3 was observed to be about 15 percent on a spectrogram taken at 9 A.M. on June 16. For the same days an intensity change of the same order was also noted, in the same spectral region for several lines due to CO_2, while no appreciable change was observed for the 4.5μ band of N_2O. Hence, it may be concluded that the absorption by CO and CO_2 was enhanced in the atmosphere of Columbus, Ohio during April and May, 1948. CO may also be expected in the solar atmosphere. However, it is believed that the solar contribution to the band observed at 4.7μ is negligible.

Details on our observations of the solar spectrum will be published in the Astrophysical Journal.

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** Now at the Institut d'Astrophysique, University of Liege, Belgium.

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Shape of the Beta-Spectrum of the Forbidden Transition of Yttrium 91

LAWRENCE M. LANGER AND H. CLAY PRICE, JR.
Indiana University, Bloomington, Indiana
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THE momentum distribution of the negatrons emitted in the 57-day disintegration of $_{39}Y^{91}$ has been determined as being different from the spectrum expected for an allowed transition. The exact shape of the spectrum gives confirmation for the shell structure model of the nucleus and for the validity of Gamow-Teller selection rules.

The measurements were made in the large, high resolution, magnetic spectrometer.[1] The activity, obtained carrier-free from Oak Ridge, was further separated from the alkaline earths. The source had a thickness of about 0.15 mg/cm^2 and was uniformly deposited on a plastic (LC-600) backing of 0.02 mg/cm^2 and held at ground potential. Both mica and thin Zapon window counters were used in appropriate and overlapping energy regions, and the data were adjusted to the same intensity level at one point.

Figure 1 shows a conventional Fermi plot of the data. The Coulomb function, F_B was evaluated by means of Bethe's approximation,[2] which was found to be in very good agreement with that calculated by expanding the complex Γ-function. It is obvious from Fig. 1 that the Fermi plot is not the straight line which is characteristic of allowed transitions and which has also been found for many presumably forbidden transitions.[3] It is instead, definitely curved, being convex toward the energy axis near the end point.[4] The maximum energy release is 1.53 Mev.

According to its "comparative lifetime" ($f=4.7\times10^8$), this transition would be empirically classified as twice-forbidden. However, Feenberg and Hammack's[5] analysis of the shell structure in nuclei leads to the prediction of a spin change of 2 units, together with a parity change. Such a transition is theoretically classified as once-forbidden under Gamow-Teller selection rules. According to the theory of forbidden spectra,[6] it also has the special property that only one type of nuclear matrix element fails to vanish for it. This means that a unique energy dependence is predicted, differing from the allowed shape by the factor

$$a\sim[(W^2-1)+(W_0-W)^2],$$

where W is the electron's energy in mc^2 units, and $W_0=4.01$ is the end point.

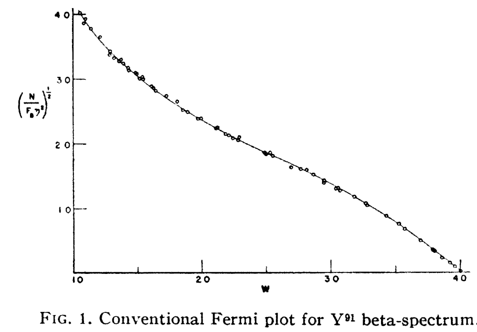

FIG. 1. Conventional Fermi plot for Y^{91} beta-spectrum.

When the ordinates of the curve in Fig. 1 are divided by a, a straight line should be obtained if the above outlined theory is correct. The actual result is shown in Fig. 2. The striking agreement with the theoretical expectations furnishes good evidence for the reliability of the shell model. It also provides the first piece of evidence for the validity of the Gamow-Teller rules based on a spectrum shape.

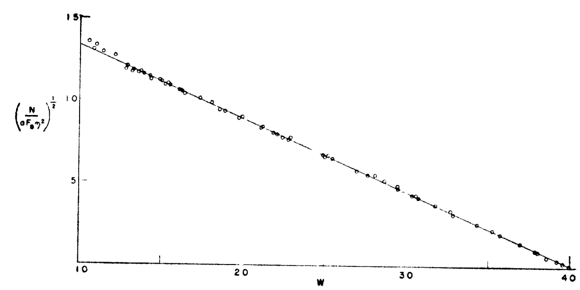

FIG. 2. Forbidden Fermi plot for Y^{91} beta-spectrum. Here the ordinates are divided by the additional factor,

$$a^{\frac{1}{2}}\sim[(W^2-1)+(W_0-W)^2]^{\frac{1}{2}}.$$

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Threshold Energy for Meson Production

WALTER H. BARKAS
Office of Naval Research, San Francisco, California
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THE threshold energy for the production of mesons by colliding systems of elementary particles can be calculated by a simple relativistic extension of the principles employed in deducing the "Q" and the threshold beam energy for ordinary nuclear reactions. This calculation does not re-