LETTERS TO THE EDITORS

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β-Radiation from Active Phosphorus and Sodium

IN order to investigate the β-radiation from active phosphorus, phosphorus pentoxide was irradiated with 5 MeV. deutrons (current approximately 40 μ A.) in the cyclotron of this Institute. A very small fraction of the sample (about 0·01 mC.) in the form of $Mg_2P_2O_7$ was placed between two foils of about 0·02 μ thickness, the preparation forming a narrow strip 7 mm. × 0·5 mm. It was then introduced into a β-spectrograph of the lens type[1] with high intensity and good resolution (in this case 1·9 per cent), and provided with a very thin foil (0·2 μ) in front of the Geiger-Müller counter. To obtain the true distribution curve, the number of particles counted must be divided by the corresponding value of $H\rho$. The spectrograph was calibrated by using the I line of thorium B, the energy of which had been determined as $H\rho = 1750$ in the semicircular spectrograph of the Institute.

If we plot $\left(\frac{N}{f}\right)^{1/2}$ against $\sqrt{1+\eta^2}$ $\left[\text{where } f(z,\eta) = \eta^2 \cdot \frac{2\pi y}{1-e^{-2\pi y}};\ y = z.\frac{\sqrt{1+\eta^2}}{137\eta};\ \eta = \frac{H\rho}{1700}\right]$ we should, according to Fermi's formula of β spectra, obtain a straight line. The Fermi diagram obtained is seen in Fig. 1. Evidently the curves are quite straight except at lower energies. For energies where $\sqrt{1+\eta^2}$ is less than 2, the experimental curves give more particles than are predicted by the Fermi formula. It is possible that this can be explained by the occurrence of scattering in the backing foil or more probably in the source itself, a process which should undoubtedly give rise to low-energy electrons. In view, however, of the thinness of the foils and narrowness of the source, this can scarcely account for the very pronounced excess of low-energy electrons in comparison with the theoretical number. According to our conceptions of the β-emission by phosphorus, this constitutes a so-called 'forbidden transition'. The Fermi formula is rather developed on the assumption of a permitted transition and, according to Fig. 1, probably cannot explain the energy distribution in this case.

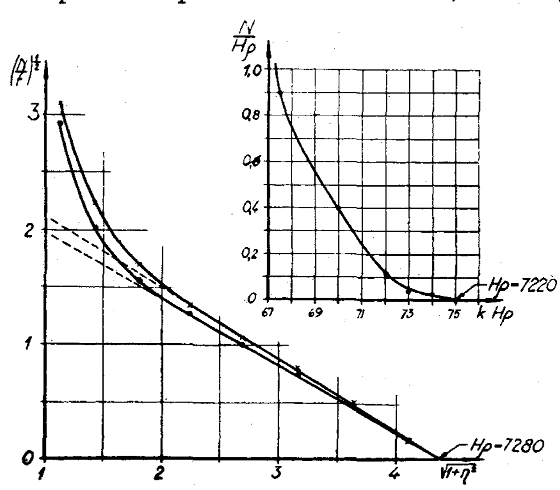

FIG. 1.

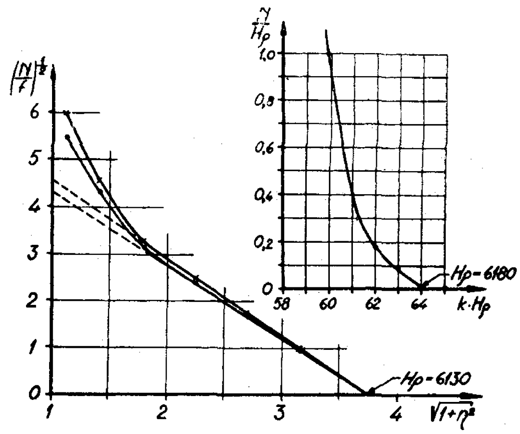

FIG. 2.

The straight part of the Fermi curve cuts the axis at $H\rho = 7280$, which fits well with the direct determination of the upper limit (corrected for the finite power of resolution) $H\rho = 7220$ or 1·71 ± 0·02 MeV., which is marked in Fig. 1. The value for the upper limit seems to be in good agreement with determinations by Lawson[2] ($H\rho = 7210$) and Lyman[3] ($H\rho = 7150$) made by the semicircular method.

With sodium, ^{24}Na, a β-radiation is emitted which also corresponds to a forbidden transition. To study this radiation, sodium hydroxide was irradiated in the cyclotron for some hours and a very small fraction of the sample in the form of sodium chloride was treated as before and introduced into the β-spectrograph. After correction for the falling off of the intensity due to the disintegration ($T = 14·8$ h.) the two Fermi curves in Fig. 2 were obtained, where the upper limit is also marked. Apparently the Fermi curve is similar in shape to that for phosphorus, with more low-energy electrons than might be expected from the theory of permitted transitions. When $\sqrt{1+\eta^2}$ is greater than 1·8, the curve is, however, a straight line and cuts the axis at $H\rho = 6130$, where the direct determination gives $H\rho = 6180$ or 1·41 ± 0·02 MeV. This value agrees well with the value obtained by Lawson[2], $H\rho = 6150$, but disagrees with that obtained by Kurie, Richardson and Paxton[4] with the cloud chamber (1·7 MeV.).

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[1] Siegbahn, Kai, *Ark. f. Mat., Astr. o. Fysik*, **30** A, No. 1 (1943).
[2] Lawson, J. L., *Phys. Rev.*, **56**, 131 (1939).
[3] Lyman, E., *Phys. Rev.*, **51**, 1 (1937).
[4] Kurie, Richardson and Paxton, *Phys. Rev.*, **49**, 368 (1936).

Nuclear Disintegrations Produced by Cosmic Rays

SINHA has recently published[1] a remarkable cloud-chamber photograph of a four-pronged disintegration of an oxygen nucleus produced by a neutral cosmic ray particle. From the appearance of the tracks, he concludes that the two outer ones (tracks 1 and 4) are due to particles of a charge higher than that of an α-particle. The two inner tracks (2 and 3) appear to be due to doubly charged particles. Their end portions are crossed by thin ionization tracks. After