effects. Figure 3 shows the effect of film temperature on absorption for two different films.

These studies of BaO films confirm the fact that the optical absorption threshold coincides with the threshold for photoconductivity[1] at about 3.8 ev. The magnitude of the absorption constant is so large that the absorption process cannot be attributed to impurity centers in the crystal lattice. Temperature variation of the absorption constant from room temperature down to about $-150°C$ is small but appears to indicate a slight accenting of the structure in the absorption constant curve near 2900A. The absorption constant does not change appreciably for variation of light intensity by a factor of 20.

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* Charles A. Coffin Fellow, 1948–49.
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## Beta-Spectrum of Praeseodymium 143

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PRAESEODYMIUM 143, a radioactive daughter substance of $Ce^{143}$ which has a half-life of 33 hr., can be produced either by ordinary nuclear reactions,[1] such as $Ce^{142}(d, p)Ce^{143}$ and $Ce^{142}(n, \gamma)Ce^{143}$, or by nuclear fission process. $Pr^{143}$ emits beta-particles with half-life determinations varying from 12.7 to 14.2 days,[1] and it does not emit gamma-rays. The beta-spectrum end point, investigated by means of aluminum absorption methods and estimated by Feather's empirical method, has been reported in the range between 0.83 and 1.0 Mev.[1] Recent spectrometer measurements[2] with sources containing a mixture of $Ce^{141}$ and $Pr^{143}$ yield straight line Fermi plots of the beta-spectrum from 565 kev, the end point of the $Ce^{141}$ spectrum, to the end point of the $Pr^{143}$ spectrum. The upper limit to the energy of the $Pr^{143}$ spectrum is reported as $920\pm10$ kev by Ter-Pogossian *et al.* and as $930\pm20$ kev by Shepherd.[2]

Recently, a strong source of $Pr^{143}$ of very high specific activity was obtained from the Isotopes Branch of the AEC at Oak Ridge in the form of a PrCl solution. This high specific activity material is suitable for beta-spectrum investigation in a beta-ray spectrometer. The $Pr^{143}$ source was prepared by depositing, on a collodion film of 10 $\mu g/cm^2$ thickness, a drop of PrCl solution to which an extremely small quantity of detergent (Anotrox X) had been added. The total amount of solid contained in the source is around 20 $\mu g$ and is spread over a circular area of 0.5 $cm^2$.

The Columbia solenoid magnetic spectrometer was used in this investigation. The resolution used was three percent defined as the full width at half-intensity. Both Nylon and collodion window counters were used to cover the upper and lower energy range of the spectrum. In plotting the Fermi plot, the explicit form[3] of the relativistic Coulomb factor

$$F(Z,\epsilon)\approx\frac{2\pi\delta}{1-\rho^{-2\pi\delta}}[\epsilon^2(1+4\gamma^2)-1]^S,$$

where $S=(1-\gamma^2)^{\frac{1}{2}}-1$, $\gamma=Z\alpha=Z/137$, $\delta=\gamma(\epsilon/\eta)$ was used.

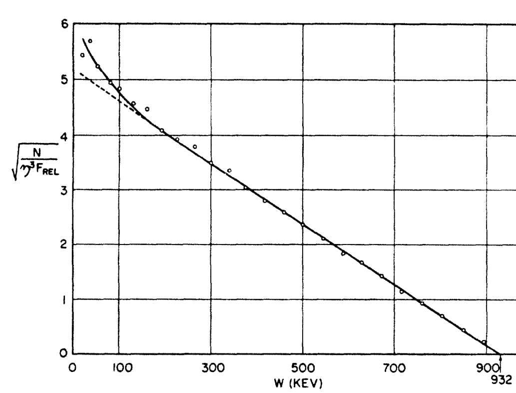


FIG. 1. Fermi plot of $Pr^{143}$ beta-spectrum.

This approximation is accurate to about 0.5 percent in this case. The Fermi plot thus obtained gives a straight line from the upper energy limit down to 170 kev (Fig. 1). Below 170 kev, the Fermi plot starts to deviate upward very gradually, which could be attributed to local variations in source thickness due to non-uniformity. The upper energy limit given by the intercept of the straight line in the Fermi plot is $932\pm2$ kev. This spectrum was investigated in the spectrometer many times, using sources from two different shipments. The results were reproducible and consistent.

Other $Pr^{143}$ sources were made from the same solutions, and the half-life was continuously followed in a G-M counter over a period of ten weeks. The decay curve (Fig. 2) is definitely a straight line on a semilogarithmic plot and gives a value of $13.7\pm0.1$ days for the half-life.

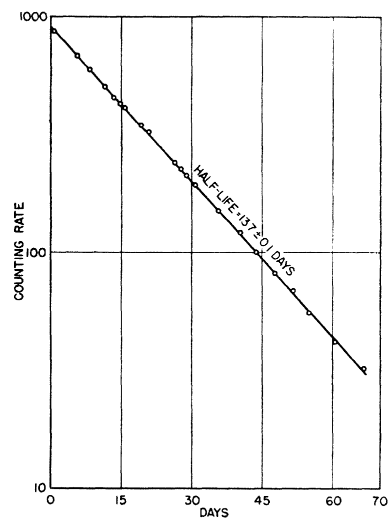


FIG. 2. Decay curve of $Pr^{143}$.

The *ft* value calculated is $1.3\times10^7$. For such a high atomic number ($Z=59$), the beta-radiation from $Pr^{143}$ should be classified empirically into the group of first- or second-forbidden transitions. Nevertheless, the shape of the spectrum follows the allowed shape as in the many other cases where the *ft* value indicates a highly forbidden transition.

We should like to thank the United States AEC which aided materially in the performance of this research.

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## The Beta-Spectrum of $_{61}Pm^{147}$

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HIGH specific activity $Pm^{147}$ has recently become available from the Isotopes Division of the AEC at Oak Ridge where it is made as a fission product. This high specific activity material, when used in the high transmission solenoidal focusing $\beta$-ray spectrometer, makes it possible to investigate its beta-spectrum using sources less than 30 $\mu g/cm^2$ thick.