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MEAN ENERGY OF THE β -SPECTRUM OF Pr^{142}

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THE beta spectrum of Pr^{142} is complex and consists of a hard component with an end-point energy of 2165 keV[1] corresponding to a unique first-forbidden transition to the ground state of the product nucleus, and a soft component with $E_{max} \sim 590$ keV and an intensity of 3.7%[2]. This component corresponds to a transition to the first and, apparently, the single excited level of Nd^{142} at an energy of 1572 keV[1,3].

No specific experimental determinations of the mean β-spectrum energy $\bar{E}_\beta$ for Pr^{142} have been made. The values computed by us from the distribution curves given by Pohm et al[1] and Jensen et al[4] are 805 and 870 keV, respectively. The error in these values is at least 5—10%. More exact values of $\bar{E}_\beta$ can be obtained from the calorimetric method, which is not affected by factors such as electron scattering in the source and in the apparatus, diffusion of radioactive atoms into the substrate material, electrical charging of the latter, etc. We give below the results of calorimetric measurements of $\bar{E}_\beta$ for Pr^{142}, performed with the technique previously described by us[5]. Two series of measurements were made with different samples. For the mean energy of the combined β-spectra of Pr^{142} we obtained the value 701 ± 16 keV, and for the main hard component of the spectrum, 814 ± 16 keV. The latter value was compared with theoretical values of $\bar{E}_\beta$ computed using the following form factors:

1) $S = 1$ (allowed spectrum);
2) $S = \alpha = (w^2 - 1) + (w_0 - w)^2$;
3) $S_1^2 = (w_0 - w)^2 L_0 + 9L_1$ [6];
4) $S_\lambda = (w^2 - 1) + \lambda(w_0 - w)^2$ [7]

and equal respectively to 831.7, 847.3, 821.3, and 820.1 keV. It is evident from the values listed that the mean energy of the Pr^{142} β-spectrum depends only slightly on the choice of form factor and is close to the value for an allowed spectrum. Nevertheless we can draw the conclusion that even for hard β-spectra with end-point energies exceeding 2 MeV, and $Z \sim 60$, use in the spectrum analysis of the form factor α, which does not take into account the influence of the Coulomb field of the nucleus, is too crude an approximation. The experimental value of $\bar{E}_\beta$ obtained by us is also closest to the values obtained with the form factors S_1^2 and S_λ, and the difference between it and the value computed with the form factor α exceeds the experimental error.

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