Disintegration of Ce¹⁴³ and Pr¹⁴³

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PILE-IRRADIATED "Speckpure" Ce was studied, using mainly spectrometer and coincidence techniques. The β-spectrum consisted of several electron peaks superimposed on a complex continuous β-spectrum. No measurable number of positrons could be observed in the spectrometer[1] using a positron baffle. The photospectrum taken in the same spectrometer showed several photolines. Table I gives the energies of the internal conversion

TABLE I. Energies of internal conversion electrons and photons from Ce¹⁴³ and Ce¹⁴¹.

Energy of the peak kev	Nature of the peak	Energy of the photons kev	Parent isotope
15.7 ±0.5	K-internal conversion	56.8 ±1	Ce¹⁴³
49.2 ±1	L-internal conversion		
27.7 ±1	(K −2L) Auger line	35.4 ±1	
34.8 ±1	(K −L −M) Auger line		
102 ±1.5	K-internal conversion		
137 ±1	L-internal conversion	143 ±2	Ce¹⁴¹
55.7 ±1	K-photoline		
125 ±2	L-photoline		
244.7 ±2	K-internal conversion		
278.5 ±1.5	L-internal conversion	283 ±4	Ce¹⁴³
197.2 ±1	K-photoline		
263.2 ±3	L-photoline		
608.6 ±4	K-internal conversion	649 ±4	Ce¹⁴³
559.2 ±4	K-photoline		
617.4 ±5	K-photoline	705 ±5	Ce¹⁴³

and photoelectron peaks observed in the β- and γ-spectra and the corresponding energies of the photons concerned. All the lines attributed to Ce¹⁴³ in Table I are found to decay with the 33-hour half-life within the statistical errors.

Fermi analysis of the β-spectrum recorded within 24 hours after the sample was taken out of the pile, showed as many as five components and an indication of a sixth component. They are 1.37±0.01 Mev (Ce¹⁴³), 1.09±0.02 Mev (Ce¹⁴³), 0.86 Mev (Pr¹⁴³), 0.57 Mev (Ce¹⁴¹), 0.42 Mev (Ce¹⁴¹), and 0.37 Mev? (Ce¹⁴³).

Fermi analysis of the β-spectrum taken after eighteen days' decay showed that the first two components 1.37 and 1.09 Mev had disappeared and the maximum energy of the strongest β in this spectrum was 0.915±0.015 Mev corresponding to the β_{max} of Pr¹⁴³ reported by Feldman et al.[2] The presence of the intense soft β of Ce¹⁴¹ makes it almost impossible to resolve the probable 370-kev β of Ce¹⁴³.

On the basis that all the Fermi plots are linear, it was found that the 1.09-Mev β is 1.4 times more intense than the 1.37-Mev β. An estimate of the intensity of the γ-rays from the photospectrum showed that the 705- and the 649-kev γ-rays are of almost equal intensity, while the 283-kev γ-ray is about 4.5 times more intense. The intensities given in the disintegration scheme are based on these estimates and are very approximate.

Comparison of the intensity of the Auger lines to that of the K-conversion lines in the β-spectrum showed that the Auger electrons are ~12 percent of the K-lines. This is precisely what is to be expected for this element of high Z value, and it is not necessary to assume the presence of the K-capture Ce¹³⁷ (36-hour half-life) in our samples. Probably the slow neutron capture cross section for Ce¹³⁶ is very small, or Ce¹³⁶ is less abundant than it is thought to be.

On the basis of the estimates of the multipolarity of the γ-rays from the internal conversion lines, the ft-value considerations of the β-transitions and the spin-orbit coupling model[3,4] of the

⁵⁸Ce¹⁴³   ⁵⁹Pr¹⁴³

Odd 2f₅/₂ [2f₇/₂ 1h₉/₂]

Even 2d₅/₂

Even 1g₇/₂
Even 2d₃/₂

Even 1g₇/₂

Odd 1h₉/₂

⁶⁰Nd¹⁴³

$\beta_1' = 0.37$ Mev
$\beta_2 = 1.09 \pm 0.02$ "
$\beta_3 = 1.37 \pm 0.01$ "
$\beta_4 = 0.915 \pm 0.015$ "

$\gamma_1 = 0.705 \pm 0.005$ "
$\gamma_2 = 0.649 \pm 0.004$ "
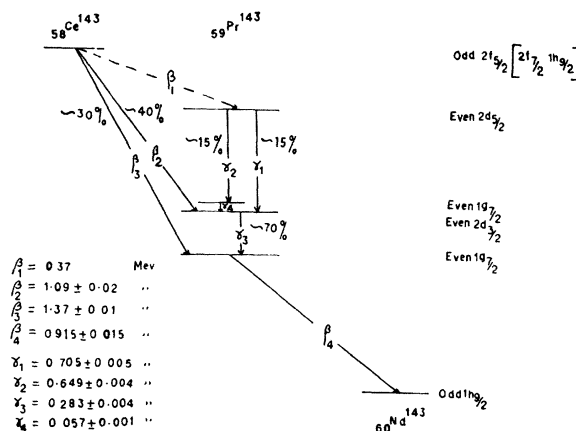$\gamma_3 = 0.283 \pm 0.004$ "
$\gamma_4 = 0.057 \pm 0.001$ "

FIG. 1. Proposed decay scheme for Ce¹⁴³ and Pr¹⁴³.

nucleus, the term schemes for the various levels in the disintegration scheme are suggested in Fig. 1.

Incidentally, from our measurements Ce¹⁴¹ appears to emit a single γ-ray of energy 143±2 kev besides the β-rays, and this is in agreement with the observations of Freedman et al.[5]

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A detailed paper will appear in *Arkiv för Fysik*.

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On the Ratio of the Nuclear Magnetic and Electric Quadrupole Interactions for Atomic Cl³⁵ and Cl³⁷

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THE hyperfine structure of the $^2P_{3/2}$ state of the stable chlorine isotopes has been re-examined by the atomic-beam radiofrequency magnetic resonance method. The new measurements disagree with the work of Davis, Feld, Zabel, and Zacharias[1] and resolve the discrepancy that has existed between the ratio of the nuclear magnetic dipole interaction constants, a^{35}/a^{37}, and the ratio of the nuclear magnetic moments μ^{35}/μ^{37} as measured directly in nuclear induction experiments.[2,3] The new results for the ratio of the quadrupole interaction constants, b^{35}/b^{37}, agree with the recent measurements, by Livingston, of the ratio of the chlorine quadrupole interaction constants in solid crystals.[4]

Figure 1 of reference 1 shows the energy levels of an atom with $I=J=\frac{3}{2}$ in an external magnetic field. Deviations from the interval rule may be introduced by the interaction of the nuclear electric quadrupole moment with the gradient of the electric field due to the electrons, by a nuclear magnetic octupole interaction, and by perturbations between adjacent fine structure levels with the same value of the total angular momentum F.[5] Theoretically, the latter two are much smaller, but our data indicate that one or both may be present; however, this does not affect the values of a and b given below. A precision experiment is under way to determine the magnitude of such effects. An experiment is also in progress to measure the ratio a^{35}/a^{37} in the metastable $J=\frac{1}{2}$ state.[6]

The experimental procedure was generally similar to that of D. F. Z. Z.,[1] and only a few details will be given here. Beams con-