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Fig. 2. Decay curve of lanthanum isotopes. 1 $-T_1 = 4.3$ hr; 2 $-T_2 = 1.1$ hr; 3 $-T_3 = 20$ min.

Figure 2: Fig. 2. Decay curve of lanthanum isotopes. 1 $-T_1 = 4.3$ hr; 2 $-T_2 = 1.1$ hr; 3 $-T_3 = 20$ min.

Abstract

Full Text

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PHYSICS

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NEW NEUTRON-DEFICIENT ISOTOPES OF RARE-EARTH ELEMENTS OF THE CERIUM GROUP

(Presented by Academician A. P. Vinogradov, 27 VIII 1962)

Earlier (¹⁻³), the formation during the spallation of samarium by high-energy protons of new neutron-deficient isotopes Eu^{143} , Sm^{141} , $Sm^?$ (possibly an isomer, $T \sim 9$ hr), $Pm^{138?}$, Pr^{134} , and La^{129} was suggested. In the present work, the half-lives of Pr^{134} and La^{129} have been refined, and the search for new light isotopes of rare-earth elements of the cerium group has been continued. Interest in this group of isotopes is due to the discovery of a new region of deformed nuclei, for which $50 < N < 82$ (⁴).

Fig. 1. Change in the activity of daughter Ce^{134} as a function of time (separation was carried out after 1 hr)

Fig. 2. Decay curve of lanthanum isotopes.
1 $-T_1 = 4.3$ hr; 2 $-T_2 = 1.1$ hr; 3 $-T_3 = 20$ min.

As the target, praseodymium oxide with a content of Pr_6O_{11} of 99.96% was used; it was irradiated with protons of energy 660 MeV on the synchrocyclotron of the Joint Institute for Nuclear Research. Fractions of rare-earth elements were obtained by the chromatographic method, and cerium was isolated in a

radiochemically pure state by extraction of $H_2[Ce(NO_3)_6]$ with diethyl ether from 8-10 *N* nitric acid. The time for separating cerium radioisotopes by the chromatographic method was 2-2.5 hr, and by extraction about 1.5 hr. The samples were measured on an MTS-20 end-window counter and on a scintillation γ -spectrometer with a 100-channel pulse-height analyzer.

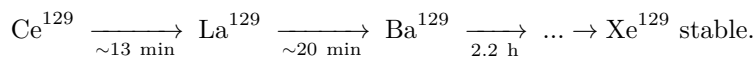
The half-life of Pr^{134} was determined by systematic separation from the irradiated praseodymium of daughter Ce^{134} with $T = 3.1$ days every 30-60 min.

From the course of the time dependence of the change in activity of the daughter Ce^{134} (number of separations), shown in Fig. 1, it follows that the half-life of Pr^{134} is 36 min. The average value, determined from 4 experiments, is 40 ± 7 min. One of the components of the γ -line with $E_\gamma \simeq 720$ keV, found in the praseodymium fraction, has the same half-life. It is possible that γ -rays of this energy appear in the decay of the isotope Pr^{134} .

Analysis of the decay curve of the activity of the lanthanum fraction (Fig. 2) makes it possible to identify the following short-lived isotopes: $La^{132,133}$ with $T = 4.3$ h, La^{131} with $T = 1.1$ h, and a new isotope with $T \sim 20$ min, apparently with $A = 129$.

The mass number of the lanthanum isotope with $T \sim 20$ min was established from the daughter isotope Ba^{129} with $T = 2.1-2.4$ h⁽⁵⁻⁷⁾. The half-life of La^{129} , determined imprecisely because of the low activity of Ba^{129} , proved to be ~ 24 min.

In the γ -spectrum of the cerium fraction, γ -rays with energy 80 ± 15 keV were found, and in the lanthanum fraction—with $E_\gamma = 115 \pm 20$ keV and $E_\gamma = 175 \pm 15$ keV and a half-life of 2.2 h, which may be attributed to Ba^{129} ^(6,7). In addition, activity with $T \sim 13$ min was found in the cerium fraction, as well as γ -radiation with energies 80 ± 15 , 315 ± 20 , and 745 ± 20 keV, whose intensity decreased with $T \sim 15$ min. On the basis of these data one may suppose that in the lanthanum and cerium fractions we detect individual members of the chain of isobars with $A = 129$:



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