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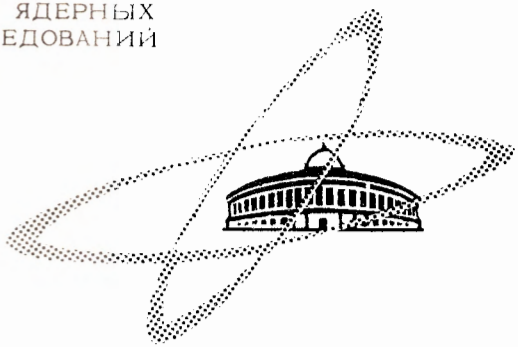

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INVESTIGATION OF THE α-SPECTRUM OF Gd^{149}

ЯФ, 1965, т.2, в2, с 201-203.

1964

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Submitted to Physics Letters

The α- decay of Gd^{149} was investigated by Hoff, Rasmussen, Thompson[1] and Rasmussen, Thompson, Ghiorso[2], who got $3,00 \pm 0.15$ MeV for the energy of α -particles, and $4 \cdot 10^3$ years (within a multiplying factor 3) for the α -partial half-life from $\frac{\alpha}{X-ray}$ ratio measurements. The aim of the present work was to make a more accurate measurement of the α -particle energy, and to determine the α -partial half-life by another method.

The measurements were carried out with a semiconductor α -spectrometer, which consisted of Si semiconductor detector, low noise, charge sensitive amplifier system, and a 128-channel pulse-height analyser. In most cases we used a 5 mm^2 effective surface detector of 23 keV resolution (full width at half-maximum) for the α -lines of ThC about 6 MeV.

During the measurements the temperature of the detector was stabilized within ± 0.15 C^o, and the variation of the room temperature did not exceed ± 1 C^o. The stability and linearity of the spectrometer were often checked by signals of a precision mercury relay pulse generator.

For calibration we used the main α -lines of Gd^{148}, Po^{210} and ThC.

The Gd sources were obtained by spallation of Ta with 660 MeV protons in the synchro-cyclotron of JINR. The rare earth elements were separated from each other by chromatographic method. After separation the Gd-fraction was electrolytically transfered on a carefully polished Pt disk of 13 mm in diameter[3].

We have taken 13 α -spectra of two different Gd sources. The data of the sources are to be seen in Table 1.

Table 1. The data of Gd sources

№ of sources	Irradiation time of Ta targets	First Second separation was made after the end of irradiation	The first spectrum measurements
1	90 min	165 min 5 days	Immediately after second separation
2	30 min	85 min 4 days	"

The α- decay of Gd sources was followed for 3 weeks.

Fig. 1. shows a characteristic α - spectrum of the Gd fraction.

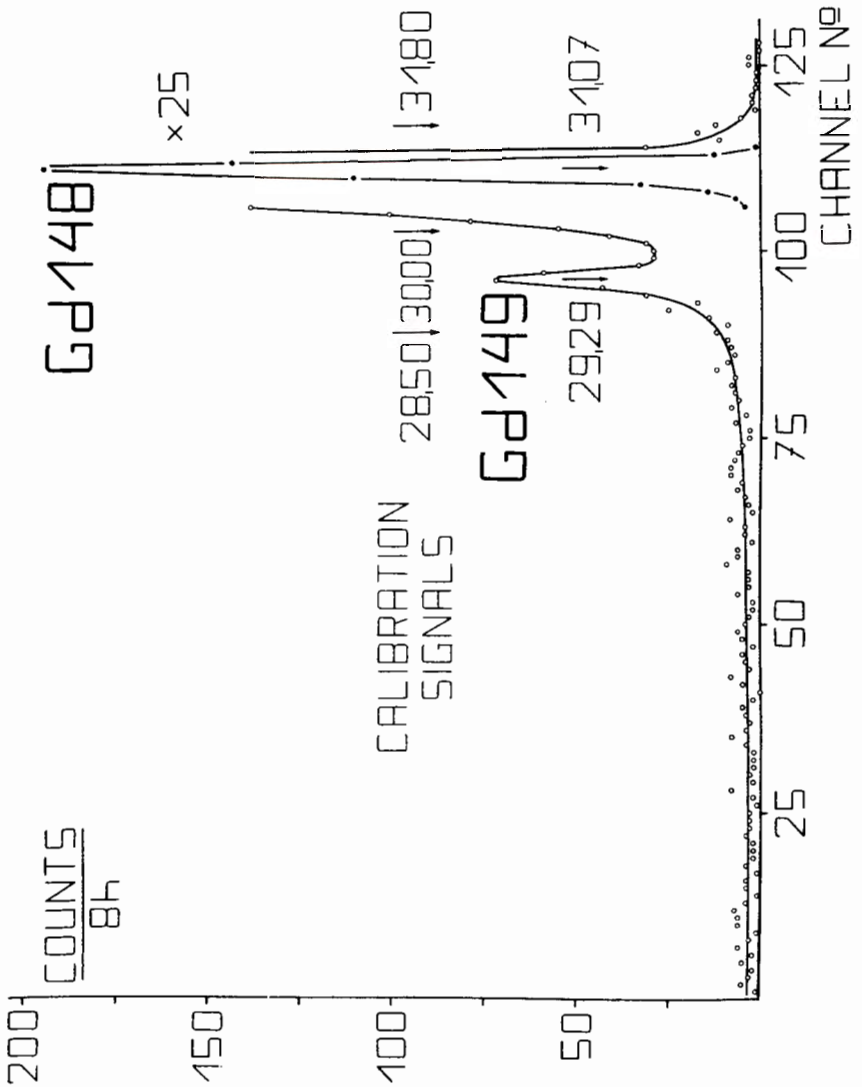

Fig.1. α - spectrum of the first Gd source immediately after second separation. The spectrum result of 4x2-hour analysis. The calibration signals were taken from a precision pulse generator.

In the α -spectrum of the second source 25 days after the irradiation we have observed a very weak α -activity of Eu^{147} (daughter of Gd^{147}) with 2.89 MeV α -particle energy.

The α -partial half-life was calculated on the basis of the following formula:

$$T_{\alpha\,149} = \frac{\sigma_{149}\ I_{0\alpha\,148}}{\sigma_{148}\ I_{0\alpha\,149}}\ T_{\alpha 148}\ ,$$

where T_α α -partial half-life,

σ cumulative cross section,

$I_{0\alpha}$ intensity of α -radiation at the end of target irradiation,

148, 149 mean, that the given value belongs to Gd^{148}, respectively to Gd^{149}.

The cumulative cross sections were calculated on the basis of Baranovskii's, Murin"s and Preobrazhenskii"s data [4]. We took 89 ± 5.4 years for $T_{\alpha 148}$ which is the mean of results [5] and [6].

The obtained results are given in Table II.

Table II. Results on Gd^{149} α -decay

Relative energy of α -particles	$\frac{E_{Gd\,149}}{E_{Gd\,148}} = 0.9484 \pm 0.0010$
Energy of α -particles, taking 3.18 ± 0.01 MeV [5] for E_{Gd148}	$E_{Gd\ 149} = 3.016 \pm 0.010$ MeV
α -partial half-life	$T_{\alpha\ Gd\ 149} = (6 \pm 4) 10^3$ years

On the basis of α -line intensity measurements a value of 8.3 ± 1.7 days was obtained for half-life of Gd^{149}, which is in agreement with the value 9.3 ± 0.3 days of [7].

From the gained α -decay energy of Gd^{149} / $Q_\alpha = (3.121 \pm 0.010)$ MeV/ one can calculate, with the aid of closed α-β - decay cycle, the β -decay energy of Tb^{149}. (See Fig. 2.)

The obtained results:

$Q_{\beta Tb149} = 3.720 \pm 0.050$ MeV, if we accept 4.081 ± 0.020 MeV for the α -decay energy of Tb^{149} [8], and 2.760 ± 0.040 MeV for the β- decay energy of Eu^{145} [9].

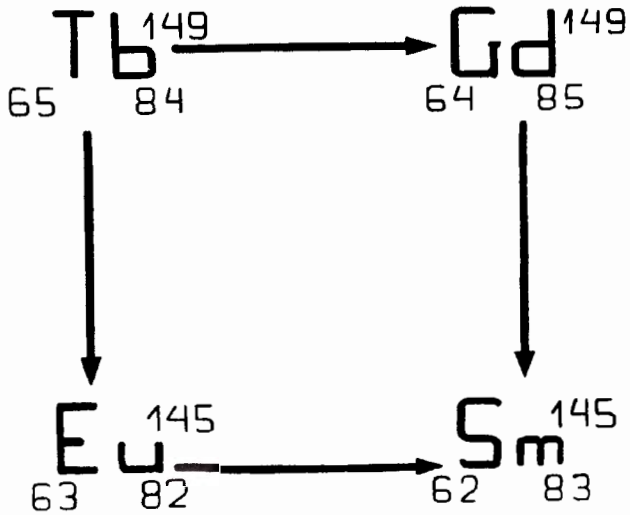

Fig.2. The decay cycle of $Tb^{149} \longrightarrow Sm^{145}$ transition.

The authors are deeply indebted to K.Ya.Gromov (JINR) and Professor A.Szalay (Institute for Nuclear Research, Debrecen, Hungary) for supporting this work and for valuable discussions, and V.A.Khalkin, H.A.Lebedev, and F.Molnár (JINR) for chemical separations.

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Received by Publishing Department
on October 28, 1964.