NEW ISOTOPE ^{145}Tb

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The new isotope ^{145}Tb ($T_{1/2} = 29.5 \pm 1.5$ s) has been identified on the IRIS on-line mass-separator facility by measuring the X-ray and γ-ray spectra of the daughter nucleus formed as a result of the $EC+\beta$ decay.

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In the course of our investigation of short lived nuclei of rare earth elements a new activity $T_{1/2} = 29.5 \pm 1.5$ s was found at the mass number $A = 145$.

The experimental technique and the identification were essentially the same as in our earlier study of neutron deficient Lu isotopes [1].

The isotope has been produced using a 1 GeV proton induced spallation reaction on tungsten target. The on-line mass-separator IRIS [2] was used to provide mass separated samples. The X-ray and γ-ray spectra were measured using Ge (Li) detectors.

The identification is based on the following:

1) In addition to the unambiguous A determination, with the help of the mass-separator, the Z assignment of the new activity was made on the basis of an analysis of the decay characteristics of the gadolinium K X-rays. Fig. 1 shows the Roentgen spectrum obtained for this isobar and the decay data for K_{α_1}Gd and K_{β_2}Gd lines. The measured half-life of these lines $T_{1/2} \sim 37$ s is significantly lower than half-life $T_{1/2} = 85 \pm 3$ s of the known isomeric state in the ^{145}Gd [3].

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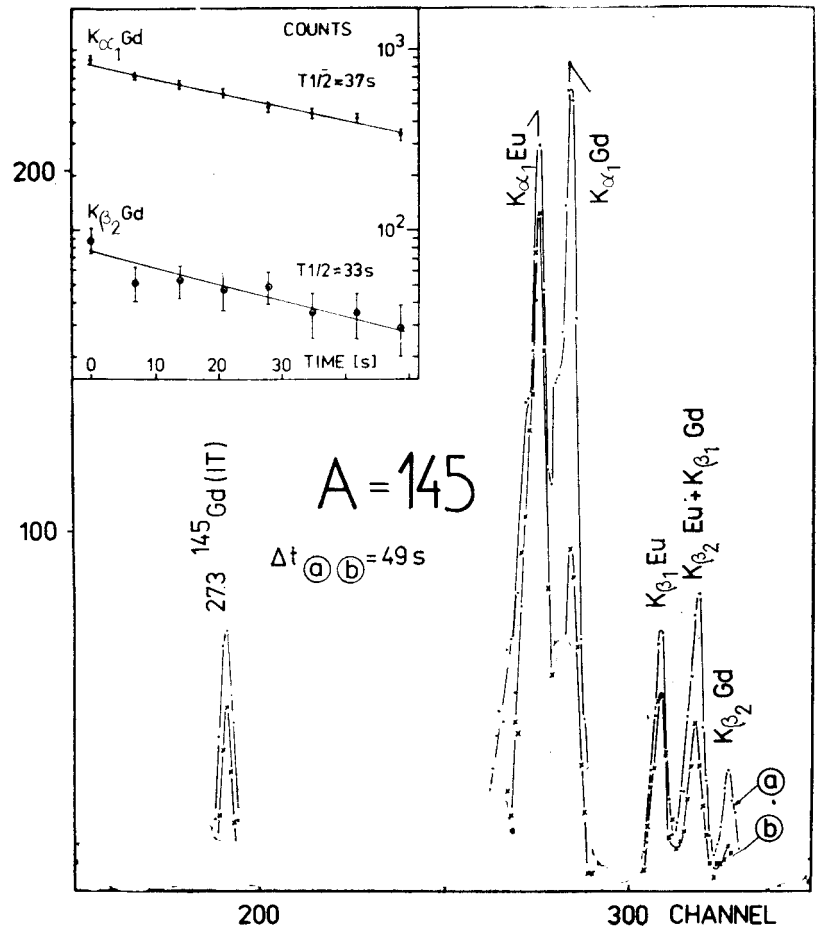

Fig. 1. Low energy part of the γ-ray spectrum in the first and last time interval and the decay characteristic for the Gd X-lines

2) In γ-ray spectra besides γ-ray transitions corresponding to the decay of well studied nuclei ^{145m}Gd [3] and ^{145g}Gd ($T_{1/2}$ = 21.8 min) [4], 15 new transitions having approximately the same half-life as Gd K X-lines were found (Table I).

The decay characteristics of the strongest new γ-lines are shown in Fig. 2.

3) Some of the γ-rays found in the present investigation are known from the in beam studies of the lower, medium-spin states in ^{145}Gd produced in ^{144}Sm (^{3}He, 2n) reaction [5].

4) The absence of evidence of other long lived isomers in the earlier studies of the ^{145}Gd with heavy projectiles strongly suggest that we are dealing with the decay of a new isotope ^{145}Tb.

On the basis of these facts the transitions with half-life $T_{1/2} = 29.5 \pm 1.5$ s have been assigned to the decay of ^{145}Tb.

The half-life observed for K X-lines of Gd (see Fig. 1) being slightly higher than for other γ-lines is due to the inner transition of the 85 s isomeric state in ^{145}Gd.

TABLE I

Energies and intensities of γ-lines assigned to the decay of ^{145}Tb

$E \pm \Delta E$ (keV)	$I_\gamma \pm \Delta I_\gamma$
200.0±0.4	18±4
246.5±0.4	10±3
257.3±0.2	83±16
268.2±0.4	6±2
523.3±0.3	29±5
536.5±0.3	65±9
571.5±0.3	39±6
698.0±0.4	12±2
935.3±0.5	19±2
988.2±0.3	100
1015.3±0.5	11±2
1107.3±0.4	33±3
1387.4±0.5	11±3
1432.9±0.4	24±4
1446.2±0.4	33±7

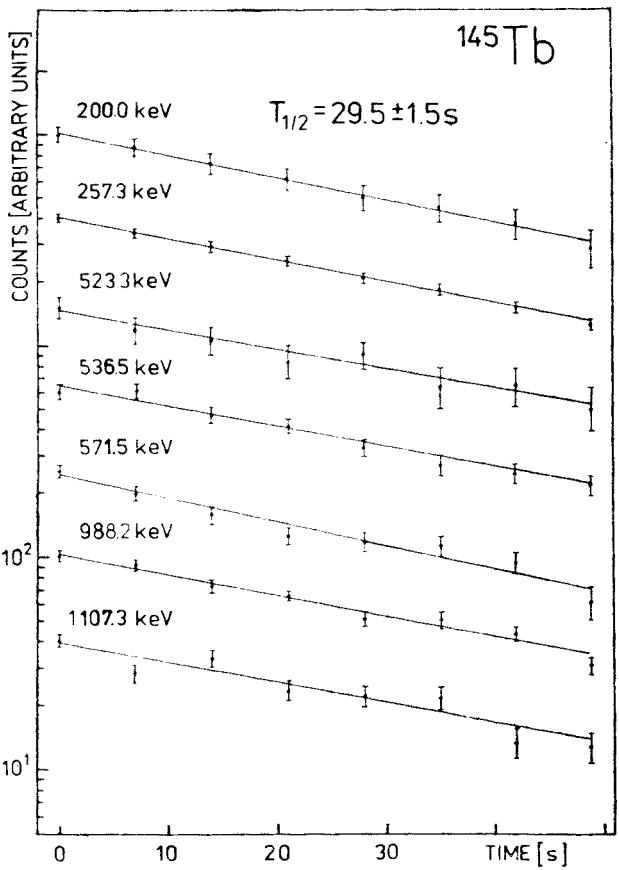

Fig. 2. Decay curves for main γ-lines assigned to the decay of ^{145}Tb

The preliminary analysis of the decay scheme of ^{145}Gd suggests that a small part of the γ-lines with energies 27.3 keV and 721.4 keV that in our spectra have $T_{1/2} \simeq 80$ s should also be related to the decay of new ^{145}Tb.

Let us finally mention that we have just been informed of a simultaneous identification of ^{145}Tb by Toth et al. in abstract [6]. The half-life measured by those authors $T_{1/2} = 30 \pm 2$ s is consistent with the value found here.

REFERENCES

[1] E. Ye. Berlovich et al., *Acta Phys. Pol.* **B11**, 455 (1980).
[2] E. Ye. Berlovich et al., EMIS Conf., Sweden 1973, p. 349.
[3] R. E. Eppley et al., *Phys. Rev.* **C2**, 1929 (1970).
[4] R. E. Eppley et al., *Phys. Rev.* **C3**, 282 (1971).
[5] J. Muhonen et al., JYFL Annual Report, JYFL, Finland 1979, p. 65
[6] K. S. Toth et al., *Bull. Am. Phys. Soc.* **25**, 486 (1980).