Gd^{146} *AND* Eu^{146} *CONVERSION-ELECTRON SPECTRA*

N. M. ANTON' EVA, A. A. BASHILOV, B. S. DZHELEPOV, and B. K. PREOBRAZHENSKII

Leningrad State University

Submitted to JETP editor July 12, 1958

J. Exptl. Theoret. Phys. (U.S.S.R.) **36**, 28-31 (January, 1959)

The conversion electron spectra of the neutron-deficient isotopes Gd^{146} and Eu^{146} were investigated. The conversion electrons observed correspond to three nuclear transitions with energies of 114.8, 115.5, and 155 kev in the case of Gd^{146} and to two transitions with energies of 630 and 742 kev in the case of Eu^{146}. Decay schemes are proposed.

WHILE investigating[1] the conversion electron spectra of neutron-deficient isotopes of Gd formed in the fission of Ta nuclei by fast protons (660 Mev), we observed an activity with a half-life of 45 days.[2] First the usual chemical methods and then chromatography were employed to isolate the gadolinium fraction. The active material was then collected on a thin aluminum foil.

The Leningrad State University's "Ketron" magnetic spectrometer, with a resolving power of 0.5%, was used to investigate the conversion-electron spectrum of the gladolinium fraction. However, in the low-energy region the lines had a greater relative width because of the scattering and stopping of electrons in the material of the radioactive preparation. A film over the counter window admitted electrons with energies over 7 kev.

Figure 1 shows the portion of the conversion electron spectrum that contains lines due to γ rays from the 45-day gadolinium, with E_γ = 114.8, 115.5, and 155 kev. Figure 2 shows a decay curve constructed from the decaying heights of the K-114.8 and L-155 peaks.

The identification of the 45-day activity was attempted by Murin et al.[3] In their report they advanced several arguments in favor of the theory that this activity is due to Gd^{146}. However, their identification cannot be considered as proved.

Our study of the 114.8- and 115.5-kev γ transitions, in which we used a magnetic spectrometer (Ketron), were impaired by the nearness of the transition energies and because the L-114.8 and L-115.5 conversion lines were not separated from the K-155 conversion line. Therefore, V. M. Lobashev and one of the authors of this paper (Bashilov) used a magnetic spectrograph of high resolv-

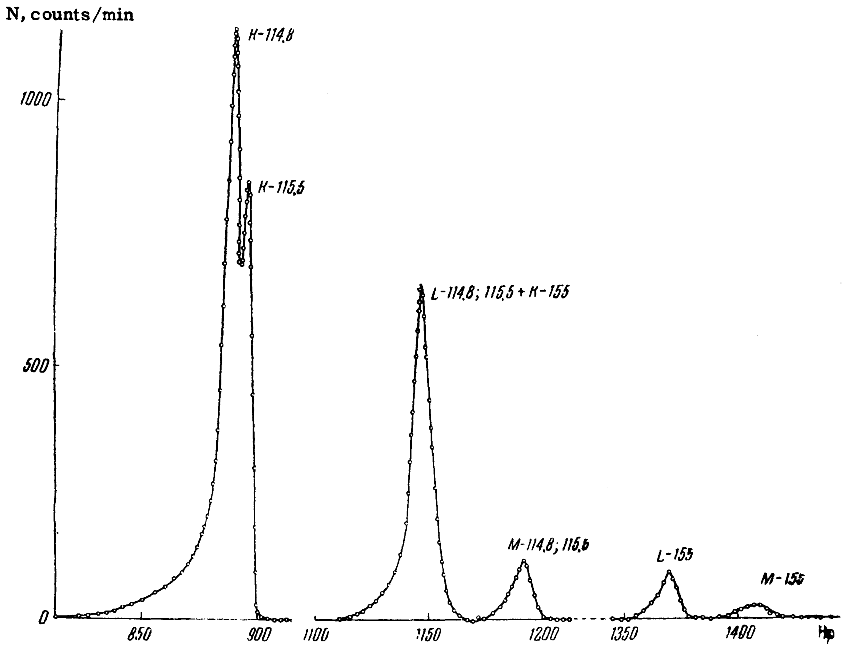

FIG. 1. The conversion electron spectra of Gd^{146}.

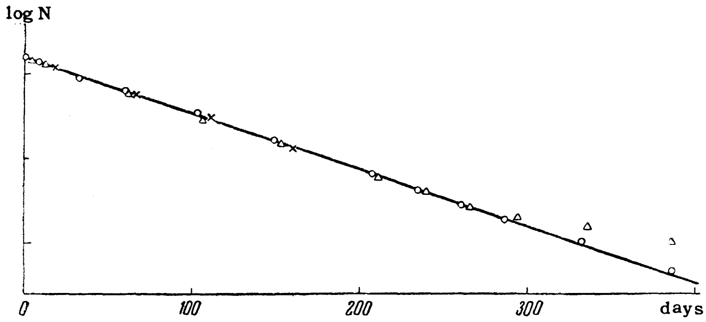

FIG. 2. Decay curve for Gd^{146}. o – 114.8; Δ – 114.8 + 115.5 + K-155; × – L-155.

ing power, available in our laboratory, for further study of the conversion electron spectrum of Gd^{146}. It has been in this way determined that the K-114.8 and K-115.5 lines possess approximately the same intensity and that for both transitions the K : L ratio is great (~ 7). Moreover, only L_1 lines were observed; no L_2 or L_3 lines appeared on the photographic plate. It is suggested that the most natural explanation of these facts is that the 114.8 and 115.5 kev γ transitions are of the M1 type and that their total intensities are approximately equal.

Murin and his co-workers[4] proved that these transitions occur in cascade.

Two factors complicated the investigation of the 155 kev transition. In the first place, as was mentioned, the K-155 conversion line was not separated in the spectrometric measurements from the L-114.8 and L-115.5 lines. Secondly, additional conversion electrons were present in our spectrum from a transition with the same energy (155 kev) but due to Gd^{151}.

A β spectrograph with a photographic plate was used to give a rough evaluation of the K : L ratio of the 155-kev γ transition immediately after the preparation of the compound, when the K-155 line of Gd^{146} was considerably more intense than the K-155 line of Gd^{151}. The ratio proved to be ~ 7.

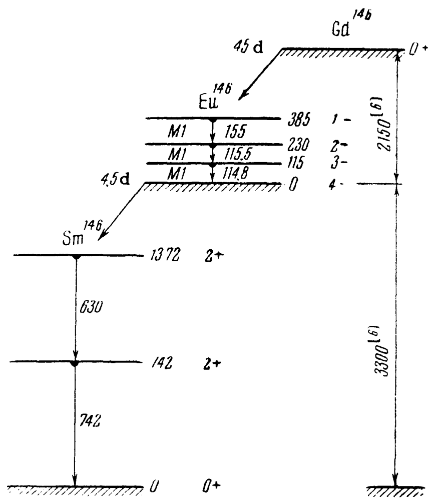

FIG. 3. $Gd^{146} \rightarrow Eu^{146} \rightarrow Sm^{146}$ decay scheme.

This indicates that the 155-kev γ transition of Gd^{146} is most likely of the M1 type.

Coincidence measurements[5] indicate that the 155-kev γ transition occurs in a cascade with at least one of the ~ 115-kev transitions. Since the 114.8- and 115.5-kev γ transitions have equal intensities, and since there are no intense lines with $E_\gamma \sim 40$ kev, it directly follows that all three transitions occur in a cascade. Moreover, the intensity of the 155-kev γ transition, based on a theoretical value for the internal conversion coefficient β_1, is also very close to the intensity of the 114.8- and 115.5-kev γ transitions. A suggested decay scheme is depicted in Fig. 3.

The daughter nucleus of Gd^{146}- Eu^{146} is radioactive and decays to the even-even Sm^{146} nucleus with $T_{1/2} = 45$ days. The decay process in Sm^{146} gives rise to at least two nuclear transitions with energies of 630 and 742 kev.

In the conversion electron spectrum of the gadolinium fraction the peaks for these conversions (Fig. 4) grow higher at first, during which time the half-life is ~ 5 days. After a while their in-

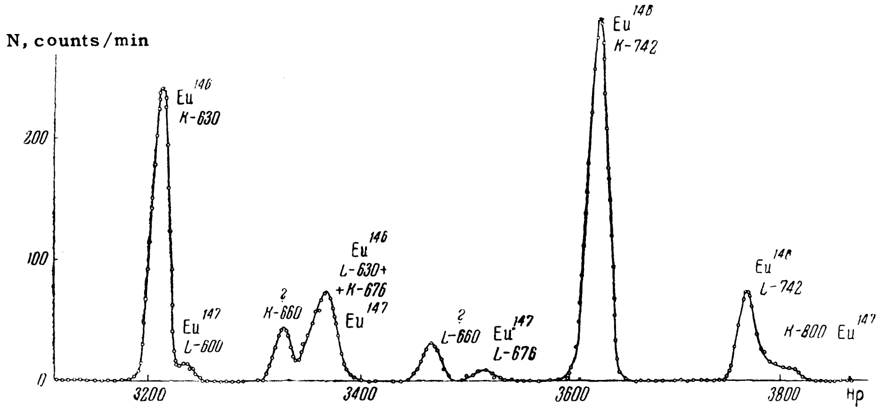

FIG. 4. The Eu^{146} conversion-electron spectrum.

tensity begins to decline, with a half-life of ~50 days. In the europium fraction spectrum the conversion lines of the transitions in question steadily decline, with a half-life of 4.5 days. All of these facts prove that 630 and 742 kev transitions must be ascribed to daughter activity of Gd^{146}.

Apparently these transitions belong to the vibrational system of levels of the Sm^{146} nucleus (Fig. 3).

The authors are grateful to V. M. Dzhelepov, Director of the Laboratory of Nuclear Problems in the Joint Institute for Nuclear Research, and to the synchrocyclotron crew for irradiating our tantalum specimens.

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Translated by A. Skumanich
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