ON THE 3+ LEVEL IN Os\textsuperscript{186} POPULATED IN Re\textsuperscript{186} \(\beta\)-DECAY

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The coincidences of the 400—1100 keV gammas with the conversion electrons of the 137 keV transition were measured with the intermediate image spectrometer modified for \(\beta - \gamma\) coincidences. The \(e_L\) 137 — \(\gamma\) 770 keV coincidences were observed. Consequently, in addition to the known 768 keV transition, there is another one with closed energy. For this transition the relative intensity ratio \(I_e^{632}/I_e^{773} = 8 \pm 2\) was determined. The corrected decay scheme of Re\textsuperscript{186} is presented.

1. INTRODUCTION

It was established recently by means of the high-resolution conversion studies of Ir\textsuperscript{186} and Ir\textsuperscript{188} activities that the transitions considered up to that time as the transitions from the second 2+ levels to the ground states in Os\textsuperscript{186} and Os\textsuperscript{188} are in reality doublets of two transitions with nearly the same energies [1, 2]. It was shown in these papers for both isotopes that one of the transitions in the doublet is in coincidence with the transition from the first excited level. The new levels established in this way are assumed to be the second levels of the rotational band of \(\gamma\)-vibrations and therefore have spins and parities 3+. For Os\textsuperscript{188} the mentioned doublet was also observed in Re\textsuperscript{188} decay [3]. Therefore, an attempt was made to establish whether the 768 keV transition in Os\textsuperscript{186} is also a doublet in Re\textsuperscript{186} decay. In this case the 3+ level should be populated only by the first-forbidden unique \(\beta\)-transition (\(\Delta J = 2\), yes).

2. EXPERIMENT

The coincidence method was chosen for solving the above problem in Re\textsuperscript{186} decay. The investigation was carried out with an intermediate image spectrometer modified for \(\beta - \gamma\) coincidences [4].

Sources were prepared by the irradiation of natural Re at a flux of \(10^{13}\) n. cm\textsuperscript{-2}. sec\textsuperscript{-1} in the pile. The irradiated samples were dissolved in nitric acid and dropped onto 5 \(\mu\) Al backing. The measurements started one week after irradiation when the presence of short-lived Re\textsuperscript{188} activity was negligible.

The gammas from the energy region 400—1100 keV in coincidences with the 125 keV electrons (the top of the L-conversion peak of the 137 keV transition) were measured. The curve A in Fig. 1 was obtained in this way. The first peak at 630 keV is mainly due to the well-known \(\gamma\) 630 — \(\gamma\) 137 keV cascade. Several effects form the second peak at 770 keV. Their contributions to the peak must be determined by additional measurements.

The first effect originates in the following way. Approximately one-third of the 125 keV electrons belongs to the continuous \(\beta\)-background. The \(\beta\)-group, with end point energy 308 keV, is in coincidence with the 768 keV gammas and the remaining \(\beta\)-background electrons contribute through the random coincidences. The measurement of the above gammas in coincidences with only the \(\beta\)-background electrons at 140 keV was performed and curve B in Fig. 1 was obtained. The ratio of the counts of the 308 keV \(\beta\)-group at 125 and 140 keV, determined from the calculated
Fermi plot, is 0.8 and nearly the same is true for the counts of the total β-background. Therefore, the area of the 770 keV peak of the curve B corrected by the factor 0.8 represents the contribution of the β-background effects into the 770 keV peak of curve A.

The second effect are the random coincidences. Measurement was made with changed delay in the coincidence circuit (125 keV electrons). Only part of these coincidences, corresponding to the conversion electrons, must be taken into account because the random coincidences with β-background are included in the preceding correction. It should be noted that the random coincidences are much smaller than the contribution discussed above and the exact division is not very significant. They were divided in the ratio of the conversion peak height to the interpolated β-background measured in the conversion electron spectrum.

Both contributions discussed above form less than one-half of the peak in the first measurement. This means that the excess is formed by the third effect — the sought γ 770—γ 137 keV cascade — and therefore there are two transitions with energy of about 770 keV. More exactly, this excess is mainly due to the γ 770—γ 137 keV cascade because there must also exist a β 176—γ 770 cascade contributing to the sought effect.

From the photopeak areas corrected for the efficiency of the γ-channel, the corrections mentioned above and for the contribution of the β 176—γ 770 keV cascade the γ-ray intensity ratio were determined:

\[ \frac{I_{632}}{I_{773}} = 8 \pm 2 \]

The transition energy of the new observed transition cannot be determined by the method used. The value 773 keV given by Emery et al. [11] is accepted. The contribution of the β 176—γ 770 keV coincidences was estimated to be 10 per cent of the γ 137—γ 773 keV ones according to the analogous case of the β 308—γ 632 keV contribution to the γ 137—γ 632 keV coincidences (see Fig. 1). It is believed that the uncertainty in the determination of the β 176—γ 773 keV coincidences is included in the error.

3. DISCUSSION

It was observed that two transitions with closed energies of about 770 keV exist in Re\(^{186}\) decay. One of them is in coincidence with the 137 keV transition and deexcites the 910 keV level. According to the concept of the collective model of a nucleus, the above level may be the second level of the γ-vibrational band with spin and parity 3\(^+\). Some experimental evidence for this is presented in [1]. The corrected decay scheme of Re\(^{186}\) is given in Fig. 2.

As mentioned above, the β-transition of this level should be the first-forbidden