QUADRUPOLE MOMENTS OF THE EVEN ISOTOPES OF OSMIUM AND OF LUTECIUM 175

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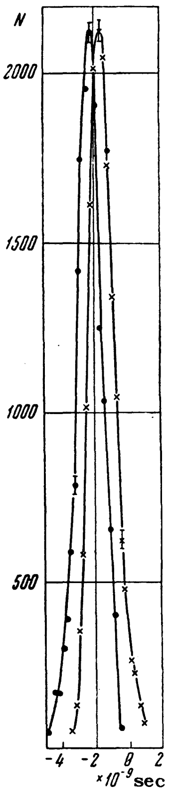
Two values are given in the literature for the half-life of the first excited state of the rotational band of the Os^{186} nucleus with an energy of 137 Kev: $T = 8.0 \times 10^{-10}$ sec (Ref. 1) and $T = 1.8 \times 10^{-9}$ sec (Ref. 2). In view of the fact that in this region of mass numbers the value of the quadrupole moment is observed to decrease with increasing number of neutrons in the shell, experiencing a jump on going from N = 114 to N = 116, it seems interesting to make the data on life-times more precise.



In the figure are presented coincidence curves, obtained with a Re^{186} source in the apparatus described in Refs. 3 — 5. The delay time is plotted along the abscissa and the number of coincidences along the ordinate. The points refer to measurements with the position of the β-ray absorber to the left of the source ($\gamma\beta$ coincidences) and the crosses to measurements with absorber to the right ($\beta\gamma$ coincidences).

From the displacement of the centers of gravity, the value $T = (6.0 \pm 0.2) \times 10^{-10}$ sec is obtained for the half-life; taking conversion into account, we obtain

$$T_\gamma = (1 + \alpha),\quad T_{\text{exp}} = (1.44 \pm 0.05)\cdot 10^{-9}\ \text{sec.}$$

for the radiation period.

Calculation according to Eqs. (29) and (31) of Bohr's article[6] gives $Q_0 = (6.4 \pm 0.1) \times 10^{-24}$ cm^2 for the nuclear quadrupole moment of Os^{186} (110 neutrons).

For Os^{188} (112 neutrons) $Q_0 = 5.1 \times 10^{-24}$ cm^2 (Ref. 7) and for Os^{190} (114 neutrons) $Q_0 = (4.2 \pm 0.9) \times 10^{-24}$ cm^2 (Ref. 8). Os^{192} (116 neutrons) is already a spherical nucleus.[9] These numbers illustrate the sharp transition from rotational structure to vibrational, already noted in the literature,[9] analogous to the long established jump-like change from vibrational structure to rotational on change of the number of neutrons from 88 to 90.[10]

At the same time, measurements were carried out on the lifetime of the first excited state of the rotational band of the Lu^{175} nucleus, for which an upper limit of $\tau \leq 2 \times 10^{-9}$ sec is given in Ref. 11. No clear relative displacement of the $\beta\gamma$ and $\gamma\beta$ coincidence curves appeared in our measurements. We estimate the upper limit of the lifetime of the 113-kev level to be 2×10^{-10} sec, or taking account of conversion, $\tau_\gamma \leq 6.8 \times 10^{-10}$ sec. Considering that the transition under discussion represents a mixture of transitions, 25% E2 and 75% M1, we obtain a partial lifetime τ_γ (E2) $\leq 1.4 \times 10^{-9}$ sec with respect to transitions of type E2.

Since the spins of the ground and first excited states of the Lu^{177} nucleus are 7/2 and 9/2 respectively, we obtain, by using Eqs. (29) and (33) of Ref. 6 for the case of E2 transitions with change of spin by unity, a lower limit for the value of the internal quadrupole moment, $Q_0 \geq 6.8 \times 10^{-24}$ cm^2. This result does not conflict with the value of the quadrupole moment for the neighboring nucleus Hf^{177}, which has an analogous rotational structure, for which according to our measurements[3] $Q_0 = 8.1 \times 10^{-24}$ cm^2.

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LIFETIME OF THE 264-Kev LEVEL OF Er^{167}

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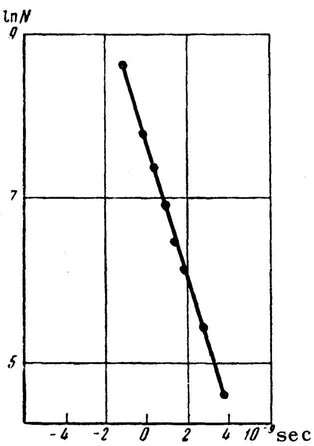
By investigating coincidences between x-rays accompanying K-capture in Tu^{167} and internal conversion electrons for the 57-kev transition, by means of the apparatus described by Berlovich,[1-3] we have determined the lifetime of the 264-kev level of Er^{167}. The figure gives on a semilogarithmic scale the decay curve of the state under investigation (the delay time is plotted along the horizontal axis) from which the half-life is found to be



$$T_{1/2} = (2.0 \pm 0.5) \cdot 10^{-9} \text{ sec.}$$

Using the findings of Gromov and Dzhelepov,[4] that the 57-kev transition is a mixture of 25% E2 and 75% M1 transitions, and taking into account approximately the conversion in all the shells, starting with the L-shell (the conversion coefficient for the L-shell was computed with the aid of tables[5]), we have obtained for the half-life of radiative decay

$$T_\gamma = T_e(1+\alpha) = 1.4 \cdot 10^{-8} \text{ sec},$$

which yields for the partial decay periods the values:

$$T_\gamma(E2) = 5.6 \cdot 10^{-8} \text{ sec and } T_\gamma(M1) = 1.87 \cdot 10^{-8} \text{ sec.}$$

Comparison with the results calculated by means of Weisskopf's formula,[6] based on the concepts of the single particle model, leads to an acceleration factor F = 310 for the transition of E2 type, and to a retardation factor F = 1/160 for the transition of M1 type.

According to Gromov and Dzhelepov,[4] the first excited level (207-kev) is a $\frac{1}{2}-$ state, while the 264-kev level may have the characteristics $\frac{1}{2}+$, $\frac{3}{2}+$ or $\frac{3}{2}-$; according to Gorodinskii et al.,[7] the most likely characteristic is $\frac{3}{2}-$. The assumption that the strongly deformed Er^{167} nucleus (17 neutrons outside a filled shell) has a rotating band with an angular momentum component $\Omega = \frac{1}{2}$ along the axis of elongation leads to a value of the internal quadrupole moment which is approximately twice as big as the values observed in this region of mass numbers.[8] However, the possibility is not excluded that the discrepancy is connected with the inaccuracy in the relative amounts of E2 and M1 transitions proposed by Gromov and Dzhelepov,[4] and that in actual fact the proportion of transitions of type E2 is considerably smaller.

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