TRANSITION MULTIPOLARITIES IN ^{233}U

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1. INTRODUCTION

The decay of the low-lying states of ^{233}U was investigated in a number of publications in which the conversion electron intensities [1,2,3], gamma intensities [1,4], and half-lives [4] were measured. The three rotational bands built on the Nilsson single-particle states, 5/2|633|, 3/2|631|, and 1/2|631|, were established on these experimental data. Mixing of bands was also considered [1,4] but the obtained results were only qualitative, due to the rather uncertain knowledge of transition multipolarities.

In the present work the precise determination of transition multipolarities were performed in order to obtain a firm basis for a more complete theoretical description of non-adiabatic effects in this nucleus.

2. EXPERIMENTAL RESULTS

The conversion spectrum of ^{233}U was measured from the decay of ^{233}Pa on an iron-free double focusing electron spectrometer. The momentum resolution was 0.02%, and the detector was a GM counter with a 0.4 mg/cm^2 mylar window. Each conversion line was measured seven times. After corrections for the decay of ^{233}Pa, areas under the lines were determined as follows:

- It was assumed that the continuous spectrum under the lines is flat and as the line base the high energy side was taken.
- The "tails" on the low energy side of the lines were cut off at the height of one tenth of the maximum.
- The graphical separation of L lines was performed under the assumption that the "tails" of L_I and L_{II} lines were identical.

The conversion coefficients were determined from these conversion intensities and the relative gamma intensities from ref. 1, taking the measured conversion coefficient

α_K(312 keV) = 0.69 (7) [2]. The experimental results are listed in Table 1 and compared to the theoretical values for pure multipoles obtained by interpolation from ref. 5.

Table 1.

Conversion Coefficients and Conversion Intensity Ratios

E_γ (keV)	CONV. COEFF. OR RATIO	EXP.		THEOR. [5] (M1)	THEOR. [5] (E2)
75.13	L_I/L_{II}	8.27	(18)	8.53	0.0393
	L_{II}/L_{III}	13.1	(15)	20.8	1.34
	L_I/L_{III}	108	(12)	177	0.0526
	$\alpha(L_I)$	8.2	(8)	7.59	0.837
86.46	L_I/L_{II}	7.73	(16)	8.65	0.0435
	L_{II}/L_{III}	9.4	(19)	21.2	1.41
	L_I/L_{III}	73	(14)	180	0.0610
	$\alpha(L_I)$	4.4	(6)	5.03	0.483
103.6	L_I/L_{II}	6.82	(36)	8.39	0.0517
	L_{II}/L_{III}	4.58	(77)	21.8	1.50
	L_I/L_{III}	31.2	(50)	183	0.0778
	$\alpha(L_I)$	3.2	(4)	2.98	0.252
299.8	K/L_I	5.56	(4)	5.81	4.88
	K/L_{II}	39.8	(12)	46.8	1.52
	L_I/L_{II}	7.17	(23)	8.07	0.311
	$\alpha(K)$	0.71	(8)	0.848	0.0762
311.7	K/L_I	5.783	(16)	5.82	4.95
	K/L_{II}	41.15	(52)	47.1	1.65
	L_I/L_{II}	7.116	(92)	8.09	0.334
	$\alpha(K)$	0.69	(7)*	0.763	0.0708
340.3	K/L_I	5.522	(40)	5.83	5.08
	K/L_{II}	37.04	(90)	46.9	1.99
	K/L_{III}	404	(99)	1239	5.61
	L_I/L_{II}	6.70	(20)	8.05	0.392
	L_{II}/L_{III}	10.91	(50)	26.4	2.81
	$\alpha(K)$	0.55	(6)	0.601	0.060
375.5	$\alpha(K)$	0.056	(8)	0.459	0.0498
398.3	$\alpha(K)$	0.047	(5)	0.391	0.0446
415.6	$\alpha(K)$	0.107	(12)	0.349	0.0412

* This value was taken from Bisgard et al [2]

The measured K-conversion coefficients for pure E2 transitions of 375.5 and 398.3 keV agree very well with theoretical values, showing that there are no large systematic errors in our conversion intensities.

3. DETERMINATION OF E2/M1 MIXING RATIOS

The mixing ratios $\delta^2=I_\gamma(E2)/I_\gamma(M1)$ are deduced from data given in Table 1 by taking into account the penetration effects in M1 conversion [6] as well as the presence of the E0 component in the 340 keV transition [7]. Experimental values of mixing ratios are listed in Table 2 and compared to the values from earlier works.

Table 2

E2/M1 Mixing Ratios

E_γ	$\delta^2 \times 10^2$ (PRES. WORK)	$\delta^2 \times 10^2$ (REF. 1)	$\delta^2 \times 10^2$ (REF. 2)
75	0.19 (7)	1.0 (1)	0
86	0.47 (14)	2.3 (5)	1 (1)
103	2.8 (8)	4.2 (1)	1 (1)
300	2.9 (16)	13.6 (13)	0
312	7.1 (9)	<2	0
340	4.0 (15)	11 (12)	0
416	367 (26)	455 (54)	354 (51)

Our values for the δ^2 confirm the presence of the E2 admixture in the transitions between the K=1/2 and K=3/2 rotational bands. They are, however, smaller than the values quoted in ref. 1. Contrary to earlier results, we have found an appreciable E2 content in the K=3/2→K=5/2 transition of 312 keV.

The obtained values for δ^2 differ from those by which Malmskog and Höjeberg [4] established that the reduced transition probabilities for E2 and M1 transitions with ΔK=1 cannot be explained by the Corriolis interaction within the frame of the Nilsson model. However these discrepancies do not affect essentially the conclusions of their work.

References

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