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ЛАБОРАТОРИЯ ЯДЕРНЫХ ПРОБЛЕМ

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ANGULAR CORRELATION MEASUREMENTS IN ^{165}Er

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I. Introduction

The $^{165}_{68}Er_{97}$ nucleus belongs to the region of large deformation rare earth nuclei. In recent years the level scheme of ^{165}Er has been studied by several methods [1-6]. In this scheme there are some rotational bands, the properties of which cannot be explained within the adiabatic approximation of the simple collective model. Their properties have been explained by the assumption of the Coriolis coupling, pairing correlations and $\Delta N=2$ interactions [2,7,8].

Up to now, the spin values for some high energy levels in ^{165}Er have not been established uniquely. The purpose of this work was to determine the spins for 589.7 and 1427.1 keV levels. For this purpose, the gamma-gamma angular correlation measurements have been carried out for (347-243) and (1184-243) keV cascades in ^{165}Er.

II. Experimental Procedure

1. Sources

The radioactive sources of ^{165}Tm were produced in the spallation reaction, bombarding a tantalum target with 660 keV protons at the Dubna synchrotron. A rare earth group has been separated from an irradiated tantalum target by means of a chemical method. The Tm fraction was chromatographically separated [9] and the monoisotopic sources were prepared with a mass-separator.

The measurements of gamma-gamma angular correlations were carried out using several liquid sources introduced in the plexiglass viol 3 mm in diameter. The source has been centered within $\leq 1\%$ accuracy.

2. Apparatus

The gamma-gamma angular correlation in ^{165}Er measurements were carried out using a conventional automatically operated coincidence system based on the fast-slow electronics with a 50 nsec time-resolution. The apparatus consists of a fixed coaxial Ge(Li) detector of 50 cc active volume and a movable ϕ 40x40 - NaI(Tl) detector. The energy resolution of the Ge(Li) detector was 4.5 keV at gamma rays of ^{60}Co. The coincidences were detected for 90, 135 and 180° angles between the two detectors and for ten minutes time exposure at each angle. Two single channel analysers have been used on the NaI(Tl) branch to select the gamma-transition (in our case 243.9 keV) and the Compton background from the gamma transitions of higher energy.

The gamma-ray spectra in coincidence with selected gamma transitions and compton background were detected by the Ge(Li) detector coupled to a multichannel analyser.

III. Results

Tables 1 and 2 present the corrected values of the angular correlation coefficients and the results of their analysis, respectively. The M1 character for 242.9 keV transition determined in /10/ and the spin values of 5/2 and 3/2 for the ground and for 242.9 keV states, respectively /3,4,5,10/, were used in the analysis.

1. The (347- 243) keV cascade deexcites, successively, the 589.7 and 242.9 keV levels to the ground state of ^{165}Er.

Table 1
Results of the gamma-gamma angular correlation measurements in ^{165}Er

Energy of levels (keV)	Cascade (keV)	A_{22}	A_{44}
589.7	347 - 243	+0.057± 0.011	−0.034± 0.038
242.9			
0.0			
1427.1	1134 - 243	−0.050± 0.018	+0.024± 0.039
242.9			
0.0			

Table 2
The values of the spins and multipolarities from angular correlation measurements

Energy of levels (keV)	Spin of levels	Transition energy (keV)	Multipolarity		Sign δ
			Present work	[10]	
589.8	1/2	346.8	M1 + ≤1% E2	M1	< 0
1427.1	3/2	1184.2	E1 + ≤3.5% M2	E1	< 0

According to the electron conversion measurements the possible spin values for the 589.7 keV excited state are 1/2, 3/2 or 5/2. By using the Arns-Wiedenbeck graphs and our experimental A_{22} coefficient(figure 1) we have obtained the spin value 1/2 for 589.1 keV level and the multipole mixing $M1+ \leq 1\%$ E2 for the 346.7 keV transition.

2. The (1184-243) keV cascade decays successively the 1427.1 and 242.9 keV levels to the ground state. The 1184.2 keV transition is mainly characterized by the electric dipole E1 [3,10] and thus the possible spin values for 1427.1 keV levels were 1/2, 3/2 or 5/2.

From the figure it is seen that our experimental coefficient A_{22} agrees only with the 3/2 values for this level. It follows also, from this figure the multipole mixing $E1+ \leq 3.5\%$ M2 for the 1184 keV transition.

IV. Discussion

Abdurazakov et al. [10] have proposed a γ -vibrational nature for the 589.7 keV state in ^{165}Er with the more probable spin 1/2.

The level at 1427.1 keV was interpreted in [3,10] as a three-quasiparticle state with a more probable spin 3/2.

Our experimental spin values 1/2 for the 589.7 keV level and 3/2 for the 1427.1 keV one, support their interpretation of the nature of these levels.

Our results on the multipolarity of the transitions 346.8 and 1184.2 keV are in good agreement with those from [10] (see Table 2) and give more precise values for them.

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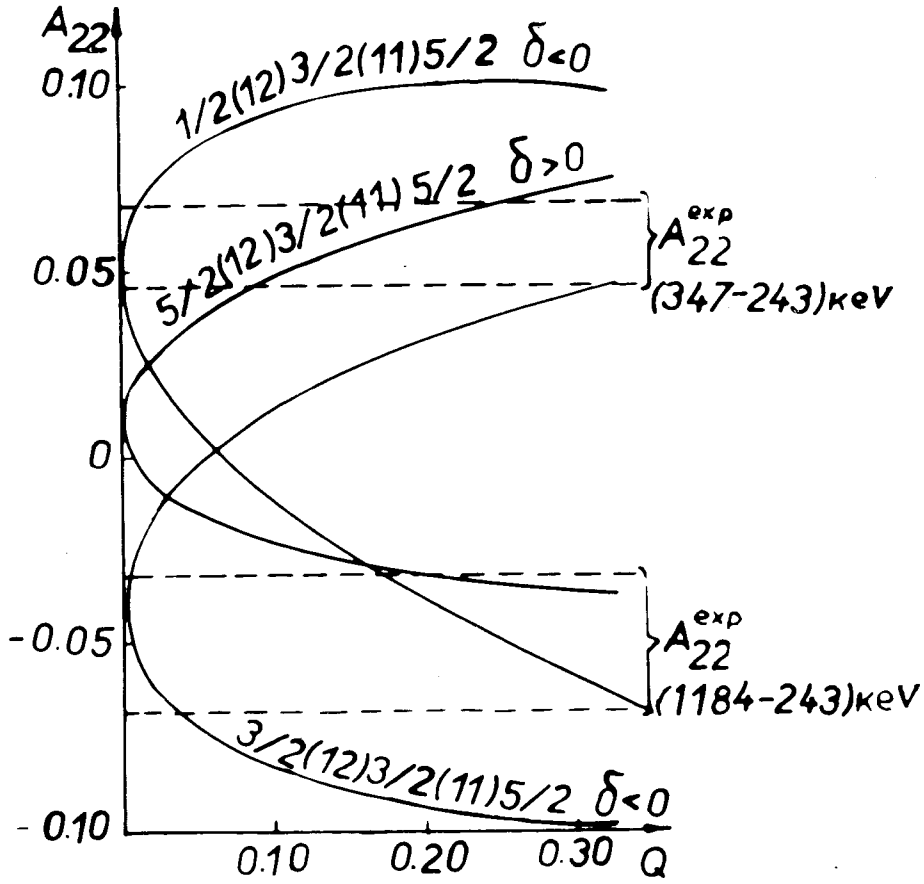

Fig. 1. The Arns-Weidenbeck graphs for (347-243) keV cascades.

References

1. P.O.Tjøm, B.Elbek. Mat. Fys. Medd. Dan. Vid. Selsk., 37, No. 7 (1969).
2. W.Andrejtscheff, H.Fuia, R.Ion-Mihai, A.B.Khalikulov, P.Manfrass, V.A.Morozov, N.Z.Marupov, T.M.Muminov, H.Prade, K.D.Schilling, G.Winter. Nucl. Phys., A220, 438 (1974).
3. A.A.Abdumalikov, A.A.Abdurazakov, K.Ya.Gromov, T.A.Islamov, H.Strusny. JINR preprint, 6-4398, Dubna, 1969.
4. A.A.Abdurazakov, K.Ya.Gromov, T.A.Islamov, H.Strusny. JINR preprint, P6-5132, Dubna, 1970.
5. G.Marguier. Thesis, Institute de Physique Nucleaire, report IPN Lyon (1971) Lycen 7115.
6. S.A.Hjorth, H.Ryde, K.A.Hagemann, G.Løvhøiden, I.C.Waddington. Nucl.Phys., A144, 513 (1970).
7. I.Kanestrom, P.O.Tjøm. Nucl.Phys., A138, 177 (1969).
8. G.Løvhøiden, P.O.Tjøm, L.O.Edwardson. Nucl. Phys., A194, 463 (1972).
9. F.Molnar, A.Horwath, V.A.Khalkin. J.Chromatog. 26, 225 (1967).
10. A.A.Abdurazakov, K.Ya.Gromov, V.Svolska, T.A.Islamov, H.Strusny. JINR preprint, P6-4889, Dubna, 1970.

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