ОБЪЕДИНЕННЫЙ
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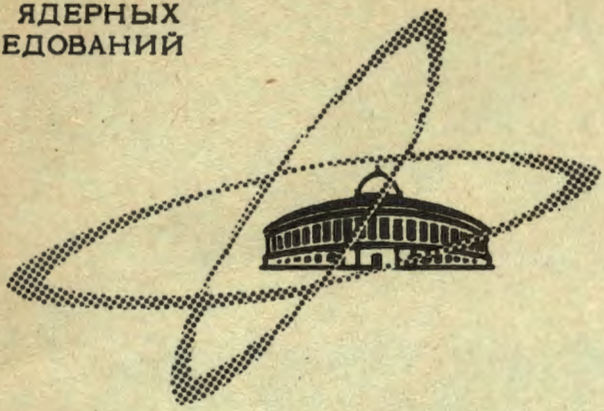

E6 - 3906

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ANGULAR CORRELATIONS OF GAMMA CASCADES IN ^{155}Gd

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ANGULAR CORRELATIONS OF GAMMA CASCADES IN ^{155}Gd

The level scheme of ^{155}Gd has been extensively studied in the last few years both in experimental and theoretical ways. The analysis of the experimental data for this nucleus is impeded by an ambiguity in the spin values of the majority of its excited states. So far only one γ-γ angular correlation measurement has been reported for this nucleus[1], the experiment, however, being limited by the resolution of NaI(Tl) -detectors. In the present work γ-γ angular correlations in the decay of ^{155}Tb$\rightarrow^{155}$Gd were measured using a Ge(Li)--detector in coincidence with an NaI(Tl) scintillation counter.

The parent ^{155}Tb isotope, with a lifetime of 5.6 days, was separated from the products of the spallation reaction in a tantalum target bombarded with 660 MeV protons from the Dubna synchrocyclotron. The separation was performed in a similar way as described in[2]. Sources were prepared in the form of $^{155}TbCl_3$ dissolved in water. Measurements were started about 10 days after each separation and were repeated 1 month later, when any traces of the ^{153}Tb activity ($T_{1/2}$ = 2.3 days) had completely decayed.

The coaxial Ge(Li) detector with a sensitive volume of ca. 13 cm^3 and energy resolution of 4 - 5 keV was mounted in a fixed position. The scintillation NaI(Tl) detector with a 2" x 2" crystal was movable, its position being automatically changed every 5 minu-

tes. The resolving time of the fast part of a conventional fast-slow coincidence circuit was set at 30 ns for measurements involving the 105 keV state ($\tau = 1.4$ ns) and at 120 ns for measurements involving the 87 keV state ($\tau = 9.6$ ns). The relevant part of the ^{155}Gd level scheme is shown in Fig. 1. Gamma-ray spectra (Fig. 2) from the germanium detector in coincidence with the 87 keV, 262 keV, and 340 keV gamma transitions were stored in parts of the memory of a 4096-channel analyser for 90°, 135° and 180° positions of the scintillation head.

The geometrical corrections were determined experimentally, measuring known angular correlations in ^{169}Tm in the same geometry. The attenuation coefficient for cascades involving the 87 keV state was taken from /3/ and that for the 262 keV - 105 keV cascade was calculated using the ratio of the lifetimes of the corresponding states. The obtained angular correlation coefficients A_2 and A_4, corrected for the geometry and for the attenuation, are given in Table 1. These results were analysed by the conventional method of ellipses.

Table 1

Experimental values of angular correlation coefficients

Cascade (energy in keV)	A_2	A_4
262 - 105	- 0.122 (10)	0.000 (15)
262 - 18 - 87	+ 0.026 (16)	- 0.007 (14)
340 - 87	+ 0.129 (24)	- 0.027 (48)
180 - 87	- 0.195 (19)	+ 0.030 (30)
148 - 87	- 0.003 (18)	- 0.040 (40)

Using the known mixing ratios for the investigated cascade transitions (4-6), the spin values of a few ^{155}Gd levels were determined. They are listed in Table 2.

Table 2

Deduced spin values of ^{155}Gd levels

Level (keV)	Spin
86.6	5/2
105.3	3/2
235.2	3/2 (7/2)
266.6	5/2
367.7	1/2, 5/2
427.3	3/2, 7/2

From the two possible spin assignments 1/2 and 5/2 for the 367.7 keV level the value 5/2 is excluded by the results of Tjøm et al. [7] on (d,p) and (d,t) reactions. The same authors observed in an unresolved 266.6 keV + 268.6 keV level a component of the $3/2^+[402]$ wave function with I = 3/2. Our results exclude I = 3/2 for the 266.6 keV level, hence this spin value should be assigned to the 268.6 keV state. The observed angular correlation for the 148 keV-87 keV cascade is in agreement with the spin I=3/2 for the 235.2keV level. Ref. [8] indicates, however, the existence of a second 148 keV weak transition (see Fig. 1.) that is also in coicidence with the 87 keV line. We cannot, therefore, exclude the possibility of I = 7/2 for the 235.2 keV state. The spin values of the 86.6 keV and 105.3 keV levels obtained in the present work are in agreement with recent theoretical predictions taking into account a strong Coriolis coupling between rotational bands in ^{155}Gd (see e.g. [4], [7], [9]). They also agree with the result reported at the Asilomar Conference on Hyperfine Interactions detected by Nuclear Radiation [10] and with the recent

data of Balabanov et al.[11] and Soinski et al.[12].

The theoretical discussion of the present results and of some peculiarities of the ^{155}Gd level scheme will be published elsewhere.

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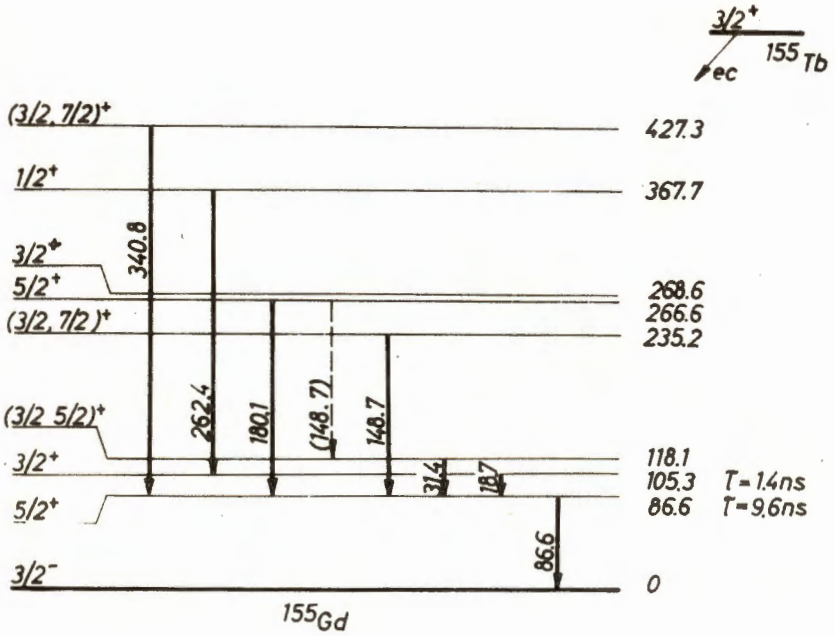

Fig. 1. Part of the ^{155}Gd level scheme. Only transitions of investigated gamma cascades are shown.

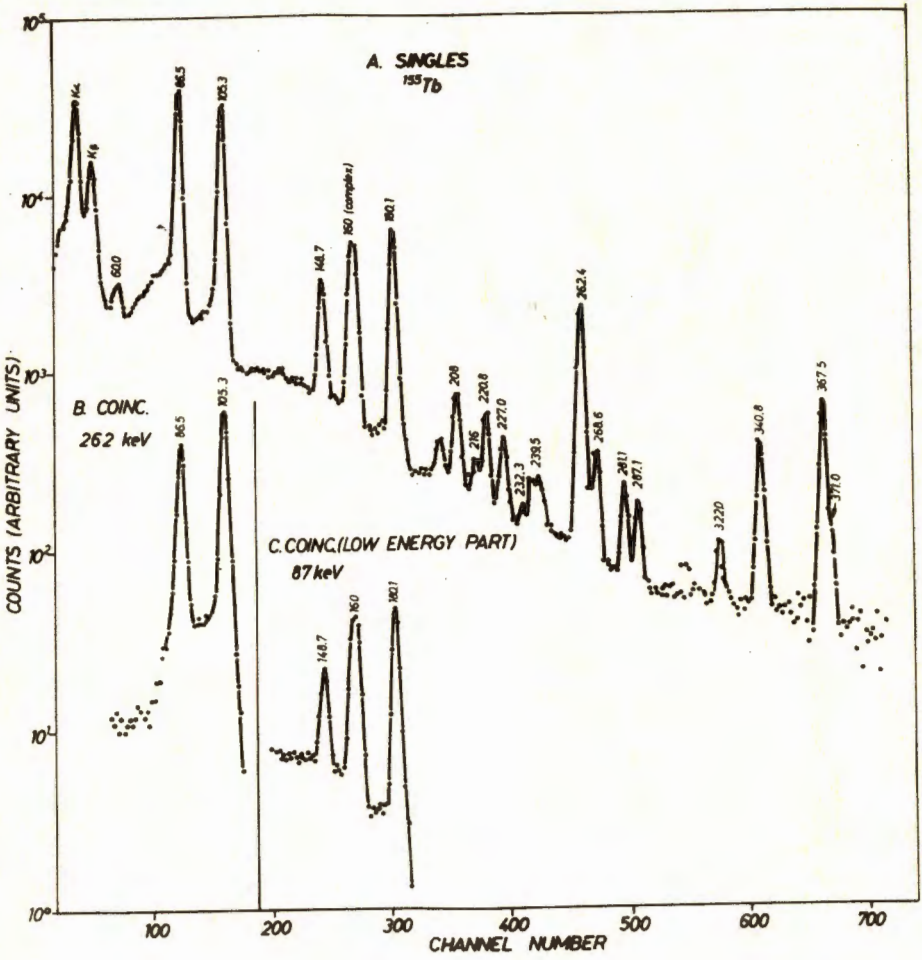

Fig.2. Example of the gamma spectrum.