SPIN OF THE 1360-keV *LEVEL OF* Sm^{150}

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Submitted to JETP editor August 13, 1963

J. Exptl. Theoret. Phys. (U.S.S.R.) **46**, 1481-1483 (April, 1964)

THE existence of a 1360-keV level was proposed in [1,2], where the level scheme of the Sm^{150} nucleus produced by decay of Eu^{150} was investigated. However, the scheme of Bieber et al. [3], who measured the spectrum of the gamma rays with energy below 2000 keV accompanying the capture of thermal neutrons by the Sm^{149} nucleus, does not contain this level. It is possible that this is due to the fact that the gamma-ray spectrum of Sm^{150} does not contain gamma rays with 1360 keV energy, which would correspond to a direct transition to the ground state.

The existence of the 1360 keV level was confirmed in a recent paper by Groshev et al. [4]. In this investigation, a gamma line with energy 6632 keV was observed, corresponding to a transition from the 7983 to the 1360 keV level. From the 1360 keV level the Sm^{150} nucleus goes to the 774 keV level, emitting a gamma quantum with energy 585 keV [4]. In the cited papers [3,4], the multipolarity of the gamma transition with 585 keV was also determined by measuring the internal conversion coefficient, and it was found that this transition is pure E1.

Recognizing that the spin of the 774 keV level is equal to 4 [2,5], we can conclude that the spin of the 1360 keV level is either 3, 4, or 5, and that the parity should be negative. The spin of the 1360 keV level was determined by measuring the angular correlation of the gamma quanta of the 585—440 keV cascade, accompanying the capture of thermal neutrons by Sm^{149}. To this end, a fast-slow coincidence circuit and a 400-channel pulse-height analyzer were used to register the spectrum of the gamma rays coinciding with the 440-keV lines.

The experimental setup was described in detail in our earlier paper [5]. The measurements were made at 90, 135, and 180° between the two detectors. Figure 1 shows one of the spectra. In the data reduction, the area of the photo peak at 585 keV was determined and the contribution of the random coincidences, which amounted to 8%, was subtracted. Figure 2 shows the theoretical correlation functions with allowance for the geometrical corrections for the three possible values of the spin. The same figure shows also the obtained experimental points.

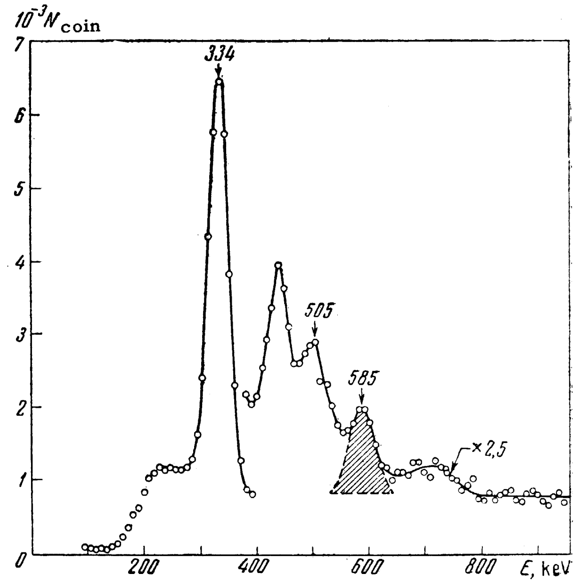

FIG. 1. Spectrum of gamma rays coinciding with the gamma rays of energy 440 keV. N_{coin} is taken over 6 hours.

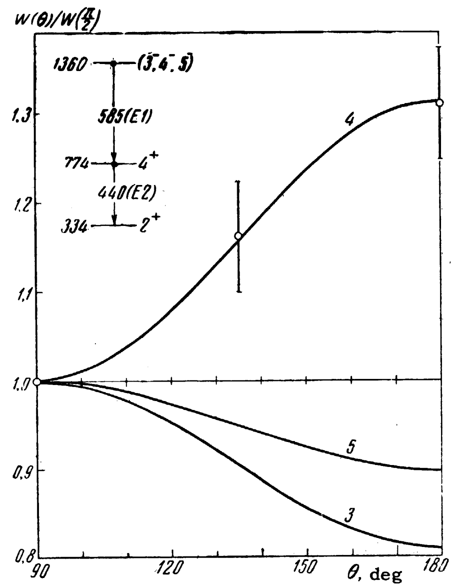

FIG. 2. Theoretical correlation functions for two possible values of the spin of the 1360 keV level and the experimental points obtained.

The best agreement with experiment is obtained assuming a transition of the type $4 \to 4 \to 2$, for which the correlation function has the following form (with allowance for the geometrical corrections)

$$W(\theta) = 1 + 0.1865\, P_2(\cos\theta),$$

where $P_2(\cos\theta)$ — Legendre polynomial. From this function follows the theoretical value

$$W(135°)/W(90°) = 1.15; \qquad W(180°)/W(90°) = 1.31;$$

the values of these ratios, calculated from the experimental data, are 1.16 ± 0.06 and 1.31 ± 0.06, respectively. It follows therefore that the spin of the 1360 keV level is equal to 4.

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Translated by J. G. Adashko
212

THE REACTIONS (n, 2n) ON $Sn^{112,124}$ *AND (n, p) ON* $Sn^{112,117}$ *AT* 14.1 MeV

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Submitted to JETP editor September 15, 1963

J. Exptl. Theoret. Phys. (U.S.S.R.) **46**, 1483-1484 (April, 1964)

It was observed[1] that for (n, p) reactions induced by 14-MeV neutrons in nuclei with the magic number Z = 28 of protons the cross sections are several times larger than those calculated by the statistical theory, if the level-density function is taken in the form $\exp(au)^{1/2}$ and the influence of the evenness of N and of Z on the density of the levels is taken into account by the Cameron δ-quantities.[2]

In the present paper we present an analogous comparison of the experimental results for (n, p) and (n, 2n) reactions with the theoretical ones in the case of Z = 50. The cross sections were measured by the method of induced β activity. The calibration reactions were Cu^{63}(n, 2n) (σ = 552 mb) and Al^{27}(n, p) (σ = 73 mb). The separation of the activities due to the (n, p) and (n, 2n) reactions on Sn^{112} was carried out analytically. To this end we used the decay schemes of Dzelepov and Peker[3]. The results are listed in the table. The experimental accuracy is not worse than 20%.

For the reaction $Sn^{124}(n, 2n)Sn^{123}$ it is possible to determine the cross section only on the ground level of Sn^{123}, owing to the large half-life of the isomer level (125 days). The ratio of the cross section on the metastable level (σ_m) to the cross section on the ground level (σ_g) is not more than 1.1, since the cross section for the neutron capture is 1900 mb. The calculated ratios of the cross sections imply that $\sigma_m/\sigma_g = (2I_m+1)/(2I_g+1)$, where I_m and I_g are the spins of the corresponding levels. As can be seen from the

Reaction	σ_{exp}, mb	σ_{calc}, mb	Data by others	$\sigma_{exp}/\sigma_{calc}$	σ_m/σ_g calc
$Sn^{112}(n, 2n)Sn^{111}$	1610	1660	1500±7 % [4]*	1	
$Sn^{124}(n, 2n)Sn^{123g}$	900	450		2	3
$Sn^{112}(n, p)In^{112}$	145	35		4	3
$Sn^{112}(n, p)In^{112m}$	100	27			
$Sn^{117}(n, p)In^{117}$	23	2		11.5	

*Measured by the annihilation method.