PARAMETERS OF THE ^{125}Te COMPOUND STATE CASCADE γ-DECAY

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Abstract

Reliable information on level density ρ and radiative strength functions k for the excitation energy region with density of excited states $\approx 10^2 MeV^{-1}$ and higher can be obtained now only by its model-free extraction from intensities $I_{\gamma\gamma}$ of two-step cascades proceeding between compound states and few low-lying levels. Full model-free determination of ρ and k in any method is possible only if one can extract from additional experimental information about general trend in dependence of ratio of strength functions of emitted reaction products of a given type on excitation energy E_{ex} of the nucleus under study.

Analysis of the available experimental data for ^{125}Te shows that the peculiarities observed earlier in other nuclei are also inherent to this nucleus.

1 Introduction

Level density ρ and strength functions of emission the nuclear reaction products are, first all, the test for any nuclear models. Naturally, confidence level of experimental values of these parameters should be high enough. If confidence of experimental level density in the regions of neutron resonanses and low-lying levels is extremely high than the contrary situation is observed out of this region of nuclear excitation. The same can be said about the radiative strength functions k of the primary gamma-transitions of the compound states decay and strength functions S of emission of products in different nuclear reactions. This discrepancy is completely caused by different ways of determination ρ in the excitation energy regions where level spacing D is significantly larger or less than the resolution σ of spectrometers used in experiment. In the case $\sigma >> D$ and ρ, and k should be determined only simultaneously with the use of mathematics apparatus for solution of reverse problems. In the case under consideration, however, they don not have simple solution even in principle.

The situation gets complicated by that, for the long time, the only method to determine level density was its extraction from the spectra of evaporated nucleons in different nuclear reactions. Besides, this method requires the use of theoretical strength functions for emission of nucleons or light nuclei. They are to be determined in the frameworks of nuclear models with a precision exceeding required accuracy in determination of ρ.

Up to now, comparison between the experimental and calculated strength functions for reactions like (d,p) or (d,t) was performed up to the excitation energy of about a half of the neutron binding energy B_n (see, for example, [1]). It shows that the details of fragmentation process of any states of nuclear potential over real levels can be reproduced in calculation within modern nuclear models only with the error of about several hundreds percents. This is caused by both approaches of conventional models and uncertainties of

their parameterization. The scale of above errors follows, first of all, from un-removable and very significant discrepancy between the experimental and calculated energies even for the most low-lying levels of the simplest structure.

Similar problems arise and in the analysis of the gamma-ray spectra from any nuclear reaction where product nucleus is excited up to 5-8 MeV and higher. In spite of existence of the advanced enough models of the radiative strength functions, the accuracy of the predicted by them k values primary transitions with low energy E_γ is really unknown. This requires one to develop new, model independent methods for simultaneous determination ρ and k values with high enough precision.

In this case the most serious problem is the necessity to extract information about general trend in dependence of strength functions ratio on excitation energy E_{ex} for given type of emitted reaction products from complementary experiment. This problem is partially solved [2] only in analysis of the experimental intensities $I_{\gamma\gamma}$ of two-step cascades proceeding between compound states and low-lying levels and gamma-ray intensities in single spectra measured with Ge detectors. Earlier version [3] of this method used zero assumption about independence of energy dependence of strength functions on the energy E_{ex} of decaying level. Of course, this led to additional (although small enough) systematic errors of determined ρ and k.

That is why, one can conclude: reliable information on level density ρ and radiative strength functions k for the excitation energy region with density of excited states $\approx 10^2 MeV^{-1}$ and higher can be obtained now only in the frameworks of method [2]. The advantages of method [2] over other known methods to determine level density [4] and radiative strength functions [5] are stipulated by the following:

a) the dependence of $I_{\gamma\gamma}$ on absolute level densities (in other methods, the spectra do not depend on absolute values of ρ and k);

b) the smallest systematic errors of two-step cascade spectra $\delta I_{\gamma\gamma}$ as compared with spectra of all known methods of determination of ρ and k;

c) much smaller transfer coefficients of systematic errors of measured intensities to the parameter errors $\delta\rho$ and δk;

d) practically unique fixation of the spin interval of excited levels;

e) although functional dependence of the two-step cascade intensity on level density and radiative strength functions cannot be simple but the interval of possible variations of ρ and k is always limited by several tens percent under condition that the $I_{\gamma\gamma}$ value used in [2] is [6] is the function of only of energy of the cascade primary transition E_1.

2 Possibility to estimate the shape of dependence $k(E_\gamma, E_{ex})$

Comparison of intensities $i_{\gamma\gamma}$ of the two-step cascades proceeding through given intermediate levels E_i with independently determined [7] intensities of the primary i_1 and secondary i_2 transitions allows determination of cascade population $P - i_1 = (i_1 \times i_2/i_{\gamma\gamma}) - i_1$ for a set of levels of any nucleus up to the excitation energy $2 - 4$ MeV and higher. In practice, its error cannot exceed the total error in determination of i_2 ($\approx 20 - 25\%$ even for relatively weak cascades or gamma-transitions). This parameter is very sensitive to the shape of dependence of $k(E_\gamma, E_{ex})$ on E_{ex}. Moreover, the ratio $k(E_\gamma, E_{ex})/k(E_\gamma, B_n)$

for gamma-transitions with equal energy and multipolarity, to the first approach, can be simply enough estimated [2] from calculation of population within different level density and strength function models.

There is no possibility to determine population of all without exclusion cascade intermediate levels E_i even at low excitation owing to the presence of registration threshold for intensities $i_{\gamma\gamma}$, i_1 and i_2. The Porter-Thomas fluctuations of the primary transition intensities and possible dependence of population of levels on structure of their wave functions complicate comparison between the experimental and calculated values of P for individual cascades and choice of adequate to the experiment models and hypotheses.

It is worthwhile to compare cascade populations summed in small intervals of excitation energy. These sums should be considered as the lower estimations for every interval.

The extent of discrepancy between the calculated population $P - i_1$ and its lover estimation is determined by both incompleteness of data on intensities of cascades and transitions and possible strong influence of structure of wave function of excited level on probability of its cascade population. This permits on to estimate [2] the dependence of k on E_{ex}.

3 Systematic errors in determination of experimental population of levels

To achieve high confidence level of ρ and k derived [2] from cascade intensities with the use of cascade population of levels it is necessary:

to get large enough set of experimental data on the intensities $i_{\gamma\gamma}$, i_1 and i_2 with small enough errors;

to determine the quantum ordering in cascades with minimum number of false assignments.

Extraction of individual cascades as pairs of resolved peaks with minimum registration threshold is affected by the following sources of systematic errors:

a) random grouping of events in resulting spectrum (result of background extraction) in pairs of false peaks;

b) registration of three-step cascades with pair of detectors in full-energy peaks.

The minimum statistics error in determination of peak areas in spectra with fixed total energy $E_1 + E_2 = B_n - E_f$ is provided by the use numerical method [8] for improving resolution without decreasing of efficiency. As a result, each spectrum is symmetrical with respect of its center. In the frameworks of obvious assumption that the probability of formation of random peaks in the region of negative or positive number of events is equal than analysis of part of spectrum with negative number of events provides rather objective determination of minimal cascade intensities which guarantee very small probability to obtain false value of $i_{\gamma\gamma}$.

A part of background events relates to registration of cascade with higher total energy so that one quantum is registered in the full-energy peak and another – in Compton background. Application of method [8] leads to formation of specific sign-variable structures with zero mathematics expectation of their areas. They may mask true cascades. Identification and minimization [9] of total area of these structures does not find any difficulties

because determination of parameters of intense cascade with higher energy is simple, as well.

Probability of registration of any cascade quantum with $E_\gamma \geq 0.5$ MeV in full-energy peak in performed experiment does not exceed 1% per 1 emitted gamma-quantum. Three-step cascades total intensity (in sum with two-step cascades with one pure quadrupole quantum) can be estimated from part of events corresponding to possible cascades to final levels with spin difference $|J_i - J_f| = 3$. In all 50 nuclei studied by us it does not exceed several tenths of percent per decay.

Due to multitude of variants of gamma-transition energies in three-step cascades, these events form wide spectrum of peaks of some amplitude. This amplitude is inversely proportional to number of variants. That is why, maximum absolute intensity of three-step cascade with given energy of the third quantum, most probably, cannot exceed $\sim 10^{-4}$ of decays. The effect quickly decreases as increasing the energy E_f of level populated by the pair of previous transitions. Therefore, distortions of the obtained $P - i_1$ values owing to registration of three-step cascades and corresponding increase in $i_{\gamma\gamma}$ are negligible in the nuclear excitation energy region $E_{ex} > 2 - 3$ MeV. But just this region demonstrates maximum influence of nuclear structure on the shape of energy dependence of radiative strength functions.

Some difficulties in determination of $P - i_1$ are made by unresolved in traditional [7] experiment doublets of cascade secondary transitions i_2. Difficulties related to doublets of primary transitions are some less due to less density of peaks in high-energy part of corresponding spectra. Partially, multiplets can be identified and resolved within the approximation procedure of single $HPGe$ detector spectra when studying the thermal neutron radiative capture with the use of information on two-step cascades and evaluated decay schemes. Besides, intensity i_2 can be distributed between cascades – members of multiplets – proportionally to $i_{\gamma\gamma}$. But it is preferable to exclude such events from the procedure of determining P if the data on $i_{\gamma\gamma}$, i_1 and i_2 for any cascade intermediate level are superfluous.

Another problem is made by overlapping of peaks in γ-ray spectra following thermal neutron radiative capture, especially in the region in the vicinity of $E_\gamma \approx 0.5B_n$. This leads to additional underestimation of intensities i_1, i_2 and population of level. This underestimation increases when energy of the level under consideration increases, too.

Spectroscopic data derived from cascade intensities have the highest confidence because the statistics stored provides true variant of the Ritz combinatorial principle at the level of 98-99% or more. In practice, all events of false coincidences of gamma-quanta sum energies of different cascades with the difference of level energies are excluded from data acquisition by electronics.

The main uncertainty in the obtained decay schemes in nuclei with any level density is related with impossibility of experimental determination of life time of cascade intermediate level and, respectively, quantum ordering in it. The maximum likelihood method [10] for its determination cannot provide errorless choice of position of cascade intermediate level from two variants. Minimization of this error can be achieved only at accounting for all the complex [11] of spectroscopic information stored for the nucleus under study.

All the data used for determination of P values are listed in table.

4 Reproduction of experimental level population in calculations

Experimental and calculated level populations can be compared in two variants:

the total population of each of N_i intermediate levels (including intensities of populating them primary transitions) is compared (Fig. 1) with several variants of calculation;

experimental results are compared (Fig. 2) with cascade population summed over 200 keV excitation energy intervals of cascade intermediate levels.

The necessity of the use of both variants is stipulated, first of all, by the registration threshold for cascades which limits experimental information on possible levels of a nucleus under study. Besides, the errors in determination of $i_{\gamma\gamma}$, i_1 and i_2 sometimes results in negative values of $P - i_1$ (this strongly manifests itself at small as compared with i1 cascade population of level). Moreover, the total population P of levels depends on model values of level densities and radiative strength functions sufficiently less than the cascade population $P - i_1$. This occurs owing to compensation of effect on population of decrease, for instance, in ρ by increase in k for the cascade primary transitions. (Total gamma-width of compound state is constant value).

Therefore, comparison between the experiment and model calculation only for summed $P - i_1$ values cannot give complete picture of the process. Complementary but qualitative confirmation for significant discrepancy between the calculation and experiment is provided by comparison of total population of levels.

There is a number of energy dependencies of strength functions and level densities being suitable for calculation of $P - i_1$. But general regularities of change in level population as changing level excitation energy can be revealed using only three variants of calculation:

(a) the level density is described by any (for example, [12]) model of non-interacting Fermi-gas, strength function for $E1$ transitions is set by known [13,14] extrapolations of the giant electric dipole resonance into the region below B_n and $k(M1)$=const with normalization of the ratio $k(M1)/k(E1)$ to the experiment in the vicinity of B_n;

(b) the calculation uses ρ and k values obtained according to [3] and providing precise description of energy dependence of two-step cascade intensities (at present only for the cascade final levels with $E_f < 1$ MeV);

(c) in the calculation there are involved level densities and strength functions providing simultaneous and precise ($\chi^2/f << 1$) description of $I_{\gamma\gamma} = F(E_1)$ (Fig. 3), total radiative width $\Gamma_\gamma$of decaying compound state and total cascade populations $P - i_1$.

Variant (c) can be realized in iterative regime: for the data obtained according to [3], there is chosen some functional dependence which changes strength functions for secondary transitions with respect to strength function [3] so that better to reproduce $P - i_1$ values. For this, it is quite enough to multiply strength functions of secondary gamma-transitions to the levels below some fixed energy by the function h which contains several narrow peaks. Dependence of their form on the nuclear excitation energy can be determined by analogy with specific heat of ideal microsystems in the vicinity of point of the second order phase transition as the following:

$$h = 1 + \alpha \times (ln(|U_c - U_1|) - ln(|U_c - U|)) \quad if \quad U < U_c, \tag{1}$$

$$h = 1 + \alpha \times (ln(|U_c - U_2|) - ln(|U_c - U|)) \;\; if \;\; U > U_c, \qquad (2)$$

with some parameters α, U_1, U_2 U_c.

Condition $(U_c - U_1) \neq (U_2 - U_c)$ provides asymmetry of peaks and more precise description of cascade population as compared, for instance, with the Lorentz curve. In the best variant tested by us, the amplitude α must grow from zero (linearly, for example) up to the maximally possible value shown on fig. 4 as the excitation energy U decreases from $U = B_n$ to $U = U_c$. Positions of peaks, their form and amplitude are determined by the $P - i_1$ values. Unfortunately, more precise notions about the shape of energy dependence of radiative strength functions of given multipolarity cannot be derived from this analysis.

Population of the level l is calculated according to equation

$$P_l = \sum_m P_m \times \Gamma_{m,l}/\Gamma_m, \qquad (3)$$

It depends on population P_m of all the higher-lying levels m and branching ratio at their decay. Although the data in figs.1 and 2 depend on both multiplicands in eq.(3) but P_l values for different low-lying levels are mainly determined by ratio of partial widths $\Gamma_{m,l}$ of populating them secondary transitions. Equation (3) cannot provide other possibility for significant increase of calculated population of high-lying levels when population of low-lying level decreases.

The obtained corrective functions are then involved in analysis [3] to derive ρ and k parameters which allow precise reproduction of cascade intensities with accounting for assumed difference in energy dependence of strength functions for primary and secondary cascade transitions. Values of $i_{\gamma\gamma}$ are shown in Fig. 3, re- determined level densities and radiative strength functions are presented in figs. 4 and 5. If it is necessary, this procedure is repeated one times with the use of the hypothesis of linearly increasing distortions of the $k(E1)$ and $k(M1)$ values when energy of decaying levels decreases and several times for hypothesis h=const. For minimization of number of fitted parameters, corrective functions in figs. 4 and 5 were supposed equal for both electric and magnetic gamma-transitions.

It should be noted, that the population of levels lying below "step-like" structures in level density cannot be reproduced without assumption about decrease in corresponding radiative strength functions also in sum energy interval. On the whole, function h at least qualitatively repeats the most general shape of dependence obtained according to [3], in practice, for all nuclei: significant increase in k for gamma- transitions to levels from the region of "step-like" structures and decrease for gamma-transitions to lower-lying levels. If these regularities do not have alternative (unknown) explanation, then simple extrapolation of the obtained results into the region $E_{ex} > B_n$ allows conclusion about possible analogous energy dependence of radiative strength functions and for primary gamma-transitions following fast neutron radiative capture. And, as a consequence, about necessity of both experimental test of models of radiative strength functions and level densities for these excitation regions and modification (to more or less extension) of algorithms for calculation and evaluation of corresponding cross-sections.

The open question is evident discrepancy between the experimental and calculated results in figs. 1 and 2. It cannot be removed in the frameworks of assumption about independence of the averaged partial width of gamma-transitions populating some levels

on structure of wave functions of these levels. This results from very big difference in calculated and experimental total populations P, for example, in the interval 3.0-3.5 MeV.

For 30 observed here (Fig. 1) from 100 expected (Fig. 4) levels, experimental population is approximately 9 times larger than the results of the best variant of calculation. This contradiction cannot be related only to the Porter-Thomas fluctuations of the widths of primary transitions populating the levels: probability of such or bigger random divergence P for one level equals ~ 0.001. The only realistic explanation is assumption about strong dependence of population of level on its structure. For example, nucleus may have two or more systems of levels of different structure. Then the mean values of ρ and k (figs. 4 and 5) cannot be considered as the mean arithmetic values. Conventional theoretical notions do not take into account this possibility. But it naturally follows from interpretation of the data presented in figs. 4 and 5.

A number the used hypotheses is inevitable at the achieved stage of the problem under solution. In this case, all the conclusions about the cascade gamma-decay process of compound state is to be considered, most probably, as qualitative than as quantitative. So, clearly expressed "step-like" structure in level density and related with it increase in $k(E1) + k(M1)$ (Fig. 4) should be considered as established with high confidence level. But the number and shape of these "steps", most probably, can be determined only in the further experiments. The same can be said about corrective functions h. If energy region corresponding to significant increase in k for the second, third and so on cascade transitions (due to the number of tested variants) calls no doubts then parameters of function h have to be considered, most probably, as very preliminary. They should be used, first of all, for planning of corrective experiments.

In this sense, the region $h < 1$ is very demonstrative. Whether the strength of gamma-transitions is re- distributed from the lower-lying levels populated by them to higher-lying or this structure of h provides only narrowing of width of the region of maximum increase in $k(E1) + k(M1)$ values in Fig. 4 – nobody can answer this question. But it should be noted that we could not reproduce observed values $P - i_1$ for all available set of nuclei without significant decrease in k.

The fact that only the lower estimation of $P - i_1$ was obtained in the experiment cannot be possible explanation. So, at low excitation energy the difference the numbers of intermediate cascade levels and levels from evaluated decay schemes decreases (due to increase in the mean intensity of cascades at practically constant threshold of their registration). This means that experimental $P - i_1$ (Fig. 2) must increase with respect to values shown in fig. 2 as increasing excitation energy and decreasing in registration thresholds for $i_{\gamma\gamma}$, i_1 and i_2. As a consequence, the difference in energy dependence of strength functions for the primary and secondary transitions must increase strength functions of gamma-transitions to high-lying levels must intensify.

Specific dependence of the product $k \times h$ (local peaks in the second multiplicand) qualitatively corresponds to theoretical [15] regularities of fragmentation of the state of any structure over nuclear levels. One of the important conclusion of this theoretical analysis is that the strength of an state (N quasi-particles and M phonons) concentrates in asymmetric peaks of limited width with "tails" in the region of high excitation energy.

5 The most probable values of level density and radiative strength functions of cascade γ-transitions in ^{125}Te

The method described above provides determination of model-free, rather precise and confident values of ρ and k. Unfortunately, in addition to some sources of possible systematic errors discussed above their values can include errors that are specific for different nuclei. For example, absolute value of k can be distorted by local deviation of the neutron resonance density from its general tendency owing to possible but not taking into account in calculated values of $I_{\gamma\gamma}$ structure effects. Or owing to possible correlations of partial radiative widths of cascade transitions and reduced neutron width which determines the main part of neutron capture cross-section. Similar correlations can change the ratio between intensities of cascades proceeding through intermediate levels with different structure and lead to additional error in ρ and k.

Analysis [2] of the available experimental data [7,16] for ^{125}Te shows that the peculiarities observed earlier in other studied nuclei manifest themselves in this nucleus, as well. There are:

two "step-like" structures in the energy dependence of ρ and

correlating with their positions variations in shape of energy dependence of k.

The data on significant increase in radiative strength functions of secondary transitions, in practice, in the same energy interval as for primary transitions should be considered as one more additional confirmation for existence in a nucleus of the excitation energy region where occurs abrupt change of its structure. One can assume that there is transition from domination of vibrational type excitations to domination of quasi- particle excitations. Apparently, this fact can be interpreted as the phase transition from super-fluid to normal state of such very specific system as a nucleus. Probably, this effect is related to breaking of the only nucleon pair [17] at the excitation energy corresponding to radical increase in level density.

6 Conclusion

The data on investigating properties of ^{125}Te are in good agreement with analogous results obtained earlier. One can consider them as preliminary indication at possible phase transition related, most probably, with breaking of one Cooper pair in the region beside $0.5B_n$ and the next one approximately on 2 MeV higher. Quantitative information on intensifying strength functions of the secondary gamma-transitions in given excitation energy interval of the nucleus can be useful for planning more detailed experiments on direct investigations of dynamics of breaking of Cooper pairs in different nuclei. Unlike any known super-fluid macrosystems, nuclei are the limited and heterogeneous according to type of statistics and magnitude of inner energy of Cooper pair with respect to the Fermi energy.

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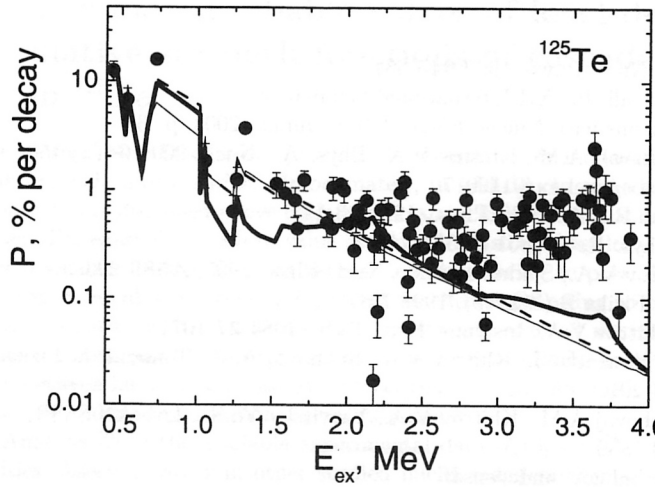

Fig. 1. *The total population of two-step cascades intermediate levels (points with bars), thin curve represents calculation within models [12,14]. Dashed curve shows results of calculation using data [3]. Thick curve shows results of calculation using level density [3], and corresponding strength functions of secondary transitions are multiplied by function h set by equations (1) and (2).*

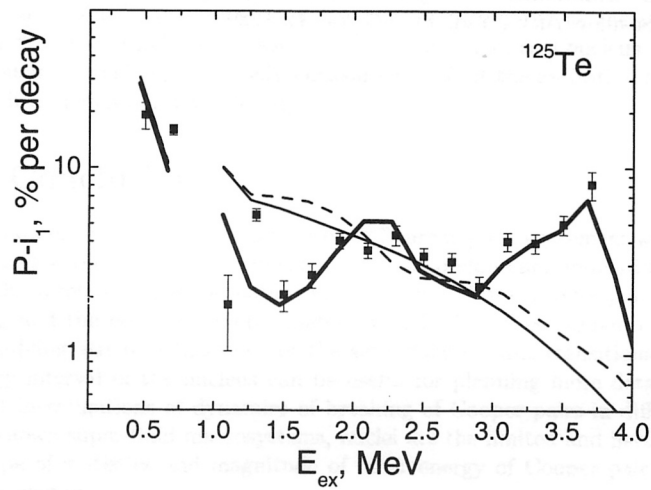

Fig. 2. *The same, as in Fig. 1, for the cascade population of levels in the 200 keV energy bins.*

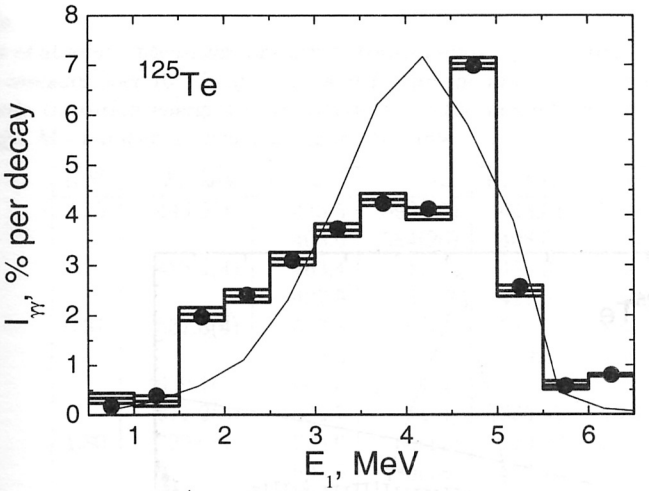

Fig. 3. *Histogram is the intensity of the two-step cascade in function of the energy of their primary transitions with statistical errors only. Line is the calculation in frame of models [12,14]. Points are the typical fit by the most probable ρ and k.*

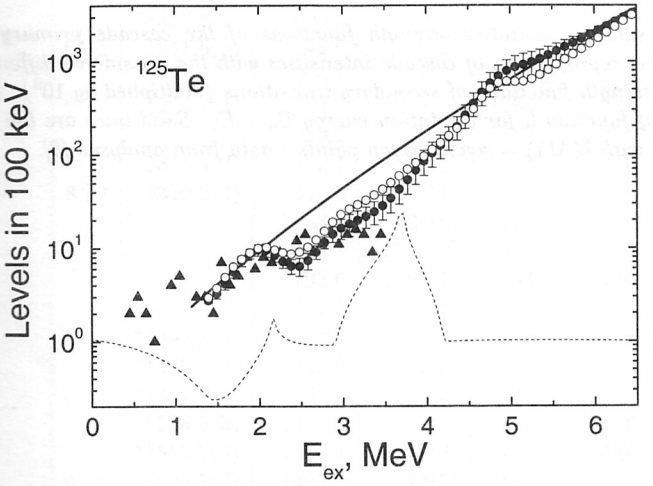

Fig. 4. *The number of intermediate levels of two-step cascades in the case of different functional dependence of strength functions for primary and secondary cascade transitions. Dashed line shows values of function h for excitation energy $B_n - E_1$. Solid line represents predictions according to model [12]. Triangles are the number intermediate levels of obtained two-step cascades. Open points - data from analyses [3].*

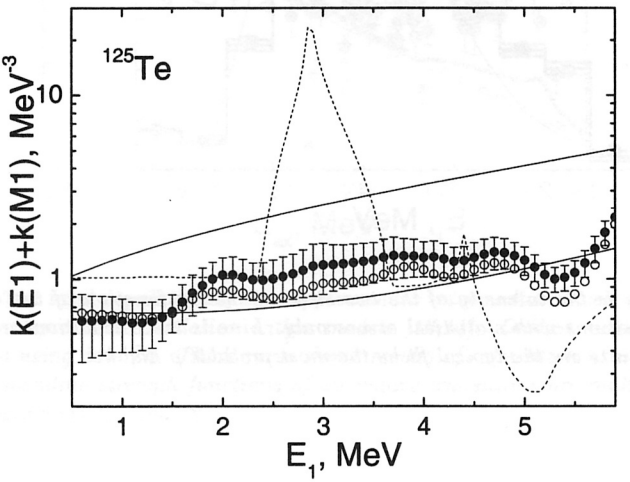

Fig. 5. *The sums of radiative strength functions of the cascade primary dipo transitions providing reproduction of cascade intensities with the considered difference their values with strength functions of secondary transitions (multiplied by* 10^9*). Dash line shows values of function h for excitation energy* $B_n - E_1$*. Solid lines are the mod [13,14] predictions with* $k(M1) = const$*. Open points - data from analysus [3].*

Table.
A list of absolute intensities for cascade transitions i_1, i_2 and intensity $i_{\gamma\gamma}$ of measured two-step cascades (per 10^5 decays). E_i and E_2 are the intermediate level and the secondary cascade transition energies respectively, E_s is the possible secondary cascade quantum energy. M - number of their placing in the table.

i_1,%	E_i, keV	E_2, keV	$i_{\gamma\gamma}$	E_s, keV	i_2, %	M
1.15	443.5(4)	443.5	590(17)	443.53	8.80	
		408.0	584(26)	408.04	5.20	
	463.4(4)	463.4	11(3)	463.35	2.30	
		427.9	35(7)	427.85	6.40	
0.31	537.8(4)	537.8	196(12)	537.79	5.80	
		502.3	107(29)	502.3	3.30	2
	*639.1(3)	603.6	14(4)			
	671.2(3)	635.7	14(4)	635.91	4.20	
1.80	729.0(4)	729.0	260(11)	729.22	1.59	
		693.5	480(18)	693.72	5.73	
	*954.4(4)	954.4	7(2)			
	1016.9(4)	981.4	5(2)	981.7	0.08	
0.10	1054.5(7)	1054.5	7(2)			
		1019.0	8(2)			
		611.0	46(13)	610.22	0.94	
0.08	1064.6(15)	1064.6	13(3)			
		1029.1	6(2)	1029.3	0.07	
		539.2	19(6)			
	1071.6(4)	546.2	16(5)	546.56	3.10	
	*1232.8(1)	695.0	73(8)			
0.07	1241.6(8)	1241.6	12(3)	1241.1	0.12	
		1206.1	16(4)	1207.29	1.12	
0.14	1264.7(4)	1264.7	8(3)	1264.91	0.08	
		1229.2	77(7)	1229.67	0.87	2
	1315.4(3)	852.1	19(5)	851.9	0.04	
3.70	1319.0(3)	1319.0	169(11)	1319.5	0.36	2
		1283.5	162(10)	1284.2	0.45	2
		855.7	224(13)	856.18	0.36	2
		793.6	1788(51)	794.22	3.02	
		381.1	3(1)			
	*1394.8(5)	1394.8	6(2)	1395.4	0.06	
	*1446.6(5)	1446.6	7(2)			
	*1474.7(5)	1031.2	9(3)	1030.92	0.61	
	*1514.5(5)	1479.0	8(3)	1477.8	0.05	2
	*1517.7(5)	1054.4	7(3)	1054.2	0.06	
0.14	1528.7(7)	1493.2	23(5)	1493.3	0.78	3
		1085.2	33(4)	1086.1	0.29	
		1065.4	32(3)	1066.29	0.66	2
	*1544.3(5)	1100.8	9(3)			
	*1571.7(4)	1128.2	9(3)			

i_1,%	E_i, keV	E_2, keV	$i_{\gamma\gamma}$	E_s, keV	i_2, %	M
	*1582.8(9)	1139.3	12(3)	1139.6	0.06	
		1119.5	7(3)			
0.23	1587.2(12)	1587.2	120(8)	1587.27	0.73	
		1551.7	16(3)	1551.8	0.08	
		1143.7	33(4)	1143.9	0.09	
		1123.9	14(3)	1123.3	0.06	
		1061.8	8(3)			
		858.0	15(2)	858.5	0.04	
0.09	1652.5(9)	1114.7	13(3)	1115.2	0.07	
		923.3	23(3)	923.29	0.29	
		331.4	16(6)			
	*1658.7(4)	1658.7	9(3)			
0.07	1669.6(2)	1669.6	28(4)	1669.9	0.31	
		1131.8	18(3)	1132.4	0.25	
		998.2	10(2)	998.5	0.11	
		940.4	19(3)	940.9	0.16	2
	*1682.6(4)	1011.2	6(2)	1010.5	0.05	
	*1709.0(4)	1673.5	10(3)			
0.22	1713.0(3)	1713.0	25(4)	1713.4	0.37	2
		1677.5	20(5)	1678.2	0.15	
		1269.5	58(8)	1269.9	0.23	
		1175.2	8(3)	1175.5	0.21	3
		1041.6	18(3)	1042.1	0.19	
		983.8	55(4)	984.33	0.29	
	*1738.6(4)	1067.2	7(2)	1066.29	0.66	2
	1767.8(3)	1230.0	11(3)	1229.67	0.87	2
	*1788.7(5)	1788.7	8(3)	1788.0	0.20	2
	*1800.7(5)	1765.2	10(4)	1766.2	0.14	
	1824.4(10)	1788.9	10(4)	1788.0	0.20	2
		1286.6	10(3)	1286.6	0.13	2
		503.3	243(64)	502.3	3.30	2
	1829.8(13)	1829.8	15(5)	1829.7	0.22	
		1794.3	15(5)	1795.1	0.19	2
		1386.3	16(4)	1385.8	0.11	
		1292.0	9(3)			
0.14	1863.6(12)	1863.6	66(9)	1863.6	0.38	2
		1828.1	14(4)	1827.3	0.10	
		1420.1	12(5)	1418.89	0.60	2
		1421.4	49(9)	1421.6	0.17	2
	*1893.7(5)	1164.5	7(3)			
0.08	1898.8(4)	1863.3	24(5)	1863.6	0.38	2
		1455.3	24(5)	1455.4	0.22	
		1452.9	18(5)	1452.9	0.11	
0.15	1904.3(3)	1904.3	38(7)	1905.4	0.38	
		1868.8	10(4)	1868.3	0.15	

i_1,%	E_i, keV	E_2, keV	$i_{\gamma\gamma}$	E_s, keV	i_2, %	M
		1460.8	42(5)	1461.36	0.35	
		1366.5	25(8)	1367.2	0.16	
		1175.1	19(3)	1175.5	0.21	3
	1913.6(4)	1878.1	14(4)	1878.5	0.11	
	1918.7(9)	1918.7	23(6)	1919.6	0.22	2
		1883.2	12(4)	1882.5	0.13	
	*1922.4(4)	1886.9	13(4)	1886.2	0.07	
4.20	1956.0(2)	1956.0	2226(49)	1956.73	2.80	
		1920.5	181(18)	1921.6	0.42	
		1492.7	613(60)	1493.3	0.78	3
		1418.2	512(32)	1418.89	0.60	2
0.62	1978.0(2)	1978.0	245(17)	1978.76	0.50	2
		1942.5	28(7)	1942.8	0.10	
		1440.2	220(22)	1440.94	0.49	
		1306.6	15(4)	1307.26	0.55	2
	*2005.5(4)	1334.1	19(5)			
1.80	2008.7(3)	2008.7	1145(36)	2009.3	1.50	2
		1973.2	100(13)	1973.9	0.19	
		1470.9	58(12)	1470.6	0.03	
		1337.3	78(9)	1338.1	0.21	2
		936.8	281(16)	937.47	0.30	2
	2011.1(3)	939.2	40(11)	940.9	0.16	2
	2043.6(5)	2008.1	14(5)	2009.3	1.50	2
0.04	2049.0(4)	1605.5	22(7)	1606.0	0.27	
		1319.8	16(4)	1319.5	0.36	2
0.22	2060.4(3)	2024.9	13(5)	2025.5	0.08	
		1616.9	152(14)	1617.51	0.50	
		1522.6	24(6)	1522.4	0.08	
		1331.2	12(4)			
0.25	2076.3(3)	2076.3	129(13)	2077.0	0.49	2
		2040.8	20(5)	2041.5	0.16	
		1538.5	12(4)	1538.7	0.07	
		1347.1	15(4)	1347.9	0.07	
		1004.4	30(5)	1005.2	0.07	
	*2091.4(3)	1420.0	17(4)	1421.6	0.17	2
0.67	2107.8(5)	2107.8	108(12)	2108.4	0.25	
		2072.3	89(10)	2073.1	0.27	
		1664.3	107(13)	1664.7	0.12	
		1570.0	12(4)			
		1035.9	287(13)	1036.73	0.39	
0.50	2129.0(2)	2093.5	217(15)	2094.1	0.56	2
		1685.5	162(16)	1686.2	0.36	
		1591.2	43(7)	1591.8	0.12	
		1057.1	22(5)	1057.5	0.09	
	*2164.6(5)	1493.2	13(5)	1494.7	0.37	2

i_1,%	E_i, keV	E_2, keV	$i_{\gamma\gamma}$	E_s, keV	i_2, %	M
	2172.0(5)	2172.0	12(4)	2173.8	0.06	
0.04	2177.6(4)	856.5	27(7)	856.18	0.36	2
0.06	2181.4(4)	1737.9	25(7)	1738.4	0.24	
	*2199.2(4)	878.1	21(7)	878.3	0.04	
0.05	2203.0(6)	1131.1	24(8)	1130.5	0.06	
0.08	2221.6(20)	2186.1	19(6)	2186.7	0.36	2
		1758.3	15(5)	1756.6	0.13	
		1492.4	30(9)	1493.3	0.78	3
		900.5	25(7)			
0.61	2225.4(2)	2189.9	72(9)	2190.7	0.21	3
		1782.0	76(11)	1782.8	0.13	
		1762.2	50(8)	1763.4	0.09	
		1554.1	147(12)	1554.8	0.36	
0.07	2246.0(4)	2246.0	13(4)	2245.3	0.11	
		1174.1	19(5)	1175.5	0.21	3
	2259.6(5)	2224.1	13(5)			
		938.5	34(7)	937.47	0.30	2
0.09	2270.6(5)	2235.1	14(5)	2235.6	0.26	
	*2277.5(5)	1205.6	15(5)			
	2282.8(5)	2282.8	13(4)	2283.2	0.13	2
0.23	2314.3(11)	2314.3	24(5)			
		2278.8	16(5)	2278.2	0.07	
		1776.5	39(7)	1778.0	0.10	
		1242.4	34(5)	1242.92	0.44	
	2332.1(3)	2332.1	17(4)	2330.3	0.17	2
	2338.8(4)	2303.3	17(5)	2302.6	0.13	
		1017.7	27(7)	1018.36	0.31	
	*2341.9(4)	1020.8	23(7)			
0.25	2351.5(7)	2316.0	37(7)	2316.2	0.11	
		1680.1	25(5)	1680.1	0.19	
		1279.6	18(5)			
0.34	2379.1(2)	2379.1	37(6)	2380.0	0.25	
		1841.3	43(11)	1841.5	0.10	
		1707.7	19(5)	1708.9	0.12	
		1649.9	78(14)	1650.3	0.17	
		1307.2	14(5)	1307.26	0.55	2
	*2399.0(4)	2399.0	22(5)	2400.5	0.13	2
0.05	2403.3(6)	2403.3	11(4)	2402.9	0.32	2
		2370.0	49(7)	2370.2	0.23	2
0.06	2409.5(2)	1337.6	33(5)	1338.1	0.21	2
0.07	2414.4(4)	2414.4	12(4)	2415.3	0.08	
		1743.0	12(4)	1744.1	0.18	
		2379.7	20(6)	2378.1	0.07	2
0.05	2438.6(4)	2403.1	20(6)	2402.9	0.32	2
	*2454.9(4)	2419.4	19(5)	2419.4	0.23	

i_1,%	E_i, keV	E_2, keV	$i_{\gamma\gamma}$	E_s, keV	i_2, %	M
	*2461.9(5)	2461.9	17(5)	2460.8	0.21	
0.26	2466.2(2)	2466.2	68(8)	2467.03	0.13	
	(2)	1928.3	175(21)	1928.9	0.45	
		2430.7	77(11)	2430.4	0.13	
		2022.7	100(29)	2022.9	0.13	
		1794.8	92(9)	1795.1	0.19	2
	*2475.2(4)	2475.2	19(5)	2475.1	0.28	2
	2489.7(2)	1417.8	39(7)			
0.04	2503.7(4)	2468.2	16(5)	2469.6	0.11	
	*2510.2(4)	2474.7	16(5)	2475.1	0.28	2
	*2511.0(4)	2511.0	18(5)	2510.9	0.18	2
	2520.8(11)	2520.8	18(5)	2521.8	0.23	
		2485.3	18(5)	2485.8	0.05	
		2077.3	31(8)	2077.0	0.49	2
		1448.9	22(6)	1448.16	0.08	
	2529.4(4)	2493.9	15(5)	2495.4	0.19	
	2543.4(4)	2543.4	21(5)			
0.46	2549.5(4)	2549.5	84(9)	2550.8	0.39	3
		2514.0	63(10)	2514.6	0.12	
		2106.0	65(12)	2106.3	0.13	
		2011.7	72(12)			
		1477.6	23(6)	1477.8	0.05	2
		1228.4	74(12)			
	*2552.7(6)	2109.2	26(9)			
	2554.6(4)	2554.6	22(5)	2554.7	0.15	2
	*2557.2(4)	2093.9	26(8)	2094.1	0.56	2
0.10	2560.5(3)	2560.5	32(6)	2560.7	0.10	
0.41	2566.7(13)	2566.7	68(8)	2566.1	0.10	
		2531.2	121(13)	2532.8	0.24	2
		2123.2	83(12)	2122.4	0.08	2
		2103.4	37(9)	2103.4	0.12	
		2028.9	22(7)			
		1494.8	25(6)	1494.7	0.37	2
	*2579.9(3)	2579.9	25(6)	2577.9	0.13	2
0.49	2584.9(6)	2584.9	24(5)			
		2549.4	108(12)	2550.8	0.39	3
		2141.4	96(13)	2141.8	0.23	
		2121.6	20(7)	2122.4	0.08	2
		2047.1	68(11)	2047.3	0.41	
		1513.0	29(6)	1513.3	0.47	
0.32	2605.8(4)	2162.3	34(9)	2163.2	0.07	
		2068.0	18(6)	2068.0	0.15	
		2606.3	111(16)	2607.0	0.19	2
		2570.8	42(8)	2571.9	0.11	2
		1534.4	78(9)	1535.0	0.11	

i_1,%	E_i, keV	E_2, keV	$i_{\gamma\gamma}$	E_s, keV	i_2, %	M
		1285.2	49(13)	1284.2	0.45	2
		2609.0	60(16)	2609.6	0.45	2
		1287.9	34(12)	1286.6	0.13	2
	2641.8(5)	1320.7	35(11)	1322.8	0.19	
0.87	2649.0(7)	2649.0	18(5)			
		2613.5	55(9)	2614.3	0.17	
		2205.5	17(6)	2204.8	0.10	
		2185.7	299(17)	2184.7	0.08	
		2111.2	26(7)	2111.4	0.10	
		1977.6	24(9)	1978.76	0.50	2
		1919.8	57(13)	1919.6	0.22	2
		1577.1	177(14)	1578.0	0.28	
0.21	2672.9(2)	2672.9	97(11)	2674.2	0.35	2
0.12	2675.1(4)	2639.6	31(7)			
		2137.3	21(7)			
		2213.9	18(5)	2215.9	0.10	
0.13	2690.2(10)	2690.2	15(5)			
		2654.7	16(6)			
0.12	2705.1(2)	2669.6	58(9)	2670.6	0.19	2
	2726.0(5)	2282.5	24(6)	2281.2	0.10	
0.16	2728.6(10)	2728.6	54(8)	2730.6	0.31	4
		2693.1	16(6)	2692.8	0.19	
		2285.1	34(7)			
		2190.8	14(5)	2190.7	0.21	3
	*2746.1(4)	2746.1	19(5)			
0.07	2751.0(4)	2751.0	18(6)	2751.1	0.07	2
		2715.5	16(6)	2716.3	0.12	
0.08	2754.0(4)	2310.5	19(6)	2310.6	0.08	
		2216.2	25(6)	2218.4	0.10	2
	*2765.4(3)	2729.9	30(6)			
0.44	2770.4(2)	2770.4	80(10)			
		2734.9	60(8)	2735.5	0.15	
		2232.6	41(7)	2233.0	0.08	
		1698.5	81(11)	1698.5	0.30	
0.10	2775.7(2)	2332.2	54(8)	2333.1	0.31	2
0.44	2785.7(4)	2785.7	54(9)	2784.3	0.09	2
		2750.2	25(6)	2751.1	0.07	2
		2247.9	24(6)	2247.2	0.13	2
		1713.8	35(8)	1713.4	0.37	2
		1464.6	44(13)			
0.07	2791.1(5)	2755.6	11(4)			
	2801.9(5)	2766.4	13(5)	2767.3	0.05	2
	2813.8(10)	2370.3	21(6)			
		2276.0	18(6)	2275.7	0.08	
0.24	2818.8(4)	2783.3	35(6)	2784.3	0.09	2

i_1,%	E_i, keV	E_2, keV	$i_{\gamma\gamma}$	E_s, keV	i_2, %	M
		2355.5	22(6)	2355.7	0.08	
0.07	2821.0(4)	2377.5	17(6)			
		2149.6	19(6)	2149.9	0.13	
	*2827.1(4)	2827.1	19(5)			
	2842.3(5)	2304.5	14(5)			
	*2845.7(5)	2402.2	23(8)	2400.5	0.13	2
0.05	2854.8(3)	2854.8	39(8)	2854.2	0.16	
		2186.3	12(3)	2186.7	0.36	2
0.06	2861.6(3)	2861.6	42(8)			
0.05	2870.8(6)	2333.0	14(5)	2333.1	0.31	2
	2875.3(4)	2875.3	20(6)	2873.6	0.05	
	2881.4(12)	2845.9	16(5)	2846.3	0.23	
		2343.6	16(5)	2345.2	0.07	
	2888.6(5)	2350.8	16(5)	2351.8	0.16	
		2217.2	8(3)	2218.4	0.10	2
0.08	2897.7(4)	2897.7	16(5)	2898.0	0.16	
		2434.4	14(5)	2435.0	0.08	3
0.04	2907.9(4)	2370.1	18(5)			
0.10	*2916.2(2)	2916.2	86(12)			
0.18	2920.0(12)	2920.0	40(9)	2922.3	0.05	
		2884.5	46(8)	2885.0	0.05	
		2476.5	25(7)			
		2456.7	16(5)			
		2248.6	9(3)			
		2190.8	21(5)	2190.7	0.21	3
	2933.6(4)	2933.6	24(6)			
0.08	2936.8(3)	2901.3	34(7)			
0.16	2951.7(4)	2916.2	29(7)	2914.1	0.08	2
	2965.1(5)	2965.1	17(6)			
0.07	2972.1(10)	2972.1	22(6)			
		2434.3	25(6)			
		2939.1	26(7)	2940.0	0.05	
		2511.3	28(7)	2510.92	0.18	2
	*2978.8(5)	2943.3	17(6)	2943.5	0.06	
0.24	2990.8(6)	2990.8	55(9)	2990.0	0.12	
		2955.3	26(6)			
		2527.5	50(9)	2527.2	0.24	
		2319.4	10(4)	2317.9	0.09	
		2261.6	16(5)			
0.25	3002.2(4)	3002.2	26(7)			
		2966.7	35(7)			
		2538.9	97(11)			
		2464.4	12(4)			
		2330.8	22(4)			
		2273.0	35(6)	2273.4	0.12	

i_1,%	E_i, keV	E_2, keV	$i_{\gamma\gamma}$	E_s, keV	i_2, %	M
0.25	3013.0(5)	2549.7	18(5)	2550.8	0.39	3
		2475.2	13(4)	2477.0	0.10	
		2569.5	33(8)	2568.2	0.20	
		2981.1	34(7)	2980.4	0.19	2
		2078.7	(1)			
0.58	3021.1(4)	3021.1	49(7)	3022.3	0.09	
		2985.6	85(11)	2986.4	0.18	2
		2577.6	61(11)	2577.9	0.13	2
		2557.8	59(9)	2557.4	0.22	2
		2483.3	49(8)	2483.8	0.06	
		2349.7	13(4)	2348.2	0.06	
		1700.0	49(11)			
	*3052.1(4)	2608.6	34(8)			
	*3056.4(5)	2531.0	13(4)	2532.8	0.24	2
0.17	*3066.4(4)	3030.9	17(5)			
0.27	3070.1(3)	2606.8	28(6)			
		2400.4	20(4)			
		3073.5	15(4)			
		2630.0	24(8)	2630.6	0.06	
		2610.2	20(6)			
	3077.9(5)	3077.9	27(5)	3078.0	0.10	
		3042.4	13(5)	3043.7	0.12	2
		2406.5	10(4)	2408.3	0.11	2
	3088.3(7)	3052.8	12(4)			
		2416.9	18(4)			
	3098.5(3)	2369.3	22(5)			
0.61	3106.1(4)	3106.1	94(9)	3106.4	0.25	2
		3070.6	11(5)			
		2662.6	153(16)	2662.8	0.11	
		2642.8	50(8)			
		2568.3	43(7)	2568.7	0.20	
		2434.7	38(5)	2435.0	0.08	3
		2376.9	19(4)	2378.1	0.07	2
		2034.2	27(7)	2032.1	0.09	
0.15	*3109.9(4)	2572.1	25(6)	2571.9	0.11	2
0.07	3136.4(5)	2673.1	21(6)			
		2598.6	12(4)			
		2408.9	11(4)	2408.3	0.11	2
0.43	3142.8(11)	3142.8	41(7)	3142.5	0.15	
		3107.3	62(9)	3106.4	0.25	2
		2617.4	17(5)	2616.2	0.09	2
		2605.0	23(5)			
		2413.6	13(4)			
		2070.9	156(14)	2070.7	0.31	
		1821.7	33(11)			

i_1,%	E_i, keV	E_2, keV	$i_{\gamma\gamma}$	E_s, keV	i_2, %	M
	3149.7(5)	2624.3	13(5)			
	*3159.0(5)	2429.8	15(4)	2428.0	0.08	2
0.08	*3163.2(5)	2434.0	14(4)	2435.0	0.08	3
0.48	3172.9(8)	2729.4	26(8)	2730.6	0.31	4
		2709.6	15(5)			
		2443.7	17(4)			
		2502.8	16(4)	2500.5	0.04	
		2103.1	47(8)			
		2733.4	29(8)			
	*3178.2(6)	3142.7	22(7)			
0.24	3184.2(6)	3184.2	46(8)	3184.2	0.15	
		2658.8	19(6)	2659.3	0.06	
		2646.4	12(4)			
		2455.0	25(5)	2454.2	0.10	
0.07	3190.7(5)	2747.2	24(7)			
0.11	3195.0(4)	3195.0	17(5)	3192.7	0.05	
		2465.8	13(4)			
0.54	3208.2(4)	3208.2	96(11)	3207.8	0.14	
		2764.7	55(9)			
		3173.1	37(7)	3174.1	0.09	
		2745.3	40(12)			
		2479.4	18(5)	2480.1	0.21	
		1887.5	100(16)	1888.4	0.15	
0.17	3232.7(4)	2694.9	40(6)			
		1911.6	45(13)	1910.5	0.14	
		2771.0	15(5)	2770.5	0.10	2
0.13	3237.4(7)	3237.4	25(6)	3238.4	0.10	
		3201.9	19(6)			
0.13	3257.8(4)	2814.3	31(7)	2814.2	0.08	
0.12	3269.0(5)	2731.2	15(5)			
	3271.2(5)	2827.7	21(7)	2827.7	0.20	2
0.15	3277.6(13)	3277.6	83(10)	3278.4	0.29	
		3242.1	22(6)	3242.0	0.07	
		2739.8	17(5)	2740.8	0.13	
		2548.4	27(5)	2547.2	0.06	
		1956.5	83(15)			
	*3280.0(6)	2608.6	10(4)	2609.6	0.45	2
	*3286.8(3)	2557.6	18(4)	2557.4	0.22	2
	*3287.6(5)	2616.2	10(4)	2616.2	0.09	2
0.29	3292.6(10)	2767.2	18(6)	2767.3	0.05	2
		1971.5	74(15)	1971.6	0.11	
	3295.9(5)	2852.4	24(7)			
0.09	3305.4(5)	2861.9	20(7)			
		2634.0	11(4)	2633.5	0.10	
0.18	*3315.8(5)	2644.4	11(4)	2644.6	0.17	2

i_1,%	E_i, keV	E_2, keV	$i_{\gamma\gamma}$	E_s, keV	i_2, %	M
	*3337.4(4)	2799.6	18(5)	2799.3	0.16	
0.15	3345.8(14)	3345.8	23(6)	3345.3	0.05	
		3310.3	29(8)	3311.9	0.13	
		2902.3	42(9)	2902.4	0.12	
		2674.4	13(4)			
0.34	3350.4(12)	3350.4	101(11)	3350.3	0.16	
		3314.9	022(7)			
		2906.9	34(9)	2906.1	0.05	2
		2812.6	29(6)			
		2679.0	10(4)	2678.4	0.27	
0.17	*3358.8(3)	2915.3	57(10)	2914.1	0.08	2
	*3365.6(4)	2827.8	24(6)			
0.04	3387.4(4)	2849.6	20(6)			
	*3396.7(6)	2933.4	13(5)	2933.2	0.20	2
	3400.7(7)	2957.2	32(9)	2956.1	0.50	2
		2862.9	18(5)			
		2729.3	16(4)	2730.6	0.31	4
		2671.5	22(6)	2670.6	0.19	2
0.15	3404.5(5)	2675.3	18(6)	2674.2	0.35	2
		2333.4	16(6)	2335.8	0.12	
	*3414.0(4)	2876.2	19(6)	2876.9	0.17	
0.15	3425.8(4)	2754.4	11(4)			
		2696.6	16(5)	2696.6	0.21	
		2963.5	47(8)	2964.6	0.18	
0.47	3430.1(3)	3430.1	39(6)	3432.1	0.07	
		3394.6	249(18)	3394.5	0.48	
		2986.6	36(11)	2986.4	0.18	2
		2892.3	24(6)	2894.0	0.16	
		2758.7	15(4)			
		2700.9	13(5)	2699.0	0.26	
0.06	3439.1(6)	3403.6	20(6)	3405.6	0.08	
		2901.3	17(6)			
0.27	3443.6(6)	3408.1	21(6)			
		3000.1	28(8)			
		2980.3	15(5)	2980.4	0.19	2
		2905.8	44(8)			
		2371.7	19(6)			
0.25	3462.5(3)	3019.0	24(8)			
		2791.1	15(4)	2792.9	0.14	
		2733.3	20(5)			
0.12	3472.4(4)	2934.6	21(6)	2933.2	0.20	2
0.14	3477.1(12)	3477.1	12(4)			
		2747.9	13(5)			
0.10	3491.6(5)	3048.1	23(8)			
	3494.6(3)	2956.8	23(6)	2956.1	0.50	2
0.24	3500.7(8)	3500.7	86(9)	3501.6	0.17	

i_1,%	E_i, keV	E_2, keV	$i_{\gamma\gamma}$	E_s, keV	i_2, %	M
		2962.9	17(5)			
		2829.3	15(4)			
		2771.5	15(5)			
		2428.8	18(5)	2428.0	0.08	2
0.10	3511.3(6)	3475.8	12(4)			
		2839.9	17(4)			
		2784.5	22(5)	2781.3	0.09	
0.08	3532.4(4)	3532.4	17(4)			
		3496.9	42(7)	3496.5	0.27	
		3088.9	87(13)	3089.1	0.10	
		2994.6	17(5)			
		2803.2	16(5)	2801.9	0.12	
		2211.3	28(7)	2211.3	0.15	
0.28	3555.4(5)	3555.4	55(7)	3554.3	0.25	
		3519.9	25(6)			
		3092.1	54(9)	3092.1	0.14	
		2826.2	14(4)	2827.7	0.20	2
0.12	3564.2(5)	3564.2	37(7)			
		3100.9	22(6)	3101.5	0.06	
		2492.3	21(6)	2492.3	0.17	
	3568.3(5)	2247.2	20(6)	2247.2	0.13	2
0.12	3579.2(6)	3135.7	31(11)			
		3041.4	18(6)	3043.7	0.12	2
		2907.8	12(4)	2906.1	0.05	2
		2850.0	15(4)			
0.07	3591.2(3)	2862.0	20(5)	2862.7	0.25	
0.18	3605.6(4)	2284.5	32(9)	2283.2	0.13	2
		2934.5	29(5)	2935.3	0.25	
0.25	3634.1(4)	2313.	31(8)	2313.7	0.34	
0.09	3645.1(5)	2915.9	13(4)	2916.9	0.24	
0.24	3652.6(3)	2331.5	41(8)	2330.3	0.17	2
0.12	3668.3(3)	2596.4	24(5)	2597.5	0.16	
0.17	3692.0(3)	2370.9	46(8)	2370.2	0.23	2
0.25	3707.1(5)	2386.0	26(8)	2383.1	0.13	
	3707.6(5)	2769.7	3(1)	2770.5	0.10	2
	3717.8(5)	2645.9	14(5)	2644.6	0.17	2
	3718.4(5)	2397.3	23(8)	2396.9	0.15	
0.20	3743.5(4)	2422.4	28(8)	2422.5	0.15	
0.05	3801.2(3)	2729.3	26(5)	2730.6	0.31	4
0.19	3876.5(5)	2555.4	29(8)	2554.7	0.15	2
0.27	3891.2(5)	2570.1	27(9)			
	3929.4(5)	2608.3	25(9)	2607.0	0.19	2

" - level is absent in known decay scheme and placed by condition that primary transition has larger energy than secondary one.