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TWO METHODS OF DETERMINATION OF PARITIES OF LOW-LYING STATES IN ^{159}Gd FROM ANALYSIS OF γ-RAY INTENSITIES FROM $^{158}\mathrm{Gd}(n_{\mathrm{res}}, \gamma)^{159}\mathrm{Gd}$ REACTION

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Два метода определения четностей низколежащих состояний в ^{159}Gd из анализа интенсивностей γ-лучей из реакции $^{158}\mathrm{Gd}(n_{\mathrm{res}}, \gamma)^{159}\mathrm{Gd}$

Энергетические уровни и переходы в ^{159}Gd были изучены с помощью радиационного захвата резонансных нейтронов в 12 изолированных резонансах ^{158}Gd. Техника времени пролета была использована на обогащенной мишени на реакторе ИБР-30 в ОИЯИ в Дубне. Зарегистрировано 80 первичных переходов и определены их абсолютные интенсивности на уровни 1/2$^{\pm}$ и 3/2$^{\pm}$ до энергии возбуждения 2,4 МэВ. Четности найденных уровней были пересчитаны с помощью двух методов: первый метод состоит в анализе интенсивностей, усредненных по 12 резонансам, а во втором методе анализируются индивидуальные интенсивности. Второй метод описан впервые.

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Two Methods of Determination of Parities of Low-Lying States in ^{159}Gd from Analysis of γ-Ray Intensities from $^{158}\mathrm{Gd}(n_{\mathrm{res}}, \gamma)^{159}\mathrm{Gd}$ Reaction

Energy levels and transitions in ^{159}Gd were studied by means of radiative capture of resonance neutrons in 12 isolated resonances of ^{158}Gd. The time-of-flight technique was used on an enriched target at the IBR-30 reactor at JINR, Dubna. A total of 80 primary gamma transitions were recorded, and their absolute intensities were determined resulting in the observation of 1/2$^{\pm}$ and 3/2$^{\pm}$ levels up to 2.4 MeV. Parities of the found levels were recalculated using two methods: the first method consists in analyzing of intensities averaging in 12 resonances, and in the second method individual intensities are analyzed. The second method is described for the first time.

The investigation has been performed at the Frank Laboratory of Neutron Physics, JINR.

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INTRODUCTION

We extensively studied spectroscopic properties of ^{159}Gd by resonance neutrons [1, 2], by neutrons from neutron filters [3], by thermal neutrons, and from (d, p) and (d, t) reactions. Full information was published in [4].

In [2] together with the other information the determination of parities of low-lying levels of ^{159}Gd was obtained. Due to big volume of information in that work, description of the method of this determination is very short. In this paper, we give a more detailed description of parity determination procedure. During preparation of this paper we recalculated all data, and there are some differences between results of the previous work ([2], Table 3) and new ones. Analysis of these differences will be done later.

1. EXPERIMENT

Energy levels and transitions in ^{159}Gd were studied by means of radiative capture of resonance neutrons in 12 isolated resonances of ^{158}Gd. The time-of-flight technique was used on an enriched target at the IBR-30 reactor at JINR, Dubna. A total of 80 primary gamma transitions were recorded and their absolute intensities were determined. Absolute intensities of 80 transitions in 12 resonances of ^{158}Gd are presented in [2] (Table 1).

As ^{158}Gd is an even-even nucleus, all resonances in the measured range of neutron energy have $J^\pi = 1/2^+$. Primary γ rays usually are $E1$ (transitions on the levels with the opposite parity) and $M1$ (transitions on the levels with the same parities). Levels on which transitions pass have $J = 1/2, 3/2$ with parity +, if transition is $M1$, or – if transition is $E1$. $M1$ transitions have energy dependence E_γ^3, and dependence of $E1$ transitions is sharper, namely, about E_γ^5. It is known that intensities of $E1$ transitions in the measured range of energies are 5–7 times more than of $M1$ transitions. From spectroscopic data eight $M1$ transitions and nine $E1$ transitions are known.

2. TASK OF PARITY DETERMINATION

Using the difference in intensities of $E1$ and $M1$ transitions, we formulated quantitative conditions of parity determination of low-lying levels in ^{159}Gd. Two methods of parity determination were used: the first method consists in analyzing of intensities averaging in 12 resonances, and in the second method individual intensities are analyzed. The second method is described for the first time.

2.1. The First Method. Eighty intensities averaged in 12 resonances were obtained. Dependence E_γ^3 was excluded from these data, and reduced data were normalized on the mean value of reduced intensities of eight known $M1$ transitions. Here formula of reducing is shown:

$$\xi_{\gamma f} = \frac{\langle I_{\gamma\lambda f}\rangle_\lambda / E_\gamma^3}{\langle\langle I(M1)_{\gamma\lambda f}\rangle_\lambda / E_\gamma^3\rangle_{M1}}, \tag{1}$$

where λ is a sign of resonance and f is a sign of the final state.

Values $\xi_{\gamma f}$ of 80 transitions are presented in Fig. 1. There are two curves and a straight line in this figure: curves are dependences of $E1$ transitions (E_γ^5) which normalization was from nine known $E1$ transitions (upper curve) and from eight known $E1$ transitions (lower curve). Straight line is a mean of eight known $M1$ transitions, its $y = 1$.

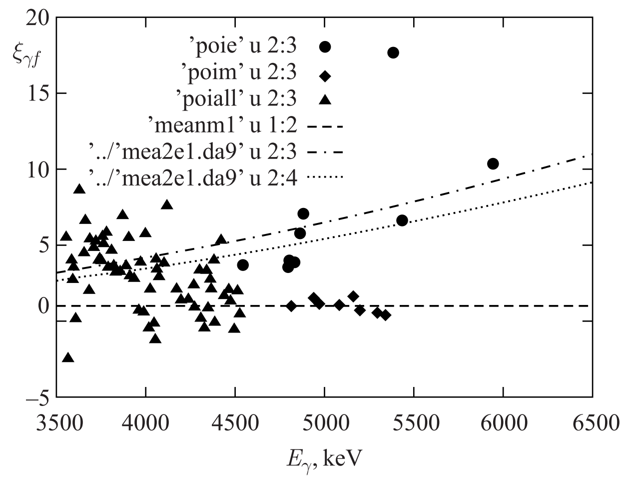

Fig. 1. Values $\xi_{\gamma f}$ of 80 γ transitions (points), curves — dependences of $E1$, and a straight line — dependence of $M1$; ● — known $E1$, ♦ — known $M1$, ▲ — unknown parities

As the point about energy 5400 keV (transition 5384.70 keV) is very high, two curves for $E1$ normalizing are plotted: upper curve with this point and lower curve without one. The meaning of these two curves will be discussed later.

It is clearly seen that intensities of $E1$ transitions are well-separated from intensities of $M1$ in the range of 4700–6000 keV. This fact gives an opportunity to separate all intensities into two groups. For this we use statistical properties of intensities. It is known that intensities of transitions from resonances of one type to the levels with certain J^π follow the Porter–Thomas (PT) law of distribution [5]. This distribution is from a class of χ^2 distributions, namely, χ^2 distribution with $\nu = 1$. Mean value of intensities from 12 resonances will obey χ^2 distribution with $\nu = 12$. To determine that some transition is $E1$ we should show that it cannot be from distribution which describes $M1$ transitions.

We should create statistical distribution which pictures this hypothesis and see how far the point of examined transition is from the center of distribution. As the distribution is normalized on 1, probability to appear accidentally in any piece of this distribution is equal to the area of distribution within this piece. For the events far to the left and far to the right from the center of distribution, probabilities are integrals from the beginning of distribution to this event for events far to the left and from this event to the end of distribution for events far to the right. An example of arbitrary distribution is shown in Fig. 2.

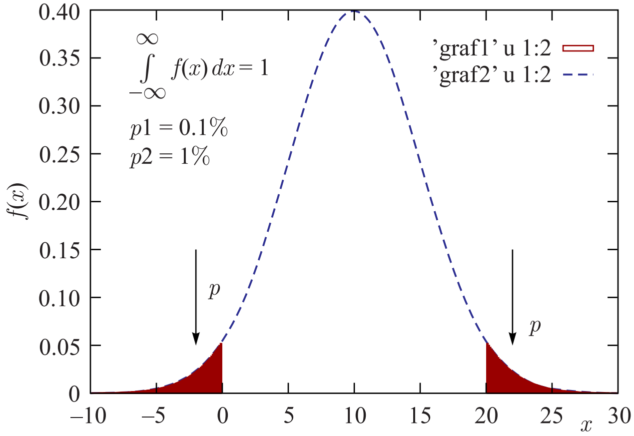

Fig. 2. Arbitrary function $f(x)$ normalized on 1

For deciding if the point of examined transition obeys or not the analyzed distribution, the confidence level must be chosen. In our works we use two confidence levels: 1% and 0.1%. For these two confidence levels critical values must be found. These are values of x integrals to which from the left or from the right are equal to confidence level. When an event falls in the piece $p1$ with confidence level 0.1%, this hypothesis is abandoned strictly and result of other hypothesis is set without parentheses, and when it falls in the piece $p2$ with confidence level 1% other hypothesis is set in parentheses. We shall use term "reability" which determines an integral of the distribution from the left to the tested point. This value will be close to 0 if the point is to the left from maximum of the distribution or close to 1 if it is to the right from maximum.

It was said that the mean value of intensities from 12 resonances will obey χ^2 distribution with $\nu = 12$. But apart from this distribution each intensity of transition has its statistical error which obeys the Gaussian distribution. Hence, χ^2 distribution with $\nu = 12$ must be convoluted with the Gaussian with individual parameters.

To find $E1$ transitions it is needed:

• to normalize all experimental intensities on mean $M1$ value;

• to obtain χ^2 distribution with $\nu = 12$;

• to make convolution of this distribution with the Gaussian which is individual for each point;

• to find critical values for two confidence levels;

• to find value reability which will be integral from the left, this value will be close to 1 as $E1$ transitions are greater than $M1$;

• to compare this value with two critical values.

To find $M1$ transitions, we should compare intensities with χ^2 distribution which is normalized on the mean of $E1$ transitions. For this dependence of $E1$ transitions must be eliminated. In [2] two dependences of $E1$ transitions were discussed: Lorentzian and Markushev–Furman model. But in this work we use a simple dependence E_γ^5 because it is sharper than others and this gives more reliable results in the energy range from 3.5 to 4.5 MeV as E_γ^5 curve is nearer to $M1$ points.

Now we must discuss the two curves in Fig. 1. The upper curve is obtained using point 5384.70 keV. During analysis of points with normalizing on $E1$ with the lower curve this point was very big and it was determined as a doublet. Further, the doublets will be marked as D or (D). In view of this the upper curve was not used and all calculations were performed with the lower curve. Using the described method the points which are lower than critical values can be determined as $M1$ or ($M1$) and points higher than critical values with integrals near 1 can be determined as D or (D).

2.2. The Second Method. This method consists in analysis of absolute intensities of each transition from resonances to each level. As there are 12 resonances, we have 12 distributions for each level. Statistical distribution of these values is PT distribution. This distribution must be convoluted with the Gaussian from the statistical error of transition intensity. In this way 12 values of reability can be obtained. These values must be analyzed. They represent 12 points on $[0, 1]$ cut. Now we try to obtain quantitative conditions to refuse the hypothesis that 12 transitions on one level belong to obtained distributions.

Divide $[0, 1]$ cut into two pieces p and q. We know that p is a small part of $[0, 1]$ cut:

$$p + q = 1.$$

From 12 resonances we have 12 independent probabilities, and the whole probability is

$$(p+q)^{12} = 1.$$

It is Newton's binomial. Open the parentheses:

$$p^{12} + 12p^{11}q + 66p^{10}q^2 + 220p^9q^3 + 495p^8q^4 + 792p^7q^5 + 924p^6q^6 + \\ + 792p^5q^7 + 495p^4q^8 + 220p^3q^9 + 66p^2q^{10} + 12pq^{11} + q^{12} = 1.$$

Now analyze some member of this expression, for instance, the fourth. This member is the probability that 9 points fall to part p. If we solve the equation $220p^9q^3 = 0.001$ or $220p^9q^3 = 0.01$ we can obtain critical values which show that probability to have 9 points in piece p is 0.1% or 1%, respectively.

In this way we can obtain all 12 pairs of critical values for all members with p of this expression. Now for all 80 transitions it is needed to do convolutions of one function of PT with the individual Gaussians from experimental errors and to find a set of 12 reability values. These data can be compared with critical values.

3. CALCULATIONS

We should

- obtain the Gaussian, χ^2 distribution with $\nu = 1$, χ^2 distribution with $\nu = 12$;
- make convolution of χ^2 distributions with Gaussians which are individual for each intensity;
- find critical values for two confidence levels for χ^2 distribution with $\nu = 12$;
- find reability values for $\nu = 12$;
- calculate critical values for 12 pairs of confidence levels for $\nu = 1$;
- analyze all data and obtain parities by two methods.

Figure 2 shows that bounds of p pieces are set far from maxima of distributions and integrating must be to the area with small values of functions.

For better precision all calculations were made in Fortran codes with variables REAL*16. Calculations with such variables give precision of results with about 33 right signs.

For the convolution all curves were replaced by piecewise continuous polynomials of the third power through each 4 points of x coordinates with different steps which were determined as gave high precision of replacing. Precision of replacing was tested by integrating of curves and comparing of integrals with 1. In Table 1 parameters of fit of some functions by polynomials are shown. It is seen that precision depends on the number of points x.

Table 1. Parameters of polynomials for four functions: N — number of points x, area — integral, NR — number of right signs in integrals

Function	N	Area	NR
Gaussian	2031	0.999999999897369E+00	9
χ^2 with $\nu = 1$	1463	0.999999991390689E+00	8
χ^2 with $\nu = 2$	5594	0.999999999999126E+00	12
χ^2 with $\nu = 12$	1950	0.999999998204125E+00	8

Function χ^2 with $\nu = 2$ is very simple: $\exp(-x)$. It was not used and is given as an example. The most computer time is spent on convolutions. In [2] these calculations were provided in old systems UNIX or SANOS and time of calculations was limited. For this reason calculations were performed with smaller precision of convolutions: namely, 5 or 6 signs. Now calculations were made on modern desktop computer, and 8 signs of precision were achieved. This is a source of differences between old and new results which will be discussed later. The most time was spent on method 2 as there must be 12 convolutions for each of 80 levels.

Borders of reability for four confidence levels were calculated and are shown in Table 2. These borders were tested by Monte Carlo simulation. In Monte Carlo simulations 12 random numbers were generated, and events which fall to pieces with borders from Table 2 were added in four counters. Results are shown in Table 3.

Table 2. Borders of reability for four confidence levels (Led) at the end of the cut $[0, 1]$

Led No.	20%	10%	1%	0.1%
1	0.97893530	0.99077201	0.99915892	0.99991661
2	0.91343027	0.94958514	0.98684847	0.99602932
3	0.83148438	0.89147431	0.95961344	0.98253584
4	0.74358207	0.82471770	0.92095554	0.95900744
5	0.65528965	0.75295264	0.87335509	0.92642683
6	0.57046992	0.67804360	0.81823516	0.88558257
7	0.49108195	0.60097700	0.75631922	0.83685452
8	0.41670281	0.52218020	0.68779033	0.78017426
9	0.34546533	0.44160458	0.61227202	0.71491122
10	0.27519742	0.35861242	0.52855957	0.63952595
11	0.20343767	0.27143469	0.43368423	0.55049646
12	0.12551473	0.17459582	0.31870794	0.43765867

Table 3. Monte Carlo test of four borders of confidence levels (Led). One billion of 12 random numbers was generated

Led No.	20%	10%	1%	0.1%
1	199988356	99997723	9999206	1000541
2	200003147	99993970	10001449	1001716
3	199990133	100008878	9997067	1000800
4	199982567	100009826	9999704	999397
5	199995607	100006117	9996229	1001007
6	199991386	100020255	10002878	1001937
7	200022638	100009744	9999832	1002330
8	200021065	100013733	9995901	1001405
9	200017754	100004531	10001494	1000768
10	200010661	99996432	10001575	1000500
11	200009661	100005569	9998226	1000163
12	200001707	100005309	10003698	1000244

4. RESULTS AND DISCUSSION

Results of the determination of parities are given in Table 4. It is similar to Table 3 in [2]. However, whereas in the second column of Table 3 in [2] f_γ are listed, here in column 3 values $\xi_{\gamma f}$ from expression (1) are led. Additionally, in that Table there was column "resonance", and here column "group" is given, where the numbers of points on $[0, 1]$ cut, for which appropriate confidence level was performed, are listed. The more groups we have, the more reliable the results.

Table 4. Final assignments of transition multipolarity *XL* are based on the analysis of analytically averaged (a) and of individual (b) γ-ray intensities. All observed levels have either spin 1/2 or 3/2 with parity as indicated. Assignments are made within 0.1% significance level (assignments within 1% are indicated in parentheses)

E_γ, keV	ΔE_γ, keV	$\xi_{\gamma f}$	$\Delta\xi_{\gamma f}$	Group[a]	Multipolarity[b]			E_f, keV	j^π
					$XL(a)$	$XL(b)$	XL		$\frac{1}{2}^\pi$, $\frac{3}{2}^\pi$
5943.0	0.2	10.4	0.3	1 2 3 4 5 6 7 8 9 10 11	$E1$	$E1$	$E1$	0.0	–
5434.7	0.2	6.6	0.3	1 2 3 4 9 10 11 12	$E1$	$E1$	$E1$	508.3	–
5384.7	0.2	17.7	0.6	2	D	D	D	558.3	–
5341.1	0.3	0.4	0.3	9 10 11 12	$M1$	$M1$	$M1$	601.9	+
5295.9	0.5	0.6	0.3	11 12	$M1$	$M1$	$M1$	647.1	+
5198.1	0.2	0.7	0.3	10 11 12	$M1$	$M1$	$M1$	744.9	+
5161.0	0.5	1.6	0.3	11		$M1$	$M1$	782.0	+

Table 4 (continued)

E_γ, keV	ΔE_γ, keV	$\xi_{\gamma f}$	$\Delta\xi_{\gamma f}$	Group[a]	Multiplicity[b] $XL(a)$	$XL(b)$	XL	E_f, keV	j^π $\frac{1}{2}^\pi, \frac{3}{2}^\pi$
5083.0	0.6	1.1	0.3	11	$(M1)$	$M1$	$M1$	860.0	+
4971.0	1.3	1.1	0.5	11	$(M1)$	$M1$	$M1$	972.0	+
4939.7	1.0	1.5	0.4	12		$(M1)$	$(M1)$	1003.3	(+)
4881.7	0.3	7.1	0.5	1 2 3 4 5 6 10	$E1$	$E1$	$E1$	1061.3	–
4863.5	0.2	5.8	0.4	1 2 3 4 5 6 7	$E1$	$E1$	$E1$	1079.5	–
4832.2	0.3	3.9	0.5	3	$E1$	$E1$	$E1$	1110.8	–
4814.4	0.3	1.0	0.4	2 10	$(M1)$	$(M1)$	$(M1)$	1128.6	(+)
4803.3	0.2	4.0	0.5	3 4 5 6	$E1$	$E1$	$E1$	1139.7	–
4796.9	0.2	3.5	0.5	2 3 4 5	$E1$	$E1$	$E1$	1146.1	–
4543.7	1.1	3.7	0.6	7 8 9	$E1$	$E1$	$E1$	1399.3	–
4526.1	1.3	0.5	0.6	11	$(M1)$	$M1$	$M1$	1416.9	+
4513.4	1.2	2.0	0.6					1429.6	
4495.2	1.3	–0.6	0.6	3 5 12	$M1$	$M1$	$M1$	1447.8	+
4474.4	1.2	1.3	0.6					1468.6	
4464.7	0.3	2.1	0.6	5		$(E1)$	$(E1)$	1478.3	(–)
4438.6	0.8	1.7	0.6	10		$(M1)$	$(M1)$	1504.4	(+)
4421.7	0.5	5.3	0.7	1 4 5 6 7 8	$E1$	$E1$	$E1$	1521.3	–
4385.9	1.0	–0.1	0.8	10	$(M1)$	$M1$	$M1$	1557.1	+
4381.7	0.5	4.0	0.8	1 6 7 8 9 11	$E1$	$(E1)$	$E1$	1561.3	–
4366.0	1.4	2.1	0.8					1577.0	
4360.7	0.9	2.8	0.8	5 9 10 11		$(E1)$	$(E1)$	1582.3	(–)
4348.4	1.5	0.9	0.8	10 11 12		$(M1)$	$(M1)$	1594.6	(+)
4340.4	1.5	3.3	1.4					1602.6	
4327.9	0.6	–0.5	0.8	6 7 9 10 11 12	$M1$	$(M1)$	$M1$	1615.1	+
4308.0	1.0	0.2	0.8	9 10 11	$(M1)$	$(M1)$	$(M1)$	1635.0	(+)
4301.4	0.8	3.3	0.8	9	$(E1)$	$E1$	$E1$	1641.6	–
4273.2	1.5	0.9	0.9	10		$(M1)$	$(M1)$	1669.8	(+)
4268.8	0.8	2.4	0.9					1674.2	
4238.4	1.0	1.4	0.8					1704.6	
4197.0	1.0	1.4	0.9					1746.0	
4172.7	0.9	2.1	0.9					1770.3	
4118.5	0.4	7.6	1.0	10	$E1$	D	D	1824.5	–
4102.1	1.5	3.8	1.0	10	$(E1)$	$E1$	$E1$	1840.9	–
4074.5	0.3	2.9	1.0					1868.5	
4062.3	1.0	3.4	1.2					1880.7	
4057.7	1.5	4.1	1.3					1885.3	
4053.5	2.0	–1.2	1.2	5 9 10 11 12	$(M1)$	$(M1)$	$(M1)$	1889.5	(+)
4046.2	3.0	–0.2	1.0		$(M1)$		$(M1)$	1896.8	(+)
4024.5	1.0	2.1	1.1					1918.5	
4017.0	0.9	–0.5	1.1		$(M1)$		$(M1)$	1926.0	(+)
3997.6	0.8	5.7	1.2	2 3 4 5 6 7 8 9	$E1$	$E1$	$E1$	1945.4	–

Table 4 (continued)

E_γ, keV	ΔE_γ, keV	$\xi_{\gamma f}$	$\Delta\xi_{\gamma f}$	Group[a]	Multiplicity[b] $XL(a)$	$XL(b)$	XL	E_f, keV	j^π $\frac{1}{2}^\pi, \frac{3}{2}^\pi$
3988.6	0.5	0.6	1.2					1954.4	
3970.9	0.3	3.9	1.3	1 2		$(E1)$	$(E1)$	1972.1	(–)
3961.4	1.0	0.7	1.3	12		$(M1)$	$(M1)$	1981.6	(+)
3934.9	2.5	2.8	1.4					2008.1	
3911.3	1.7	3.0	1.3	2 6		$(E1)$	$(E1)$	2031.7	(–)
3904.7	1.7	5.5	1.3	3 4 5 6 8	$E1$	$E1$	$E1$	2038.3	–
3890.0	2.5	3.6	1.3	4 5 6		$E1$	$E1$	2053.0	–
3870.4	0.4	6.9	1.4	12	$E1$	(D)	(D)	2072.6	–
3856.8	1.7	3.3	1.4	1		$(E1)$	$(E1)$	2086.2	(–)
3831.6	0.7	3.2	1.5	6		$(E1)$	$(E1)$	2111.4	(–)
3821.1	1.7	3.6	1.5	9 10		$(E1)$	$(E1)$	2121.9	(–)
3808.7	1.7	4.7	1.5	5 6		$(E1)$	$(E1)$	2134.3	(–)
3789.6	1.0	3.5	1.5					2153.4	
3780.4	1.0	5.8	1.6	12	$(E1)$	(D)	(D)	2162.6	–
3764.3	1.0	5.1	1.5	2 3 4 5	$(E1)$	$E1$	$E1$	2178.7	–
3758.0	1.0	5.6	1.6	2 7 9 10 11 12	$(E1)$	$(E1)$	$(E1)$	2185.0	(–)
3752.2	1.4	4.0	1.6	3 7		$(E1)$	$(E1)$	2190.8	(–)
3742.2	1.0	4.1	1.6	8		$(E1)$	$(E1)$	2200.8	(–)
3736.4	1.6	4.0	1.7					2206.6	
3720.6	0.8	5.3	1.7	11	$(E1)$	(D)	(D)	2222.4	–
3709.0	1.0	4.8	1.7	11		$(E1)$	$(E1)$	2234.0	(–)
3686.9	1.0	5.4	2.0					2256.1	
3683.2	0.8	2.0	2.0					2259.8	
3662.1	0.7	6.6	2.0	8 9	$(E1)$	(D)	(D)	2280.9	–
3655.0	1.0	4.5	1.9	7		(D)	(D)	2288.0	–
3628.7	0.7	8.6	3.7	12		(D)	(D)	2314.3	–
3607.6	0.8	0.2	2.1					2335.4	
3596.0	0.5	3.5	2.2	1		$(E1)$	$(E1)$	2347.0	(–)
3591.7	1.7	2.7	2.1	1		$E1$	$E1$	2351.3	–
3585.2	0.5	4.0	2.2	1		$(E1)$	$(E1)$	2357.8	(–)
3565.4	0.8	–2.5	2.1	7		$(M1)$	$(M1)$	2377.6	(+)
3554.4	0.8	5.5	2.2	1 2 3 4		$(E1)$	$(E1)$	2388.6	(–)

[a] Number of points on $[0, 1]$ cut for which appropriate confidence level was performed.
[b] Transitions with unusually strong intensities are labelled by D to indicate the possibility of a doublet or of a nonstatistically large fluctuation.

Now results which are worse than in [2] will be listed. Although for transition 4474.4 keV in [2] was parity (+), now parity is not determined. For transitions 4348.4, 4308.0, and 4053.5 keV results from + became (+).

For some transitions now results are better: for 4381.7 and 3720.6 keV results are changed from (–) to – without parentheses. In Table 3 in [2] there are 3 columns with the determination of XL. For 5384.7 keV in these columns there are $E1$ determinations. Now all three values of XL of 5384.7 keV transition are changed from $E1$ to D. This indicates probability of nonstatistical big intensity of this transition. For transitions 3780.4, 3720.6, 3662.1, and 3655.0 keV values of XL became (D).

These results demonstrate importance of precision of calculations for more reliable determination of parities.

Now analysis of differences in parity determination by two methods will be obtained. Schematic comparison of the results is shown in Fig. 3.

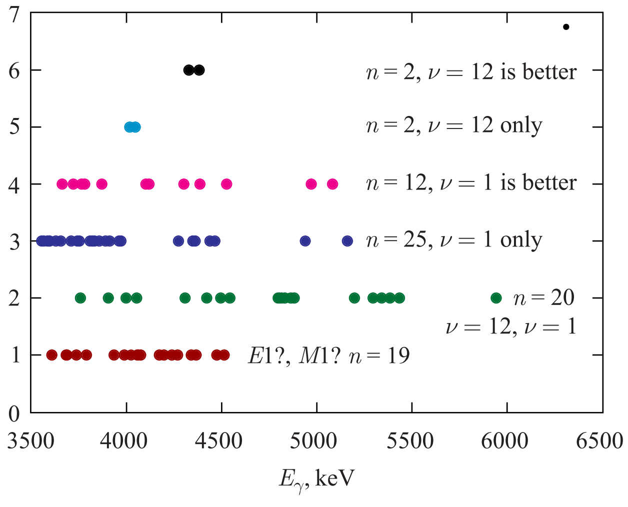

Fig. 3. Schematical view of the differences of results of parity determination by two methods

One can see that for 19 transitions parities were not determined. For 20 transitions determinations by two methods coincide. For 25 transitions determinations are obtained only by the second method, and for two transitions determination by the second method is more precise. For two transitions determination is obtained only by the first method, and for two transitions this method gave more precise result. This demonstrates that method 2 is a harder criterion than method 1.

There are many D and (D) determinations for transitions in the region 3500–4500 keV. This can demonstrate that E_γ^5 is very sharp, and the Lorentzian or Markushev–Furman model may be more real.

SUPPLEMENT

As we have a software toolkit to calculate integrals of some functions, we prepared several tables. We hope that these data will have a wider set of arguments and more precise values than those received from the Internet.

Table S1. Values of $\Phi(x) = \frac{1}{\sqrt{2\pi}} \int\limits_{x}^{\infty} \exp(-\frac{z^2}{2})dz$ **for integer values of argument**

x	$\Phi(x)$	x	$\Phi(x)$
1.00	1.5865525E-01	8.00	6.2209606E-16
2.00	2.2750132E-02	9.00	1.1285884E-19
3.00	1.3498980E-03	10.00	7.6198530E-24
4.00	3.1671242E-05	11.00	1.9106596E-28
5.00	2.8665157E-07	12.00	1.7764821E-33
6.00	9.8658764E-10	13.00	6.1171566E-39
7.00	1.2798125E-12		

Table S2. Reverse values for $\Phi(x) = \frac{1}{\sqrt{2\pi}} \int\limits_{x}^{\infty} \exp\left(-\frac{z^2}{2}\right) dz$ **for values of** 10^{-n} **of** $\Phi(x)$

$\Phi(x)$	x	$\Phi(x)$	x
1.0E-01	1.2815516E+00	1.0E-14	7.6506281E+00
1.0E-02	2.3263479E+00	1.0E-15	7.9413453E+00
1.0E-03	3.0902323E+00	1.0E-16	8.2220822E+00
1.0E-04	3.7190165E+00	1.0E-17	8.4937932E+00
1.0E-05	4.2648908E+00	1.0E-18	8.7572903E+00
1.0E-06	4.7534243E+00	1.0E-19	9.0132712E+00
1.0E-07	5.1993376E+00	1.0E-20	9.2623401E+00
1.0E-08	5.6120012E+00	1.0E-21	9.5050250E+00
1.0E-09	5.9978070E+00	1.0E-22	9.7417899E+00
1.0E-10	6.3613409E+00	1.0E-23	9.9730456E+00
1.0E-11	6.7060232E+00	1.0E-24	1.0199157E+01
1.0E-12	7.0344838E+00	1.0E-25	1.0420452E+01
1.0E-13	7.3487961E+00	1.0E-26	1.0637224E+01

Table S3. Values of $\Phi(x) = \frac{1}{\sqrt{2\pi}} \int_x^\infty \exp(-\frac{z^2}{2}) dz$ **for steps of** x**:** $\Delta x = 0.01$

x	00	01	02	03	04
0.00	5.0000000E-01	4.9601064E-01	4.9202169E-01	4.8803353E-01	4.8404656E-01
0.10	4.6017216E-01	4.5620469E-01	4.5224157E-01	4.4828321E-01	4.4433000E-01
0.20	4.2074029E-01	4.1683384E-01	4.1293558E-01	4.0904588E-01	4.0516513E-01
0.30	3.8208858E-01	3.7828048E-01	3.7448417E-01	3.7069998E-01	3.6692826E-01
0.40	3.4457826E-01	3.4090297E-01	3.3724273E-01	3.3359782E-01	3.2996855E-01
0.50	3.0853754E-01	3.0502573E-01	3.0153179E-01	2.9805597E-01	2.9459852E-01
0.60	2.7425312E-01	2.7093090E-01	2.6762889E-01	2.6434729E-01	2.6108630E-01
0.70	2.4196365E-01	2.3885207E-01	2.3576250E-01	2.3269509E-01	2.2965000E-01
0.80	2.1185540E-01	2.0897009E-01	2.0610805E-01	2.0326939E-01	2.0045419E-01
0.90	1.8406013E-01	1.8141125E-01	1.7878638E-01	1.7618554E-01	1.7360878E-01
1.00	1.5865525E-01	1.5624765E-01	1.5386423E-01	1.5150500E-01	1.4916995E-01
1.10	1.3566606E-01	1.3349951E-01	1.3135688E-01	1.2923811E-01	1.2714315E-01
1.20	1.1506967E-01	1.1313945E-01	1.1123244E-01	1.0934855E-01	1.0748770E-01
1.30	9.6800485E-02	9.5097918E-02	9.3417509E-02	9.1759136E-02	9.0122672E-02
1.40	8.0756659E-02	7.9269841E-02	7.7803841E-02	7.6358510E-02	7.4933700E-02
1.50	6.6807201E-02	6.5521712E-02	6.4255488E-02	6.3008364E-02	6.1780177E-02
1.60	5.4799292E-02	5.3698928E-02	5.2616138E-02	5.1550748E-02	5.0502583E-02
1.70	4.4565463E-02	4.3632937E-02	4.2716221E-02	4.1815138E-02	4.0929509E-02
1.80	3.5930319E-02	3.5147894E-02	3.4379502E-02	3.3624969E-02	3.2884119E-02
1.90	2.8716560E-02	2.8066607E-02	2.7428950E-02	2.6803419E-02	2.6189845E-02
2.00	2.2750132E-02	2.2215594E-02	2.1691694E-02	2.1178270E-02	2.0675163E-02
2.10	1.7864421E-02	1.7429178E-02	1.7003023E-02	1.6585807E-02	1.6177383E-02
2.20	1.3903448E-02	1.3552581E-02	1.3209384E-02	1.2873721E-02	1.2545461E-02
2.30	1.0724110E-02	1.0444077E-02	1.0170439E-02	9.9030756E-03	9.6418699E-03
2.40	8.1975359E-03	7.9762603E-03	7.7602536E-03	7.5494114E-03	7.3436310E-03
2.50	6.2096653E-03	6.0365581E-03	5.8677417E-03	5.7031263E-03	5.5426234E-03
2.60	4.6611880E-03	4.5271111E-03	4.3964883E-03	4.2692434E-03	4.1453014E-03
2.70	3.4669738E-03	3.3641604E-03	3.2640958E-03	3.1667163E-03	3.0719592E-03
2.80	2.5551303E-03	2.4770750E-03	2.4011825E-03	2.3274002E-03	2.2556767E-03
2.90	1.8658133E-03	1.8071438E-03	1.7501569E-03	1.6948100E-03	1.6410612E-03
3.00	1.3498980E-03	1.3062384E-03	1.2638734E-03	1.2227687E-03	1.1828907E-03
3.10	9.6760321E-04	9.3543672E-04	9.0425520E-04	8.7403152E-04	8.4473917E-04
3.20	6.8713794E-04	6.6367486E-04	6.4095298E-04	6.1895109E-04	5.9764850E-04
3.30	4.8342414E-04	4.6647986E-04	4.5008724E-04	4.3422992E-04	4.1889195E-04
3.40	3.3692927E-04	3.2481440E-04	3.1310568E-04	3.0179062E-04	2.9085709E-04
3.50	2.3262908E-04	2.2405335E-04	2.1577340E-04	2.0777983E-04	2.0006352E-04
3.60	1.5910859E-04	1.5309850E-04	1.4730151E-04	1.4171061E-04	1.3631902E-04
3.70	1.0779973E-04	1.0362962E-04	9.9611389E-05	9.5739885E-05	9.2010127E-05
3.80	7.2348044E-05	6.9483396E-05	6.6725837E-05	6.4071629E-05	6.1517155E-05
3.90	4.8096344E-05	4.6148061E-05	4.4274484E-05	4.2472931E-05	4.0740805E-05
4.00	3.1671242E-05	3.0359374E-05	2.9099071E-05	2.7888426E-05	2.6725601E-05
4.10	2.0657507E-05	1.9782956E-05	1.8943620E-05	1.8138162E-05	1.7365291E-05
4.20	1.3345749E-05	1.2768534E-05	1.2215116E-05	1.1684566E-05	1.1175989E-05
4.30	8.5399055E-06	8.1627273E-06	7.8014600E-06	7.4554671E-06	7.1241358E-06
4.40	5.4125439E-06	5.1685310E-06	4.9350451E-06	4.7116544E-06	4.4979439E-06

Table S3 (continued)

x	05	06	07	08	09
0.00	4.8006119E-01	4.7607782E-01	4.7209683E-01	4.6811863E-01	4.6414361E-01
0.10	4.4038231E-01	4.3644054E-01	4.3250507E-01	4.2857628E-01	4.2465457E-01
0.20	4.0129367E-01	3.9743189E-01	3.9358013E-01	3.8973875E-01	3.8590812E-01
0.30	3.6316935E-01	3.5942357E-01	3.5569125E-01	3.5197271E-01	3.4826827E-01
0.40	3.2635522E-01	3.2275811E-01	3.1917751E-01	3.1561370E-01	3.1206695E-01
0.50	2.9115969E-01	2.8773972E-01	2.8433885E-01	2.8095731E-01	2.7759532E-01
0.60	2.5784611E-01	2.5462691E-01	2.5142890E-01	2.4825223E-01	2.4509709E-01
0.70	2.2662735E-01	2.2362729E-01	2.2064995E-01	2.1769544E-01	2.1476388E-01
0.80	1.9766254E-01	1.9489452E-01	1.9215020E-01	1.8942965E-01	1.8673294E-01
0.90	1.7105613E-01	1.6852761E-01	1.6602325E-01	1.6354306E-01	1.6108706E-01
1.00	1.4685906E-01	1.4457230E-01	1.4230965E-01	1.4007109E-01	1.3785657E-01
1.10	1.2507194E-01	1.2302440E-01	1.2100048E-01	1.1900011E-01	1.1702320E-01
1.20	1.0564977E-01	1.0383468E-01	1.0204232E-01	1.0027257E-01	9.8525329E-02
1.30	8.8507991E-02	8.6914962E-02	8.5343451E-02	8.3793322E-02	8.2264439E-02
1.40	7.3529260E-02	7.2145037E-02	7.0780877E-02	6.9436623E-02	6.8112118E-02
1.50	6.0570758E-02	5.9379941E-02	5.8207556E-02	5.7053433E-02	5.5917403E-02
1.60	4.9471468E-02	4.8457226E-02	4.7459682E-02	4.6478658E-02	4.5513977E-02
1.70	4.0059157E-02	3.9203903E-02	3.8363570E-02	3.7537980E-02	3.6726956E-02
1.80	3.2156775E-02	3.1442763E-02	3.0741909E-02	3.0054039E-02	2.9378980E-02
1.90	2.5588060E-02	2.4997895E-02	2.4419185E-02	2.3851764E-02	2.3295468E-02
2.00	2.0182215E-02	1.9699270E-02	1.9226172E-02	1.8762766E-02	1.8308900E-02
2.10	1.5777607E-02	1.5386335E-02	1.5003423E-02	1.4628731E-02	1.4262118E-02
2.20	1.2224473E-02	1.1910625E-02	1.1603792E-02	1.1303844E-02	1.1010658E-02
2.30	9.3867055E-03	9.1374675E-03	8.8940426E-03	8.6563190E-03	8.4241864E-03
2.40	7.1428107E-03	6.9468508E-03	6.7556526E-03	6.5691191E-03	6.3871548E-03
2.50	5.3861460E-03	5.2336082E-03	5.0849257E-03	4.9400158E-03	4.7987966E-03
2.60	4.0245885E-03	3.9070326E-03	3.7925623E-03	3.6811080E-03	3.5726010E-03
2.70	2.9797632E-03	2.8900681E-03	2.8028146E-03	2.7179449E-03	2.6354021E-03
2.80	2.1859615E-03	2.1182050E-03	2.0523590E-03	1.9883759E-03	1.9262091E-03
2.90	1.5888696E-03	1.5381952E-03	1.4889987E-03	1.4412419E-03	1.3948872E-03
3.00	1.1442068E-03	1.1066850E-03	1.0702939E-03	1.0350030E-03	1.0007825E-03
3.10	8.1635231E-04	7.8884569E-04	7.6219469E-04	7.3637526E-04	7.1136397E-04
3.20	5.7702504E-04	5.5706107E-04	5.3773742E-04	5.1903543E-04	5.0093691E-04
3.30	4.0405780E-04	3.8971236E-04	3.7584092E-04	3.6242915E-04	3.4946312E-04
3.40	2.8029328E-04	2.7008769E-04	2.6022918E-04	2.5070689E-04	2.4151027E-04
3.50	1.9261558E-04	1.8542740E-04	1.7849061E-04	1.7179710E-04	1.6533898E-04
3.60	1.3112015E-04	1.2610762E-04	1.2127523E-04	1.1661698E-04	1.1212703E-04
3.70	8.8417285E-05	8.4956678E-05	8.1623774E-05	7.8414179E-05	7.5323642E-05
3.80	5.9058912E-05	5.6693513E-05	5.4417677E-05	5.2228232E-05	5.0122111E-05
3.90	3.9075597E-05	3.7474882E-05	3.5936316E-05	3.4457634E-05	3.3036648E-05
4.00	2.5608816E-05	2.4536358E-05	2.3506569E-05	2.2517850E-05	2.1568659E-05
4.10	1.6623764E-05	1.5912380E-05	1.5229982E-05	1.4575455E-05	1.3947723E-05
4.20	1.0688526E-05	1.0221345E-05	9.7736484E-06	9.3446657E-06	8.9336559E-06
4.30	6.8068766E-06	6.5031222E-06	6.2123268E-06	5.9339654E-06	5.6675330E-06
4.40	4.2935145E-06	4.0979826E-06	3.9109799E-06	3.7321520E-06	3.5611587E-06

Table S3 (continued)

x	00	01	02	03	04
4.50	3.3976731E-06	3.2413813E-06	3.0919816E-06	2.9491843E-06	2.8127114E-06
4.60	2.1124547E-06	2.0133449E-06	1.9187002E-06	1.8283287E-06	1.7420459E-06
4.70	1.3008075E-06	1.2385840E-06	1.1792232E-06	1.1225992E-06	1.0685911E-06
4.80	7.9332815E-07	7.5465148E-07	7.1779111E-07	6.8266525E-07	6.4919564E-07
4.90	4.7918328E-07	4.5538196E-07	4.3272106E-07	4.1114808E-07	3.9061285E-07
5.00	2.8665157E-07	2.7215018E-07	2.5835740E-07	2.4523992E-07	2.3276592E-07
5.10	1.6982674E-07	1.6107941E-07	1.5276783E-07	1.4487109E-07	1.3736923E-07
5.20	9.9644263E-08	9.4420316E-08	8.9461565E-08	8.4755020E-08	8.0288299E-08
5.30	5.7901340E-08	5.4812617E-08	5.1883626E-08	4.9106383E-08	4.6473291E-08
5.40	3.3320448E-08	3.1512375E-08	2.9799518E-08	2.8177026E-08	2.6640286E-08
5.50	1.8989562E-08	1.7941685E-08	1.6949983E-08	1.6011539E-08	1.5123582E-08
5.60	1.0717590E-08	1.0116331E-08	9.5478729E-09	9.0104811E-09	8.5025082E-09
5.70	5.9903714E-09	5.6488087E-09	5.3262027E-09	5.0215317E-09	4.7338276E-09
5.80	3.3157460E-09	3.1236421E-09	2.9423814E-09	2.7713688E-09	2.6100411E-09
5.90	1.8175079E-09	1.7105387E-09	1.6097081E-09	1.5146734E-09	1.4251104E-09
6.00	9.8658764E-10	9.2761663E-10	8.7208535E-10	8.1979840E-10	7.7057114E-10
6.10	5.3034233E-10	4.9815570E-10	4.6787679E-10	4.3939536E-10	4.1260740E-10
6.20	2.8231580E-10	2.6492301E-10	2.4857744E-10	2.3321759E-10	2.1878545E-10
6.30	1.4882282E-10	1.3951773E-10	1.3078165E-10	1.2258060E-10	1.1488258E-10
6.40	7.7688476E-11	7.2759818E-11	6.8137173E-11	6.3801973E-11	5.9736751E-11
6.50	4.0160006E-11	3.7575403E-11	3.5153696E-11	3.2884846E-11	3.0759417E-11
6.60	2.0557889E-11	1.9216001E-11	1.7959943E-11	1.6784344E-11	1.5684158E-11
6.70	1.0420977E-11	9.7312207E-12	9.0862281E-12	8.4831544E-12	7.9193316E-12
6.80	5.2309575E-12	4.8799373E-12	4.5520255E-12	4.2457316E-12	3.9596590E-12
6.90	2.6001270E-12	2.4232685E-12	2.2582182E-12	2.1042031E-12	1.9604997E-12
7.00	1.2798125E-12	1.1915906E-12	1.1093412E-12	1.0326677E-12	9.6119916E-13
7.10	6.2378445E-13	5.8021477E-13	5.3963532E-13	5.0184464E-13	4.6665460E-13
7.20	3.0106280E-13	2.7975938E-13	2.5993787E-13	2.4149702E-13	2.2434237E-13
7.30	1.4388386E-13	1.3357119E-13	1.2398548E-13	1.1507637E-13	1.0679693E-13
7.40	6.8092249E-14	6.3149708E-14	5.8560167E-14	5.4298840E-14	5.0342650E-14
7.50	3.1908917E-14	2.9563682E-14	2.7388121E-14	2.5370161E-14	2.3498573E-14
7.60	1.4806537E-14	1.3704796E-14	1.2683786E-14	1.1737686E-14	1.0861087E-14
7.70	6.8033115E-15	6.2908869E-15	5.8164853E-15	5.3773292E-15	4.9708407E-15
7.80	3.0953588E-15	2.8593993E-15	2.6411668E-15	2.4393498E-15	2.2527322E-15
7.90	1.3945171E-15	1.2869445E-15	1.1875529E-15	1.0957294E-15	1.0109063E-15
8.00	6.2209606E-16	5.7354222E-16	5.2872583E-16	4.8736333E-16	4.4919236E-16
8.10	2.7479594E-16	2.5309881E-16	2.3309184E-16	2.1464522E-16	1.9763895E-16
8.20	1.2019352E-16	1.1059425E-16	1.0175159E-16	9.3606722E-17	8.6105328E-17
8.30	5.2055697E-17	4.7851036E-17	4.3981656E-17	4.0421177E-17	3.7145267E-17
8.40	2.2323932E-17	2.0500536E-17	1.8824215E-17	1.7283261E-17	1.5866883E-17
8.50	9.4795348E-18	8.6966677E-18	7.9776661E-18	7.3173858E-18	6.7110918E-18
8.60	3.9858050E-18	3.6530288E-18	3.3477056E-18	3.0675987E-18	2.8106511E-18
8.70	1.6594209E-18	1.5193740E-18	1.3910090E-18	1.2733631E-18	1.1655521E-18
8.80	6.8408077E-19	6.2572930E-19	5.7229861E-19	5.2337862E-19	4.7859301E-19
8.90	2.7923344E-19	2.5516282E-19	2.3314411E-19	2.1300440E-19	1.9458519E-19

Table S3 (continued)

x	05	06	07	08	09
4.50	2.6822958E-06	2.5576810E-06	2.4386211E-06	2.3248796E-06	2.2162300E-06
4.60	1.6596751E-06	1.5810469E-06	1.5059987E-06	1.4343746E-06	1.3660252E-06
4.70	1.0170832E-06	9.6796480E-07	9.2112960E-07	8.7647597E-07	8.3390657E-07
4.80	6.1730737E-07	5.8692876E-07	5.5799124E-07	5.3042920E-07	5.0417989E-07
4.90	3.7106741E-07	3.5246590E-07	3.3476451E-07	3.1792137E-07	3.0189646E-07
5.00	2.2090503E-07	2.0962824E-07	1.9890785E-07	1.8871743E-07	1.7903176E-07
5.10	1.3024323E-07	1.2347492E-07	1.1704700E-07	1.1094295E-07	1.0514704E-07
5.20	7.6049605E-08	7.2027701E-08	6.8211879E-08	6.4591943E-08	6.1158180E-08
5.30	4.3977116E-08	4.1610976E-08	3.9368321E-08	3.7242919E-08	3.5228842E-08
5.40	2.5184910E-08	2.3806729E-08	2.2501779E-08	2.1266292E-08	2.0096687E-08
5.50	1.4283480E-08	1.3488733E-08	1.2736967E-08	1.2025929E-08	1.1353481E-08
5.60	8.0223919E-09	7.5686498E-09	7.1398760E-09	6.7347371E-09	6.3519686E-09
5.70	4.4621725E-09	4.2056968E-09	3.9635766E-09	3.7350313E-09	3.5193212E-09
5.80	2.4578651E-09	2.3143359E-09	2.1789757E-09	2.0513324E-09	1.9309781E-09
5.90	1.3407124E-09	1.2611897E-09	1.1862679E-09	1.1156881E-09	1.0492052E-09
6.00	7.2422917E-10	6.8060774E-10	6.3955125E-10	6.0091274E-10	5.6455344E-10
6.10	3.8741473E-10	3.6372472E-10	3.4144996E-10	3.2050801E-10	3.0082108E-10
6.20	2.0522634E-10	1.9248874E-10	1.8052405E-10	1.6928651E-10	1.5873299E-10
6.30	1.0765746E-10	1.0087687E-10	9.4514100E-11	8.8543992E-11	8.2942877E-11
6.40	5.5925076E-11	5.2351491E-11	4.9001459E-11	4.5861309E-11	4.2918187E-11
6.50	2.8768542E-11	2.6903889E-11	2.5157631E-11	2.3522413E-11	2.1991329E-11
6.60	1.4654651E-11	1.3691379E-11	1.2790171E-11	1.1947112E-11	1.1158530E-11
6.70	7.3922578E-12	6.8995870E-12	6.4391198E-12	6.0087941E-12	5.6066772E-12
6.80	3.6924994E-12	3.4430274E-12	3.2100952E-12	2.9926280E-12	2.7896194E-12
6.90	1.8264311E-12	1.7013637E-12	1.5847049E-12	1.4759003E-12	1.3744312E-12
7.00	8.9458896E-13	8.3251302E-13	7.7466849E-13	7.2077231E-13	6.7056000E-13
7.10	4.3388950E-13	4.0338530E-13	3.7498883E-13	3.4855709E-13	3.2395661E-13
7.20	2.0838582E-13	1.9354516E-13	1.7974375E-13	1.6691009E-13	1.5497751E-13
7.30	9.9103427E-14	9.1955114E-14	8.5314018E-14	7.9144766E-14	7.3414407E-14
7.40	4.6670116E-14	4.3261240E-14	4.0097410E-14	3.7161306E-14	3.4436807E-14
7.50	2.1762912E-14	2.0153468E-14	1.8661211E-14	1.7277748E-14	1.5995274E-14
7.60	1.0048966E-14	9.2966542E-15	8.5998175E-15	7.9544295E-15	7.3567513E-15
7.70	4.5946274E-15	4.2464693E-15	3.9243063E-15	3.6262274E-15	3.3504597E-15
7.80	2.0801864E-15	1.9206673E-15	1.7732063E-15	1.6369054E-15	1.5109327E-15
7.90	9.3255758E-16	8.6019640E-16	7.9337184E-16	7.3166645E-16	6.7469377E-16
8.00	4.1397018E-16	3.8147224E-16	3.5149084E-16	3.2383387E-16	2.9832366E-16
8.10	1.8196214E-16	1.6751230E-16	1.5419473E-16	1.4192194E-16	1.3061309E-16
8.20	7.9197263E-17	7.2836234E-17	6.6979507E-17	6.1587641E-17	5.6624234E-17
8.30	3.4131483E-17	3.1359128E-17	2.8809117E-17	2.6463852E-17	2.4307109E-17
8.40	1.4565141E-17	1.3368876E-17	1.2269652E-17	1.1259697E-17	1.0331855E-17
8.50	6.1544256E-18	5.6433761E-18	5.1742520E-18	4.7436570E-18	4.3484663E-18
8.60	2.5749715E-18	2.3588213E-18	2.1606019E-18	1.9788441E-18	1.8121974E-18
8.70	1.0667637E-18	9.7625187E-19	8.9333143E-19	8.1737329E-19	7.4779984E-19
8.80	4.3759648E-19	4.0007220E-19	3.6572951E-19	3.3430181E-19	3.0554455E-19
8.90	1.7774118E-19	1.6233920E-19	1.4825722E-19	1.3538338E-19	1.2361522E-19

Table S3 (continued)

x	00	01	02	03	04
9.00	1.1285884E-19	1.0302825E-19	9.4044651E-20	8.5835899E-20	7.8335909E-20
9.10	4.5165915E-20	4.1190986E-20	3.7562165E-20	3.4249647E-20	3.1226165E-20
9.20	1.7897488E-20	1.6306247E-20	1.4855011E-20	1.3531595E-20	1.2324862E-20
9.30	7.0222842E-21	6.3916175E-21	5.8170151E-21	5.2935454E-21	4.8167059E-21
9.40	2.7281536E-21	2.4806846E-21	2.2554401E-21	2.0504449E-21	1.8638970E-21
9.50	1.0494515E-21	9.5331268E-22	8.6589531E-22	7.8641615E-22	7.1416157E-22
9.60	3.9972212E-22	3.6274493E-22	3.2915582E-22	2.9864739E-22	2.7093988E-22
9.70	1.5074932E-22	1.3666856E-22	1.2389075E-22	1.1229648E-22	1.0177718E-22
9.80	5.6292823E-23	5.0984280E-23	4.6171773E-23	4.1809388E-23	3.7855419E-23
9.90	2.0813752E-23	1.8832309E-23	1.7037809E-23	1.5412777E-23	1.3941357E-23
10.00	7.6198530E-24	6.8876271E-24	6.2251473E-24	5.6258302E-24	5.0837079E-24
10.10	2.7621095E-24	2.4942138E-24	2.2520781E-24	2.0332472E-24	1.8354979E-24
10.20	9.9136251E-25	8.9432419E-25	8.0670440E-25	7.2759690E-25	6.5618185E-25
10.30	3.5230651E-25	3.1750661E-25	2.8611579E-25	2.5780292E-25	2.3226877E-25
10.40	1.2396660E-25	1.1161083E-25	1.0047660E-25	9.0444148E-26	8.1405354E-26
10.50	4.3190063E-26	3.8846774E-26	3.4936792E-26	3.1417240E-26	2.8249449E-26
10.60	1.4899011E-26	1.3387454E-26	1.2028056E-26	1.0805624E-26	9.7064672E-27
10.70	5.0889109E-27	4.5680907E-27	4.1001667E-27	3.6798088E-27	3.3022193E-27
10.80	1.7210178E-27	1.5433503E-27	1.3838869E-27	1.2407766E-27	1.1123553E-27
10.90	5.7628644E-28	5.1628174E-28	4.6247904E-28	4.1424212E-28	3.7099954E-28
11.00	1.9106596E-28	1.7100186E-28	1.5302954E-28	1.3693252E-28	1.2251658E-28
11.10	6.2721944E-29	5.6079758E-29	5.0135996E-29	4.4817753E-29	4.0059674E-29
11.20	2.0386675E-29	1.8209669E-29	1.6263522E-29	1.4523927E-29	1.2969117E-29
11.30	6.5608999E-30	5.8544763E-30	5.2235960E-30	4.6602371E-30	4.1572231E-30
11.40	2.0905954E-30	1.8636466E-30	1.6611697E-30	1.4805441E-30	1.3194277E-30
11.50	6.5957714E-31	5.8739201E-31	5.2305500E-31	4.6571857E-31	4.1462611E-31
11.60	2.0603912E-31	1.8330780E-31	1.6306813E-31	1.4504879E-31	1.2900781E-31
11.70	6.3726749E-32	5.6639810E-32	5.0335999E-32	4.4729337E-32	3.9743226E-32
11.80	1.9515573E-32	1.7328064E-32	1.5384227E-32	1.3657089E-32	1.2122648E-32
11.90	5.9173577E-33	5.2488630E-33	4.6554270E-33	4.1286747E-33	3.6611597E-33
12.00	1.7764821E-33	1.5742253E-33	1.3948573E-33	1.2358038E-33	1.0947782E-33
12.10	5.2805588E-34	4.6747081E-34	4.1379570E-34	3.6624719E-34	3.2413019E-34
12.20	1.5541198E-34	1.3744459E-34	1.2154235E-34	1.0746932E-34	9.5016317E-35
12.30	4.5287070E-35	4.0011594E-35	3.5347145E-35	3.1223362E-35	2.7577942E-35
12.40	1.3066180E-35	1.1532639E-35	1.0178075E-35	8.9817177E-36	7.9251960E-36
12.50	3.7325643E-36	3.2912114E-36	2.9017574E-36	2.5581338E-36	2.2549777E-36
12.60	1.0557226E-36	9.2996508E-37	8.1910641E-37	7.2139119E-37	6.3526976E-37
12.70	2.9564853E-37	2.6017220E-37	2.2893009E-37	2.0141959E-37	1.7719740E-37
12.80	8.1975609E-38	7.2067274E-38	6.3350254E-38	5.5682081E-38	4.8937229E-38
12.90	2.2504851E-38	1.9765045E-38	1.7357066E-38	1.5240935E-38	1.3381467E-38
13.00	6.1171566E-39				

Table S3 (continued)

x	05	06	07	08	09
9.00	7.1484170E-20	6.5225278E-20	5.9508508E-20	5.4287426E-20	4.9519528E-20
9.10	2.8466774E-20	2.5948659E-20	2.3650952E-20	2.1554571E-20	1.9642068E-20
9.20	1.1224634E-20	1.0221611E-20	9.3072962E-21	8.4739283E-21	7.7144163E-21
9.30	4.3823863E-21	3.9868346E-21	3.6266264E-21	3.2986364E-21	3.0000129E-21
9.40	1.6941535E-21	1.5397160E-21	1.3992185E-21	1.2714154E-21	1.1551713E-21
9.50	6.4848145E-22	5.8878352E-22	5.3452837E-22	4.8522468E-22	4.4042506E-22
9.60	2.4577865E-22	2.2293198E-22	2.0218904E-22	1.8335799E-22	1.6626433E-22
9.70	9.2234135E-23	8.3577611E-23	7.5726036E-23	6.8605273E-23	6.2147944E-23
9.80	3.4271988E-23	3.1024696E-23	2.8082305E-23	2.5416455E-23	2.3001395E-23
9.90	1.2609161E-23	1.1403136E-23	1.0311442E-23	9.3233391E-24	8.4290872E-24
10.00	4.5933711E-24	4.1499174E-24	3.7489042E-24	3.3863062E-24	3.0584759E-24
10.10	1.6568171E-24	1.4953822E-24	1.3495433E-24	1.2178069E-24	1.0988211E-24
10.20	5.9171769E-25	5.3353370E-25	4.8102330E-25	4.3363801E-25	3.9088187E-25
10.30	2.0924290E-25	1.8848102E-25	1.6976238E-25	1.5288759E-25	1.3767655E-25
10.40	7.3262614E-26	6.5927834E-26	5.9321503E-26	5.3371871E-26	4.8014196E-26
10.50	2.5398547E-26	2.2833091E-26	2.0524732E-26	1.8447911E-26	1.6579593E-26
10.60	8.7182529E-27	7.8298722E-27	7.0313192E-27	6.3135830E-27	5.6685490E-27
10.70	2.9630809E-27	2.6585083E-27	2.3850060E-27	2.1394288E-27	1.9189477E-27
10.80	9.9712674E-28	8.9374604E-28	8.0100424E-28	7.1781483E-28	6.4320136E-28
10.90	3.3223808E-28	2.9749684E-28	2.6636198E-28	2.3846191E-28	2.1346305E-28
11.00	1.0960744E-28	9.8048762E-29	8.7700305E-29	7.8436282E-29	7.0143882E-29
11.10	3.5803184E-29	3.1995787E-29	2.8590440E-29	2.5544993E-29	2.2821682E-29
11.20	1.1579603E-29	1.0337936E-29	9.2284950E-30	8.2372990E-30	7.3518337E-30
11.30	3.7081351E-30	3.3072319E-30	2.9493794E-30	2.6299866E-30	2.3449486E-30
11.40	1.1757276E-30	1.0475740E-30	9.3329642E-31	8.3140261E-31	7.4055965E-31
11.50	3.6910219E-31	3.2854395E-31	2.9241336E-31	2.6023027E-31	2.3156628E-31
11.60	1.1472941E-31	1.0202120E-31	9.0711623E-32	8.0647765E-32	7.1693307E-32
11.70	3.5309424E-32	3.1367147E-32	2.7862257E-32	2.4746536E-32	2.1977052E-32
11.80	1.0759540E-32	9.5487563E-33	8.4733816E-33	7.5183681E-33	6.6703293E-33
11.90	3.2462619E-33	2.8780961E-33	2.5514313E-33	2.2616185E-33	2.0045258E-33
12.00	9.6974966E-34	8.5891457E-34	7.6067153E-34	6.7359866E-34	5.9643362E-34
12.10	2.8682798E-34	2.5379345E-34	2.2454126E-34	1.9864093E-34	1.7571069E-34
12.20	8.3997961E-35	7.4249946E-35	6.5626673E-35	5.7999131E-35	5.1253016E-35
12.30	2.4355714E-35	2.1507837E-35	1.8991070E-35	1.6767140E-35	1.4802170E-35
12.40	6.9922582E-36	6.1685309E-36	5.4413026E-36	4.7993325E-36	4.2326821E-36
12.50	1.9875501E-36	1.7516638E-36	1.5436195E-36	1.3601494E-36	1.1983669E-36
12.60	5.5937411E-37	4.9249675E-37	4.3357198E-37	3.8165933E-37	3.3592892E-37
12.70	1.5587262E-37	1.3710053E-37	1.2057722E-37	1.0603476E-37	9.3236945E-38
12.80	4.3005115E-38	3.7788328E-38	3.3201068E-38	2.9167773E-38	2.5621898E-38
12.90	1.1747695E-38	1.0312369E-38	9.0515094E-39	7.9440212E-39	6.9713452E-39

Table S4. Critical values of the chi-square distribution. When 9 right signs were not ensured values with fewer signs are displayed

N	Probability greater than the critical value							
	0.001	0.005	0.010	0.025	0.050	0.100	0.250	0.500
1	1.0827566E+01	7.879439E+00	6.634897E+00	5.0238862E+00	3.8414588E+00	2.70554345E+00	1.32330370E+00	4.5493642E-01
2	1.38155106E+01	1.05966347E+01	9.21034037E+00	7.37775891E+00	5.99146455E+00	4.60517019E+00	2.77258872E+00	1.38629436E+00
3	1.626624E+01	1.2838156E+01	1.1344867E+01	9.3484036E+00	7.8147279E+00	6.2513886E+00	4.10834493E+00	2.36597388E+00
4	1.8466827E+01	1.486026E+01	1.32767041E+01	1.11432868E+01	9.48772904E+00	7.77944034E+00	5.38526906E+00	3.3566940E+00
5	2.05150057E+01	1.67496023E+01	1.50862725E+01	1.28325020E+01	1.10704977E+01	9.23635690E+00	6.62567976E+00	4.35146019E+00
6	2.2458E+01	1.85475842E+01	1.68118938E+01	1.44493753E+01	1.25915872E+01	1.06446407E+01	7.84080412E+00	5.34812063E+00
7	2.4321886E+01	2.02777399E+01	1.84753069E+01	1.60127643E+01	1.40671404E+01	1.20170366E+01	9.03714755E+00	6.34581120E+00
8	2.6124482E+01	2.19549550E+01	2.00902350E+01	1.75345461E+01	1.55073131E+01	1.33615661E+01	1.02188550E+01	7.34412150E+00
9	2.78772E+01	2.358935E+01	2.1665994E+01	1.9022768E+01	1.6918978E+01	1.46836566E+01	1.13887514E+01	8.3428327E+00
10	2.95882984E+01	2.51881796E+01	2.32092512E+01	2.04831774E+01	1.83070381E+01	1.59871792E+01	1.25488614E+01	9.34181777E+00
11	3.12641336E+01	2.67568489E+01	2.47249703E+01	2.19200493E+01	1.96751376E+01	1.72750085E+01	1.37006928E+01	1.03409981E+01
12	3.2909490E+01	2.82995187E+01	2.62169672E+01	2.33366641E+01	2.10260698E+01	1.85493478E+01	1.48454037E+01	1.13403224E+01
13	3.45282E+01	2.981947E+01	2.7688250E+01	2.4735605E+01	2.236203E+01	1.98119293E+01	1.59839062E+01	1.23397559E+01
14	3.612327E+01	3.1319350E+01	2.9141238E+01	2.6118948E+01	2.3684791E+01	2.10641442E+01	1.7116934E+01	1.3339274E+01
15	3.769730E+01	3.2801321E+01	3.0577914E+01	2.74883929E+01	2.49957901E+01	2.23071296E+01	1.82450856E+01	1.43388595E+01
16	3.92524E+01	3.4267187E+01	3.19999269E+01	2.88453507E+01	2.62962276E+01	2.35418289E+01	1.93688602E+01	1.53384989E+01
17	4.0790217E+01	3.57184657E+01	3.34086636E+01	3.01910091E+01	2.75871116E+01	2.4769035E+01	2.04886762E+01	1.63381824E+01
18	4.2312396E+01	3.71564515E+01	3.48053057E+01	3.15263784E+01	2.88692994E+01	2.59894231E+01	2.16048898E+01	1.73379024E+01
19	4.38201960E+01	3.85822566E+01	3.61908691E+01	3.28523269E+01	3.01435272E+01	2.72035710E+01	2.27178067E+01	1.83376529E+01
20	4.53147466E+01	3.99968463E+01	3.75662348E+01	3.41696069E+01	3.14104328E+01	2.84119806E+01	2.38276920E+01	1.93374292E+01
21	4.6797038E+01	4.14010648E+01	3.89321727E+01	3.54788759E+01	3.26705733E+01	2.96150894E+01	2.49347770E+01	2.03372276E+01
22	4.82679423E+01	4.27957E+01	4.02893604E+01	3.67807121E+01	3.39244385E+01	3.08132823E+01	2.60392650E+01	2.13370448E+01
23	4.97282325E+01	4.4181275E+01	4.16383981E+01	3.80756273E+01	3.51724616E+01	3.20068997E+01	2.71413360E+01	2.23368784E+01
24	5.11785978E+01	4.55585119E+01	4.29798201E+01	3.93640770E+01	3.64150285E+01	3.31962443E+01	2.82411500E+01	2.33367263E+01
25	5.26196558E+01	4.69278902E+01	4.43141049E+01	4.06464691E+01	3.76524841E+01	3.43815870E+01	2.93388503E+01	2.43365867E+01
26	5.40519624E+01	4.82898823E+01	4.56416827E+01	4.19231701E+01	3.88851387E+01	3.55631713E+01	3.04345654E+01	2.53364581E+01

Table S4 (continued)

Probability greater than the critical value							N
0.750	0.900	0.950	0.975	0.990	0.995	0.999	
1.01531044E-01	1.57907741E-02	3.9321E-03	9.820691E-04	1.570879E-04	3.927042E-05	1.57079633E-06	1
5.75364145E-01	2.10721031E-01	1.02586589E-01	5.06356160E-02	2.0100672E-02	1.00250836E-02	2.0010007E-03	2
1.21253290E+00	5.8437437E-01	3.5184632E-01	2.1579528E-01	1.14832E-01	7.172177E-02	2.42976E-02	3
1.92255753E+00	1.06362322E+00	7.10723021E-01	4.8441856E-01	2.9710948E-01	2.0698909E-01	9.08040E-02	4
2.67460281E+00	1.61030799E+00	1.14547623E+00	8.3121161E-01	5.54298077E-01	4.11741904E-01	2.10212603E-01	5
3.45459884E+00	2.20413066E+00	1.63538289E+00	1.23734425E+00	8.720903E-01	6.7572678E-01	3.81067E-01	6
4.25485218E+00	2.83310692E+00	2.16734991E+00	1.68986918E+00	1.2390423E+00	9.8925568E-01	5.98494E-01	7
5.07064042E+00	3.48953913E+00	2.73263679E+00	2.17973075E+00	1.64649737E+00	1.34441309E+00	8.571048E-01	8
5.8988259E+00	4.16816E+00	3.3251128E+00	2.7003895E+00	2.087901E+00	1.734933E+00	1.15195E+00	9
6.73720077E+00	4.86518205E+00	3.94029914E+00	3.24697278E+00	2.5582122E+00	2.15585648E+00	1.47874346E+00	10
7.58414279E+00	5.57778479E+00	4.57481308E+00	3.81574825E+00	3.05348411E+00	2.60322189E+00	1.83385266E+00	11
8.43841878E+00	6.30379606E+00	5.22602948E+00	4.40378850E+00	3.57056896E+00	3.0738236E+00	2.21420939E+00	12
9.2990655E+00	7.0415046E+00	5.891864E+00	5.0087505E+00	4.10692E+00	3.565035E+00	2.617218E+00	13
1.01653138E+01	7.7895336E+00	6.5706314E+00	5.628726E+00	4.6604251E+00	4.0747E+00	3.04067E+00	14
1.10365377E+01	8.54675624E+00	7.2609439E+00	6.262138E+00	5.2293489E+00	4.6009156E+00	3.4827E+00	15
1.19122197E+01	9.3122364E+00	7.9616456E+00	6.9076644E+00	5.8122125E+00	5.14221E+00	3.941628E+00	16
1.27919264E+01	1.00851863E+01	8.6717602E+00	7.56419E+00	6.4077598E+00	5.6972171E+00	4.416093E+00	17
1.36752903E+01	1.08649361E+01	9.39045508E+00	8.2307462E+00	7.01491090E+00	6.2648047E+00	4.9048488E+00	18
1.45619967E+01	1.16509100E+01	1.01170131E+01	8.90651648E+00	7.63272965E+00	6.84397145E+00	5.4068160E+00	19
1.54517735E+01	1.24426092E+01	1.08508114E+01	9.59077739E+00	8.26039833E+00	7.43384426E+00	5.92104075E+00	20
1.63443838E+01	1.32395980E+01	1.15913052E+01	1.02828978E+01	8.89719794E+00	8.03365342E+00	6.4466766E+00	21
1.72396194E+01	1.40414932E+01	1.23380146E+01	1.09823207E+01	9.54249234E+00	8.64271640E+00	6.98296844E+00	22
1.81372967E+01	1.48479558E+01	1.30905142E+01	1.16885519E+01	1.01957156E+01	9.26042478E+00	7.52923977E+00	23
1.90372525E+01	1.56586841E+01	1.38484250E+01	1.24011502E+01	1.08563615E+01	9.88623350E+00	8.08488158E+00	24
1.99393409E+01	1.64734080E+01	1.46114076E+01	1.31197200E+01	1.15239754E+01	1.05196521E+01	8.64934363E+00	25
2.08434311E+01	1.72918850E+01	1.53791566E+01	1.38439050E+01	1.21981469E+01	1.11602374E+01	9.22212682E+00	26

Table S4 (continued)

N	Probability greater than the critical value							
	0.001	0.005	0.010	0.025	0.050	0.100	0.250	0.500
27	5.54760202E+01	4.96449153E+01	4.69629421E+01	4.31945110E+01	4.01132721E+01	3.67412167E+01	3.15284116E+01	2.63363393E+01
28	5.68922854E+01	5.09933763E+01	4.82782358E+01	4.44607918E+01	4.13371382E+01	3.79159225E+01	3.26204941E+01	2.73362292E+01
29	5.83011735E+01	5.23356178E+01	4.95878845E+01	4.57222858E+01	4.25569678E+01	3.90874698E+01	3.37109086E+01	2.83361269E+01
30	5.97030643E+01	5.36719619E+01	5.08921813E+01	4.69792422E+01	4.37729718E+01	4.02560237E+01	3.47997425E+01	2.93360315E+01
31	6.10983061E+01	5.50027039E+01	5.21913948E+01	4.82318896E+01	4.49853433E+01	4.14217358E+01	3.58870759E+01	3.03359425E+01
32	6.24872191E+01	5.63281150E+01	5.34857718E+01	4.94804377E+01	4.61942595E+01	4.25847451E+01	3.69729821E+01	3.13358591E+01
33	6.38700985E+01	5.76484453E+01	5.47755398E+01	5.07250801E+01	4.73998839E+01	4.37451796E+01	3.80575290E+01	3.23357809E+01
34	6.52472175E+01	5.89639259E+01	5.60609087E+01	5.19659952E+01	4.86023674E+01	4.49031575E+01	3.91407790E+01	3.33357074E+01
35	6.66188288E+01	6.02747709E+01	5.73420734E+01	5.32033485E+01	4.98018496E+01	4.60587884E+01	4.02227899E+01	3.43356381E+01
36	6.79851676E+01	6.15811791E+01	5.86192145E+01	5.44372936E+01	5.09984602E+01	4.72121739E+01	4.13036155E+01	3.53355728E+01
37	6.93464525E+01	6.28833354E+01	5.9892500E+01	5.56679733E+01	5.21923197E+01	4.83634084E+01	4.23833057E+01	3.63355111E+01
38	7.07028874E+01	6.41814124E+01	6.11620868E+01	5.68955205E+01	5.33835406E+01	4.95125798E+01	4.34619070E+01	3.73354527E+01
39	7.2054663E+01	6.54755709E+01	6.24281210E+01	5.81200597E+01	5.45722278E+01	5.06597705E+01	4.45394627E+01	3.83353974E+01
40	7.34019575E+01	6.67659618E+01	6.36907398E+01	5.93417071E+01	5.57584793E+01	5.18050572E+01	4.56160136E+01	3.93353448E+01
41	7.47449384E+01	6.80527265E+01	6.49500713E+01	6.05605717E+01	5.69423871E+01	5.29485120E+01	4.66915977E+01	4.03352949E+01
42	7.60837627E+01	6.93359975E+01	6.62062363E+01	6.17767558E+01	5.81240377E+01	5.40902025E+01	4.77662506E+01	4.13352474E+01
43	7.74185782E+01	7.06158996E+01	6.74593479E+01	6.29903555E+01	5.93035120E+01	5.52301921E+01	4.88400060E+01	4.23352022E+01
44	7.87495242E+01	7.18925505E+01	6.87095130E+01	6.42014615E+01	6.04808866E+01	5.63685407E+01	4.99128954E+01	4.33351590E+01
45	8.00767320E+01	7.31660608E+01	6.99568321E+01	6.54101590E+01	6.16562334E+01	5.7505305E+01	5.09849487E+01	4.43351178E+01
46	8.14003257E+01	7.44365354E+01	7.12014003E+01	6.66165288E+01	6.28296204E+01	5.86405374E+01	5.20561939E+01	4.53350784E+01
47	8.27204225E+01	7.57040731E+01	7.24433074E+01	6.78206470E+01	6.40011120E+01	5.97742889E+01	5.31266576E+01	4.63350407E+01
48	8.40371337E+01	7.69687677E+01	7.36826385E+01	6.90225858E+01	6.51707689E+01	6.09066070E+01	5.41963650E+01	4.73350046E+01
49	8.53505646E+01	7.82307081E+01	7.49194743E+01	7.02224136E+01	6.63386489E+01	6.20375368E+01	5.52653399E+01	4.83349699E+01
50	8.66608152E+01	7.94899785E+01	7.61538912E+01	7.14201952E+01	6.75048065E+01	6.31671210E+01	5.63336049E+01	4.93349367E+01

Table S4 (continued)

Probability greater than the critical value							N
0.750	0.900	0.950	0.975	0.990	0.995	0.999	
2.17494050E+01	1.81138960E+01	1.61513958E+01	1.45733827E+01	1.28785044E+01	1.18075874E+01	9.80277692E+00	27
2.26571557E+01	1.89392424E+01	1.69278750E+01	1.53078606E+01	1.35647098E+01	1.24613359E+01	1.03908791E+01	28
2.35665861E+01	1.97677436E+01	1.77083662E+01	1.60470717E+01	1.42564546E+01	1.31211489E+01	1.09860535E+01	29
2.44776077E+01	2.05992346E+01	1.84926610E+01	1.67907723E+01	1.49534565E+01	1.37867199E+01	1.15879511E+01	30
2.53901393E+01	2.14335645E+01	1.92805686E+01	1.75387386E+01	1.56554564E+01	1.44577674E+01	1.21962504E+01	31
2.63041066E+01	2.22705945E+01	2.00719135E+01	1.82907649E+01	1.63622155E+01	1.51340321E+01	1.28106546E+01	32
2.72194412E+01	2.31101967E+01	2.08665340E+01	1.90466615E+01	1.70735137E+01	1.58152744E+01	1.34308890E+01	33
2.81360797E+01	2.39522533E+01	2.16642807E+01	1.98062529E+01	1.77891469E+01	1.65012725E+01	1.40566988E+01	34
2.90539637E+01	2.47966548E+01	2.24650152E+01	2.05693766E+01	1.85089262E+01	1.71918203E+01	1.46878470E+01	35
2.99730390E+01	2.56432999E+01	2.32686090E+01	2.13358816E+01	1.92326758E+01	1.78867265E+01	1.53241128E+01	36
3.08932552E+01	2.64920943E+01	2.40749426E+01	2.21056272E+01	1.99602320E+01	1.85858125E+01	1.59652903E+01	37
3.18145653E+01	2.73429500E+01	2.48839044E+01	2.28784823E+01	2.06914421E+01	1.92889116E+01	1.66111868E+01	38
3.27369256E+01	2.81957852E+01	2.56953904E+01	2.36543246E+01	2.14261631E+01	1.99958679E+01	1.72616220E+01	39
3.36602949E+01	2.90505229E+01	2.65093032E+01	2.44330392E+01	2.21642613E+01	2.07065353E+01	1.79164265E+01	40
3.45846351E+01	2.99070914E+01	2.73255515E+01	2.52145186E+01	2.29056111E+01	2.14207768E+01	1.85754414E+01	41
3.55099100E+01	3.07654230E+01	2.81440495E+01	2.59986620E+01	2.36500947E+01	2.21384633E+01	1.92385169E+01	42
3.64360859E+01	3.16254544E+01	2.89647167E+01	2.67853742E+01	2.43976010E+01	2.28594736E+01	1.99055120E+01	43
3.73631309E+01	3.24871258E+01	2.97874771E+01	2.75745657E+01	2.51480254E+01	2.35836932E+01	2.05762936E+01	44
3.82910151E+01	3.33503809E+01	3.06122591E+01	2.83661523E+01	2.59012692E+01	2.43110142E+01	2.12507359E+01	45
3.92197100E+01	3.42151665E+01	3.14389953E+01	2.91600541E+01	2.66572391E+01	2.50413343E+01	2.19287200E+01	46
4.01491890E+01	3.50814324E+01	3.22676215E+01	2.99561957E+01	2.74158469E+01	2.5774557E+01	2.26101332E+01	47
4.10794268E+01	3.59491310E+01	3.30980774E+01	3.07545057E+01	2.81770089E+01	2.65105910E+01	2.32948686E+01	48
4.20103993E+01	3.68182173E+01	3.39303056E+01	3.15549165E+01	2.89406460E+01	2.72493491E+01	2.39828247E+01	49
4.29420838E+01	3.76886484E+01	3.47642517E+01	3.23573637E+01	2.97066827E+01	2.79907489E+01	2.46739053E+01	50

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