^{123}I – Comments on evaluation of decay data by V. Chisté and M.M. Bé

1) Decay Scheme

There are 2 excited levels at 247 keV and 532 keV in ^{123}Te that have not been reported here. The 247 keV isomer ($T_{1/2}$ = 119,7 d) is not populated in the electron capture decay of ^{123}I, and the expected electron capture population to the level 532 keV, if any, is very small.

2) Nuclear Data

The Q value is from Audi and Wapstra (1995Au04)

Level energies, spin and parities are from S. Ohya and T. Tamura (1993Oh12).

For level E = 687 keV, there are two possible spin values : 3/2+ and 5/2+. The 5/2+ value was suggested by Schoeters (1979Sc13) not after a measurement but by considering a proposal from Walters (1976Wa13). On the other hand, the $3/2^+$ value was measured by Sergolle (γγ coincidence (1969Se09) and Coulomb excitation (1970Se03)), Lien ((d,p) reaction (1975Li22)) and Andreev (Coulomb excitation (1975An16)). Then, the adopted value is 3/2+.

The half-life value, calculated by the Lweight program (version 3), is the weighted mean of:

$T_{1/2}$

Reference	Value (h)	Comments
Anderson (1964Anderson)	13,30 (5)	
Hupf (1968Hu01)	13,02 (4)	
Jonsson (1968Jo02)	13,4 (5)	
Karim (1973Ka45)	13,50 (11)	
Lagoutine (1982La25)	13,21 (2)	
Hoppes (1982HoZJ)	13,219 (7)	Superseded 1992Un01
Unterweger (1992Un01)	13,2235 (19)	
da Silva (2004Da05)	13,2228 (29)	
Schrader (2004Sc04)	13,232 (6)	

The original uncertainty given by Hupf (1968Hu01) (= 0,02) seems under estimated and has been multiplied by 2 by the evaluator. The uncertainty adopted by Lagoutine (1982La25) is the sum of the statistical uncertainty assessed at 3σ and the systematic uncertainty at 1σ; consequently, the standard deviation cannot be obtained dividing the original uncertainty by 3 and we adopted the value 0,02. With this set of data, the reduced χ^2 is 4,7. The largest contribution comes from the value of Unterweger (1992Un01), amounting to 62 %. The program Lweight 3 increases the uncertainty for the 1992Un03 value from 0,0019 to 0,00242 in order to reduce its relative weight from 62 % to 50 %.

The adopted value is the weighted mean: *13,2234 h*, with the external uncertainty of *0,0037 h*.

2.1) Electron Capture Transitions

The partial sub-shell capture probabilities are calculated with the program EC-Capture for the Allowed and 1st Forbidden transitions.
The electron capture probabilities and the related uncertainties have been deduced from the imbalance on each level of the decay scheme, assuming no EC transition to the ground state and to the 599 keV level. If this transition exists its intensity is of the order of a few per thousands.

2.3) Gamma Transitions

For the 159, 280, 346, 440 and 624 keV gamma transitions, the adopted δ (mixing of different multipolarities) are from the Krane evaluation (1977Kr13) of experimental measurements in which angular distribution and correlation data have been analyzed. For other transitions, the values of δ are from S. Ohya and T. Tamura (1993Oh12).
The internal conversion coefficients are calculated by ICC Computer Code (program Icc99v3a – GETICC dialog). The adopted values are interpolated from Rösel tables.

For the 159 keV gamma transition, many values of δ^2 have been found in the literature, as shown in the following table:

Reference	**Value of δ^2**	**Value of α_T**
Goldberg et al – Phys. Rev. 100(1955)1350	0,013 (1)	1,919 10^{-1}
Fagg et al – Phys. Rev. 100(1955)1299	0,0034 (20)	1,905 10^{-1}
Chu et al – Phys. Rev. 133(1964)B1361	0,0067 (11)	1,909 10^{-1}
Gupta et al – Nucl. Phys. 80(1966)471	0,011 (8)	1,916 10^{-1}
Alkhazov et al – Phys. Serv. 28(1964)1575	0,004 (5)	1,906 10^{-1}
Törnkvist et al – Nucl. Phys. A130(1969)604	0,0119 (9)	1,917 10^{-1}
Krane et al - Atomic Data and Nuclear Data Tables 19(1977)19	0,012 32 (47) (adopted value)	1,918 10^{-1}

It can be noted that even with values of δ^2 quite different the resulting α_T values are close with differences smaller than 1 %; thus the adopted uncertainty is 1 %.

For the 440 keV gamma transition, the following values of δ^2 have been found in the literature:

Reference	**Value of δ^2**	**Value of α_T**
Sergolle et al – Nucl. Phys. A139(1969)554	0,149	0,012 991 2
Sergolle et al – Nucl. Phys. A145(1970)351	0,16	0,012 980 3
Roney et al – Nucl. Phys. A236(1974)165	4,41	0,012 088 6
Schoeters et al – Nucl. Phys. A323(1979)1	10,11	0,011 963 7
Krane - et al - Atomic Data and Nuclear Data Tables 19(1977)19	4,41 (adopted value)	0,012 088 6

In his articles (1969 and 1970), Sergolle deduced two values of δ for the 440 keV transition from 2 values of δ^2 for the 159 keV transition. The one reported here (δ^2(440) = 0,149) was calculated with δ^2(159) = 0,0119 (Tornkvist). Nevertheless, this value is not close to the adopted one.

The 1 % mixture of the 505 keV transition is from Sergolle (1969).

For the other transitions, measurements aren't precise, and only ranges of values are given for δ^2.
Uncertainties calculations:

∗ For the 257 and 330 keV transitions (E2 pure), the α_T , α_K and α_L uncertainties are taken to be 3 % from the calculated values with ICC Computer Code (program Icc99v3a).

* For the other transitions, the uncertainties calculations were made as follow: α_T was calculated for a pure M1(or M3) transition and for a pure E2 transition. The difference between these values, normalized by α_T, is the uncertainty (%) of α_T. The same method is used for α_K and α_L uncertainties.

3) Atomic Data

Atomic values (ω_K, ϖ_L and n_{KL}) are from Schönfeld (1996Sc06).
The X-ray and Auger electron emission probabilities are calculated from the data set values by using the program EMISSION.

4) Radiation emissions

4.1) Gamma ray emissions

Gamma ray emission energies are from S. Ohya and T. Tamura (1993Oh12) and W. B. Walters (1976Wa13).

The measured emission intensities are given in table 1, they are relative to a value of 100 for the 159 keV gamma ray. Energy values are in keV.

Remarks to table 1:
The original uncertainties given by Jacquemin (1987Ja13) for the 440, 528 and 538 lines have been multiplied by 2 by the evaluator to take into account some important factors:

1) During the measurement, there was a contamination that was not taken into account (Te-123m) by the author;
2) As the value given is an absolute value, the uncertainty on the relative intensity given in table 1, has been estimated using the normalization factor and its uncertainty taking from the reference quoted by Jacquemin.

Two sets of values (R. C. Ragaine (1968Ra11) and E. H. Spejewski(1970Sp03)) were omitted in several cases from the analysis due to discrepancy with the other data.

For the 528 keV gamma line, the value given by R. K. Gupta (1960Gu14) was also omitted because it did not agree with the other values.

The normalization factor to convert the relative emission intensities to absolute intensities is calculated with the formula:

$$\text{Normalization} = \frac{100}{(\sum(1 + \alpha_T)P_{rel})}$$

where the sum is to be done over all the gamma transitions to the ground state.
From the calculated α_T and the evaluated relative emission intensities (Table 1), the deduced normalization factor is ***83,25 (21)***. The uncertainties were calculated through their propagation on the above formula.
Absolute emission intensities are given on the last line in table 1.

4.2) Conversion electrons

The conversion electron emission intensities were deduced from the ICC values and from the gamma-ray emission probabilities. To our knowledge, there are no measured values for the conversion electron emission intensities.

Additional Reference

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Ref	174,2	182,61	192,17	197,26	198,25	206,82	207,82	242,32	247,96	257,51	278,36
60Gu02											
68Ra11		0,03(2)	0,03(2)						0,08(1)		
70Sp03		0,03(1)	0,03(2)						0,07(2)		
73Sodd		0,028(4)	0,025(4)		0,005(2)		0,0022(16)		0,068(6)		
76Wa13	0,0010(3)	0,0155(5)¤	0,0238(8)	0,0004(2)	0,004(1)	0,004(1)	0,0013(4)	0,0004	0,0854(15)**	0,0018(5)	0,0027(5)
86AgZW									0,0864(31)	0,0026(12)	
87Ja13											
Adopted	0,0010(3)	0,022(6)	0,0239(8)	0,0004(2)	0,0042(9)	0,004(1)	0,00135(4)	0,0004	0,0838(27)	0,0019(5)	0,0027(5)
N	1	4	4	1	2	1	2	1	5	2	1
chi**2/N-1	0	2,07	0,09	0	0,2	0	0,3	0	2,16	0,38	0
Method		LWM, exp.unc	LWM, int. unc.		LWM, int. unc.		LWM, int. unc.		LWM, ext. unc.	LWM, int. unc.	
Abs. Value	0,00083(25)	0,0183(50)	0,0199(7)	0,00033(17)	0,0035(7)	0,0033(8)	0,00112(32)	0,0003330(8)	0,0698(23)	0,00160(22)	0,00225(42)

** = Input uncertainty multiplied by 1,75 in the program LWEIGHT

¤ = Input uncertainty multiplied by 7,30 in the program LWEIGHT

exp.unc. = LWM expanded the uncertainty so range includes the most precise value.

int.unc. = internal uncertainty

ext.unc. = external uncertainty

Normalization factor = 83,25 (21)

Ref	281,03	295,09	329,38	330,7	343,73	346,35	405,02	437,5	440,02	454,76	505,33
60Gu02	0,14(3) £			0,012(3)		0,16(3)			0,44(9)		0,280(6)
68Ra11	0,08(1)					0,12(2) (O)			0,42(2) (O)		0,31(5)
70Sp03	0,08(3)					0,11(3) (O)			0,42(8) (O)		0,32(8)
73Sodd	0,09(1)			0,017(6)		0,12(1)			0,46(2)	0,004(1)	0,27(3)
76Wa13	0,095(1)	0,0019	0,0031(7)	0,0139(5)	0,0051(5)	0,151(1)	0,0035(7)	0,0009(9)	0,514(6)	0,0047(6)	0,379(3)
86AgZW	0,095(44)			0,0142(7)	0,0055(5)	0,152(6)	0,0036(3)		0,524(21)	0,0051(3)	0,376(2)
87Ja13									0,450(29) ®		
Adopted	0,0948(1)	0,0019	0,0031(7)	0,01398(40)	0,00530(35)	0,151(1)	0,00358(28)	0,0009(9)	0,508(5)	0,00495(26)	0,32(5)
N	5	1	1	4	2	4	2	1	5	3	6
chi2/N-1**	0,68	0	0	0,27	0,32	3,22	0,02	0	2,98	0,66	3,8
Method	LWM, int. unc.			LWM, int. unc.	LWM, int. unc.	LWM, int. unc.	LWM, int. unc.		LWM, int. unc.	LWM, int. unc.	LWM, int. unc.
Abs. Value	0,0789(9)	0,0015818(40)	0,0026(6)	0,01164(33)	0,00441(29)	0,1257(9)	0,00298(23)	0,0007(7)	0,4229(43)	0,00412(22)	0,266(42)

® = Initial uncertainty multiplied by 2 by the evaluator

int.unc. = internal uncertainty

£ = Data rejection parameters for deviation from weighted average
(Chauvenet's criteria)

(O) = omitted value

Normalization factor = 83,25 (21)

Table 1.I-123, gamma emission intensities, relative values to the 158 keV and, absolute values 04/12/01

Ref	528,96	538,54	556,05	562,79	578,26	599,69	610,05	624,57	628,26	687,95	735,78
60Gu02	2,0(3) (O)										
68Ra11	1,27(11) (O)	0,32(2) (O)						0,08(1)		0,03(1)	0,04(1) (O)
70Sp03	1,26(24) (O)	0,31(6) (O)						0,07(2) (O)		0,04(2) £	0,05(2) (O)
73Sodd	1,40(5)	0,38(4)	0,0033(4)	0,0012(3)				0,085(5)		0,030(2)	0,06(3)
76Wa13	1,670(5)	0,458(5)	0,0037(5)	0,0013(5)	0,0018(5)	0,0031(11)	0,0013(4)	0,100(1)*	0,0019(3)	0,0321(15)	0,0739(14)
86AgZW	1,66(5)	0,460(21)		0,0014(1)	0,0015(1)	0,0032(2)		0,101(5)	0,0020(2)	0,0329(9)	0,0742(35)
87Ja13	1,41(6)®	0,379(31)®									
Adopted	1,58(10)	0,455(5)	0,00346(31)	0,00138(9)	0,00151(1)	0,0032(2)	0,0013(4)	0,0958(24)	0,00197(17)	0,0323(7)	0,074(1)
N	4	4	2	3	2	2	1	4	2	4	3
chi2/N-1**	8,34	3,3	0,39	0,21	0,35	0,01	0	3,28	0,08	0,5	0,11
Method	LWM, exp.unc.	LWM, int. unc.	LWM, int. unc.	LWM, int.unc.	LWM, int.unc.	LWM, int. unc.		LWM, ext. unc.	LWM, int. unc.	LWM, int. unc.	LWM, int. unc.
Abs. Value	1,32(8)	0,3788(43)	0,00288(26)	0,00115(7)	0,00126(8)	0,00266(17)	0,00108(33)	0,0798(20)	0,00164(14)	0,0269(6)	0,0616(8)

* = Input uncertainty multiplied by 3,33 in the program LWEIGHT

® = Initial uncertainty multiplied by 2 by the evaluator

£ = Data rejection parameters for deviation from weighted average (Chauvenet's criteria)

(O) = omitted value

exp.unc. = LWM expanded the uncertainty so range includes the most precise value

int.unc. = internal uncertainty
ext.unc. = external uncertainty

Normalization factor = 83,25 (21)

Ref	783,59	837,1	877,52	894,8	909,12	1036,63	1068,12
60Gu02							
68Ra11	0,05(1) (O)						
70Sp03	0,05(2) (O)						
73Sodd	0,068(5)	0,0008(2)	0,0010(2)	0,0017(5)	0,0017(4)	0,0010(2)	0,0014(2)
76Wa13	0,0713(14)	0,0006(1)	0,0013(8)	0,0011(3)	0,0016(3)	0,0012(3)	0,0017(1)
86AgZW	0,0718(35)	0,00070(1)	0,0010(1)	0,0012(1)	0,0017(1)	0,0012(1)	0,0018(1)
87Ja13							
Adopted	0,0712(13)	0,000699(10)	0,00100(9)	0,00121(9)	0,00169(9)	0,00116(9)	0,00171(8)
N	3	3	3	3	3	3	3
chi**2/N-1	0,22	0,62	0,07	0,55	0,05	0,41	1,61
Method	LWM, int. unc.	LWM, int. unc.	LWM, int. unc.	LWM, int. unc.	LWM, int.unc.	LWM, int. unc.	LWM, ext.unc.
Abs. Value	0,0591(11)	0,000582(8)	0,00083(7)	0,00101(7)	0,00141(8)	0,00097(7)	0,00142(7)

(O) = omitted value

int.unc. = internal uncertainty

ext.unc. = external uncertainty

Normalization factor = 83,25 (21)