Coulomb excitation 2016Cl03,2016Cl01

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Jun Chen, Balraj Singh	NDS 164, 1 (2020)	15-Feb-2020

2016Cl03, 2016Cl01 (also 2017Cl02): beam=^{98}Sr at 276.3 MeV from REX-ISOLDE-CERN facility. Targets=2.1 mg/cm^2 thick ^{60}Ni and 1.5 mg/cm^2 thick ^{208}Pb. Detected scattered Sr ions and target recoils using Si strip detectors, and γ rays in prompt coincidence with scattered particles using Miniball array. Measured Eγ, Iγ, (particle)γ-coin, differential Coulomb excitation cross sections. Deduced E2 matrix elements for levels in ^{98}Sr up to 10$^+$ using GOSIA least-squares fitting code, and spectroscopic quadrupole moments. Previously known lifetimes of first 2$^+$, 4$^+$, 8$^+$ and 10$^+$ and that of second 0$^+$, branching ratios for the decays of the second 0$^+$ and 2$^+$ states, and E2/E0 branching ratio for the second 2$^+$ state were used as input parameters in the GOSIA analysis. Since the GOSIA analysis does not permit inclusion of E0 data into the input files, an indirect method by introducing an hypothetical 1$^+$ level at 130 keV and an M1 transition of 85-keV from excited 0$^+$ to this 1$^+$ level. The details of this procedure are given in the text on page 8 of 2016Cl03. Comparison with mean-field (5DCH) calculations, and two-state mixing model.

Other: 2015Bo11.

Additional information 1.

^{98}Sr Levels

All matrix elements are from 2016Cl03 with statistical uncertainties only and systematic uncertainties from GOSIA analysis are expected to be 3%.

Quadrupole moments are listed here in units of e*b, whereas 2016Cl01 give these in e*fm^2 units. The uncertainties are statistical.

E(level)	J$^\pi$‡	T$_{1/2}$†	Comments
0.0#	0$^+$		<Q^2>=1.30 e^{2}b^2 *4* (2016Cl03).
144.7#	2$^+$	2.77 ns *6*	Q=−0.52 *24* (2016Cl01) E2 matrix element=+1.13 *1*. Diagonal E2 matrix element=−0.63 *+32−28*. T$_{1/2}$: 2016Cl03 use T$_{1/2}$=2.80 ns *8* from 1989Ma47 in their GOSIA analysis. other: 2.01 ns *21* (2016Cl03, using RDDS method, and the intensities of the stopped and in-flight components). This value is lower than 2.77 ns *6* from B(E2). 2016Cl03 ascribe the disagreement to underestimation of number of counts in the stopped peak due to decrease of the Miniball efficiency for decays occurring after the implantation in the silicon detector. 2016Cl03 deduce a scaling factor of 1.4 from comparison of their measured T$_{1/2}$ and that in the literature. This factor was applied to measured lifetime of a level in ^{98}Rb.
215.6	0$^+$	23 ns *8*	T$_{1/2}$: 2016Cl03 use T$_{1/2}$=22.8 ns *14* from average of 21.2 ns *17* in 2002Lh01 and 25 ns *2* in 1980Sc13 in their GOSIA analysis. Additional information 2. E2 matrix element (to 144,2$^+$)=+0.404 *+14−17*. <Q^2>=0.33 e^{2}b^2 *3* (2016Cl03).
434.1#	4$^+$	78.9 ps *20*	Q=−1.87 *+14−25* (2016Cl01) T$_{1/2}$: 2016Cl03 use T$_{1/2}$=80 ns *6* from 1989Ma47 in their GOSIA analysis. E2 matrix element=+1.76 *5*. Diagonal E2 matrix element=−2.82 *+21−22*.
867.4#	6$^+$	7.86 ps *24*	Q=−1.21 *+39−16* (2016Cl01) T$_{1/2}$: from 7.86 ps *6* from GOSIA anlaysis, with a 3% systematic uncertainty added by evaluators. E2 matrix element=+2.46 *+11−10*. Diagonal E2 matrix element=−1.86 *+33−31*.
871.3	(2$^+$)	8.6 ps *14*	Q=+0.02 *+13−12* (2016Cl01) E2 matrix element (to g.s.)=−0.101 *8*. E2 matrix element (to 215,0$^+$)=+0.41 *3*. E2 matrix element (to 144,2$^+$)=0.07 *+10−5*, sign not known. M1 matrix element (to 144,2$^+$)=0.09 *+1−2*, sign not known. E2 matrix element (to 433,4$^+$)=+0.23 *+9−8*. Diagonal E2 matrix element=+0.04 *+32−20*.

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Coulomb excitation 2016Cl03,2016Cl01 (continued)

^{98}Sr Levels (continued)

E(level)	J$^{\pi}$‡	$T_{1/2}$†	Comments
1433.7#	8^+	2.94 ps *35*	Q=−0.95 +*74*−*88* (2016Cl01) $T_{1/2}$: 2016Cl03 use $T_{1/2}$=2.97 ps *48* from 1996Sm04 in their GOSIA analysis. E2 matrix element=+2.37 +*17*−*14*. Diagonal E2 matrix element=−1.4 +*15*−*13*.
(2123.2#)	10^+	1.07 ps +*18*−*20*	$T_{1/2}$: deduced by evaluators from B(E2) value in 2016Cl01. Note that no E2 matrix element or B(E2) value is given in 2016Cl03.

† Quoted values of half-lives are deduced from their GOSIA analysis, with statistical uncertainty only. Note that the previously known lifetimes of first 2^+, 4^+, 8^+ and 10^+ and that of the second 0^+ and the literature branching ratios for the second 0^+ and 2^+ were used in authors′ GOSIA analysis. Evaluators do not use the half-lives as well as the transition probabilities extracted by 2016Cl03 in the recommended values in Adopted Levels, except those for the 867, 6^+ and 871, 2^+ levels, for which a 3% systematic uncertainty from GOSIA analysis has been added by evaluators.

‡ From the Adopted Levels.

\# Band(A): g.s. band.

γ(^{98}Sr)

E_{γ}†	γ counts‡	E_i(level)	J^{π}_i	E_f	J^{π}_f	Mult.†	α#	Comments
(71.0)		215.6	0^+	144.7	2^+	E2	3.51	B(E2)(W.u.)=61 *5* (2016Cl03) E_{γ}: This γ is not observed in 2016Cl01 but considered in the fitting procedure. It is noted in Table I of 2016Cl01 that this transition strength is deduced from half-lives in 2002Lh01 and 1980Sc13.
144.7	399×10^2 *15*	144.7	2^+	0.0	0^+	E2	0.262	B(E2)(W.u.)=96 *3* (2016Cl03) Counts for ^{208}Pb target: 38000 *500* in 29.2°−41.9° (c.m.) range, 38100 *500* in 45.2°−68.1° (c.m.) range, 4730 *440* in 132.5°−139.9° (c.m.) range. Counts for ^{60}Ni target: 26700 *900* in 54.0°−69.9° (c.m.) range, 17700 *900* in 72.7°−97.5° (c.m.) range, 5700 *500* in 100.0°−112.9° (c.m.) range.
215.6		215.6	0^+	0.0	0^+	E0		
289.4	1082×10^1 *14*	434.1	4^+	144.7	2^+	E2	0.0218	B(E2)(W.u.)=129 +*8*−*7* (2016Cl03) Other counts for ^{208}Pb target: 1410 *50* in 29.2°−41.9° (c.m.) range, 4680 *80* in 45.2°−68.1° (c.m.) range, 1390 *60* in 132.5°−139.9° (c.m.) range. Counts for ^{60}Ni target: 2510 *100* in 54.0°−69.9° (c.m.) range, 4140 *80* in 72.7°−97.5° (c.m.) range, 1410 *50* in 100.0°−112.9° (c.m.) range.
433.3	1910 *50*	867.4	6^+	434.1	4^+	[E2]		B(E2)(W.u.)=175 +*17*−*14* (2016Cl03) Other counts for ^{208}Pb target: 56 *13* in 29.2°−41.9° (c.m.) range, 380 *30* in 45.2°−68.1° (c.m.) range, 390 *20* in 132.5°−139.9° (c.m.) range. Counts for ^{60}Ni target: 200 *20* in 54.0°−69.9° (c.m.) range, 610 *30* in 72.7°−97.5° (c.m.) range, 250 *30* in 100.0°−112.9° (c.m.) range.
(437.7)		871.3	(2^+)	434.1	4^+	[E2]		B(E2)(W.u.)=4 +*4*−*2* (2016Cl03) E_{γ}: from level-energy difference. This transition is considered in GOSIA analysis by 2016Cl01. Iγ(438)/Iγ(656)=0.042 +*52*−*27*, deduced by evaluators

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Coulomb excitation 2016Cl03,2016Cl01 (continued)

$\gamma(^{98}Sr)$ (continued)

E_γ †	γ counts ‡	E_i(level)	J^π_i	E_f	J^π_f	Mult. †	δ	Comments
								from B(E2) values for the respective γ transitions. It is noted in Table I of 2016Cl01 that this transition strength is deduced using branching ratio from 2002Lh01.
566.3	140 *40*	1433.7	8^+	867.4	6^+	[E2]		B(E2)(W.u.)=123 *+19−14* (2016Cl03) Other value of count for ^{208}Pb target: 45 *10* in 132.5°−139.9° (c.m.) range. γ not observed for ^{60}Ni target.
655.8	110 *30*	871.3	(2^+)	215.6	0^+	[E2]		B(E2)(W.u.)=13 *2* (2016Cl03) Other counts for ^{208}Pb target: 47 *9* in 45.2°−68.1° (c.m.) range, 29 *7* in 132.5°−139.9° (c.m.) range. Counts for ^{60}Ni target: 51 *12* in 54.0°−69.9° (c.m.) range, 60 *10* in 72.7°−97.5° (c.m.) range, 24 *6* in 100.0°−112.9° (c.m.) range.
(689.5 *2*)		(2123.2)	10^+	1433.7	8^+	[E2]		B(E2)↓=0.34 *+8−5* (2016Cl01) Note that B(E2) value or corresponding matrix element is not given in 2016Cl03. This γ is not observed in 2016Cl03 but considered in the fitting procedure.
726.7	42 *13*	871.3	(2^+)	144.7	2^+	[M1+E2]	0.7 *10*	B(E2)↓=0.0010 *+48−9*; B(M1)↓=0.0016 *+4−6* B(E2)(W.u.)=0.61 *+22−23* (2016Cl03) Other Iγ value for ^{208}Pb target: 12 *5* in 132.5°−139.9° (c.m.) range. γ not observed for ^{60}Ni target. δ: deduced by 2016Cl03 from B(E2) and B(M1) matrix elements, sign is unknown.
871.2 @		871.3	(2^+)	0.0	0^+	[E2]		B(E2)(W.u.)=0.77 *13* (2016Cl03) It is noted in Table I of 2016Cl01 that this transition strength is deduced using branching ratio from 2002Lh01. From B(E2) values in 2016Cl01, evaluators deduce Iγ(871)/Iγ(656)=0.25 *+9−7*.

† From the Adopted dataset, unless otherwise stated. Energies are rounded values.

‡ From 2016Cl03 for ^{208}Pb target in the 84.4°−127.3°(c.m.) range. Corresponding values for other angles, and for the ^{60}Ni target are given in comments. All values are without efficiency correction.

Total theoretical internal conversion coefficients, calculated using the BrIcc code (2008Ki07) with Frozen orbital approximation based on γ-ray energies, assigned multipolarities, and mixing ratios, unless otherwise specified.

@ Placement of transition in the level scheme is uncertain.

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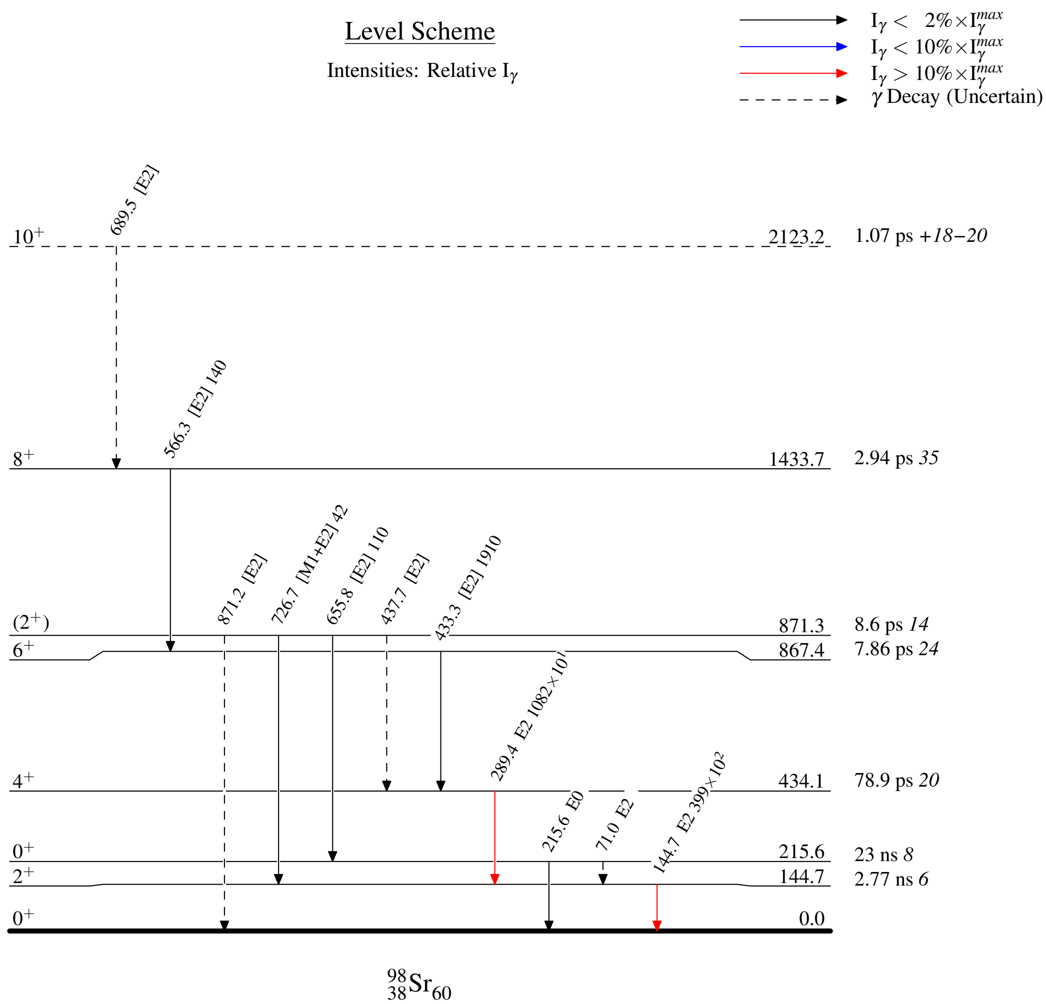
Level Scheme

Intensities: Relative I_γ



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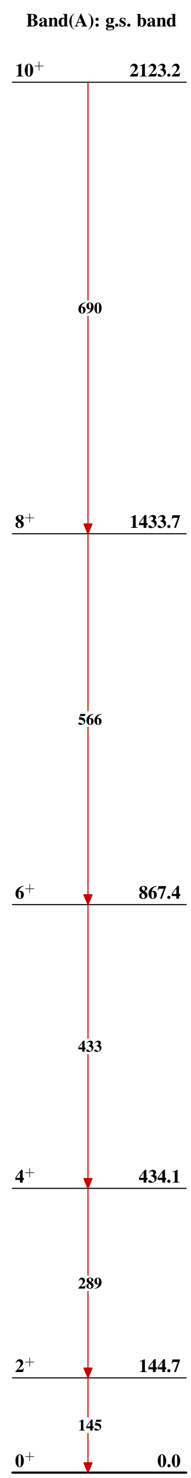

$^{98}_{38}Sr_{60}$