^{135}Sn β^- decay (515 ms) 2005Sh36,2002Sh08,2001Ko45

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Balraj Singh	ENSDF	31-Dec-2016

Parent: ^{135}Sn: E=0.0; J^π=(7/2$^-$); $T_{1/2}$=515 ms *5*; Q(β^-)=9057 *4*; %β^- decay=100.0

^{135}Sn-J^π,$T_{1/2}$: From ^{135}Sn Adopted Levels.

^{135}Sn-Q(β^-): From 2012Wa38.

2005Sh36: ^{135}Sn isotope produced in U(n,F) using UC_2 target, neutrons produced by 1.4 GeV protons bombarding a tungsten target. The Sn isotopes selectively ionized using the Resonance Ionization Laser Ion Source consisting of three Cu vapor pumped dye lasers. Mass separation. Measured Eγ, Iγ, $\gamma\gamma$, γ(t). Data collected with "laser-on" and "laser-off" to distinguish which peaks in γ spectra belonged to decay of Sn isotopes and which were a result of decay of surface ionized ^{135}Cs. Shell-model calculations.

See also 2005Sh23 for ^{135}Sn delayed neutron decay to ^{134}Sb.

2002Sh08 (also 2001Sh12): Measured Eγ, Iγ, $\gamma\gamma$, lifetimes, delayed neutron probability using high-efficiency Mainz neutron long counter with 3-ring concentric array of 50 ^{3}He proportional counters, β detector and Pb-shielded Ge detectors. A total of 12 γ rays reported.

2001Ko45: Measured Eγ and $\gamma\gamma$ using two large and one small low-energy Ge detectors in coincidence with β rays recorded in a thin plastic scintillator. Only three γ rays reported at 281.7, 732.4 and 923.4.

2007Ko66: ^{135}Sn activity produced from fission of ^{235}U by thermal neutrons followed by mass spectrometer OSIRIS at Studsvik facility. Measured lifetime of the 282 level using $\beta\gamma\gamma$(t) technique. Fast response β, BaF_2 and Ge detectors were used. Comparison of M1 and E2 transition probabilities of 282γ with shell-model calculations.

All data are from 2005Sh36, unless otherwise stated.

Total decay energy of 7066 keV *219* calculated (by RADLIST code) from level scheme is lower than the expected value of 8910 keV *410*.

^{135}Sb Levels

E(level)†	J^π‡	$T_{1/2}$	Comments
0.0	(7/2$^+$)		
281.8 *1*	(5/2$^+$)	6.1 ns *4*	$T_{1/2}$: from $\beta\gamma\gamma$(t) (2007Ko66).
439.9 *3*	(3/2$^+$)		
706.9 *3*	(11/2$^+$)		
798.0 *3*	(9/2$^+$)		
1014.1 *2*	(5/2$^+$,7/2,9/2$^+$)		J^π: (7/2$^+$) (2005Sh36).
1026.8 *2*	(7/2$^+$,9/2)		J^π: (9/2$^+$) (2005Sh36).
1112.9 *3*	(5/2$^+$,7/2$^+$)		J^π: (5/2$^+$) (2005Sh36).
1206.9 *3*	(5/2$^+$,7/2,9/2$^+$)		J^π: (7/2$^+$) (2005Sh36).
1333.0 *4*	(7/2$^+$,9/2)		J^π: (9/2$^+$) (2005Sh36).
1352.9 *6*	(5/2,7/2$^+$)		J^π: (5/2$^+$) (2005Sh36).
1386.9 *3*	(5/2,7/2,9/2$^+$)		J^π: (7/2$^+$) (2005Sh36).
1455.9 *3*	(5/2,7/2,9/2$^+$)		J^π: (7/2$^+$) (2005Sh36).
1549.0 *5*			
1596.9 *4*	(7/2$^+$,9/2)		J^π: (9/2$^+$) (2005Sh36).
1630.0 *4*	(5/2,7/2,9/2$^+$)		J^π: (7/2$^+$) (2005Sh36).
1733.9 *3*	(5/2,7/2$^+$)		J^π: (5/2$^+$) (2005Sh36).
1830.9 *6*	(5/2,7/2,9/2)		J^π: (5/2$^+$) (2005Sh36).
1855.2 *3*	(5/2,7/2,9/2$^+$)		J^π: (7/2$^+$) (2005Sh36).
2037.8 *5*			
2088.9 *3*	(5/2,7/2$^+$)		J^π: (5/2$^+$) (2005Sh36).
2169.9 *4*	(5/2$^+$,7/2,9/2)		J^π: (7/2$^+$,9/2$^+$) (2005Sh36).
2211.9 *6*			
2440.0 *5*			
2461.9 *4*	(5/2,7/2,9/2$^+$)		J^π: (5/2$^+$,7/2$^+$) (2005Sh36).
2764.0 *5*			
3263.0 *5*			

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^{135}Sn β^- decay (515 ms) 2005Sh36,2002Sh08,2001Ko45 (continued)

^{135}Sb Levels (continued)

† From least-squares fit to Eγ data, normalized χ^2=0.46.
‡ From Adopted Levels. 2005Sh36 tentatively assign more restrictive values, assuming most transitions as M1 for this near closed-shell nucleus.

β^- radiations

E(decay)	E(level)	Iβ⁻†‡	Log *ft*†	Comments
(5794 *4*)	3263.0	0.11	7.3	av Eβ=2560.8 *19*
(6293 *4*)	2764.0	0.16	7.3	av Eβ=2797.0 *19*
(6595 *4*)	2461.9	0.16	7.4	av Eβ=2940.0 *19*
(6617 *4*)	2440.0			
(6845 *4*)	2211.9	0.09	7.7	av Eβ=3058.2 *20*
(6887 *4*)	2169.9	0.70	6.8	av Eβ=3078.1 *19*
(6968 *4*)	2088.9	2.34	6.3	av Eβ=3116.4 *19*
(7019 *4*)	2037.8	0.28	7.2	av Eβ=3140.5 *19*
(7202 *4*)	1855.2	1.40	6.6	av Eβ=3226.8 *19*
(7226 *4*)	1830.9	0.26	7.3	av Eβ=3238.3 *20*
(7323 *4*)	1733.9	1.58	6.6	av Eβ=3284.1 *19*
(7427 *4*)	1630.0	0.40	7.2	av Eβ=3333.2 *19*
(7460 *4*)	1596.9	0.58	7.0	av Eβ=3348.9 *19*
(7508 *4*)	1549.0	0.10	7.8	av Eβ=3371.5 *19*
(7601 *4*)	1455.9	4.00	6.2	av Eβ=3415.4 *19*
(7670 *4*)	1386.9	2.03	6.5	av Eβ=3448.0 *19*
(7704 *4*)	1352.9	0.07	8.0	av Eβ=3464.1 *19*
(7724 *4*)	1333.0	1.32	6.7	av Eβ=3473.4 *19*
(7850 *4*)	1206.9	13.0	5.8	av Eβ=3532.9 *19*
(7944 *4*)	1112.9	1.45	6.8	av Eβ=3577.3 *19*
(8030 *4*)	1026.8	1.49	6.8	av Eβ=3617.9 *19*
(8043 *4*)	1014.1	12.6	5.8	av Eβ=3623.9 *19*
(8259 *4*)	798.0	0.88	7.1	av Eβ=3725.8 *19*
(8350# *4*)	706.9	<0.29	>7.6	av Eβ=3768.7 *19*
(8617# *4*)	439.9	<0.07	>8.2	av Eβ=3894.4 *19*
(8775 *4*)	281.8	1.21	7.0	av Eβ=3968.8 *19*
(9057 *4*)	0.0	33 *3*	5.66 *4*	av Eβ=4101.4 *19*

† Values are considered as approximate for excited states since a large gap of ≈5.5 MeV between Q(β^-) and the highest known level at 3263 leaves the possibility of additional levels and unobserved γ decays. The log *ft* arguments used by 2005Sh36 for some of the J^π assignments are not considered by the evaluators as strong arguments.
‡ Absolute intensity per 100 decays.
# Existence of this branch is questionable.

γ(^{135}Sb)

Iγ normalization: Σ(Iγ of γ rays to g.s.)=46 *4*. %β^-n=21 *3* and %β feeding to g.s.=33 *3* (2002Sh08).

E_γ†	I_γ@	E_i(level)	J_i^π	E_f	J_f^π	Mult.	α&
158.0 *5*	0.6 *3*	439.9	(3/2$^+$)	281.8	(5/2$^+$)		
180.0 *5*	1.2 *3*	1206.9	(5/2$^+$,7/2,9/2$^+$)	1026.8	(7/2$^+$,9/2)		
180.0 *5*	1.0 *2*	1386.9	(5/2,7/2,9/2$^+$)	1206.9	(5/2$^+$,7/2,9/2$^+$)		
216.0 *5*	6.1 *1*	1014.1	(5/2$^+$,7/2,9/2$^+$)	798.0	(9/2$^+$)	[D,E2]	0.07 *5*
243.0 *5*	0.7 *2*	1630.0	(5/2,7/2,9/2$^+$)	1386.9	(5/2,7/2,9/2$^+$)		

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^{135}Sn β^- decay (515 ms) 2005Sh36,2002Sh08,2001Ko45 (continued)

$\gamma(^{135}Sb)$ (continued)

E_γ[†]	I_γ[@]	E_i(level)	J_i^π	E_f	J_f^π	Mult.	α[&]	Comments
274.0 *5*	0.6 *1*	1386.9	(5/2,7/2,9/2$^+$)	1112.9	(5/2$^+$,7/2$^+$)			
281.7[‡] *1*	100	281.8	(5/2$^+$)	0.0	(7/2$^+$)	[M1,E2]	0.041 *4*	Additional information 1.
320.0 *5*	0.6 *2*	1026.8	(7/2$^+$,9/2)	706.9	(11/2$^+$)			
360.0 *5*	0.4 *1*	1386.9	(5/2,7/2,9/2$^+$)	1026.8	(7/2$^+$,9/2)			
409.0 *5*	3.7 *1*	1206.9	(5/2$^+$,7/2,9/2$^+$)	798.0	(9/2$^+$)			
429.0 *5*	1.7 *2*	1455.9	(5/2,7/2,9/2$^+$)	1026.8	(7/2$^+$,9/2)			
440.0 *5*	4.1 *2*	439.9	(3/2$^+$)	0.0	(7/2$^+$)			
535.0 *5*	1.5 *2*	1333.0	(7/2$^+$,9/2)	798.0	(9/2$^+$)			
570.0 *5*	0.91 *7*	1596.9	(7/2$^+$,9/2)	1026.8	(7/2$^+$,9/2)			
626.0 *5*	1.07 *8*	1333.0	(7/2$^+$,9/2)	706.9	(11/2$^+$)			
633.0 *5*	1.21 *5*	2088.9	(5/2,7/2$^+$)	1455.9	(5/2,7/2,9/2$^+$)			
673.0 *5*	0.6 *1*	1112.9	(5/2$^+$,7/2$^+$)	439.9	(3/2$^+$)			
707.0 *5*	4.5 *2*	706.9	(11/2$^+$)	0.0	(7/2$^+$)			
732.4[‡] *2*	37 *2*	1014.1	(5/2$^+$,7/2,9/2$^+$)	281.8	(5/2$^+$)			E_γ: 732 (2005Sh36). I_γ: others: 26 *4* (2002Sh08), 41 *5* (2001Ko45).
798.0 *5*	17 *1*	798.0	(9/2$^+$)	0.0	(7/2$^+$)			
799.0 *5*	0.9 *2*	1596.9	(7/2$^+$,9/2)	798.0	(9/2$^+$)			
829.0 *5*	2.2 *3*	1855.2	(5/2,7/2,9/2$^+$)	1026.8	(7/2$^+$,9/2)			
831.0 *5*	2.5 *3*	1112.9	(5/2$^+$,7/2$^+$)	281.8	(5/2$^+$)			
890.0 *5*	1.6 *3*	1596.9	(7/2$^+$,9/2)	706.9	(11/2$^+$)			
913.0 *5*	0.3 *1*	1352.9	(5/2,7/2$^+$)	439.9	(3/2$^+$)			
925.0 *5*	35 *2*	1206.9	(5/2$^+$,7/2,9/2$^+$)	281.8	(5/2$^+$)			E_γ: 923.4 *2* (2001Ko45).
976.0 *5*	1.1 *3*	2088.9	(5/2,7/2$^+$)	1112.9	(5/2$^+$,7/2$^+$)			
1014.0 *5*	10.9 *4*	1014.1	(5/2$^+$,7/2,9/2$^+$)	0.0	(7/2$^+$)			
1027.0 *5*	12 *1*	1026.8	(7/2$^+$,9/2)	0.0	(7/2$^+$)			
1105.0 *5*	1.3 *2*	1386.9	(5/2,7/2,9/2$^+$)	281.8	(5/2$^+$)			
1113.0 *5*	1.9 *4*	1112.9	(5/2$^+$,7/2$^+$)	0.0	(7/2$^+$)			
1143.0 *5*	2.0 *2*	2169.9	(5/2$^+$,7/2,9/2)	1026.8	(7/2$^+$,9/2)			
1174.0 *5*	4.3 *5*	1455.9	(5/2,7/2,9/2$^+$)	281.8	(5/2$^+$)			
1207.0 *5*	16.9 *6*	1206.9	(5/2$^+$,7/2,9/2$^+$)	0.0	(7/2$^+$)			
1294.0 *5*	2.1 *3*	1733.9	(5/2,7/2$^+$)	439.9	(3/2$^+$)			
1333.0 *5*	3.1 *3*	1333.0	(7/2$^+$,9/2)	0.0	(7/2$^+$)			
1372.0 *5*	1.0 *3*	2169.9	(5/2$^+$,7/2,9/2)	798.0	(9/2$^+$)			
1387.0 *5*	6.0 *4*	1386.9	(5/2,7/2,9/2$^+$)	0.0	(7/2$^+$)			
1391.0 *5*	0.7 *2*	1830.9	(5/2,7/2,9/2)	439.9	(3/2$^+$)			
1452.0 *5*	4.1 *3*	1733.9	(5/2,7/2$^+$)	281.8	(5/2$^+$)			
1456.0 *5*	12.4 *3*	1455.9	(5/2,7/2,9/2$^+$)	0.0	(7/2$^+$)			
1505.0 *5*	0.4 *1*	2211.9		706.9	(11/2$^+$)			
1549.0[#] *5*	0.43 *5*	1549.0		0.0	(7/2$^+$)			
1573.0 *5*	0.9 *1*	1855.2	(5/2,7/2,9/2$^+$)	281.8	(5/2$^+$)			
1630.0 *5*	1.7 *4*	1630.0	(5/2,7/2,9/2$^+$)	0.0	(7/2$^+$)			
1649.0 *5*	1.1 *1*	2088.9	(5/2,7/2$^+$)	439.9	(3/2$^+$)			
1734.0 *5*	0.6 *1*	1733.9	(5/2,7/2$^+$)	0.0	(7/2$^+$)			
1756.0 *5*	1.2 *1*	2037.8		281.8	(5/2$^+$)			
1807.0 *5*	4.8 *4*	2088.9	(5/2,7/2$^+$)	281.8	(5/2$^+$)			
1855.0 *5*	4.2 *2*	1855.2	(5/2,7/2,9/2$^+$)	0.0	(7/2$^+$)			
2089.0 *5*	1.84 *6*	2088.9	(5/2,7/2$^+$)	0.0	(7/2$^+$)			
2179.0 *5*	0.37 *7*	2461.9	(5/2,7/2,9/2$^+$)	281.8	(5/2$^+$)			
2440.0[#] *5*	0.3 *2*	2440.0		0.0	(7/2$^+$)			
2463.0 *5*	0.31 *4*	2461.9	(5/2,7/2,9/2$^+$)	0.0	(7/2$^+$)			
2764.0[#] *5*	0.7 *5*	2764.0		0.0	(7/2$^+$)			
3263.0[#] *5*	0.5 *2*	3263.0		0.0	(7/2$^+$)			

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^{135}Sn β^- decay (515 ms) 2005Sh36,2002Sh08,2001Ko45 (continued)

$\gamma(^{135}Sb)$ (continued)

† 2005Sh36 list Eγ to nearest keV. Since the uncertainty is stated as 0.5 keV, the evaluators have added a decimal place in Eγ value.
‡ From 2001Ko45.
# This γ is assumed by 2005Sh36 as a ground-state transition since not observed in $\gamma\gamma$ coincidence, no other transitions were found by 2005Sh36 to populate a level of the same energy as Eγ.
@ For absolute intensity per 100 decays, multiply by 0.23 *2*.
& 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.

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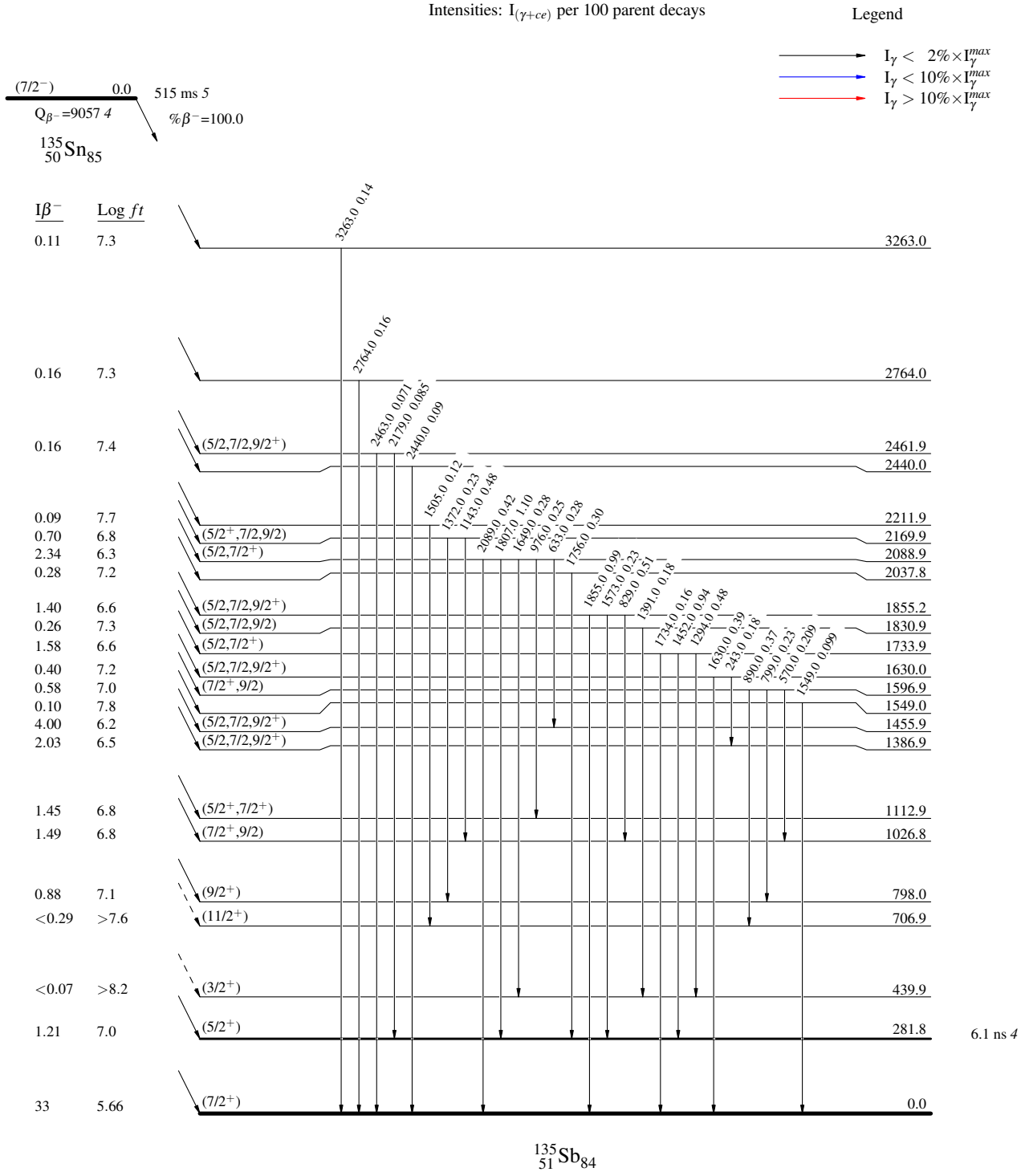
Decay Scheme

Intensities: $I_{(\gamma+ce)}$ per 100 parent decays



^{135}Sn β^- decay (515 ms) 2005Sh36,2002Sh08,2001Ko45

Decay Scheme (continued)

Intensities: $I_{(\gamma+ce)}$ per 100 parent decays