^{7}Li(^{7}Li,p),^{7}Li(^{7}Li,pγ) 1972Wy01,2009Iw03

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	J. H. Kelley, C. G. Sheu and J. E. Purcell	NDS 198,1 (2024)	1-Aug-2024

1956Al60, 1957No14: ^{7}Li(^{7}Li, p)^{13}B E=1.61 MeV, Measured σ(E$_p$,θ=90°), deduced reaction Q=5.97 MeV *3* and ΔM=20.39 MeV *3*. First observation of ^{13}B (2012Th01).

1959Mo12: ^{7}Li(^{7}Li,p) E=2 MeV; identified reaction protons using ΔE-E. Deduced Q=5.97 MeV *5* and observed states at 0, 3.70 *5*, 4.16 *5*, 5.05 *8* and 5.5 *1* MeV. The 3.70 MeV state is later identified by (1963Ca09) as a doublet, but with similar precision.

1963Ca09: ^{7}Li(^{7}Li,pγ) E=3 MeV. Evaporated ^{7}LiF target. Measured γ rays in coincidence with associated charge particles using a solid state particle detector and NaI(Tl) detectors. Resolved previously reported first excited state as two groups; deduced E$_x$=3.50 *5*, 3.70 *5* and 4.16 MeV. Estimated cascade from 4.16 MeV →3.50 is 25% *10*.

1969Th01: ^{7}Li(^{7}Li,pγ) E=5.1-6.3 MeV; measured σ(E$_\gamma$,$\theta(\gamma)$) for γ rays emitted from a 156 μg/cm^2 enriched ^{7}LiF target. Measurements were taken at θ=0°, 90° and 150°. Deduced τ_m of >0.3 ps and <0.38 ps for ^{13}B*(3.53,3.71), respectively. For ^{13}B(4.13) τ_m=62 fs *50* was deduced and J=7/2 was suggested. E$_\gamma$ for ^{13}B(3.53,4.13) were reported.

1972Wy01: ^{7}Li(^{7}Li,p) E=14 MeV; measured σ(E$_p$). Deduced seven new levels at 5558-8683 keV from analysis of protons measured at θ=10° using Si detectors. Used beam from Van de Graaff at Univ. of Iowa. Published energies are based on ^{13}B(4132) peak, which has subsequently been reduced by 1 keV.

2003Fl02: ^{7}Li(^{7}Li,p) E=50.9 MeV from Florida State Univ. Tandem/LINAC accelerator facility; measured ^{9}Li+α coincidences; reconstructed relative energies and deduced resonance at E$_x$≈13.6 MeV along with higher-energy unresolved structures.

2009Iw03: ^{7}Li(^{7}Li,p) E=5.4 MeV beam provided by the FN Tandem facility at the Univ. of Cologne. Targets consisted of ^{7}LiF deposited on Au foil. Measured γ rays using EUROBBALL cluster Ge detector at 0° and five coaxial detectors at 140°. They detected particles in coincidence with γ using eight Si photodiodes at θ=62°−81° and used the Doppler-shift method to measure the lifetime of excited states in ^{13}B. A lifetime limit of τ_m<30 fs is deduced for ^{13}B(3.71, 4.13, 4.83). For the 3.68 MeV state, τ_m=55 fs *20* was deduced. For 3.53 MeV the lifetime τ_m=1.3 ps *3* is four times longer than earlier results. The long lifetime of ^{13}B(3.53) suggests it is a 3/2$^-$ intruder state. The double escape peak from 4.54 MeV ^{11}B contaminant γ ray was found to be less than 10% of the 3.53 MeV peak.

Also see (2009IwZZ).

^{13}B Levels

E(level)	J$^\pi$	T$_{1/2}$[†]	Comments
0	3/2$^-$		
3536.8 *42*	(3/2$^-$)	0.90 ps *21*	E(level): From Eγ (1969Th01). J$^\pi$: From (2009Iw03). T$_{1/2}$: From τ_m=1.3 ps *2* (2009Iw03). See also τ_m>0.3 ps (1969Th01).
3681	+	38 fs *14*	E(level),T$_{1/2}$: From τ_m=55 fs *20* (2009Iw03). J$^\pi$: From L(t,p)=1 from 3/2$^-$ ^{11}B$_{g.s.}$ (quoted by (2009Iw03) from (1964Mi04)).
3700 *50*		≤21 fs	E(level): From (1959Mo04). T$_{1/2}$: From τ_m<30 fs (2009Iw03); see also τ_m<0.38 ps (1969Th01).
4134.1 *78*		≤21 fs	E(level): From Eγ (1969Th01); see also 4160 *50* (1959Mo04). T$_{1/2}$: From τ_m<30 fs (2009Iw03); see also τ_m=62 fs *50* (1969Th01). 1963Ca09 reports a 25% *10* branch to unresolved 3.48+3.53 MeV states, and 75% *10* to ground and an upper limit of <10% to the 3.70 MeV state.
4833[‡] *10*		≤21 fs	T$_{1/2}$: From τ_m<30 fs (2009Iw03).
5033[‡] *8*			E(level): other: 5050 keV *80* (1959Mo12).
5391[‡] *8*			
5557[‡] *8*			E(level): other: 5500 keV *100* (1959Mo12).
6169[‡] *8*			
6419[‡] *8*			
6939[‡] *15*			
7516[‡] *8*			
7859[‡] *20*			

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^{7}Li(^{7}Li,p),^{7}Li(^{7}Li,pγ) 1972Wy01,2009Iw03 (continued)

^{13}B Levels (continued)

E(level)	Comments
8129‡ *10*	
8682‡ *9*	
13600	E(level): From ^{9}Li+α kinematic reconstruction (2003Fl02).

† Deduced from lifetime measured in the Doppler-shift attenuation method (2009Iw03).
‡ From values given in (1972Wy01) that used E_x=4132 as the energy standard. When the energy of the standard was decreased by 1 keV, previous evaluations decreased these energies by 1 keV as is done for values given here.

γ(^{13}B)

E_i(level)	J_i^π	E_γ†	I_γ‡	E_f	J_f^π	Mult.	Comments
3536.8	(3/2$^-$)	3536.3 *42*		0	3/2$^-$	[M1,E2]	B(M1)(W.u.)<7.2×10^{-4} (2009Iw03); B(E2)(W.u.)<0.81 (2009Iw03) E_γ: From (1969Th01).
3681	+	3680		0	3/2$^-$	[E1]	B(E1)(W.u.)=6.4×10^{-4} *23* (2009Iw03)
3700		163	<10	3536.8	(3/2$^-$)		E_γ: No evidence for this transition is reported; (1963Ca09) assign an upper limit of <10%.
		3700	100	0	3/2$^-$		
4134.1		434	<10	3700			
		597.3	25 *10*	3536.8	(3/2$^-$)		
		4133.4 *78*	75 *10*	0	3/2$^-$		E_γ: From (1969Th01).
4833		4832		0	3/2$^-$		E_γ: Observed by (2009Iw03).

† From level-energy difference unless otherwise indicated.
‡ From (1963Ca09).

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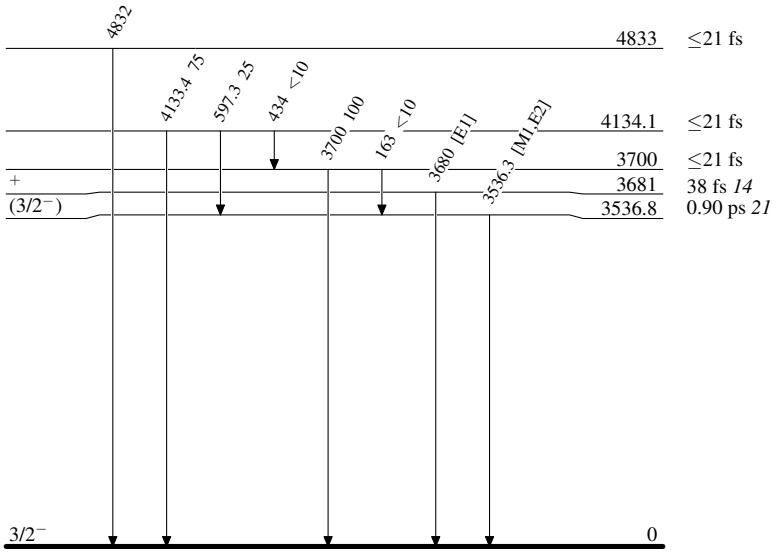
Level Scheme

Intensities: % photon branching from each level



$^{13}_{5}B_{8}$