^{9}Be(^{6}Li,d),(^{7}Li,t)

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

1964Ca05: ^{9}Be(^{7}Li,t) E=3.2 MeV; populated the first eight states of ^{13}C (not all resolved). No triton groups are observed to the previously reported ^{13}C states at 5.51 and 6.10 MeV.

1969Sn02: ^{9}Be(^{7}Li,t) E=5.6,5.8,6.0,6.2 MeV; measured σ(E;E$_t$,θ). Absolute differential cross sections at θ=10°−170° have been measured; ^{13}C levels observed.

1971Go24: ^{9}Be(^{6}Li,d),(^{7}Li,t) E=24,30 MeV; measured σ(E$_d$,θ), σ(E$_t$,θ). ^{13}C deduced levels, α-particle structure.

1989As01: ^{9}Be(^{6}Li,d) E=30 MeV; measured σ(E$_d$), σ(θ); deduced optical model parameters. ^{13}C deduced levels, L, J, π, spectroscopic strengths.

1998Le17: ^{7}Li(^{9}Be,t) E≈6.5-9.0 MeV/nucleon; measured E$_\alpha$ vs angle following compound nucleus decay. ^{13}C deduced levels, widths, α-decay branching ratios.

2010RoZR, 2010RoZZ: ^{9}Be(^{6}Li,d) E=25.5 MeV; measured E$_d$, I$_d$(θ); deduced σ(θ); calculated σ(θ) using DWBA.

2011Bo17: ^{9}Be(^{6}Li,d) E=25.5 MeV; measured reaction products, deuteron spectra; deduced σ(θ), J, π. Comparison with DWBA calculations.

2012Wh01: XUNDL dataset compiled by TUNL, 2012.

The authors studied the decay modes of ^{13}C states by measuring deuterons from the ^{9}Be(^{6}Li,d)^{13}C reaction in coincidence with ^{12}C or α particles from breakup of ^{13}C into ^{12}C+n or α+^{9}Be, respectively.

A beam of 42 MeV ^{6}Li ions impinged on a 240 μg/cm^2 ^{9}Be target at the Munich MLL tandem laboratory. Recoiling deuterons were detected in the Q3D spectrometer, which was optimized for sensitivity to E$_x$=11550 keV (10.6 to 13.0 MeV) or 13280 keV (12.4 to 15.1 MeV). Charged particle ejectiles from breakup of correlated ^{13}C* were detected in an array of four 50 mm×50 mm position sensitive Si strip detectors that covered 12° to 91° and −36° to 39° in the vertical and horizontal planes, respectively. The ^{12}C+n$_0$/n$_1$ and ^{9}Be+α_0 breakup paths were analyzed.

The absolute particle widths were determined for n$_0$, n$_1$ and α_0 decay reactions by correlating deuterons in the Q3D focal plane with events in the strip detector array.

^{13}C Levels

E(level)[†]	J$^\pi$[†]	Γ[‡#]	L[†]	Spectroscopic Strength[†]	Comments
0	1/2$^-$		2	1.9	E(level): From (1964Ca05,1969Sn02,1971Go24,1989As01).
3089	1/2$^+$		1	2.3	E(level): From (1964Ca05,1969Sn02,1971Go24,1989As01, 2010RoZZ).
3685	3/2$^-$		0+2	1.7	E(level): From (1964Ca05,1971Go24,2010RoZZ); see also (1969Sn02,1989As01: unresolved doublet). L: From (2010RoZZ, 2011Bo17), L=0 in (1989As01).
3854	5/2$^+$		1	1.4	E(level): From (1964Ca05,2010RoZZ); see also (1969Sn02,1989As01: unresolved doublet).
6864	5/2$^+$		1+3	0.19	E(level): See (1964Ca05,1969Sn02,1971Go24,1989As01, 2010RoZZ). Spectroscopic Strength: for L=1 transfer; S=0.38 for L=3 transfer.
7492	(7/2$^+$)				E(level): From (2010RoZZ); see also (1964Ca05,1969Sn02: unresolved doublet) and (1971Go24,1989As01: unresolved levels).
7547	5/2$^-$				E(level): From (2010RoZZ); see also (1964Ca05,1969Sn02: unresolved doublet).
7686	3/2$^+$				E(level): From (1964Ca05,1969Sn02).
8860	1/2$^-$				E(level): From (^{7}Li,t) (1971Go24).
9500	9/2$^+$		3	0.55	E(level): From (1969Sn02,1989As01,2010RoZZ); see also (1971Go24: unresolved levels).
9897	3/2$^-$		0+2	7.2	E(level): From (1969Sn02,1989As01,2010RoZZ); see also (1971Go24: unresolved levels). Spectroscopic Strength: for L=0 transfer; S=1.45 for L=2 transfer.

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^{9}Be(^{6}Li,d),(^{7}Li,t) (continued)

^{13}C Levels (continued)

E(level)†	Jπ†	Γ‡#	L†	Spectroscopic Strength†	Comments
10772	7/2−	61 keV	4	24.6	E(level): From (2010RoZR,2010RoZZ,2011Bo17,2012Wh01 (the experimental resolution is 82 keV)); see also (1971Go24: unresolved levels), (1989As01: the centroid of the peak is 10750 keV *18* with Γ=130 keV after removal of the 70 keV experimental resolution, more likely, the doublet E_x=10.753 and 10.818 MeV are populated) and (1998Le17: E_x=10768 keV with energy separation for fitting fixed at 70 keV). Γ: $\Gamma\alpha_0/\Gamma$<(0.05), Γ_{n0}/Γ=0.91 *11*, $\Gamma_{n1}/\Gamma\leq$0.13 (2012Wh01). See also Γ=55 keV (1998Le17: Γ_{exp} was fixed at $\Gamma_{exp}=(\Gamma^2+50^2)^{1/2}$, using Γ values from (1991Aj01)). L: From (2011Bo17); L=2 in (1989As01).
10816	(5/2−)	35 keV	4		E(level): From (2010RoZR,2010RoZZ,2011Bo17,2012Wh01(the experimental resolution is 82 keV)); see also (1989As01: unresolved doublet) and (1998Le17: E_x=10838 keV with energy separation for fitting fixed at 70 keV). Γ: $\Gamma\alpha_0/\Gamma$<(0.02), Γ_{n0}/Γ=0.51 *4*, Γ_{n1}/Γ=0.51 *4* (2012Wh01). See also Γ=25 keV (1998Le17: Γ_{exp} was fixed at $\Gamma_{exp}=(\Gamma^2+50^2)^{1/2}$, using Γ values from (1991Aj01)). L: From (2011Bo17).
10969	1/2+	33 keV *5*			E(level): From (1998Le17); see also E_x=11010 keV (2012Wh01). Γ: From (1998Le17); see also Γ=85 keV, $\Gamma\alpha_0/\Gamma$<(0.08), Γ_{n0}/Γ=0.68 *3*, Γ_{n1}/Γ=0.42 *2* (2012Wh01).
11080	1/2−	<15 keV			E(level): From (2010RoZZ,2011Bo17); see also E_x=11112 keV (1998Le17). Γ: From (1998Le17).
11711		38 keV *10*			E(level): From (1998Le17: see also E_x=11700 keV); the authors compared with (1991Aj01) Adopted Levels and suggested E_x=11.74 MeV *1* and Γ=40 keV *10*. Γ: Average of 33 keV *10* and 43 keV *10* (1998Le17).
11841	7/2+	46 keV *9*			E(level): From (1998Le17,2012Wh01(the experimental resolution is 82 keV)); see also (1989As01: unresolved doublet whose peaks have widths that are consistent with proposed 3/2− strength at 11.85 MeV and a 5/2− state at 12.13 MeV (1986Aj01)) and (1998Le17). Γ: From (1998Le17); see also 238 keV ((2012Wh01)). $\Gamma\alpha_0/\Gamma$<(0.10), Γ_{n0}/Γ=0.49 *8*, Γ_{n1}/Γ=0.71 *11* (2012Wh01).
11959		240 keV *30*			E(level): From (1998Le17: see also E_x=11969 keV); the authors compared with (1991Aj01) Adopted Levels and suggested E_x=11.96 MeV *3*. See also (1971Go24). Γ: From (1998Le17: see also Γ=235 keV *40*).
12123	5/2−	219 keV			E(level): From (2012Wh01: the experimental resolution is 82 keV); see also (1989As01: unresolved doublet). Γ: $\Gamma\alpha_0/\Gamma$<(0.17), Γ_{n0}/Γ=0.49 *8*, Γ_{n1}/Γ=0.53 *8* (2012Wh01).
12300	1/2−		2		E(level): From (2011Bo17,2010RoZR). Jπ: From (2010KaZZ: ^{13}C(α,α'); E_x=12.5 MeV); see discussions in (2010RoZR,2011Bo17). L: From (2011Bo17).

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^{9}Be(^{6}Li,d),(^{7}Li,t) (continued)

^{13}C Levels (continued)

E(level)[†]	Jπ[†]	Γ[‡#]	Comments
12830		1 MeV	E(level),Γ: From (1998Le17); the authors compared with (1991Aj01) Adopted Levels and suggested E_x=12.8 MeV *2* and Γ=1.0 MeV *2*.
13270		315 keV *30*	E(level): From (1998Le17: see also E_x=13360 keV); the authors compared with (1991Aj01) Adopted Levels and suggested E_x=13.28 MeV *3* and Γ=310 keV *30*. See also E_x=13300 keV (1971Go24). Γ: From (1998Le17: see also Γ=380 keV *40*).
13410	(9/2$^-$)	33 keV *10*	E(level): From (1989As01); see also E_x=13300 and 13370 keV (1998Le17). Γ: From (1998Le17).
13570?		≈75 keV	E(level): From (1998Le17: see also E_x=13530 keV); see also E_x=13500 keV (2011Bo17). Γ: Average of (65) keV and (85) keV (1998Le17).
13779?	(5/2,3/2)$^+$	77 keV *30*	E(level): From (1971Go24, 2012Wh01(the experimental resolution is 82 keV)); see also E_x=13730 keV (1998Le17). Γ: From (1998Le17); see also 117 keV (2012Wh01). $\Gamma\alpha_0/\Gamma$=0.54 *2*, Γ_{n0}/Γ<(0.10), Γ_{n1}/Γ=0.45 *2* (2012Wh01).
13920		100 keV *25*	E(level): From (1998Le17); the authors compared with (1991Aj01) Adopted Levels and suggested recommended values of E_x=13.92 MeV *3* and Γ=100 keV *30*. Γ: From (1998Le17).
14120		160 keV *20*	E(level): (1989As01: unresolved doublet; E_x=14.11 MeV (5/2$^-$) and 14.16 MeV(7/2$^+$)), (2011Bo17: broad resonance) and E_x=14080 keV (1998Le17). Γ: From (1998Le17).
14360		115 keV *35*	E(level),Γ: From (1998Le17).
14582?	(7/2$^+$,9/2$^+$)	130 keV	E(level): From (1971Go24,2011Bo17,2012Wh01(the experimental resolution is 82 keV)). Γ: $\Gamma\alpha_0/\Gamma$=0.94 *3*, Γ_{n0}/Γ<(0.12), Γ_{n1}/Γ=0.13 *2* (2012Wh01).
15100			E(level): From (2011Bo17).
15200[@]			E(level): From (1971Go24).
16700[@]			E(level): From (1971Go24).
18500[@]			E(level): From (1971Go24).

[†] Values mainly from DWBA analysis of spectroscopic strengths in (1989As01) ^{9}Be(^{6}Li,d).

[‡] From (2012Wh01) except where noted; the experimental resolution of 82 keV has been removed from the quoted Γ_{total} value.

[#] Widths shown in Fig. 6 in (1998Le17) are Γ_{exp}, while the width listed here are $\Gamma=(\Gamma^2_{exp}-(50\text{ keV})^2)^{1/2}$, taking the experimental resolution as 50 keV from state 4 (1998Le17).

[@] Some states are not associated with Adopted Levels because inadequate details for association are given in the literature.