^{13}C(α,n)

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	C. G. Sheu, J. H. Kelley, J. Purcell	ENSDF	5-Aug-2021

For analyses and measurements of astrophysical S-factors and ANC^2 values see (1968Da05,2006Jo11,2008Pe09,2014LaZU).

1954Tr09: ^{13}C(α,n), E=1.0-3.5 MeV; measured reaction products, E_n, I_n; deduced neutron yields; calculated energy levels.
1956Bo61: ^{13}C(α,n), E=1.8-5.3 MeV; cross sections and widths of the resonances were detremined.
1957Wa46: ^{13}C(α,n); measured products; deduced σ, σ(E), resonance parameters.
1963Sp02: ^{13}C(α,nγ), E=5-10 MeV; the excitation function for 6 and 7 MeV gamma radiation from the reaction ^{13}C(α,nγ) has been studied at intervals of approximately 10 keV for E_α=5 to 10 MeV.
1965Ba32: Cross sections for the reaction ^{13}C(α,α) at θ_{cm}=54.7°, 107.9°, 142.6°, 169.6° and for the reaction ^{13}C(α,n)^{16}O at θ_{cm}=0° were measured. A beam of E(α)=2-3.5 MeV from the 5.5-MeV Van de Graff accelerator bombarded a self-supporting foils made either from 41.6% ^{13}C-enriched methyl iodide, or from 56.7% ^{13}C-enriched methane with thickness ≈15 μg/cm^2. Using dispersion-theory analysis, a consistent set of J$^\pi$ and partial-width values for 11 excitation energies E_x=8-9 MeV were obtained. See also (1965BaZY).
1967Se07: ^{13}C(α,n), E=1.95-5.57 MeV; measured total cross section. Deduced Γ_a, Γ_n along with the reduced widths γ^2_α and γ^2_n for the levels corresponding to the 2.68, 2.81, 3.72, and 4.62-MeV resonances.
1968Ke02: Cross sections of reactions ^{13}C(α,α_0) and ^{13}C(α,n) were measured by bombardment of an E_α=12 MeV beam on to self-supporting, 20-30 μg/cm^2 thick, enriched ^{13}C targets at the Van de Graaff facility/Australian National University. Two surface-barrier detectors (for (α,α_0)) and two 2.5 cm×5 cm plastic scintillators (for (α,n)) were used to detect particles. Using a dispersion-theory analysis, the J$^\pi$ and partial width values were obtained for 11 states of ^{17}O with E_x=9-10 MeV.
1969Sc04: ^{13}C(α,n), E=1.38-2.26 MeV; measured angular distribution of n-polarization. ^{17}O deduced resonances, J, π, level-width.
1970Ro08: Thin foil targets of 50.5% enriched ^{13}C, 30.3 μg/cm^2 *17* thick, were bombarded with E(α)=4.5-10.5 MeV ion beams produced from the University of Virginia 5.5 MeV Van de Graaff accelerator. Neutrons were detected using a 2.5 cm×2.5 cm long stilbene crystal and a 2.5 cm×5.0 cm long Ne 213 liquid scintillator with detection efficiencies of ±6%. The energy scale for the excitation function was calibeated with an uncertainty of ±10 keV. The excitation function was measured at θ= 0° and angular distributions were measured at θ=0°−170°. Energy levels of ^{17}O at E_x=10-13 MeV with J$^\pi$ values up to 9/2 were deduced.
1971Ba06: ^{13}C(α,n), E=3.36-4.80 MeV; measured σ(E; θ), P(n)(E; θ). ^{17}O resonances deduced J, π.
1973Ba10: ^{13}C(α,n), E=1-5 MeV; measured σ(E); ^{17}O deduced resonances, level-width.
1973Bu14: ^{13}C(α,n), E=2.075,2.25,2.43 MeV; measured n-polarization(θ), σ(θ). ^{17}O levels deduced J, π.
1973Lo16: ^{13}C(α,n), measured E_n, I_n.
1975Be44: ^{13}C(α,nγ), measured σ(E,E_γ). ^{17}O deduced resonances, Γ.
1976Mc11: ^{13}C(α,n), E=4.2-8.7 MeV; measured σ(E,E_n,θ). ^{17}O deduced T=3/2 levels, Γ. Enriched target.
1976Ra36: ^{13}C(α,n), E=0.60-1.15 MeV; measured σ(E); deduced astrophysical σ factors. ^{17}O 1.056-MeV resonance deduced parameters. Enriched target.
1981HaZV: ^{13}C(α,n), E≈35 MeV; measured σ(En,θ). Cluster transfer, DWBA analysis. Tof, solid state counters, magnetic spectrograph.
1982CrZY: ^{13}C(α,n), E=35 MeV; measured σ(E_n), σ(θ). DWBA, cluster transfer, knockout mechanisms.
1983HaZX: ^{13}C(α,n), E=35 MeV; measured σ(θ). DWBA, three nucleon stripping, semimicroscopic, cluster models.
1990We10: ^{13}C(α,n), E=2.406-3.308 MeV; measured σ(θ), polarization. New design high pressure ^{4}He-polarimeter.
1993Br17: ^{13}C(α,n), E=650-1600 KeV; measured yield vs E. ^{17}O deduced resonances, Γ_n, Γ_α, resonance strengths.
1993Dr08: ^{13}C(α,n), E(cm)≈275-1075 keV; measured σ(E); deduced astrophysical S-factor, reaction rates at helium burning temperatures.
1993DrZZ: E=0.35-1.4 MeV; measured E_n, σ, resonance energy, width, strength, S-factor, reaction rate. Comparison with other measurements.
2001He22: ^{13}C(α,α), E=2.6-6.2 MeV; measured σ(θ). ^{13}C(α,n), E=0-2 MeV; calculated σ, S-factor following r-matrix analysis of elastic scattering data. Comparison with earlier results for s-process conditions.
2003Ka51: ^{13}C(α,n), E(cm)≈200-800 keV; deduced astrophysical S-factors, reaction rate.
2003Ku36: ^{13}C(α,n), E(cm)=0-800 keV; deduced astrophysical S-factors, reaction rates.
2005Ha69: ^{13}C(α,n), E=0.8-8.0 MeV; measured σ, neutron yields.
2007PeZZ: ^{13}C(α,n), deduced S_α factor.
2008He11: ^{13}C(α,n), E(cm)=320-700 keV; ^{13}C(α,α), E=2.6-6.2 MeV; measured radii, σ, σ(θ), S-factor. ^{17}O deduced levels, J, π,

^{13}C(α,n) (continued)

resonance parameters.
2009Ma70: ^{13}C(α,n),(α,γ), E=2.000,2.270 MeV; measured Eγ, Iγ, $\gamma(\theta)$, E_n, σ, and $\sigma(\theta)$; deduced astrophysical S factors. Comparison with previous experimental data.
2018Sm01: ^{13}C(α,n), E not given; measured reaction products, Eγ, Iγ, E_n, I_n; deduced yields.
2020Fe06: ^{13}C(α,$n_{0,1,2}$), E=5.2-6.4 MeV; analyzed excitations functions and impact on backgrounds for large volume ν detectors.

Theory:
1977Li19: ^{13}C(α,n), E<7 MeV; analyzed σ(E).
1987De38: ^{13}C(α,n),(α,α), E=low; calculated transfer, elastic $\sigma(\theta)$, σ(E). Generator corrdinate method.
1996Le06: ^{17}O; calculated levels using parameters for ^{13}C+α cluster system. Semi-microscopic algebraic cluster model.
2003Ku03: ^{13}C(α,n), E(cm)=0-800 keV; calculated astrophysical S-factors, reaction rates.
2008St11: ^{13}C(α,n), analyzed reaction rates.
1997Ha37: ^{13}C(α,n), E not given; analyzed reaction σ data; deduced astrophysical S-factor vs E, extrapolation methods accuracy. Astrophysical implications.
1999An35: ^{13}C(α,n), E<10 MeV; compiled, analyzed σ, S-factors; calculated astrophysical reaction rates vs T_9. Analytical approximations.
2001Du11: ^{13}C(α,n), E(cm)=0.1-1 MeV; calculated σ, S-factor. Comparison with data, Astrophysics interest.
2001Du12: ^{13}C(α,n), E(cm)≈0.2-2 MeV; calculated S-factors. Comparisons with data.
2005Ad03: ^{13}C(α,n), E=0-5 MeV; calculated phase shifts, transition amplitudes. Comparison of DWBA and microscopic cluster model.
2005Du20: ^{13}C(α,n), E(cm)≈0.1-1.2 MeV; calculated S-factors. ^{17}O; calculated levels, J, π. Generator coordinate method, comparison with data.
2005Pi19: ^{13}C(α,n), E=low; analyzed astrophysical reaction rates.
2007Mu10: ^{13}C(α,n), E=0-0.9 MeV; calculated astrophysical S-factor. Asymptotic normalization coefficient method. Comparison with data. 2008KaZX: ^{13}C(α,n), E≈0.1-10 MeV; analyzed S-factors.
2008Lu01: ^{13}C(α,n), E not given; analyzed reaction rates as neutron sources for s process in AGB stars.
2012Mi24: ^{13}C(α,n), E<1 MeV; analyzed available data; calculated reaction rates, isotope abundances. Comparison with available data.
2014Ku13: ^{13}C(α,n), E=0.7-4.7 MeV; calculated σ using multi-channel R-matrix with care for covariances; deduced resonances. Compared to ENDF/B-VII.1 and Harisopulos data.
2015LaZW: ^{13}C(α,n), E(cm)=0-1.2 MeV; calculated S-factor using R-matrix. Compared to data.
2015Vl01: ^{13}C(α,n), E=4-9 MeV; analyzed available data; deduced thick target yields and their uncertainties.
2016La06: ^{13}C(α,n), E(cm)<1 MeV; calculated S-factors. R-matrix, Trojan horse method (THM) resonance parameters.
2016Sp03: ^{13}C(α,n), E(cm)=0-1.2 MeV; compiled S-factor data, fitting THM (Trojan Horse Method) and calculations.
2017HaZY: ^{13}C(α,n), E=0-5.4 MeV ; calculated σ. ^{13}C(α,α), E=2-5.7 MeV; calculated $\sigma(\theta)$.
2017Mu14: ^{13}C(α,n), E(cm)<1.1 MeV; calculated astrophysical S factor as a function of the α-^{13}C relative kinetic energy using the R-matrix approach for resonances and Trojan horse method (THM) for S factor. Comparison with experimental data. Relevance to neutron generation in low-mass AGB stars.
2017Pa45: ^{13}C(α,n), E not given; analyzed available data; deduced isotopic abundance ratios of s-elements in presolar SiC grains.
2017Pe13: ^{13}C(α,n), E=0.8-8.0 MeV; analyzed σ(E) measured in the work of 2005Ha69; deduced uncertainty in the cross section of about 50% above 5 MeV, due to changes in neutron detector efficiency due to different neutron energies that are possible above the ^{16}O first excited-state, and which were not adequately accounted for in 2005Ha69 who used a moderated neutron detector. Relevance to s-process nucleosynthesis.
2017Tr03: ^{13}C(α,n), E(cm)<1 MeV; analyzed available data; deduced σ, S-factors, astrophysical reaction rates, asymptotic normalization coefficients.
2018Cr02: ^{13}C(α,n), E not given; analyzed available data; deduced impact of reaction rate variations on variations of the element surface distributions.
2018Mo15: ^{13}C(α,n), E=0.8-8 MeV; analyzed previous experiments for σ(E) data and deduced corrected σ(E) based on improved determination of neutron detection efficiency; calculated branching ratios for the (α,n0), (α,n1), (α,n2), (α,n3) and (α,n4) channels using TALYS code, and compared with experimental values.
2018Ze01: ^{13}C(α,n), E<9 MeV; calculated σ of inverse reaction using the reciprocity theorem and Web calculator.

$^{13}C(\alpha$,n) (continued)

^{17}O Levels

Notes:
Many authors viewed the uncertainty in excitation energy as equal to the uncertainty in resonance energy; it was not possible to resolve this issue.

E(level)	J^π	Γ	L	E_α(res) (keV)	Comments
6860.3[†] *7*				656.0 *7*	E(level): from E_α=656.0 keV *7* (1993Br17). $(\omega\gamma)_n$=1.85×10^{-4} eV *20*, $(\omega\gamma)_\gamma$<5 μeV (1993Br17).
6972.1[†] *8*				802.2 *8*	E(level): from E_α=802.2 keV *8* (1993Br17). $(\omega\gamma)_n$=4.54×10^{-4} eV *35*, $(\omega\gamma)_\gamma$<8 μeV (1993Br17).
7166.5[‡] *15*	5/2[#]	1.5[‡] keV *2*		1056.3 *15*	E(level): from E_α=1056.3 keV *15* (1973Ba10). See also E_α(keV)=1056 (1976Ra36), 1054 (2005Ha69). Γ: See also Γ=5 keV (1957Wa46), Γ_n/Γ_α=(1300) (1957Wa46). ωγ=12.1 eV *6* (2005Ha69), 11.9 eV *6* (Deduced from the resonance yield, 4434±135 n/μC (1992Br05, 1973Ba10), and the stopping power in ^{13}C (Ziegler, The Stopping and Range of Ions in Matter, Vol. 3 (1977)); see (1993Br17)).
7202?					E(level): authors (2008Pe09) listed the value from (1993Ti07). Involvement in $^{13}C(\alpha$,n) is suggested from its population in $^{13}C(^7Li$,t). Γ: Γ_n=400 keV, Γ_α=0.09 keV (2008Pe09) which is consistent with (1966Li03: Γ_n/Γ>0.99 in ^{16}O+n measurement).
7380.9[‡] *15*	5/2+[@]	0.6[‡] keV *+2−1*		1336.7 *15*	E(level): from E_α=1336.7 keV *15* (1973Ba10). See also E_α=1336 keV (2005Ha69). Γ: See also Γ(keV)=3 (1969Sc04), ≤4 (1957Wa46), Γ_n/Γ_α=(450) (1957Wa46). ωγ=33.3 eV *18* (2005Ha69).
7383.9[‡] *15*		0.8[‡] keV *+3−2*	3,2[&]	1340.6 *15*	E(level): from E_α=1340.6 keV *15* (1973Ba10).
7572.9 *21*	7/2−[@]	≤1[‡] keV	4,3[&]	1587.9 *25*	E(level): from E_α=1587.9 keV *21*, which is the average of (1973Ba10: 1590 keV *2*) and (1993Br17: 1585.7 keV *15*). See also E_α=1590 keV (2005Ha69). Γ: See also Γ(keV)=3 (1969Sc04), ≤4 (1957Wa46). ωγ=10.8 eV *5* (1993Br17), 11.5 eV *12* (2005Ha69).
7693[‡] *6*	5/2+[@]	≤15[‡] keV	3,2[&]	1745 *6*	E(level): from E_α=1745 keV *6* (1973Ba10). Γ: See also Γ=22 keV (1957Wa46,1969Sc04).
7952[‡] *8*	1/2+[@]	79[a] keV *10*	1,0[&]	2083 *8*	E(level): from E_α=2083 keV *8* (1973Ba10). See also E_α(keV)=2090 (1956Bo61), 2080 (1967Se07), 2075 (1973Bu14). E(level): triplet (1957Wa46). Γ: See also Γ(keV)=75 (1973Ba10), 110 (1957Wa46,1969Sc04), Γ(lab)=100 keV (1956Bo61), Γ_n/Γ_α=10 (1957Wa46). J^π: See also (1973Bu14).
8079[‡] *8*	3/2−[@]	71[a] keV *8*	2,1[&]	2250 *8*	E(level): from E_a=2250 keV *8* (1973Ba10). See also E_α(keV)=2250 (1956Bo61,1967Se07), 2240 (1963Bu14). Γ: See also Γ(keV)=70 (1957Wa46, 1969Sc04), 110 (1973Ba10), Γ(lab)=100 keV (1956Bo61), Γ_n/Γ_α=10 (1957Wa46). J^π: See also (1973Bu14) who suggest the π is ambiguous.
8199[‡] *8*	3/2+[@]	71[a] keV *5*	1,2[&]	2407 *8*	E(level): from 2407 keV *8* (1973Ba10). See also

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$^{13}C(\alpha,n)$ (continued)

^{17}O Levels (continued)

E(level)	J^π	Γ	L	E_α(res) (keV)	Comments
					E_α(keV)=2410 (1967Se07), 2420 (1956Bo61), 2430 (1973Bu14), 2440 (1954Tr09). Γ: See also Γ(keV)=60 (1957Wa46,1969Sc04), 70 (1973Ba10), Γ(lab)=80 keV (1956Bo61), Γ_n/Γ_α=13 (1957Wa46). J^π: See also (1973Bu14) who suggest the π is ambiguous.
8350[‡] 4	$1/2^-$[@]	9[a] keV 3	0,1[&]	2604 4	E(level): from E_α=2604 keV 4 (1973Ba10). See also E_α(keV)=2610 (1967Se07), 2605 (1956Bo61), E_n=4440 keV (1956Be98: Fig. 5 top). Γ: See also Γ(keV)=18 (1957Wa46,1969Sc04), 15 (1973Ba10), Γ(lab)≤6 keV (1956Bo61), Γ_n/Γ_α=6.7 (1957Wa46). J^π: See also (1973Bu14) who suggest the π is ambiguous.
8408[‡] 3	$5/2^+$[a]	4[a] keV 3	3,2[b]	2680 3	E(level): from E_α=2680 keV 3 (1973Ba10). See also E_α(keV)=2680 (1967Se07), 2660 (1954Tr09), 2690 (1956Bo61), E_n=4530 keV (1956Be98: Fig. 5 top). Γ: See also Γ(keV)=8 (1973Ba10), 11 (1957Wa46), Γ(lab)=10 keV (1956Bo61), Γ_n=3.84 keV and Γ_α=0.16 keV (1967Se07), Γ_n/Γ_α=19 (1957Wa46).
8473[‡] 3	7/2[#]	7[a] keV 3		2765 3	E(level): from E_α=2765 keV 3 (1973Ba10). See also E_α(keV)=2770 (1967Se07), 2775 (1956Bo61), 2760 (1954Tr09), E_n=4590 keV (1956Be98: Fig. 5 top). E(level): doublet (1957Wa46). Γ: See also Γ(keV)=8 (1973Ba10), 9 (1957Wa46), Γ(lab)=10 keV (1956Bo61), Γ_n/Γ_α=31 (1957Wa46).
8507[‡] 3	$(3/2,5/2^-)$[#a]	5[a] keV 3	2,3[b]	2809 3	E(level): from E_α=2809 keV 3 (1973Ba10). See also E_α(keV)=2810 (1967Se07), 2825 (1956Bo61), E_n=4630 keV (1956Be98: Fig. 5 top). Γ: See also Γ(keV)=6 (1973Ba10), 11 (1957Wa46), Γ(lab)≤7 keV (1956Bo61), Γ_n=4.57 keV and Γ_α=0.43 keV (1967Se07), Γ_n/Γ_α=2.8 (1957Wa46).
8698[‡] 5	$3/2^-$[c]	50[a] keV 3		3059 5	E(level): from E_α=3059 keV 5 (1973Ba10). See also E_α(keV)=3070 (1967Se07), 3090 (1956Bo61), 3100 (1971Ba06), E_n=4850 keV (1956Be98: Fig. 5 top). E(level): triplet (1957Wa46). Γ: See also Γ(keV)=50 (1973Ba10), 85 (1957Wa46), Γ(lab)=90 keV (1956Bo61), Γ_n/Γ_α=17 (1957Wa46).
8700?[c]	$1/2^-$[c]			≈3100	E(level): broad; from E_α≈3100 keV (1971Ba06).
8896[‡] 8	$3/2^+$[c]	101[a] keV 3		3318 8	E(level): from E_α=3318 keV 8 (1973Ba10). See also E_α(keV)=3320 (1967Se07), 3300 (1954Tr09), 3330 (1956Bo61), 3360 (1971Ba06), E_n=5080 keV (1956Be98: Fig. 5 top). Γ: See also Γ(keV)=115 (1973Ba10), 110 (1957Wa46), Γ(lab)=150 keV (1956Bo61), Γ_n/Γ_α=3.5 (1957Wa46).
8970[‡] 4	$7/2^-$[c]	21[a] keV 3		3415 4	E(level): from E_α=3415 keV 4 (1973Ba10). See also E_α(keV)=3420 (1956Bo61, 1967Se07,1971Ba06), E_n=5130 keV (1956Be98: Fig. 5 top). Γ: See also Γ(keV)=14 (1973Ba10), 35 (1957Wa46). Γ(lab)=30 keV (1956Bo61), Γ_n/Γ_α=35 (1957Wa46).
9146[‡] 4		4[a] keV 3		3645 4	E(level): from E_α=3645 keV 4 (1973Ba10). See also E_α(keV)=3650 (1967Se07), 3670 (1956Bo61), 3640 (1971Ba06). Γ: See also Γ=9 keV (1973Ba10), Γ(lab)≤8 keV (1956Bo61).
9180[c]				3690	E(level): from E_α=3690 keV (1971Ba06).

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^{13}C(α,n) (continued)

^{17}O Levels (continued)

E(level)	J$^{\pi}$	Γ	L	E$_{\alpha}$(res) (keV)	Comments
9199[‡] *4*	5/2[a]	4[a] keV *3*	2,3[b]	3714 *4*	E(level): from E$_{\alpha}$=3714 keV *4* (1973Ba10). See also E$_{\alpha}$(keV)=3720 (1967Se07,1971Ba06), 3730 (1956Bo61), E$_{n}$=5380 keV (1956Be98: Fig. 5 top). Γ: See also Γ=8 keV (1973Ba10), Γ(lab)≤5 keV (1956Bo61), Γ$_{n}$=3.86 keV and Γ$_{\alpha}$=0.14 keV (1967Se07).
9491[‡] *4*		8[a] keV *3*		4096 *4*	E(level): from E$_{\alpha}$=4096 keV *4* (1973Ba10). See also E$_{\alpha}$(keV)=4120 (1967Se07), 4125 (1956Bo61), 4110 (1971Ba06). Γ: See also Γ=16 keV (1973Ba10), Γ(lab)=15 keV (1956Bo61).
9.6×10^{3}?[c]	3/2^{-}[c]				E(level): broad; from unresolved broad level near E$_{\alpha}$≈4.3E3 keV (1971Ba06).
9719[‡] *5*	7/2^{+}[c]	25[‡] keV		4394 *5*	E(level): from E$_{\alpha}$=4394 keV *5* (1973Ba10). See also E$_{\alpha}$=4380 keV (1971Ba06).
9739	3/2^{+}[c]	15[a] keV *3*		4420	E(level): from E$_{\alpha}$=4420 keV (1956Bo61,1967Se07,1971Ba06), This level is associated with E$_{x}$=9786 keV in Adopted Levels. Γ: See also Γ(lab)=25 keV (1956Bo61). It appears this level is not real. No single experiment reports more than two of the three levels at 9.72, 9.74 and 9.77 MeV. The energies of these levels are better resolved in ^{16}O(n,n) (1980Ce03).
9773?[‡] *15*		≈25[‡] keV		4465 *15*	E(level): from E$_{\alpha}$=4465 keV *15* (1973Ba10). See also E$_{\alpha}$(keV)=4500 (1956Bo61), (4490) (1967Se07). Γ: See also Γ(lab)=70 keV (1956Bo61).
9863[‡] *5*	(9/2^{+})[c]	14[‡] keV		4583 *5*	E(level): from E$_{\alpha}$=4583 keV *5* (1973Ba10). See also E$_{\alpha}$=4580 keV (1971Ba06).
9876[‡] *15*	9/2[a]	5[a] keV *3*	4,5[b]	4600 *15*	E(level): from E$_{\alpha}$=4600 keV *15* (1973Ba10). See also E$_{\alpha}$(keV)=4620 (1967Se07), 4630 (1956Bo61). Γ: See also Γ(keV)≈10 (1973Ba10), Γ(lab)=15 keV (1956Bo61), Γ$_{n}$=4.7 keV and Γ$_{\alpha}$=0.3 keV (1967Se07).
9976[‡] *20*	5/2^{+}[c]	≈80[‡] keV		4730 *20*	E(level): from E$_{\alpha}$=4730 keV *20* (1973Ba10). See also E$_{\alpha}$(keV)=4750 (1956Bo61), 4700 (1971Ba06), (4770) (1967Se07). Γ: See also Γ(lab)=200 keV (1956Bo61).
10045[‡] *20*		≈100[‡] keV		4820 *20*	E(level): from E$_{\alpha}$=4820 keV *20* (1973Ba10). See also E$_{\alpha}$=(4850) keV (1967Se07).
10136[c]				4940	E(level): from E$_{\alpha}$=4940 keV (1971Ba06).
10177[‡] *5*	(5/2^{+},7/2^{-})[d]	50[a] keV *3*		4993 *5*	E(level): from E$_{\alpha}$=4993 keV *5* (1973Ba10). See also E$_{\alpha}$(keV)=4980 (1971Ba06), 4995 (1970Ro08), 5040 (1967Se07), 5050 (1956Bo61). Γ: See als 45 keV (1973Ba10), Γ(lab)=65 keV (1956Bo61).
10335[‡] *15*	(5/2^{+},7/2^{-})[d]	150[‡] keV		5200 *15*	E(level): from E$_{\alpha}$=5200 keV *15* (1973Ba10). See also E$_{\alpha}$=5185 keV (1970Ro08).
10422.3[e] *20*	(5/2^{-},7/2^{-})[d]	14[f] keV *3*		5314.0 *25*	E(level): from E$_{\alpha}$=5314.0 keV *25* (1975Be44). See also E$_{\alpha}$(keV)=5317 *10* (1963Sp02), 5325 *10* (1973Ba10), 5290 (1967Se07), 5370 (1970Ro08). Γ: See also Γ(keV)=11 *9* (1975Be44), 23 keV (1973Ba10).

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^{13}C(α,n) (continued)

^{17}O Levels (continued)

E(level)	J$^{\pi}$	Γ	E_{α}(res) (keV)	Comments
10498	(5/2^{+},7/2^{-})[d]		5413	E(level): from E_{α}=5413 keV, which is the average of (1967Se07: 5410 keV) and (1970Ro08: 5415 keV).
10558.5[e] *20*	(7/2^{-},9/2^{+})[d]	51[e] keV *2*	5492.0 *25*	E(level): from E_{α}=5492.0 keV *25* (1975Be44). See also E_{α}(keV)=5496 *10* (1963Sp02), 5540 (1970Ro08). Γ: See also Γ=50 keV *20* (1963Sp02).
10777.9[e] *20*	(1/2^{+},7/2^{-})[d]	74[e] keV *3*	5779.0 *25*	E(level): from E_{α}=5779.0 keV *25* (1975Be44). See also E_{α}(keV)=5771 *10* (1963Sp02), 5790 (1970Ro08). Γ: See also Γ=85 keV *30* (1963Sp02).
10905[e] *2*	(5/2)[d]	46[e] keV *2*	5945 *3*	E(level): from E_{α}=5945 keV *3* (1975Be44). See also E_{α}(keV)=5945 *10* (1963Sp02), 5995 (1970Ro08). Γ: See also Γ=55 keV *20* (1963Sp02).
11036[e] *2*		31[e] keV *3*	6117 *3*	E(level): from E_{α}=6117 keV *3* (1975Be44). See also E_{α}=6107 keV *10* (1963Sp02). Γ: See also Γ=45 keV *10* (1963Sp02).
11076[g] *5*	1/2^{-}[g]	5.0[g] keV *11*	6169	T=3/2 (1976Mc11) E(level): from E_{α}=6169 keV which is calculated from the E_{x} given in (1976Mc11); see also E_{α}=6220 keV (1970Ro08). J$^{\pi}$: See also (3/2^{-},7/2^{+}) (1970Ro08). Γ: From (1976Mc11). A preliminary result, 5 keV *1*, from a BAPS was picked up by (1973Ad02: ^{18}O(^{3}He,α) and used to derive various partial widths. See also $(\Gamma_{\alpha0}\Gamma_{n0})^{1/2}/\Gamma_{tot}$=0.23 (1976Mc11) which corresponds to $\Gamma_{\alpha0}/\Gamma$=0.06 *2* when combined with the value Γ_{n0}/Γ=0.91 *15* (1973Ad02).
11238[e] *2*	(3/2^{-},7/2^{+})[d]	80.0[e] keV *25*	6380 *3*	E(level): from E_{α}=6380 keV *3* (1975Be44). See also E_{α}(keV)=6367 *10* (1963Sp02), 6480 (1970Ro08). Γ: See also Γ=100 keV *30* (1963Sp02).
11622[e] *2*		65[e] keV *2*	6883 *3*	E(level): from E_{α}=6883 keV *3* (1975Be44). See also E_{α}=6878 keV *10* (1963Sp02). Γ: See also Γ=120 keV *30* (1963Sp02).
11751[f] *10*		40[f] keV *25*	7051 *10*	E(level): from E_{α}=7051 keV *10* (1963Sp02).
11816[f] *15*	(5/2,7/2)[d]	12[f] keV *3*	7136 *15*	E(level): from E_{α}=7136 keV *15* (1963Sp02). See also E_{α}=7160 keV (1970Ro08).
12005[f] *15*			7384 *15*	E(level): from E_{α}=7348 keV *15* (1963Sp02).
12109[f] *20*		150[f] keV *50*	7520 *20*	E(level): from E_{α}=7520 keV *20* (1963Sp02).
12274[f] *15*		100[f] keV *30*	7736 *15*	E(level): from E_{α}=7736 keV *15* (1963Sp02).
12385[f] *20*			7880 *20*	E(level): from E_{α}=7880 keV *20* (1963Sp02).
12421[f] *15*			7927 *15*	E(level): from E_{α}=7927 keV *15* (1963Sp02).
12458[g] *5*	3/2^{-}[g]	8[g] keV *2*	7976	T=3/2 (1976Mc11) E(level): from E_{α}=7976 keV which is calculated from the E_{x} given in (1976Mc11). See also E_{α}=8000 keV (1970Ro08). J$^{\pi}$: See also (3/2^{-},9/2^{+}) (1970Ro08).
12596[f] *15*		75[f] keV *30*	8156 *15*	E(level): from E_{α}=8156 keV *15* (1963Sp02).
12670[f] *15*	(3/2^{-},9/2^{+})[d]	≈75[f] keV	8253 *15*	Γ: Beginning in (1971Aj02) the Γ for this level was listed at ≈5 keV attributed to ^{13}C(α,n) (1969Sp02). However this was a typo. (1969Sp02) report ≈75 keV. E(level): from E_{α}=8253 keV *15* (1963Sp02). See also E_{α}=8328 keV (1970Ro08).
12813[f] *25*			8440 *25*	E(level): from E_{α}=8440 keV *25* (1963Sp02).
12928[f] *20*	(1/2^{+},7/2^{-})[d]	≥150[f] keV	8590 *20*	E(level): from E_{α}=8590 keV *20* (1963Sp02). See also E_{α}=8657 keV (1970Ro08).
12944[g] *6*	1/2^{+}[g]	6[g] keV *2*	8612	T=3/2 (1976Mc11)

Continued on next page (footnotes at end of table)

^{13}C(α,n) (continued)

^{17}O Levels (continued)

E(level)	J$^{\pi}$	Γ	E$_{\alpha}$(res) (keV)	Comments
				E(level): from E$_{\alpha}$=8612 keV which is calculated from the E$_x$ given in (1976Mc11).
12993[g] *6*	5/2^{-}[g]	≤3[g] keV	8676	T=3/2 (1976Mc11) E(level): from E$_{\alpha}$=8676 keV which is calculated from the E$_x$ given in (1976Mc11). See also 13027 keV *20* (1963Sp02: E$_{\alpha}$=8720 keV *20*).
13077[f] *15*		16[f] keV *4*	8785 *15*	E(level): from E$_{\alpha}$=8785 keV *15* (1963Sp02).
13485[f] *15*		≈120[f] keV	9319 *15*	E(level): from E$_{\alpha}$=9319 keV *15* (1963Sp02).
13610[f] *15*		250[f] keV *100*	9483 *15*	E(level): from E$_{\alpha}$=9483 keV *15* (1963Sp02). Γ: =150-350 keV.

[†] From (1993Br17).
[‡] From (1973Ba10).
[#] From (1957Wa46).
[@] From (1969Sc04). But see (1973Bu14) who claim π deduced by (1969Sc04) is sometimes ambiguous.
[&] L$_{\alpha}$,L$_{\alpha'}$ (1969Sc04).
[a] From (1967Se07).
[b] L$_{\alpha}$,L$_{n}$ (1967Se07).
[c] From (1971Ba06).
[d] From (1970Ro08).
[e] From (1975Be44).
[f] From (1963Sp02).
[g] From (1976Mc11).