Adopted Levels

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

S(n)=17770 *10*; S(p)=1512 *10*; Q(α)=−8220 *10* 2021Wa16
S_{2n}=40770 *60*; S_{2p}=2112 *10*; Q(εp)=15826 *10* (2021Wa16).

Theoretical studies:
Level properties and model analyses:
1978Gu10, 1987Sa15, 2001Sa06, 2001Su10, 2002Sa12, 2008Sh16, 2010Ti04, 2011Sh21, 2013Ti05, 2013Ma60, 2016Pa05, 2017Br02, 2020So01, 2022Zo01, 2023Me02.

Charge symmetry in mirror nuclei:
1971Bl12, 1973Sa25, 1974Ch46, 1999Ba21, 2021Ca23, 2023Se01.

Magnetic moments:
1999Ba21, 2003Su04, 2003Su28, 2013De06, 2016Me17, 2021Ca23.

Analyzed β-decay, β-p decay data.
1973Ha77, 1977Ce05, 1977Ri08, 1993Ch06.

Solar and cosmogenic production rates:
2006Li57, 2018Ge07, 2019Zh29.

In the early studies of (1984Se15, 1993Wa07) using $^{13}C(\pi^+,\pi^-)$, the levels observed in the excitation spectrum appeared as broad groups with excitation energies around E_x=3, 4.5, 6 and 8.7 MeV. In the later work of (2007GuZW), using $^{16}O(^3He,^6He)$, more structures are observed revealing a collection of narrower states. Finally, in the seminal work of (2021Ch45), analysis of the decay mechanism further resolved the groups observed by (2007GuZW) into narrower states that dominantly proton decay to different ^{12}N states.

^{13}O Levels

Cross Reference (XREF) Flags

A	$^1H(^{12}N,p)$:res	F	$^9Be(^{16}O,^{13}O)$	K	$^{14}N(p,2n)$
B	$^1H(^{14}O,d)$	G	$^{12}C(p,\pi^-)$	L	$^{14}N(^{12}N,^{13}O)$
C	$^2H(^{12}N,^{13}O)$	H	$^{12}C(^{15}O,^{13}O)$	M	$^{16}O(^3He,^6He)$
D	$^2H(^{14}O,t)$	I	$^{13}C(\pi^+,\pi^-)$	N	$^{28}Si(^{13}O,X)$
E	$^9Be(^{13}O,^{13}O),(^{13}O,p^{12}N)$	J	$^{13}C(^{11}B,^{11}Li)$	O	$^{208}Pb(^{13}O,^{13}O)$

E(level)	J^π	$T_{1/2}$ or Γ	XREF	Comments
0.0	$3/2^-$	8.58 ms *5*	BCD FGHIJKLMNO	%ε+%β^+=100; %β^+p=11.3 *23* (2005Kn02) T=3/2 μ=1.3891 *3* (1996Ma38,2019StZV) Q=0.0111 *8* (2016St14,2021StZZ) Q: From reanalysis of (1999Ma46). J^π: Allowed *ft* values to ^{13}N $J^\pi=1/2^-$, $3/2^-$, $5/2^-$ states (1970Es03). $T_{1/2}$: From weighted average of 8.7 ms *4* (1965Mc09), 8.95 ms *20* (1970Es03) and 8.55 ms *5* (1990As01).
2428† *18*	$1/2^+$&	358 keV *19*	AB E G M	%p=100

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Adopted Levels (continued)

^{13}O Levels (continued)

E(level)	J^π	$T_{1/2}$ or Γ	XREF	Comments
				XREF: A(2.69E3)B(2.8E3)G(2.82E3)M(2650). E(level),J^π,Γ: From (2021Ch45) ^{9}Be(^{13}O,^{13}O). See also E_x=2400 keV *50* (1991Go13,1991GoZR) ^{16}O(^{3}He,^{6}He), E_x=2690 keV *50* (2007Sk02) ^{1}H(^{12}N,p), and E_x=2690 keV *50* from the (2007GuZW: ΔE estimated by evaluator) ^{16}O(^{3}He,^{6}He) conference proceedings. Other values reported near this energy are E_x=2.82 MeV *24* (1978Co15) ^{12}C(p,π^-) and E_x=2.8 MeV *3* (2012Su21) ^{1}H(^{14}O,d). Γ: See also Γ=0.45 MeV *10* (2007Sk02), <300 keV (2012Su21) and <100 keV (2007GuZW: est.).
3006† *13*	3/2$^+$&	55 keV *19*	E i	%p=100 XREF: i(2.75E3). E(level),J^π,Γ: From (2021Ch45) ^{9}Be(^{13}O,^{13}O). See also E_x=2956 keV *15* and Γ<50 keV (2013So11) ^{9}Be(^{13}O,^{13}O). Ambiguity exists in the level energies obtained from the ^{13}C(π^+,π^-) reaction. A narrow resonance is reported in (1984Se15) with E_x=2.75 MeV *4* and in (1993Wa07) with 3.10 MeV *7*; we associate these observations with either or both of the E_x=3006 keV and 3051 keV Adopted Levels of this evaluation.
3051‡ *16*	5/2$^+$&	54 keV *19*	E i m	%p=100 XREF: i(2.75E3)m(3120). E(level),J^π,Γ: From (2021Ch45) ^{9}Be(^{13}O,^{13}O). See also E_x=3025 keV *16* and Γ<50 keV (2013So11) ^{9}Be(^{13}O,^{13}O) and E_x=3038 keV *9* (2019We11) ^{9}Be(^{13}O,^{13}O). Also see E_x=2750 keV *40* (1984Se15) and 3100 keV *70* (1993Wa07) both from ^{13}C(π^+,π^-), and 3120 keV *50* (2007GuZW:ΔE est.) ^{16}O(^{3}He,^{6}He). Γ: See also ≈0.43 MeV (2007GuZW:est.).
3290?@ *50*	(1/2,3/2)$^-$	75 keV *30*	A m	XREF: m(3120). E(level),J^π,Γ: From R-matrix analysis in (2007Sk02) ^{1}H(^{12}N,p). See also E_x=3120 keV *50* and Γ=0.43 MeV *10* (2007GuZW:est.) ^{16}O(^{3}He,^{6}He). E(level): This level is listed because of the significant energy difference between 3290 and the nearest level at E_x=3051 keV and because of the broad width of the group reported in (2007GuZW) that may suggest both groups were populated in that study. But, its existence is rather uncertain.
3692† *13*	7/2$^+$&	53 keV *21*	E m	%p=100 XREF: m(3800). E(level),J^π,Γ: From (2021Ch45) ^{9}Be(^{13}O,^{13}O). See also E_x=3669 keV *13* and Γ<50 keV (2013So11) ^{9}Be(^{13}O,^{13}O), E_x=3701 keV *10* (2019We11) ^{9}Be(^{13}O,^{13}O). Also see E_x=3800 keV *50* and Γ≈160 keV (2007GuZW: ΔE and Γ est.) ^{16}O(^{3}He,^{6}He) where the unresolved ^{13}O*(3692+3721) states may have been observed.
3721# *16*	(3/2$^+$,5/2$^+$,5/2$^-$)&	10 keV *+19−10*	E m	%p=100

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Adopted Levels (continued)

^{13}O Levels (continued)

E(level)	J^π	$T_{1/2}$ or Γ	XREF	Comments
				XREF: m(3800). E(level),J^π,Γ: From (2021Ch45) ^{9}Be(^{13}O,^{13}O). See also E_x=3800 keV *50* and Γ≈160 keV (2007GuZW: ΔE and Γ est.) ^{16}O(^{3}He,^{6}He) where the unresolved ^{13}O*(3692+3721) states may have been observed.
4287† *13*	(3/2+,5/2+)&	170 keV *25*	B E I M	%p=100 XREF: I(4210)M(4410). E(level),J^π,Γ: From (2021Ch45) ^{9}Be(^{13}O,^{13}O). E(level): See also E_x=4.21 MeV (1984Se15) and 4500 keV *90* (1993Wa07) discrepant values reported in ^{13}C(π^+,π^-), 4.2 MeV *3* (2012Su21) ^{1}H(^{14}O,d) and 4410 keV *50* (2007GuZW: ΔE est.) ^{16}O(^{3}He,^{6}He). J^π: See also (1/2−,3/2,5/2+) (2012Su21) and (1/2−) from (1993Wa07). Γ: See also Γ=0.6 MeV *4* (1993Wa07), <500 keV (2012Su21) and ≈0.43 MeV (2007GuZW: est.).
4866‡ *20*	(1/2+,1/2−,3/2−)&	103 keV *37*	E	%p=100 E(level),J^π,Γ: From (2021Ch45) ^{9}Be(^{13}O,^{13}O).
4892† *25*	7/2+&	323 keV *27*	E M	%p=100 E(level),J^π,Γ: From (2021Ch45) ^{9}Be(^{13}O,^{13}O). See also E_x=4.95 MeV *10* and Γ≈280 keV (2007GuZW: ΔE and Γ estimated by evaluator.) ^{16}O(^{3}He,^{6}He).
5483# *17*	7/2−&	204 keV *41*	E	%p=100 E(level),J^π,Γ: From (2021Ch45) ^{9}Be(^{13}O,^{13}O).
5951‡ *18*	(7/2+,7/2−)&	875 keV *68*	E IJ M	%p=100 XREF: J(6E3). E(level),J^π,Γ: From (2021Ch45) ^{9}Be(^{13}O,^{13}O). E(level): (2021Ch45) suggests two states in this region: one at E_x=5951 keV *18* along with a questionable state at ≈6.2 MeV; both have broad widths of around 1 MeV. Other reactions have reported broad states near E_x≈6 MeV, but none have suggested or resolved two states. We associate all firm states reported in this region with the lower level reported in (2021Ch45), but highlight that the associations may be different if both states are found to exist. Other energies reported near E_x=6 MeV are 6020 keV *80* (1984Se15) and 6100 keV *90* (1993Wa07) both from ^{13}C(π^+,π^-), 6.00 MeV *10* (2007GuZW: ΔE est.) ^{16}O(^{3}He,^{6}He) and 6 MeV (2007TaZR) ^{13}C(^{11}B,^{11}Li). Γ: Other reported widths are Γ≈1.2 MeV (1984Se15) and Γ=0.6 MeV *4* (1993Wa07) from ^{13}C(π^+,π^-); (1984Se15) suggest the group may correspond to one or more unresolved states. See also Γ≈1.0 MeV (2007GuZW: est.).
≈6.2×10^3?#			E	%p=100 $T_{1/2}$ or Γ: Γ=BROAD. E(level),$T_{1/2}$ or Γ: From (2021Ch45) ^{9}Be(^{13}O,^{13}O).

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Adopted Levels (continued)

^{13}O Levels (continued)

E(level)	$T_{1/2}$ or Γ	XREF	Comments
6.90×10^3 [@] *10*	≈160 keV	M	From (2007GuZW: ΔE and Γ est.) ^{16}O(^{3}He,^{6}He).
8.7×10^3 [@] *2*	3.1 MeV *5*	IJ	E(level),Γ: From (1993Wa07) ^{13}C(π^+,π^-). See also E_x=8.8 MeV *5* and Γ=3.0 MeV *6* (1991Mo02) and E_x=8.8 MeV (2007TaZR) ^{13}C(^{11}B,^{11}Li). E(level): Suggested GDR⊗IAS (GDR built on isobaric analog states) see (2007TaZR, 1984Se15).

† Decays to p+$^{12}N_{g.s.}$. See details in (2021Ch45) ^{9}Be(^{13}O,^{13}O).
‡ Decays to p+^{12}N(961 keV:2^+). See details in (2021Ch45) ^{9}Be(^{13}O,^{13}O).
# Decays to p+^{12}N(1.19 MeV:2^-). See details in (2021Ch45) ^{9}Be(^{13}O,^{13}O).
@ Decay mode not specified.
& From (2021Ch45) analysis of the *m* sub-state distributions obtained by comparison of measured ^{12}N+p angular distributions with those expected for proton decay via the relevant *s*-, *p*- and *d*-wave components. Angular distributions are found that uniquely identify J^π values.