Adopted Levels, Gammas

Q(β^-)=13896 *19*; S(n)=2828 *24*; S(p)=15208 *25* 2021Wa16
Prior reviews: 1972Aj02, 1978Aj05, 1983Aj01, 1987Aj02, 1995Ti07.

Shell Model analysis of ^{18}N:
The ground state spin of ^{18}N is J$^\pi$=1$^-$ (1982Ol01) while a simple shell-model analysis predicts J$^\pi$=2$^-$. Detailed discussion is given (1983Sh44, 1984Ba24, 2012Yu07, 2018Ji07).

See other relevant theoretical analysis in:
1988PoZS, 1993Pa14, 1993Po11, 1997Ba54, 2000Zh42, 2004La24, 2004Ne16, 2004Su23, 2005Fo13, 2006Ko02, 2016Ma06, 2018Fo04, 2018Fo17, 2019Fo08.

Other relevant reaction studies:
1981SuZS, 1987Su06: Systematic measurement of μ^- capture rates.
1983As01, 1984As05: ^{18}O(π^-,π^0). Studied isospin dependence of single-charge-exchange reactions for ($\pi^\pm$,π^0) reactions at LAMPF. See also (1980Ge09, 1982ArZT).
1998Mu17: Theoretical analysis on μ capture rates on light nuclei.
1999He33: Theoretical analysis of astrophysically relevant neutron capture in unstable nitrogen nuclei.
2019Zh29: Calculated μ^- spalation yields on Ar leading to ^{18}N, which is a source of background in the DUNE neutrino detector.

^{18}N Levels

Cross Reference (XREF) Flags

A	^{18}C β^- decay	J	^{9}Be(^{40}Ar,^{18}N)	S	^{18}O(^{11}B,^{11}C)
B	^{19}C β^-n decay	K	^{12}C(^{22}Ne,^{18}N)	T	^{18}O(^{18}O,^{18}N)
C	^{2}H(^{17}N,p)	L	^{14}C(^{7}Li,^{3}He)	U	^{28}Si(p,^{18}N):spallation
D	^{9}Be(^{11}B,2pγ)	M	^{14}C(^{18}O,^{18}N)	V	^{181}Ta(^{18}O,^{18}Nγ)
E	^{9}Be,^{12}C(^{18}N,X)	N	^{18}O(π^-,γ)	W	^{181}Ta(^{22}Ne,^{18}N)
F	^{9}Be(^{18}O,p2α)	O	^{18}O(n,p)	X	^{232}Th(p,^{18}N)
G	^{9}Be(^{18}O,^{18}N):moment	P	^{18}O(d,^{2}He)	Y	^{232}Th(^{18}O,^{18}N),(^{22}Ne,^{18}N)
H	^{9}Be(^{19}N,^{18}N)	Q	^{18}O(t,^{3}He)		
I	^{9}Be(^{22}Ne,^{18}N)	R	^{18}O(^{7}Li,^{7}Be)		

E(level)	J$^\pi$	T$_{1/2}$	XREF	Comments
0.0	1$^-$	619 ms *2*	AB DEFGHIJKLMNOPQR TUVWXY	%β^-=100; %$\beta^-\alpha$=12.2 *6* (1989Zh04); %β^-n=12.0 *13* (1994ReZZ) T=2 μ=0.3273 *4* (2009De34) Q=0.0123 *12* (1999Og03) J$^\pi$: From ^{18}N β^- decay to ^{18}O$_{g.s.}$ (1982Ol01). T$_{1/2}$: From (2005Li60), See also 620 ms *8* (2007Bu01), 625 ms *30*, 635 ms *40* and 609 ms *60* (2007Lo05), 620 ms *14* (1999Og03), 0.63 s *2* (1994Sc01), 658 ms *44* (1994ReZZ), 624 ms *12* (1982Ol01) and 0.63 s *3* (1964Ch19). μ: From β-NMR (2009De34) and (2019StZV). See also μ=0.3279 *13* (1998Og04) and (−)0.135 *15* (1999Ne01). Q: From (1999Og03) and (Priv. comm. Nick Stone (2021)). This is an update of (2014StZZ). See also +0.027 *4* (1999Ne01). See other discussion in (2003Um02).

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued)

^{18}N Levels (continued)

E(level)	J^π	$T_{1/2}$	XREF	Comments
114.71† *10*	(2^-)‡	0.40 ns *11*	ABCD H P R V	%IT=100 $T_{1/2}$: From (2008Wi05).
587.39† *20*	(2^-)‡		AB D H LM ST V	%IT=100
742.0† *4*	(3^-)‡		CD H L R V	%IT=100
1170 *20*	(1^-)		C N	%IT=100 E(level),J^π: From ^{2}H(^{17}N,p) (2013Ho21).
1734.75† *19*	(1,2)#		A	%IT=100 J^π: From ^{18}C β^- decay (1991Pr03).
2210			C R	%IT=100
2405.0† *9*		0.11 ps *+51−7*	R V	%IT=100 $T_{1/2}$: From τ=0.16^{+74}_{-10} ps and E_γ=1663.0 keV *8* (2020Zi03).
2614.35† *21*	1^+#		A	%IT=100 J^π: From ^{18}C β^- decay (1991Pr03).
2.9×10^3? *2*			N	E(level): From ^{18}O(π^-,γ).
6.9×10^3? *2*			N	E(level): From ^{18}O(π^-,γ).
8.5×10^3? *2*			N	E(level): From ^{18}O(π^-,γ).
10.1×10^3? *2*			N	E(level): From ^{18}O(π^-,γ).

† From least squares fit to (E_x: E_γ), (115: 114.7 *1*), (587: 472.7 *2*), (742: 154.6 *3*, 627 *1*), (1735: 1147.8 *4*, 1619.9 *3*, 1734.8 *4*), (2405: 1663.0 *8*), (2614: 879.7 *2*, 2025.3 *8*, 2499.3 *4*, 2614.2 *4*) from averages of γ energies given in ^{18}C β^- (1991Pr03), ^{9}Be(^{11}B,2pγ) (2008Wi05) and ^{181}Ta(^{18}O,^{18}Nγ) (2020Zi03).

‡ Suggested by theory (1984Ba24). See also (1982Ol01,1991Pr03).

See (1993Ch06).

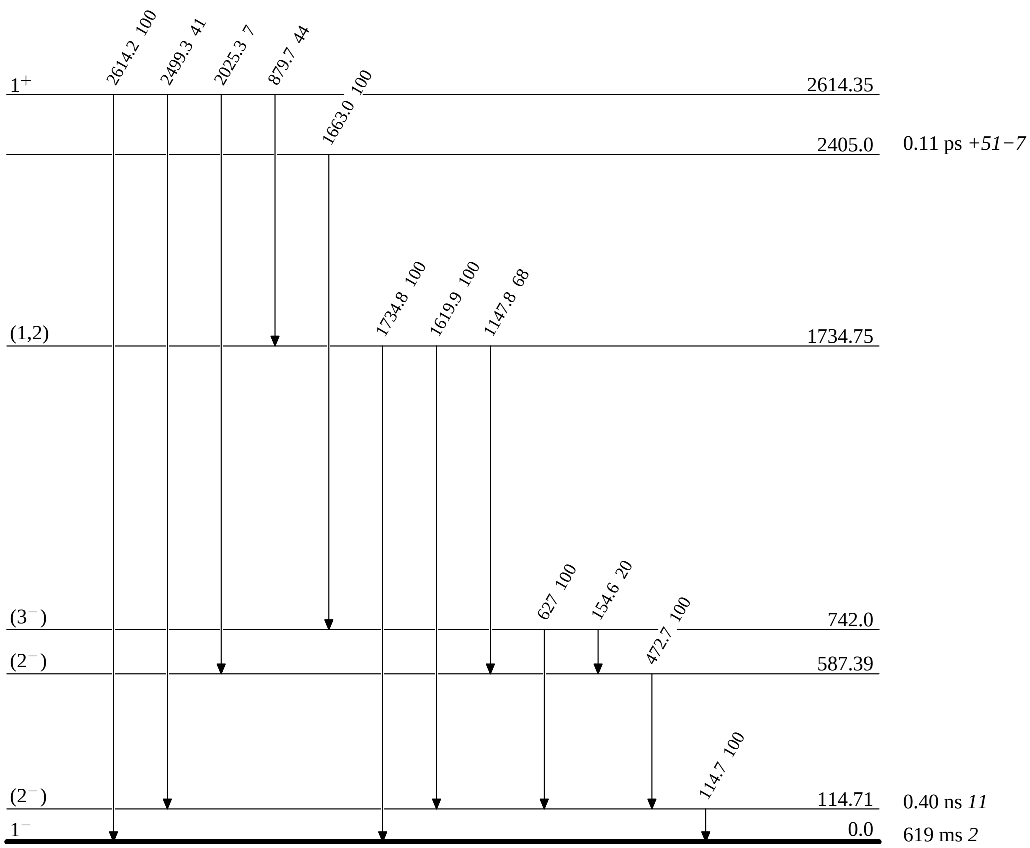
γ(^{18}N)

E_i(level)	J^π_i	E_γ	I_γ	E_f	J^π_f	Comments
114.71	(2^-)	114.7 *1*	100	0.0	1^-	B(M1)(W.u.)=0.036 *10*
587.39	(2^-)	472.7 *2*	100 *16*	114.71	(2^-)	
742.0	(3^-)	154.6 *3*	20	587.39	(2^-)	
		627 *1*	100	114.71	(2^-)	I_γ: From (2008Wi05).
1734.75	(1,2)	1147.8 *4*	68 *20*	587.39	(2^-)	
		1619.9 *3*	100 *25*	114.71	(2^-)	
		1734.8 *4*	100 *25*	0.0	1^-	I_γ: A discrepancy exists between the (1991Pr03) Table 1 and Table 3 γ-ray intensities for E_x=1734 keV; we use values from Table 1. This choice is necessary to reproduce their relative β^- feedings to ^{18}N*(1734,2614).
2405.0		1663.0 *8*	100	742.0	(3^-)	I_γ: From (2020Zi03).
2614.35	1^+	879.7 *2*	44 *4*	1734.75	(1,2)	
		2025.3 *8*	7 *5*	587.39	(2^-)	
		2499.3 *4*	41 *9*	114.71	(2^-)	
		2614.2 *4*	100 *11*	0.0	1^-	

Adopted Levels, Gammas

Level Scheme

Intensities: Relative photon branching from each level



$^{18}_{7}N_{11}$

^{18}C β^- decay 1991Pr03

Parent: ^{18}C: E=0; $J^\pi=0^+$; $T_{1/2}$=92 ms *2*; $Q(\beta^-)$=11810 *40*; %β^- decay=100.0
^{18}C-$T_{1/2}$: From (1995Sc03).
^{18}C-$Q(\beta^-)$: From (2021Wa16).
Decay to neutron-bound levels:

1991Pr03: A beam of ^{18}C, produced using the GANIL/LISE facility, was implanted into a plastic scintillator. Activity was collected for 300 ms followed by an equal time of decay counting. A 40% relative efficience HPGe detector was placed near the stopper, and decay events were recorded for β and β-γ coincidence events. The authors aimed to resolve the β^-0n and β^-1n decay branches. In the article, the decay of ^{18}C and ^{18}N were measured under identical experimental conditions; then the ratio of the intensity of the ^{18}O E_γ=1982 keV transition, which is strongly populated in ^{18}N decay, was analyzed to determine the sum of ^{18}C decay branches to bound ^{18}N states. %β^-0n=81 *5* was deduced. This implies %β^-1n=19 *5*.

A total of 9 γ-ray ^{18}N transitions were identified along with others associated with ^{17}N and ^{18}O. The γ-ray intensities are presented in two formats: first- they are given as relative intensities normalized to the strongest line (Table 1), the E_γ=2614 keV transition; second- intensities are given for a 100% branching sum out of each level (Table 3).

The authors discussed the likelihood of γ-ray summing effects as a potential source of systematic uncertainty; this is because a single HPGe detector was used and it was placed close to the decay stopper foil. Secondly, they discussed an inconsistency of their data where a higher intensity feeds the E_x=115 keV level than is observed exiting the level. Authors suggest this inconsistency may be attributed to the state having a long lifetime causing a significan fraction (≈1/2) to fall outside the DAQ coincidence window.

The evaluator finds significant problems with the intensity balance for the E_x=115 and 572 keV level γ rays; the E_x=115 keV level lifetime is about a ns (2008Wi05). For the analysis, the decay intensities are set equal to the feeding intensities for these two states. Furthermore there is a discrepancy in the decay branching ratios of ^{18}N*(1734) state given in Table 1 vs. Table 3. We take the Table 1 values, since they should require less interpretation to obtain, and since they are required to arrive at their deduced relative β^- branching ratios.

In spite of the experimental uncertainties, (1991Pr03) is the only ^{18}C β^- decay study that provides γ-ray spectroscopy information on ^{18}N levels. In their analysis, the authors suggest a negligible first-forbidden branch to $^{18}N_{g.s.}$, and so they normalize their measured relative branching ratios with %β^-0n=81 *5* to obtain the absolute decay intensities.

The following table is from (1991Pr03). It gives the measured energies and relative intensities of γ-rays assigned to the β^- decay of ^{18}C. The two entries marked with ^{17}N involve beta delayed neutron emission.

E_γ	I_γ	E_γ	I_γ.
114.9 *2*	32 *1*	1734.8 *4*	25 *5*.
471.7 *2*	15 *2*	2025.3 *8*	7 5.
879.7 2	44 *4*	2499.3 *4*	41 9.
1147.8 *4*	17 *5*	2614.2 *4*	100 11.
1619.9 *3*	25 *5*.		
^{17}N(E_γ=1374.0 *10*)	24 *5*.		
^{17}N(E_γ=1849.9 *4*)	11 *5*.		

Decay to neutron-unbound levels:

1991Pr03: As mentioned above, %β^-1n=19 *5* was deduced by comparing the measured γ-ray yields from ^{18}C and ^{18}N decay reactions.

1988Mu08,1989Le16: ^{18}C ions from fragmentation of ^{86}Kr (1988Mu08) and ^{48}Ca (1989Le16) on a ^{181}Ta target at GANIL were selected using the LISE spectrometer and implanted into a Si detector. The telescope was surrounded by a thin plastic scintillator β counter and segmented 4π NE102A scintillator neutron array. Neutron energy thresholds of 440 keV and 350 keV were utilized in (1988Mu08) and (1989Le16), respectively. Delayed neutron emission probabilities of P_n=(25.0 *45*)% and (50 *10*)% were deduced, respectively.

1991Re02: ^{18}C spallation products from 800 MeV proton bombardment of a ^{232}Th target were transported to the TOFI spectrometer at LAMPF. The ions were implanted in a Si detector. The β-delayed neutrons were detected in a polyethylene moderated ^3He counter; half-lives and β-delayed neutron probabilities were deduced from analysis of the number of implanted ions (per beam pulse) and the rate of β-delayed neutrons detected in the zero-threshold counter. The β-delayed neutron probability =(43.3 *65*)% was deduced along with $T_{1/2}$=94 ms *27*.

New data was collected using the experimental configuration of (1991Re02), and the collective results were analyzed. In (1994ReZZ) P_n=(30.2 *17*)% and $T_{1/2}$=92.9 ms *53* are given. In later unpublished works (1995ReZZ,2008ReZZ), P_n=(31.5 *15*)% and $T_{1/2}$=92 ms *5* are indicated. Other analyses of these data are found in (1993ReZX,1994KiZU).

^{18}C β^- decay 1991Pr03 (continued)

1995Sc03: A ^{18}C beam from the NSCL/A1200 was stopped in a plastic scintillator implantaion detector that was surrounded by an array of 15 plastic scintillator neutron detectors. The beam was collected in the stopping detector for 206 ms followed by a 222 ms beam-off counting period. Neutron events are recorded for β signals in the implantation detector in coincidence with neutron signals in the 99.7 cm flight path neutron array. Neutron energies were determined via time-of-flight; the array was configured with a low-energy threshold of ≈750 keV. Background activity from ^{18}N and ^{17}N, the ^{18}C decay daughters, was separable from the ^{18}C decays.

Seven neutron groups are evident in the energy spectrum; however, the lack of n-γ coincidence data and unknown spectroscopy of ^{18}N levels above the neutron binding precludes assignment of the neutron groups to ^{18}N levels. This is further accented by the known participation of ^{17}N*(1374,1850) levels in the β^-n reaction as reported in (1991Pr03). The intensity of β^-n neutron events reported in (1995Sc03) is (21.4 *44*)%. The neutrons can go to ^{17}N*(0,1374,1849), which implies ^{18}N excitation energies listed below.

E_n (MeV)	Branching Ratio (%)	S_n+E(n+$^{17}N_{g.s.}$)	S_n+E(n+^{17}N*(1374))	S_n+E(n+^{17}N*(1849)).
0.88 *2*	13.1 *13*	3.76 MeV *2*	5.13 MeV *2*	5.61 MeV *2*.
1.55 *2*	3.65 *41*	4.47 MeV *2*	5.84 MeV *2*	6.32 MeV *2*.
1.91 *2*	0.87 *16*	4.85 MeV *2*	6.22 MeV *2*	6.70 MeV *2*.
2.47 *2*	0.76 *13*	5.44 MeV *2*	6.81 MeV *2*	7.29 MeV *2*.
2.78 *2*	0.96 *14*	5.77 MeV *2*	7.14 MeV *2*	7.62 MeV *2*.
3.25 *3*	1.24 *15*	6.27 MeV *3*	7.64 MeV *2*	8.12 MeV *2*.
4.59 *4*	0.86 *12*	7.68 MeV *4*	9.05 MeV *2*	9.53 MeV *2*.

Comments:

The P_n=(31.5 *15*)%=%β^-1n value from (2008ReZZ) is reluctantly accepted. The evaluator notes that amongst the Kim/Reeder articles and conference reports, a wide range of values are presented. Measurements listed above using neutron arrays having finite neutron-energy thresholds found discrete neutron groups adding to ≈20% of the decay intensities; however, because the moderated ^{3}He counter used by Reeder is sensitive to all energy neutrons, this approach should provide the most reliable P_n value.

Taking %β^-1n=(31.5 *15*), the relative intensities of γ transitions reported in (1991Pr03) are normalized to give %β^-0n=(68.5 *15*). In (1991Pr03), the feeding into ^{18}N*(115,572) states is greater than the decay out of the states, which required adjustments to the intensity balance.

See theoretical discussion on β decay in (1993Ch06); also see (2016Ta07).

^{18}N Levels

E(level)†	J^π	$T_{1/2}$	Comments
0.0	1^-	619 ms *2*	T=2 $T_{1/2}$: From (2005Li60).
114.71 *10*	(2^-)		
587.39 *20*	(2^-)		
1734.75 *19*	(1,2)		
2614.35 *21*	1^+		

† From Adopted Levels.

β^- radiations

E(decay)	E(level)	$I\beta^-$†‡	Log *ft*
(9.20×10^3 *4*)	2614.35	61 *5*	4.16 *4*
(1.008×10^4 *4*)	1734.75	7 *3*	5.29 *19*

† (31.5 *15*)% of the β^- transitions feed levels that decay by neutron emission, so $\Sigma I\beta^-$=(68.5 *15*)% for the β^- branches included here.

‡ Absolute intensity per 100 decays.

^{18}C β^- decay 1991Pr03 (continued)

$\gamma(^{18}N)$

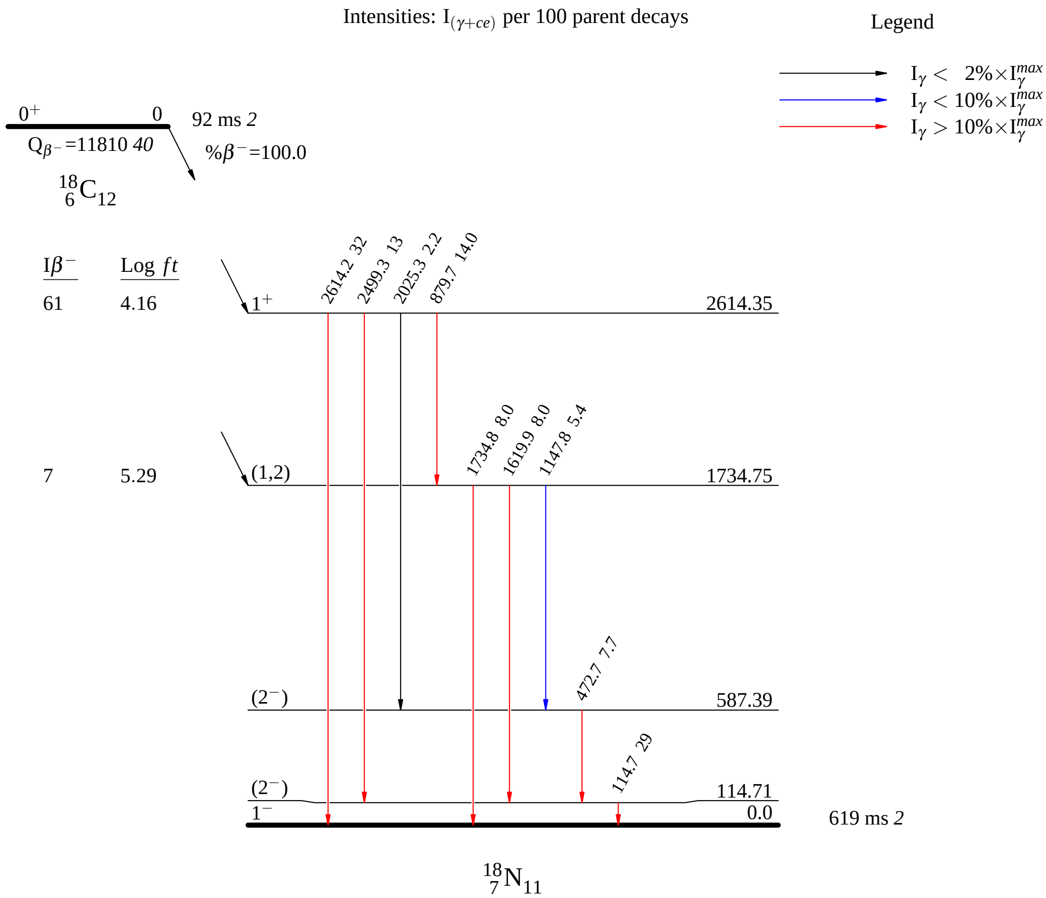
E_γ †	I_γ ‡	E_i(level)	J^π_i	E_f	J^π_f	Comments
114.7 *1*	90 *13*	114.71	(2⁻)	0.0	1⁻	%Iγ=28.7 *30*
472.7 *2*	24 *7*	587.39	(2⁻)	114.71	(2⁻)	%Iγ=7.6 *23*
879.7 *2*	44 *4*	2614.35	1⁺	1734.75	(1,2)	%Iγ=14.0 *17*
1147.8 *4*	17 *5*	1734.75	(1,2)	587.39	(2⁻)	%Iγ=5.4 *17*
1619.9 *3*	25 *5*	1734.75	(1,2)	114.71	(2⁻)	%Iγ=8.0 *17*
1734.8 *4*	25 *5*	1734.75	(1,2)	0.0	1⁻	%Iγ=8.0 *16*
2025.3 *8*	7 *5*	2614.35	1⁺	587.39	(2⁻)	%Iγ=2.2 *16*
2499.3 *4*	41 *9*	2614.35	1⁺	114.71	(2⁻)	%Iγ=13.1 *31*
2614.2 *4*	100 *11*	2614.35	1⁺	0.0	1⁻	%Iγ=31.9 *29*

† From Adopted Levels and Gammas.
‡ For absolute intensity per 100 decays, multiply by 0.319 *27*.

^{18}C β^- decay 1991Pr03

Decay Scheme

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



^{19}C β^-n decay 1995Oz02

Parent: ^{19}C: E=0; $T_{1/2}$=45.5 ms *40*; Q(β^-n)=11.23×10^3 *10*; %β^-n decay=47 *3*
^{19}C-$T_{1/2}$: From (1995Oz02).
^{19}C-Q(β^-n): From (2021Wa16).
1988Du09: A beam of ^{19}C ions, produced in the GANIL/LISE spectrometer was implanted into a 7 mm thick plastic scintillator that was surrounded by a 500 liter gadolinium doped 4π liquid scintillator neutron detector array. The lower-level threshold was essentially zero because of the Gd(n,γ) sensitivity. Analysis of the data indicated P_{0n}=(46 *3*)%, P_{1n}=(47 *3*)% and P_{2n}=(7 *3*)%. See also (1988DuZT,1988DUZZ).
1995Oz02: A beam of ^{19}C ions was produced by fragmenting a ^{22}Ne beam on a ^{9}Be target at RIKEN. The beam was magnetically separated, degraded to lower energies, and finally stopped in a plastic scintillator that was sandwiched between four other scintillator detectors. A valid β-decay event required a coincidence between three ajacent detectors. Three neutron walls surrounded the implantation target and covered about 1.4 sr. The decay neutron energy was deduced by the time of flight between the implantation detector and the neutron wall detectors. The ToF was calibrated by studying the decay of ^{17}N which has three visible known neutron groups. A set of two NaI detectors also faced the target for use measuring γ-ray singles events and n-γ coincidence events.
The measured neutron spectrum shows several decay groups. A significant ^{17}B component was present in the beam, and its decay radiations presented a background that was analyzed and subtracted. The final analysis of the neutron energy spectrum revealed five neutron groups that are attributed to β delayed neutron decay of ^{19}C to ^{18}N* states, or of its its daughter ^{19}N to ^{18}O states.
Throughout the experiment, ions were implanted for a 100 ms period followed by a 200 ms counting period; analysis of the time dependence for the neutron groups permitted assignment of four groups to decay of ^{19}C ($T_{1/2}$≈50 ms) and one group to decay of ^{19}N ($T_{1/2}$≈320 ms).
Four neutron groups at E_n=0.46, 1.01, 1.50 and 2.08 are observed; poor statistics prohibited full analysis of the E_n=2.08 MeV group. Since n-γ correlations were used to characterize the decay paths, the results are presented by normalizing to %β^-1n=(47 *3*)% from (1988Du09).
See also (1994OzZY,1995OzZY).

^{18}N Levels

E(level)†	J$^\pi$†	$T_{1/2}$†
0.0	1$^-$	619 ms *2*
114.71 *10*	(2$^-$)	0.40 ns *11*
587.39 *20*	(2$^-$)	

† From Adopted Levels.

γ(^{18}N)

E_γ	I_γ†	E_i(level)	J^π_i	E_f	J^π_f
114.7	47.	114.71	(2$^-$)	0.0	1$^-$
472.7	14.3	587.39	(2$^-$)	114.71	(2$^-$)

† Absolute intensity per 100 decays.

Delayed Neutrons (^{18}N)

E(n)	E(^{18}N)	I(n)†‡	E(^{19}N)	Comments
460 *10*	587.39	14.3 *20*	6400	E_n=460 keV *10* implies E_x(^{19}N)=6400 keV *27*.
1010 *10*	114.71	20.0 *16*	6508	E_n=1010 keV *10* implies E_x(^{19}N)=6508 keV *27*.
1500 *20*	114.71	12.7 *15*	7025	E_n=1500 keV *20* implies E_x(^{19}N)=7025 keV *33*.

Continued on next page (footnotes at end of table)

$^{19}C\ \beta^{-}$n decay 1995Oz02 (continued)

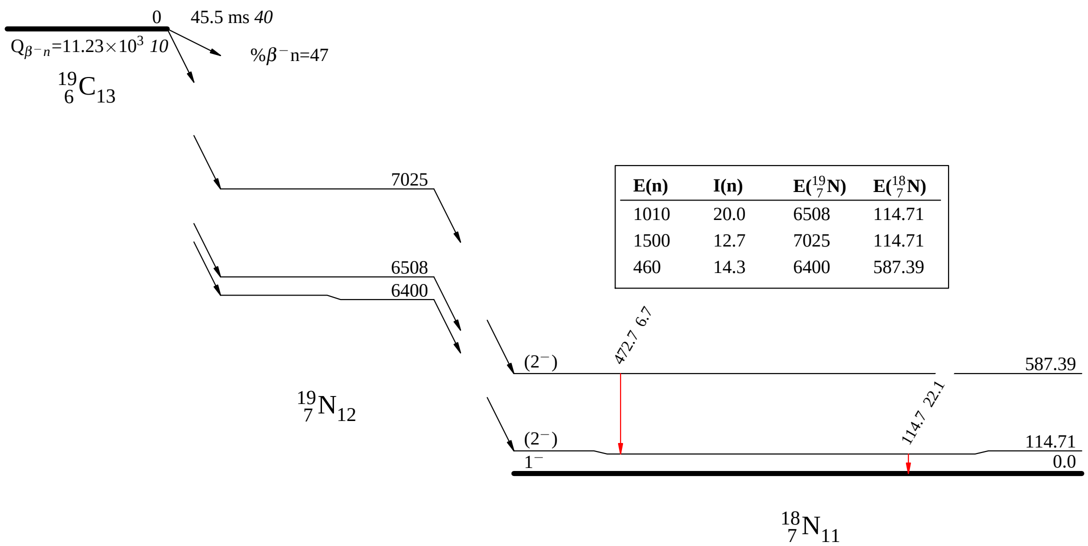
Delayed Neutrons (^{18}N) (continued)

† Normalized to (47 *3*)%; see (1988Du09).
‡ Absolute intensity per 100 decays.

^{19}C β^-n decay 1995Oz02

Decay Scheme

γ Intensities: I_γ per 100 parent decays
I(n) Intensities: I(n) per 100 parent decays



E(n)	I(n)	E($^{19}_{7}$N)	E($^{18}_{7}$N)
1010	20.0	6508	114.71
1500	12.7	7025	114.71
460	14.3	6400	587.39

^{2}H(^{17}N,p) 2013Ho21

2013Ho21: XUNDL dataset compiled by TUNL (2013).

A beam of E(^{17}N)=13.6 MeV/nucleon ions, produced via proton removal from ^{18}O beam at the ATLAS In-Flight Facility, impinged on either 140 or 220 μg/cm^2 deuterated polyethylene targets. Protons ejected from the target were detected upstream of the target using the HELIOS detector to reconstruct the event kinematics. Detection of the forward moving ^{18}N/^{17}N reaction product helped reduce backgrounds and remove contributions from beam contaminants.

The proton kinematics were analyzed to deduce the reaction Q values and excitation energies for populated groups. The energy resolution (FWHM) was ≈275 keV. Three groups corresponding to E_x=0.12, 0.74 and 1.17 MeV are observed below the neutron separation energy. The proton angular distributions are analyzed via PTOLEMY/DWBA analysis. The group at E_x=1.17 MeV is reasonably fitted using *l*=0, though the resulting spectroscopic factor is not reasonable; hence the group is suggested as either a single $J^\pi=1^-$ state or a $J^\pi=1^-$, 0^- doublet. An excess of strength is observed near E_x=2.2 MeV, which may correspond to previously known levels at E_x≈2.21 and 2.42 MeV (1983Pu01).

The spectroscopic strengths and spectroscopic factors are deduced for the observed levels and limits of S≤0.07 and ≤0.05 are set for unobserved states at E_x=0, 0.59 MeV, respectively.

^{18}N Levels

E(level)	J^π	L	S[†]	Comments
120 *10*	2^-	2	0.67 *3*	
740 *10*	3^-	2	0.69 *3*	
1170 *20*	(1^-)	0	0.96 *19*	The authors indicate $J^\pi=(1^-)$ in the summary; though in the discussion and in Table I they suggest a possible doublet with $J^\pi=(0^-$ and $1^-)$ and S=0.72 *14*, assuming equivalent values of S for 0^- and 1^- states .
≈2.2×10^3?				

† Absolute uncertainties in the normalized values estimated as 30%.

^{9}Be(^{11}B,2pγ) 2008Wi05

2008Wi05: XUNDL compiled by McMaster (2008).

Elements of the STARS-LIBERACE array were used at Berkeley to identify the ^{18}N events produced in ^{9}Be+^{11}B reactions and to measure the associated γ rays. Measured E_γ, I_γ, γ(2p) coin, level lifetimes.

In the first of two configurations, an E(^{11}B)=50 MeV beam, provided by the 88-Inch cyclotron, impinged on a 2.6 mg/cm^2 ^{9}Be that was surrounded by five HPGe clover detectors distributed at θ=40°, 90° and 140°. An annular position sensitive ΔE-E detector was positioned 3 cm downstream of the target and was used to detect the residual 2 protons associated with ^{18}N events. A thin lead foil covered the ΔE detector and stopped heavier particle ejectiles. γ-ray transitions between known states at ^{18}N*(0,115,587,742) are unambiguously identified along with their intensities.

The second configuration was similar to the first, except a thinner 1.35 mg/cm^2 target was used and a ^{nat}Pb stopper foil was used to measure the lifetime of the first excited state using the recoil-distance method. Events from ^{16}N transitions are also observed and used for internal calibration. The lifetime τ=582 ps *165* is reported. Results are compared with shell-model calculations. See also (2008WiZT).

^{18}N Levels

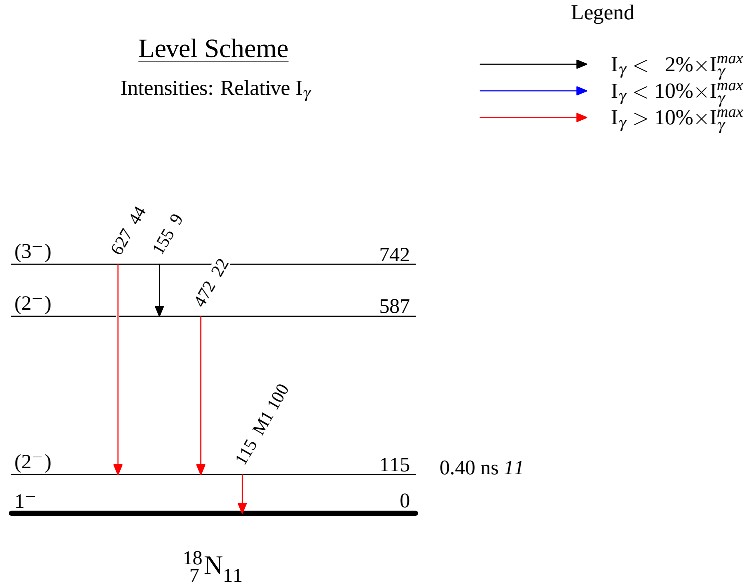
E(level)	J^π	$T_{1/2}$	Comments
0	1^-		Configuration: 47% $\pi(p_{1/2})\otimes\nu(d_{5/2})^3$; 36% $\pi(p_{1/2})\otimes\nu[(d_{5/2})^2(s_{1/2})]$.
115	(2^-)	0.40 ns *11*	$T_{1/2}$: From recoil-distance method (2008Wi05). Configuration: 68% $\pi(p_{1/2})\otimes\nu(d_{5/2})^3$; 16% $\pi(p_{1/2})\otimes\nu[(d_{5/2})(s_{1/2})^2]$.
587	(2^-)		Configuration: 48% $\pi(p_{1/2})\otimes\nu(d_{5/2})^3$; 34% $\pi(p_{1/2})\otimes\nu[(d_{5/2})^2(s_{1/2})]$.
742	(3^-)		Configuration: 69% $\pi(p_{1/2})\otimes\nu(d_{5/2})^3$; 17% $\pi(p_{1/2})\otimes\nu[(d_{5/2})(s_{1/2})^2]$.

γ(^{18}N)

E_γ †	I_γ	E_i(level)	J^π_i	E_f	J^π_f	Mult.	Comments
115 *1*	100	115	(2^-)	0	1^-	M1	B(M1)(W.u.)=0.036 *10* Mult.: From RUL, E2 component is ruled out.
155 *1*	9	742	(3^-)	587	(2^-)		
472 *1*	22	587	(2^-)	115	(2^-)		
627 *1*	44	742	(3^-)	115	(2^-)		

† The authors state 1 keV resolution.

$^{9}Be(^{11}B,2p\gamma)$ 2008Wi05



^{9}Be(^{18}O,p2α) 1982Ol01

1982Ol01: ^{9}Be(^{18}O,p2α) was used to produce ^{18}N at the entrance window of a cylindrical 1.5 cm by 13 cm 1.7 atm helium-filled gas cell at BNL. The ^{18}N was stopped in the gas and transferred to a counting area where decays to ^{18}O were observed. Branching ratios to ^{18}O states were determined. Analysis, including the assumption of 15% decay to non-γ-emitting states, determines $J^{\pi}=1^{-}$ for $^{18}N_{g.s.}$. Additionally, $T_{1/2}$=624 ms *12* was determined.

2003Fr32: ^{9}Be(^{18}O,p2α) at 80 MeV/nucleon was used to produce ^{18}N at the NSCL/A1200. The ^{18}N ions were implanted into a stack of four ΔE-ΔE-ΔE-E detectors; most ions stopped in the the first three detectors. A 120% efficiency HPGe detector at θ=90° measured the β-delayed γ emissions from ^{18}N decay to ^{18}O. The K1200 cyclotron *rf* was dephased for a second with a two second periodicity so that implanted ions were identified and counted on an event-by-event basis in the first second, and the decay radiations were measured in the final second. A redundant set of amplifiers readout the Si detectors in the counting period, permitting a measurement of β-delayed α particles. The branching ratio to γ-emitting states in ^{18}O* was determined as 76.7% *72*(stat.) *55*(sys.); the branch to $^{18}O_{g.s.}$ is estimated as 2.6% (1982Ol01).

Further discussion on $\beta^{-}\alpha$ (12.2 *6*)% from (1989Zh04) and β^{-}n (12.0 *13*)% from (1994ReZZ: update of 2001Re03) is given. The authors indicate their value is consistent with these results.

^{18}N Levels

E(level)†	J^{π}†	$T_{1/2}$†
0	1^{-}	624 ms *12*

† From (1982Ol01).

^{9}Be,^{12}C(^{18}N,X) 2001Oz03,2019Ba11

Includes ^{9}Be, ^{12}C, ^{28}Si, ^{197}Au targets.

2001Oz03: The interaction cross section of ^{12}C(^{18}N,X) was measured at 1020 MeV/nucleon using the GSI/FRS. σ_I=1046 mb *8* for ^{18}N was deduced. The matter radius $R_{r.m.s.}$=2.65 fm *2* was deduced. See also (2001Oz04).

2002Li40: A beam of 33 MeV/nucleon ^{18}N ions from the Lanzhou/RIBLL was fragmented on either a ^{9}Be or ^{197}Au target. The reaction products were identified using a set of fourteen ΔE-ΔE-E Si telescopes that covered θ=2.1°−10°; coincident neutrons were also measured using a set of sixteen NE110 plastic scintillator detectors. The fragment isotopic yields were obtained in the analysis and compared with a relativistic mean field calculation of the ^{18}N nucleon density distribution.

2006Kh08: The reaction cross section of ^{18}N ions on ^{28}Si was measured at GANIL by impinging a 53.2 MeV/nucleon ^{18}N beam, produced using the SISSI solenoids, into a ΔE-ΔE-E-VETO telescope that was placed at the focal plane of the SPEG spectrometer. The cross section σ_R=2104 mb *32* was measured.

2019Ba11: The charge-changing cross sections of nitrogen nuclei were measured at GSI to determine the systematic variations of the charge distributions. Beams of ≈775-940 MeV/nucleon $^{14-22}$N ions were seperately produced in the FRS and impinged on a 4.01 g/cm^2 carbon target. MUSIC ionization chambers identified beam particles before and after the target on an event-by-event basis. The charge-changing cross sections were determined and analyzed using a Glauber model. The rms point proton and matter radii for ^{18}N deduced in the measurement are R^{p}_{rms}=2.53 fm *3* and R^{m}_{rms}=2.68 fm *2*.

See related discussion in (2002Me12,2017Ah08).

^{18}N Levels

E(level)	Comments
0	$R^{m}_{r.m.s.}$=2.65 fm *2* (2001Oz03), see also R^{p}_{rms}=2.53 fm *3* and R^{m}_{rms}=2.68 fm *2* (2019Ba11).

$^{9}Be(^{18}O,^{18}N)$:moment 2009De34

2009De34: XUNDL dataset compiled by TUNL (2009).

β-NMR measurement.

A 74.3 MeV/nucleon ^{18}O primary beam bombarded a ^{9}Be target at GANIL producing ^{18}N ions via single charge-exchange reactions. The ^{18}O beam incident on the ^{9}Be target was tuned and optimized so than an off-axis component of the fragment beam was accempted into the LISE spectrometer (i.e. $\theta_{lab}\neq 0°$). The resulting spin-polarized beam was implanted into a room temperature MgO crystal held in a static B_0=0.39971 T magnetic field. Using standard β-NMR techniques, the asymmetry of emitted β particled was measured using a pair of ΔE-E plastic scintillators, and the μ=0.3273 μ_N *4* was determined.

^{18}N Levels

E(level)	J^π	Comments
0	1^-	μ=0.3273 *4* (2009De34) μ: β-NMR method, g(^{18}N)=0.3273 *4*, sign is not determined in this measurement. J^π: From Adopted Levels. A long lived isomer in ^{18}N could influence these measurements (1999Og03).

^{9}Be(^{19}N,^{18}N) 2012Ro22

2012Ro22: XUNDL dataset compiled by TUNL (2012).

The authors produced beams of ^{19}N by fragmenting a 700 MeV/nucleon ^{40}Ar beam on a thick ^{9}Be target and magnetically filtering the products in the first half of the FRS at GSI. The secondary beam particles were easily identified at the intermediate focal plane by their energy loss and time of flight in a set of standard detectors.

The beams impinged on a 1.72 g/cm^2 Be target and underwent further reactions, including one-neutron knockout reactions. Analysis of the FRS final focal plane detectors, coupled with measurements from the MINIBALL γ-ray spectrometer which was located at the 1.72 g/cm^2 target permitted identification of ^{18}N levels populated in the 1n knockout reactions.

^{18}N Levels

E(level)	J$^{\pi}$†	σ (mb)	Comments
0‡	1$^-$	41 *10*	Cross section value deduced by the compilers from total cross section of 65 mb *10*.
115‡	(2$^-$)		
587	(2$^-$)	6 *2*	σ (mb): <6 mb *2*. This level is populated in BR<0.09 *2* of 1n-knockout reactions at E/nucleon≈700 MeV.
728 *40*	(3$^-$)	15 *2*	σ (mb): >15 mb *2*. This level is populated in BR>0.23 *1* of 1n-knockout reactions at E/nucleon≈700 MeV. If this is the only level populated then BR<0.32 *4*.

† From Adopted Levels.

‡ Branching ratio (BR) of 0.64 assigned by compilers to 0+115 levels, assuming a maximum branching=0.36 for 587+728 levels. (2012Ro22) do not mention the population of g.s. and 115 levels.

^{9}Be(^{22}Ne,^{18}N)

1994Sc01: ^{18}N produced in the fragmentation of ^{22}Ne on a ^{9}Be target at the NSCL/A1200 were identified via ΔE-E and implanted into a thin plastic scintillator. The scintallator was at the center of a large-area neutron array comprised of 15 curved plastic bars that covered 14.3% of 4π. Activity was collected for 2.14 s before a 2.01 s counting period. β-delayed neutron yields were measured along with the neutron energy spectrum. Neutron energies were determiend by the time-of-flight between a β-particle in the implantation scintillator and a neutron in the array, which was 100.9 cm away. Decay to several ^{17}O levels was observed. %β^-n=2.2 *4* was determined for production of high-energy neutrons above the 1 MeV threshold. $T_{1/2}$=630 ms *20* was determined. See also (1993ShZW).

1997Ne01,1997Co15,1998Ne04: ^{18}N ions, produced by fragmenting a ^{22}Ne beam on a ^{9}Be target using the LISE3 spectrometer, were implanted into a 8 K cooled Mg crystal that was oriented with β=6° and held within a variable magnetic field. Analysis of the asymmetry of the β radiation with field strength over the range 0-2000 Gauss indicated a 14.4% spin alignment.

1999Ne01: Following up on (1997Ne01), a β-level mixing NMR technique (β-LMR) was developed and utilized to determine μ=0.135 μ_N *15*. They also obtained the ratio of the quadrupole interaction frequency to the magnetic moment and determined Q=+27 mb *4*. Results are discussed and compared with shell model calculations.

2005Li60: A thick Be target was bombarded by a 68.8 MeV/nucleon ^{22}Ne beam to produce ^{18}N ions that were selected and stopped in a thin plastic scintillation detector. Two different plastic scintillator arrays (neutron walls) were used to detect delayed neutrons with coverage of 30% and 2.2% of 4π sr for high energy and low energy, respectively. The neutron detection efficiecies were calibrated with the known ^{17}N β^-n decay neutron spectrum. A set of 3 HPGe detectors were positioned around the target to measure γ-ray emissions.

Beam was collected in the target for cycles of 2.0 s activation periods followed by 2.0 s counting periods. The result $T_{1/2}$=619 ms *2* was obtained from analysis of the β-ray decay curve observed in the thin plastic catcher foil; a small 5% ^{20}O ($T_{1/2}$=13.5 s) component was the main active beam contaminant. An exclusive gate on the on the strongest neutron peak at E_n= 0.58 MeV yielded the value $T_{1/2}$=610 ms *23*.

Analysis of the ToF spectrum indicates decays of 11 neutron emitting states in ^{18}O. The total observed BR is 6.98% *146* for fast neutrons.

2007Lo05: A Be target was bombarded by a 68.8 MeV/nucleon ^{22}Ne beam to produce ^{18}N ions that were selected and stopped in a thin plastic scintillation detector. A neutron sphere composed of eight identical plastic scintillator counters was used to detect delayed neutrons; each segment covered 3.75% of 4π sr. A calibration using ^{17}N provided the neutron detection efficiency up to E_n=1.73 MeV. In this measurement, the emphasis was on fast neutrons. Nine neutron groups were observed, eight are in good agreement with those reported by (2005Li60). The total observed β-delayed BR is 7.03% *146*.

Three $T_{1/2}$ values were obtained by analyzing the β-time spectra corresponding to the strongest three neutron peaks, 625 ms *30*, 635 ms *40* and 609 ms *60*.

^{18}N Levels

E(level)	$T_{1/2}$	Comments
0	619 ms *2*	μ=(−)0.135 *15* (1999Ne01) Q=+0.027 *4* (1999Ne01) $T_{1/2}$: Half-lives of 630 ms *20* (1994Sc01), 619 ms *2* (2005Li05), and 625 ms *30*, 635 ms *40* and 609 ms *60* (2007Lo05) were determined in this reaction. %β^-n: Analysis of fast neutrons measured by (2005Li60) and (2007Lo05) indicates consistency with %β^-n≥7%.

^{9}Be(^{40}Ar,^{18}N)

2000Oz01: A beam of ^{40}Ar at E≈1 GeV/nucleon impinged on a Be target (4.0 g/cm^2) at the GSI/FRS facility. The ^{19}B fragments of interest were identified using the B_ρ settings along with scintillators to measured ΔE and time-of-flight. The ^{18}N production cross section was measured as roughly ≈3.95×10^{-14} b.

2007No13: Production of ^{18}N via projectile fragmentation was studied at the RIKEN Accelerator Research Facility using ^{40}Ar beams at E=90, 94 MeV/nucleon that impinged on either a 95 mg/cm^2 thick ^{9}Be target or a 17 mg/cm^2 thick ^{nat}Ta target. The beams were momentum analyzed using the RIPS doubly achromatic spectrometer before being identified using two surface-barrier silicon counters and a plastic scintillator to identify products via ΔE and time-of-flight (TOF) at the focal plane. The fragment momentum distribution and production cross sections were deduced. See also (2015Mo17) for transverse momentum (P_T) distribution and width (σ_T) analysis.

2012Kw02: Several light neutron-rich nuclides, produced by projectile fragmentation of an ^{40}Ar beam at E=140 MeV/nucleon, bombarded one of three targets, 668 mg/cm^2 ^{9}Be, 775 mg/cm^2 ^{nat}Ni, and 1086 mg/cm^2 ^{181}Ta at the National Superconducting Cyclotron Laboratory (NSCL). Fragments were momentum analyzed using the A1900 separator and identified at the final focus using time-of-flight and a telescope consisting of five Si ΔE detectors. The fragmentation cross sections, parallel momentum transfers, and parallel momentum distribution widths were measured and compared to the theoretical predictions.

^{18}N Levels

E(level)
0

$^{12}C(^{22}Ne,^{18}N)$ 1998Og04,1999Og03

1998Co37: ^{18}N ions, produced by fragmenting a ^{22}Ne beam on a ^{12}C target, were selected using the LISE3 spectrometer and implanted into a a 40 K cooled Mg crystal oriented along β=1.5°. Using the Level Mixing Resonance method to interpret the variation asymmetry of β radiation with field strength 0-2000 Gauss indicated a the value eQ=3.2 e-fm^2 *3*.

1998Og04,1998OgZY,: ^{18}N ions were produced at RIKEN by fragmenting a 110 MeV/nucleon ^{22}Ne beam on a ^{12}C target and selecting ^{18}N using the RIPS fragment separator. Optimum settings indicated 2.2% polarization at θ=3.5° ^{18}N emission angle. The beam was implanted into a Pt stopper foil that was held at 30 K. Using standard β-NMR techniques, μ=0.3279 μ_N *17* was determined. A similar scan using a single crystal Mg stopper resulted in a determination of the quadrupole coupling constant eqQ/h=73.2 kHz *18*. A prelinary value Q=12.1 mb *12* was determined by comparison with Q(^{12}N) and related field gradients. See also (2000AsZZ).

1999Og03,1999OgZV: In an expansion of results presented in (1998Og04), further experimental details are given. The decay rate was determined from analysis of the β-ray time spectrum. $T_{1/2}$=620 ms *14* was obtained. In this work, the field gradients determined for ^{12}N and ^{14}N and their Q values were considered resulting in Q=12.3 mb *12*. Results are compared with perviously reported values and shell model predictions.

^{18}N Levels

E(level)	J^π	$T_{1/2}$	Comments
0	1^-	620 ms *14*	μ=0.3279 *13* (1998Og04) Q=12.3 *12* (1999Og03) J^π: From Adopted Levels. $T_{1/2}$: From (1999Og03).

^{14}C(^{7}Li,^{3}He) 1980KrZX

1980KrZX: The ^{14}C(^{7}Li,^{3}He) reaction was measured using E(^{7}Li)=32, 42, 48 MeV beams at Strasbourg using a ΔE-ΔE-E telescope to detect ^{3}He reaction products at θ=32°. Evidence for three states is observed; they are presumably ^{18}N*(0,0.53,0.83 MeV) with ΔM=13.29 MeV *6* for the ground state. Shell model predictions for the lowest six states are given. Subsequent measurements indicate the lowest state observed is a doublet.

^{18}N Levels

E(level)‡	Comments
0†	E(level): ΔM=13.29 MeV *6*.
530 *60*	
830 *60*	

† The ground state was later resolved as a doublet in ^{18}O(^{7}Li,^{7}Be) (1983Pu01).
‡ Energies deduced in this work are unreliable because of the low-lying doublet.

^{14}C(^{18}O,^{18}N) 1980Na14

1980Na14: The ^{14}C(^{18}O,^{18}N) reaction was measured using a E(^{18}O)=92.2 MeV beam from the Orsay Tandem. The ^{18}N reaction products were momentum analyzed using 180° double-focusing magnetic spectrograph having ΔE≈200 keV (FWHM). The ground state was observed with ΔM=13217 keV *40* along with an excited state at 575 keV. The ground state is later resolved as a doublet. See also (1979BeZL,1980BeYR).

^{18}N Levels

E(level)‡	Comments
0†	E(level): ΔM=13217 keV *40*.
575 *25*	

† The ground state was later resolved as a doublet in ^{18}O(^{7}Li,^{7}Be) (1983Pu01).
‡ Energies deduced in this work are unreliable because of the low-lying doublet.

$^{18}O(\pi^-,\gamma)$ 1982Gm02

1978St27: Population of $^{18}N_{g.s.}$ and a state at ≈7 MeV are reported in measurements using the SIN (Schweizerisches Inst. fuer Nuklearforschung) pion spectrometer. See also Alder et al., AIP Conference Proceedings 33, 628 (1976). Other related work is published in (1979St08).

1982Gm02: The SIN spectrometer data are further analyzed and show evidence for states up to 10.1 MeV. The ground and E_x=6.9 MeV states are most strongly populated.

^{18}N Levels

E(level)
0
1.3×10^3 *2*
2.9×10^3 *2*
6.9×10^3 *2*
8.5×10^3 *2*
10.1×10^3 *2*

^{18}O(n,p) 1964Ch19

1964Ch19: ^{18}O(n,p) was first measured using the Palo Alto Lockheed Missiles and Space Company Van de Graaff accelerator. The results confirmed the particle stability of ^{18}N.

A beam of ≈19 MeV neutrons, produced via the T(d,n) reaction, irradiated a 97% ^{18}O enriched water sample for a second before it was transfered to a counting area where combinations of β-γ-γ coincidence events were collected for about five seconds using a pair of NaI γ-ray detectors and a plastic scintillator β-ray detector. Measurements with a ^{16}O water sample were also collected so observations could be compared with the well-understood reaction to ^{16}N. The β-spectrum was measured and a strong feeding of ^{18}O*(4.45 MeV) was observed.

The β endpoint was investigated using γ-β coincidences; the ^{18}N-^{18}O mass difference was found as 13.9 MeV *4*, implying ΔM=13.1 MeV *4* . There is no evidence for a strong decay branch to $^{18}O_{g.s.}$. $T_{1/2}$=0.63 s *3* was deduced from the γ-gated β-ray decay curve. The ground state spin was constrained as J=$(0,1,2)^-$ from analysis of log*ft*.

2001KaZY: The ^{18}O(n,p) cross section was measured at E_n=14.94 MeV using activation techniques at the JAERI D-T neutron source. σ=1.15 mb *17*.

^{18}N Levels

E(level)	$T_{1/2}$	Comments
0[†]	0.63 s *3*	E(level): ΔM=13.1 MeV *4*. $T_{1/2}$: From (1964Ch19).

[†] The ground state was later resolved as a doublet in ^{18}O(^{7}Li,^{7}Be) (1983Pu01).

^{18}O(d,^{2}He) 1978DeYP

1978DeYP: ^{18}O(d,^{2}He→2p). Using a ^{18}O gas target and E_d=50 and 55 MeV beams from the 88-inch, the ^{18}O(d,^{2}He) energy spectrum was determined from analysis of the residual 2p particles from ^{2}He breakup. Evidence for three levels is presented based on a strong central peak with broad shoulders on either side. These are labeled preliminarily as ^{18}N*(0,0.28,0.45 MeV) with ΔM=−13.04 MeV *10* corresponding to the ground state. The evaluator suggests that the strong central peak corresponds to the presently accepted 115 keV state. See also (1979DeZO).

^{18}N Levels

E(level)†	Comments
0?	E(level): ΔM=−13.04 MeV *10*.
0.28×10^{3} *10*	
0.45×10^{3}? *10*	

† Energies deduced in this work are unreliable.

^{18}O(t,^{3}He) 1969St07

1969St07: ^{18}O(t,^{3}He). E_t=22 MeV. Population of the ^{18}N ground state was observed at the Los Alamos tandem facility. A 22 MeV triton beam entered a gas chamber filled with 99.3% ^{18}O gas enriched oxygen. Reaction products were measured using a ΔE-E telescope that was moved to cover θ=16.5°, 20° and 25°. The 2.2 μm thick Havar foil exit window of the target cell limited the sensitivity of the measurement so that only the ground state group was observed with Q=−14038 keV *30*; this corresponds to ΔM=13274 keV *30*.

^{18}N Levels

E(level)	Comments
0†	E(level): ΔM=13274 keV *30*.

† The ground state was later resolved as a doublet in ^{18}O(^{7}Li,^{7}Be) (1983Pu01).

$^{18}O(^{7}Li,^{7}Be)$ 1983Pu01

1983Pu01: The $^{18}O(^{7}Li,^{7}Be)$ reaction was measured using the Australian National University Pelletron accelerator. A beam of ^{7}Li ions impinged on a 140 μg/cm^2 99.2% enriched NiO^{18} target and reactions products were momentum analyzed using an Enge spectrometer at θ=4.5°, 8.5°, 10° and 15°. The lowest peak is resolved as a doublet where the ground state is found with ΔM=13116 keV *20*. Additional peaks shown in the spectrum correspond to E_x=121 keV *10* and 747 keV *10*. Additional groups associated with ^{18}N, not shown in the article, are found at E_x=2.21 and 2.42 MeV.

^{18}N Levels

E(level)	Comments
0	E(level): ΔM=13116 keV *20*. E(level): The strength of this state is 7% of the strength of the 121 keV state.
121 *10*	
747 *10*	
2.21×10^3	
2.42×10^3	

$^{18}O(^{11}B,^{11}C)$ 1983Pu01

1983Pu01: The article mainly discussed a $^{18}O(^{7}Li,^{7}Be)$ measurement at Australian National University Pelletron accelerator. A note added in proof indicates new data on $^{18}O(^{11}B,^{11}C)$ that shows ^{18}N has a state at 0.58 MeV and none at 1.01 MeV. This result is relevant to discussion given in (1983Pu01) related to the the shell model analysis found in (1982Ol01). No further results appear on $^{18}O(^{11}B,^{11}C)$.

^{18}N Levels

E(level)
580

$^{18}O(^{18}O,^{18}N)$ 1981NaZQ

1981NaZQ: The $^{18}O(^{18}O,^{18}N)$ reaction was measured using a E(^{18}O)=100 MeV beam from the Orsay Tandem. The ^{18}N reaction products were momentum analyzed using 180° double-focusing magnetic spectrograph at θ=4°−8°. The ground state was observed with ΔM=13207 keV *35* along with an excited state at 575 keV. See also (1981BeYZ).

^{18}N Levels

E(level)‡	Comments
0†	E(level): ΔM=13207 keV *35*.
575 *25*	

† The ground state was later resolved as a doublet in $^{18}O(^{7}Li,^{7}Be)$ (1983Pu01).
‡ Energies deduced in this work are unreliable because of the low-lying doublet.

^{28}Si(p,^{18}N):spallation 1993Bu21,2007Bu01

1993Bu21,2007Bu01: ^{28}Si(p,^{18}N): A thick target of $NaAlSiO_4$ was bombarded by a 500 MeV proton beam to produce ^{18}N ions that were selected by the TISOL separator at TRIUMF. The resulting ^{18}N^{16}O molecular beam was implanted in a 10 μg/cm^2 carbon foil. After a 1.0 s collection time, the catcher foil was rotated to a position between two Si surface barrier detectors. $T_{1/2}$=620 ms *8* was measured for the activity.

The observed α-spectrum was calibrated at the E_α=1.081 and 1.409 MeV peaks (from ^{18}O*(7616,8038)) and analyzed with the R-matrix approach. The full range of the α-particle spectrum was roughly double that of (1989Zh04) and additional α-groups were observed at higher energies. In the analysis the branching ratios are normalized to 12.2% from (1989Zh04).

^{18}N Levels

E(level)	$T_{1/2}$	Comments
0	620 ms *8*	Deduced discrete $\beta^-\alpha$ decay branches and normalized to %$\beta^-\alpha$=12.2 from (1989Zh04). $T_{1/2}$: From (2007Bu01).

^{181}Ta(^{18}O,^{18}Nγ) 2020Zi03

2020Zi03: XUNDL dataset compiled at TUNL (2020).
The authors investigated the level structure of ^{18}N and measured the lifetime of the E_x=2404 keV state in ^{18}N via DSAM techniques.
A beam of 126 MeV ^{18}O ions from the GANIL cyclotrons impinged on a 6.64 mg/cm^2 ^{181}Ta target. The ^{18}N ions that scattered at θ=45° (±6°) were momentum analyzed using the VAMOS++ ion tracking system. A collection of γ-ray detectors from the AGATA and PARIS arrays plus two large-volume $LaBr_3$ detectors provided a high granularity for γ-ray energy and angle measurement. The γ-ray detectors were aligned along the VAMOS++ axis at $\theta_{rel.}$=115°−175° (AGATA) and $\theta_{rel.}$=90°(PARIS+$LaBr_3$). The γ rays detected in coincidence with ^{18}N ions in the VAMOS++ spectrometer were analyzed.
The authors developed a Monte Carlo analysis of the Doppler shift attenuation spectrum that accounts for population (and subsequent deexcitation) of levels via low-momentum transfer and deep-inelastic reaction processes. The accuracy of the method relies on the precise angle determination between the scattered projectile and the Doppler-shifted γ ray.
2020Zi01: Extension of analysis presented in (2020Zi03) except the γ-ray spectrum is shown over a broader range. Additional unplace transitions are discussed corresponding to E_γ=1720, 2073, 2301 keV.
See analysis of the ^{18}O+^{181}Ta fragmentation process in (2010Mi08).

^{18}N Levels

E(level)†	J^π	$T_{1/2}$	Comments
0.0	1^-		
114.6	(2^-)		
587.3	(2^-)		
741.6	(3^-)		
2404.6		0.11 ps *+51−7*	$T_{1/2}$: From $\tau=0.16^{+74}_{-10}$ ps and E_γ=1663.0 keV *8* (2020Zi03).

† From (2020Zi03) Figure 5.

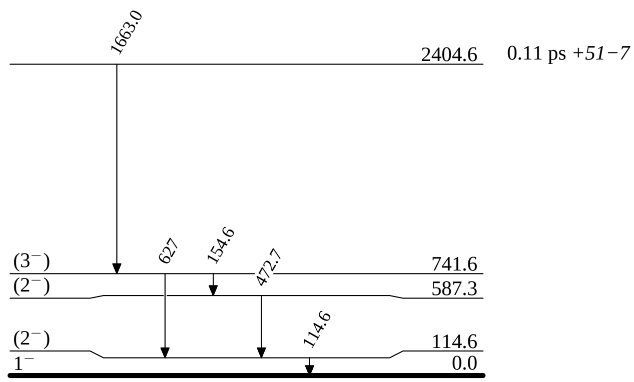
γ(^{18}N)

E_γ†	E_i(level)	J^π_i	E_f	J^π_f	Comments
114.6 *1*	114.6	(2^-)	0.0	1^-	
154.6 *3*	741.6	(3^-)	587.3	(2^-)	
472.7 *2*	587.3	(2^-)	114.6	(2^-)	E_γ: From ^{18}C β^- (1991Pr03).
627 *1*	741.6	(3^-)	114.6	(2^-)	E_γ: From ^{9}Be(^{11}B,2pγ) (2008Wi05).
x1566‡ *1*					
1663.0 *8*	2404.6		741.6	(3^-)	E_γ: From (2020Zi03); see also 1662.3 keV *3* in (2020Zi01).
x1720‡					
x2073.4 *8*					
x2300.9 *8*					

† From (2020Zi03) except where indicated.
‡ Placement of transition in the level scheme is uncertain.
x γ ray not placed in level scheme.

$^{181}Ta(^{18}O,^{18}N\gamma)$ 2020Zi03

Level Scheme



$^{18}_{7}N_{11}$

^{181}Ta(^{22}Ne,^{18}N) 1989Zh04

1989Zh04: A thick Ta target was bombarded by a 35 MeV/nucleon ^{22}Ne beam to produce ^{18}N ions that were selected by the Reaction Products Mass Separator (RPMS) at the NSCL/MSU. The ^{18}N ions were implanted into a telescope comprised of five Si detectors that was situated in the focal plane of the RPMS. An implantation period of 1.2 s was used for collecting activity; this was followed by a 1.3 s counting period. The β-decay products were detected with essentially 100% efficiency. The apparatus was calibrated using β-delayed α-particle emissions groups from ^{11}Be and ^{8}Li nuclei.

Two strong groups are observed in the α-particle spectrum, resulting from decays of the ^{18}O*(7616,8038) states with $J^{\pi}=1^{-}_{3}$ and 1^{-}_{4}, respectively. A broad peak near 3 MeV (E_x=9 MeV, $\Gamma_{\alpha}\approx$500 keV) is also observed but the origin was unclear. (1987Aj02) suggests there may be 6 unresolved α-particle emitting groups in this region. The β-decay branching ratios to ^{18}O*(7616,8038) are found as 6.8% *5* and 1.8% *2* assuming Γ_{α}/Γ=1.0 for these states. The branching ratio ≥(3.6 *2*)% was deduced for the broad structure. A total β-delayed α-decay branching ratio of (12.2 *6*)% is deduced.

^{18}N Levels

E(level)	Comments
0	%$\beta^{-}\alpha$=12.2 *6* (1989Zh04)

^{232}Th(p,^{18}N) 1991Re02

1991Re02: Spallation products from 800 MeV proton bombardment of a ^{232}Th target were captured by a transport line with a mass-to-charge filter and transfered to the TOFI spectrometer at LAMPF. The beam line was separately tuned to transport a number of different nuclides. The ions were implanted in a Si detector, and identification by standard techniques was implemented. The β-delayed neutrons were detected in a polyethylene moderated ^{3}He counter; half-lives and β-delayed neutron probabilities were deduced from analysis of the number of implanted ions (per beam pulse) and the rate of β-delayed neutrons detected in the zero-threshold counter. The β-delayed neutron probability =14.3% *20* was deduced along with $T_{1/2}$=790 ms *210*; an additional proceedings result of P_n=12.0% *13* (U. Koster et al., AIP Conf. Proc. 455 (1998) p. 989) is mentioned in the text.

A reanalysis of the (1991Re02) data, with additional data was published in (1994ReZZ). The reanalysis indicates P_n=(12.0 *13*)% and $T_{1/2}$=658 ms *44*. Other reanalyses of these data are found in (1993ReZX,1994KiZU,1995ReZZ,2008ReZZ).

^{18}N Levels

E(level)	$T_{1/2}$	Comments
0	658 ms *44*	$\%\beta^{-}n$=12.0 *13* (1994ReZZ) $T_{1/2}$: From (1994ReZZ).

^{232}Th(^{18}O,^{18}N),(^{22}Ne,^{18}N) 1969Ar13

1969Ar13: The authors analyzed the transfer reaction products resulting from E(^{18}O)=122 MeV bombardment of a 5 mg/cm^2 metallic ^{232}Th foil at Dubna. The reaction products were momentum analyzed in a magnetic spectrometer and then focused on a ΔE-E Si detector telescope, which provided particle identification. ^{18}N was identified.

1977Ar06: The transfer reaction products resulting from E(^{22}Ne)=172 MeV bombardment of a 2.5 mg/cm^2 metallic ^{232}Th foil were measured at Dubna. The reaction products were momentum analyzed in a magnetic spectrometer positioned at θ=12° and 40° and then focused on a ΔE-E Si detector telescope, which provided particle identification. ^{18}N was identified.

^{18}N Levels

E(level)
0

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