^{18}N β^-n decay 1994Sc01,2005Li60,2007Lo05

History

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

Parent: ^{18}N: E=0; $J^\pi=1^-$; $T_{1/2}$=619 ms *2*; Q(β^-n)=5851 *19*; %β^-n decay=12.0 *13*

^{18}N-$T_{1/2}$: from (2005Li60), see also $T_{1/2}$=624 ms *12* (1982Ol01) and 620 ms *8* (2007Bu01).

^{18}N-Q(β^-n): from (2021Wa16).

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*.

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 (Other unpublished reanalyses are found in 1995ReZZ, 2008ReZZ).

1993ReZX: ^{18}N(β^-n); measured β-delayed neutron average energies. Ring ratio technique.

1994Sc01: A Be target was bombarded by a 75 MeV/A ^{22}Ne beam to produce ^{18}N ions that were selected and stopped in a thin plastic detector. The implantation detector was surrounded by 15 large area neutron detectors that covered 14.3% of 4π, and neutron energies were determined by time-of-flight between the implantation foil and the neutron array.

The lifetime $T_{1/2}$=624 ms *12* was measured. Nine neutron groups with energies (branching ratios) of E_n=0.99 MeV *3* (0.16 *3*)%, 1.16 MeV *2* (0.39 *9*)%, 1.35 MeV *2* (0.47 *9*)%, 1.55 MeV *2* (0.14 *3*)%, 1.77 MeV *2* (0.17 *3*)%, 2.07 MeV *3* (0.16 *3*)%, 2.46 MeV *3* (0.43 *9*)%, 2.78 MeV *3* (0.13 *3*)% and 3.26 MeV *3* (0.19 *4*)% were observed in the ToF spectrum. The total observed branching ratio (Branching) to neutron unbound levels is 2.2% *4*.

2005Li60: A thick Be target was bombarded by a 68.8 MeV/A ^{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 with E_n (branching ratio)=0.58 MeV *2* (5.04 *112*)%, 0.79 MeV *4* (0.28 *6*)%, 0.97 MeV *2* (0.11 *3*)%, 1.16 MeV *3* (0.18 *3*)%, 1.35 MeV *3* (0.24 *4*)%, 1.48 MeV *3* (0.05 *2*)%, 1.72 MeV *3* (0.18 *3*)%, 1.98 MeV *4* (0.11 *3*)%, 2.44 MeV *4* (0.43 *6*)%, 2.70 MeV *4* (0.13 *2*)% and 3.22 MeV *5* (0.23 *3*)%. The total observed Branching is 6.98% *146*. The β-delayed γ-ray emissions were briefly discussed, though there is no mention of any transitions observed in ^{17}O; it is assumed that none are observed.

2007Lo05: A Be target was bombarded by a 68.8 MeV/A ^{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.

Three $T_{1/2}$ values were obtained by gating the β-time spectrum corresponding to various neutron peaks, 625 ms *30*, 635 ms *40* and 609 ms *60*. In this measurement, the emphasis was on fast neutrons. Nine neutron peaks were observed, eight are in good agreement with 2005Li60. Peaks are observed at E_n=1.13 MeV *3*, 1.35 MeV *3*, 1.58 MeV *3*, 1.79 MeV *3*, 2.05 MeV *3*, 2.43 MeV *4*, 2.76 MeV *4*, 3.22 MeV *4* and 3.78 MeV *5* (0.05 *3*)%. A new peak at E_n(lab)=3.78 MeV *5* was identified. The detection efficiency for groups with E_n < 2.0 MeV was low, and therefore the proceedure for fitting of these peaks relied on prior analysis. The total observed β-delayed Branching is 7.03% *146*.

In this experiment, the calibration using ^{17}N provided the neutron detection efficiency up to 1.73 MeV, the authors used the efficiency curve obtained in 2005Li60 (efficiency up to 3.22 MeV) to determine the absolute Branching of this new peak. The Branching of 0.05% *3* corresponding to E_x(^{18}O)=12.05 MeV *5* and log *ft*=5.24 *3* was deduced. This new state was also observed by 1995Se02 in an electron scattering experiment, who found the $J^\pi=1^-$ or 2^+. The present authors concluded $J^\pi=1^-$.

Comments:

P_n=12.0% *13* is reported in the reanalysis of 1991Re02. Results reported in (2005Li60, 2007Lo05) can account for only (7.03 *146*)%; the missing strength of ≈5% is attributed to one or several states in ^{18}O with 8.044 MeV ≤E_x≤8.50 MeV, where the

^{18}N β^-n decay 1994Sc01,2005Li60,2007Lo05 (continued)

corresponding neutron group's emission energy is below the threshold of the neutron detector systems.

No evidence was found for population of a broad state at $E_x \approx 9$ MeV (suggested by 1989Zh04 in β-delayed α-emission); In 1994Sc01 an upper limit for its Branching of ≤1% was deduced from the total number of counts in the relevant energy range. Comparing with 1989Zh04, it can be concluded that most of the observed width corresponds to the Γ_α of this state.

In 1994Sc01, neutron groups with a total Branching of 2.2% *4* were observed; a comparison with those same groups observed in 2005Li60 yields a slightly lower Branching of 1.66% *28*. The analysis of 2005Li60, which finds a total %β^-n intensity of (7.0 *15*)%, may be limited by an insensitivity to low energy neutrons. In addition 2007Lo05 taylored their sensitivity to fast neutron groups, which were difficult to resolve, and a new transition in the β-delayed neutron decay is observed. No neutron peaks between 3.78 and 5.5 MeV were observed.

See also (1993ShZW).

^{17}O Levels

E(level)[†]	J$^\pi$[†]
0.0	5/2$^+$

[†] From Adopted Levels.

Delayed Neutrons (^{17}O)

E(n)[†]	E(^{17}O)	I(n)[†‡]	E(^{18}O)	Comments
580 *20*	0.0	5.0 *11*	8659	I(n)=(5.04 *112*)%.
790 *40*	0.0	0.28 *6*	8882	
970 *20*	0.0	0.11 *3*	9072	
1160 *30*	0.0	0.18 *3*	9274	
1350 *30*	0.0	0.24 *4*	9475	
1480 *30*	0.0	0.05 *2*	9612	
1720 *30*	0.0	0.18 *2*	9867	
1980 *40*	0.0	0.11 *3*	10142	
2440 *40*	0.0	0.43 *6*	10629	
2700 *40*	0.0	0.13 *2*	10904	
3220 *50*	0.0	0.23 *3*	11455	
3780 *50*	0.0	0.05 *3*	12048	E(n),I(n): from (2007Lo05).

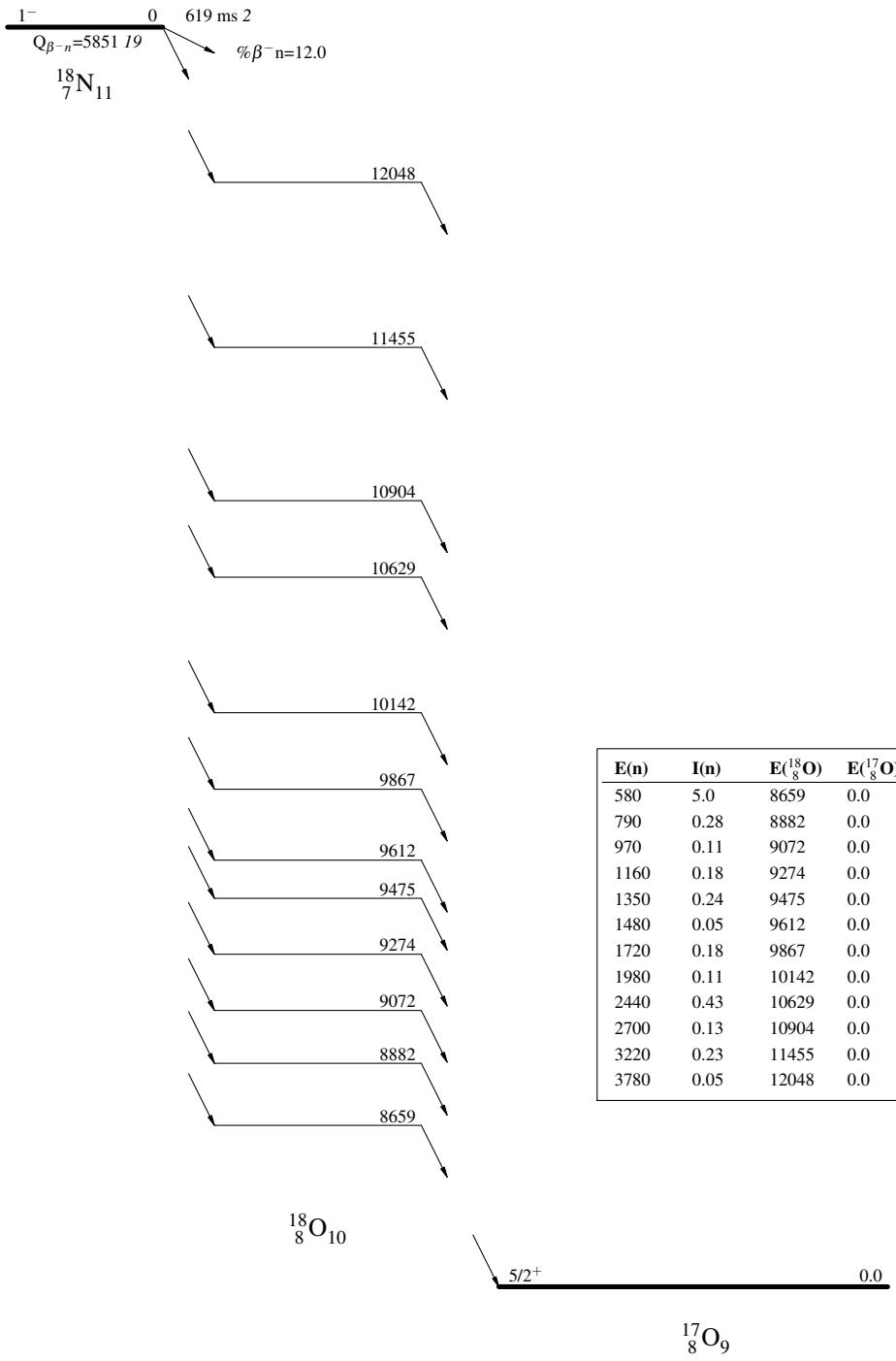
[†] From (2005Li60) except where noted.

[‡] Absolute intensity per 100 decays.

^{18}N β^-n decay 1994Sc01,2005Li60,2007Lo05

Decay Scheme

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



E(n)	I(n)	E($^{18}_{8}$O)	E($^{17}_{8}$O)
580	5.0	8659	0.0
790	0.28	8882	0.0
970	0.11	9072	0.0
1160	0.18	9274	0.0
1350	0.24	9475	0.0
1480	0.05	9612	0.0
1720	0.18	9867	0.0
1980	0.11	10142	0.0
2440	0.43	10629	0.0
2700	0.13	10904	0.0
3220	0.23	11455	0.0
3780	0.05	12048	0.0