^{17}Ne $\beta^+\alpha$ decay 2002Mo19

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

Parent: ^{17}Ne: E=0; $J^\pi=1/2^-$; $T_{1/2}$=109.2 ms *6*; Q($\beta^+\alpha$)=8730.1 *4*; %$\beta^+\alpha$ decay=2.77 *19*

^{17}Ne-$T_{1/2}$: Weighted mean from (1971Ha05,1988Bo39).

^{17}Ne-Q($\beta^+\alpha$): From (2021Wa16).

^{17}Ne-%$\beta^+\alpha$ decay: From (2002Mo19).

1988Bo39: A beam of ^{17}Ne ions was produced at the CERN/ISOLDE facility, using proton spallation reactions on a MgO target. Neon ions from the target were collected, post-accelerated to 60 keV and magnetically separated to obtain the ^{17}Ne beam, which was implanted in a 50 μg/cm^2 carbon foil. An annular plastic scintillator detector was placed on the upstream side of the target (w.r.t. beam) while a series of different ΔE Si surface-barrier detectors (covering ≈0.2% of 4π) were separately placed on the downstream side of the target. The Si detectors had thicknesses of 10, 15, 27 and 1000 μm and were used to characterize the proton and α groups of the delayed particle spectrum. Twenty-eight different groups of β-delayed protons and αs were identified. The lifetime was measured by collecting ^{17}Ne ions for 0.2 s and counting for 1.0 s. The value T=109.3 ms *6* was obtained. See other results on decay to ^{17}F in (1993Bo36,1993RiZY).

1997Ki19,1998Ch05,2002Ch61,2002Mo19: A series of experiments on ^{17}Ne decay were carried out at the TRIUMF/TISOL facility. The aim of the measurements was to exploit the ^{17}Ne(βp) reaction as a means to populate astrophysically important states in ^{16}O. Proton spallation of a MgO target resulted in ^{17}Ne ions that were implanted on a collection tape that was positioned at the center of various counting station configurations.

1998Ch05: A set of four ΔE-E telescopes were used to study the decay ^{17}Ne(β)^{17}F*(11193 keV)→p+^{16}O*(9590) and ^{17}Ne(β)^{17}F*(11193 keV)→α+^{13}N*(2365,3502+3547); a total of 11 decay branches were observed for the decay of ^{17}F*(11193 keV).

2002Ch61: The configuration of (1998Ch05) was improved by implementing double-sided Si strip detectors into parts of the counting station; this lowered the pile-up and random coincidence rates. It is noted that the reported branching ratios show a significant systematic dependence on the detector configuration.

2002Mo19: ^{17}Ne β delayed particle emission was studied using four different experimental techniques: proton-γ coincidences, proton-γ angular correlations, ToF spectra for the proton and α particle spectra, and a ratio cut for a clean α spectrum. Proton-γ coincidences were determined using a beam of ^{17}Ne ions at the TISOL facility at TRIUMF. The beam traveled through a four-sector annular silicon detector and was implanted onto a collection tape directly in front of a plastic scintillator and a HPGe detector that was not in the vacuum system. Counting rates were very high so only γ-ray events with energy above 4 MeV were accepted. A particle-β coincidence spectrum was also recorded by the Silicon detector.

Proton-γ angular correlations were studied using two HPGe γ-ray detectors and four ion-implanted Silicon detctors surrounding a carbon collector foil. Angular correlations between emitted protons and ^{16}O γ rays were measured. Using this method, J^π was determined for states in ^{17}F.

ToF spectra were determined for proton and α particle emissions. A beam of ^{17}Ne ions passed through a carbon collector foil that was positioned at an angle and centered between to scintillation paddles, the beam then passed into a SSB detector. Time and pulse-height information were recorded. A clean α spectrum was not able to be produced because β-proton coincidences at low energies were very strong and obscured the weaker α decay peaks. Therefore, the ratio cut technique was used to obtain a cleaner spectrum.

A thin SSB detector was placed on the opposite side of a collector foil and a PIPS detector. Each detector had a thicker detector behind it in order to reject background events due to electrons and high energy protons. The PIPS detector recorded particle recoil and the SSB detector recorded coincident α particles. Additional background events were removed using the ratio-cut technique.

Using these methods, relative proton and α branching ratios were determined along with branching ratios for the β decay of ^{17}Ne. Using these branching ratios, reduced Gamow-Teller matrix elements were determined. β-delayed proton decay to α-unbound states in ^{16}O was also examined because of its relevance to astrophysics (helium-burning stage of stellar evolution).

The values %βp=95.4 *46* and %$\beta\alpha$=2.77 *19* are deduced from the tables given in (2002Mo19).

^{17}Ne $\beta^+\alpha$ decay 2002Mo19 (continued)

^{13}N Levels

E(level)[†]	J$^\pi$[‡]
0.0	1/2$^-$
2365	1/2$^+$
3502	3/2$^-$
3547	5/2$^+$

[†] From (2002Mo19).
[‡] From Adopted Levels.

γ(^{13}N)

E$_\gamma$[†]	E$_i$(level)	J$_i^\pi$	E$_f$	J$_f^\pi$
1137	3502	3/2$^-$	2365	1/2$^+$
2365	2365	1/2$^+$	0.0	1/2$^-$
3502	3502	3/2$^-$	0.0	1/2$^-$

[†] From level-energy differences.

Delayed Alphas (^{13}N)

E(α)[†]	E(^{13}N)	I(α)[†‡#]	E(^{17}F)	E(α)[†]	E(^{13}N)	I(α)[†‡#]	E(^{17}F)
1397	3547	0.0016 *9*	11193	2301	2365	0.0682 *69*	11193
1432	3502	0.0016 *9*	11193	2776	0.0	0.0570 *58*	9450
1725	0.0	2.09 *18*	8075	3219	0.0	0.0499 *49*	10030
1821	0.0	0.215 *22*	8200	3701	0.0	0.00066 *58*	10660
2001	0.0	0.092 *9*	8436	3892	0.0	0.0115 *16*	10910
2299	0.0	0.178 *17*	8825	4110	0.0	0.0024 *7*	11193

[†] From (2002Mo19).
[‡] The feeding to the particle unbound states is determined by normalizing the %β^+ strength to the relative Iβ^+-p and Iβ^+-α branching ratios using the measured β^+p, β^+pγ, $\beta^+\alpha$, $\beta^+\alpha\gamma$ observations and by assuming I$\beta^+_{g.s.}$<0.55% (1997Mi08) and Iβ^+(495 keV)=1.59% *17* (1993Bo36,1998Oz01: and including a correction for the γ-ray feeding from the 11193 keV isobaric analog state).
[#] Absolute intensity per 100 decays.

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Decay Scheme

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

E(α)	I(α)	E($^{17}_{9}$F)	E($^{13}_{7}$N)
1725	2.09	8075	0.0
1821	0.215	8200	0.0
2001	0.092	8436	0.0
2299	0.178	8825	0.0
2776	0.0570	9450	0.0
3219	0.0499	10030	0.0
3701	0.00066	10660	0.0
3892	0.0115	10910	0.0
4110	0.0024	11193	0.0
2301	0.0682	11193	2365
1432	0.0016	11193	3502
1397	0.0016	11193	3547