^{17}B β^- decay:5.08 ms 2013Ue01

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	J. H. Kelley, G. C. Sheu	ENSDF	01-May-2017

Parent: ^{17}B: E=0; J^π=(3/2$^-$); $T_{1/2}$=5.08 ms *5*; Q(β^-)=2274×10^1 *17*; %β^- decay=100.0

^{17}B-Q(β^-): From 2012Wa38.

^{17}B-J^π,$T_{1/2}$: From ^{17}B Adopted Levels in ENSDF database.

^{17}B-P_{0n}=0.22 *4*, P_{1n}=0.63 *5*, P_{2n}=0.12 *2* P_{3n}=0.035 *7* and P_{4n}=0.004 *3* (1988Du09, 2013Ue01).

1988Du09,1987DuZU,1988DuZT,1989MuZU: ^{17}B was produced by fragmentation of a 60 MeV/n ^{22}Ne beam impinging on either a tantalum or a carbon target and was selected using the LISE spectrometer. The β-particles were detected by a plastic scintillator while the delayed neutrons were detected through the Gd(n,γ) reaction in a 500 liter 4π neutron ball. $T_{1/2}$=5.08 ms *5*, P_{0n}=0.21 *2*, P_{1n}=0.63 *1*, P_{2n}=0.11 *7*, P_{3n}=0.035 *7* and P_{4n}=0.004 *3* were measured. See also (1989Le16).

1991Re02,1995ReZZ,2008ReZZ: 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 transferred to the TOFI spectrometer at LAMPF. The beamline was separately tuned to transport a number of different nuclides. The neutrons were detected in a polyethylene moderate ^3He counter, and standard techniques were implemented. The 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. In (1991Re02) the β-delayed neutron probability P_n(=P_{1n}+2P_{2n}+3P_{3n}+...)=(65 *35*)% and $T_{1/2}$=5.9 ms *30* were deduced. In later publication, such as (P.L. Reeder et al., Int. Conf. on Nucl. Data for Science and Technology, May 9-13, 1994, Gatlinburg, Tennessee), and (1995ReZZ,2008ReZZ) P_n=(104 *26*)% and $T_{1/2}$=5.20 ms *45* were deduced.

1996Ra02: A beam of ^{17}B ions was produced by fragmenting a ^{22}Ne beam on a ^9Be target. The beam was magnetically separated, degraded to lower energies, and finally stopped In a plastic scintillator. The implantation detector was sandwiched between four other scintillator β-ray detectors. A valid ^{17}B 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 measured neutron spectrum shows two prominent decay groups of ^{17}B β delayed neutrons at E_n=2.91 and 1.80 MeV, as well as a strong peak at E_n=0.82 MeV from the ^{16}N daughter decay. A full analysis of the neutron energy spectrum revealed two neutron groups corresponding to known branches In ^{16}N decay and four groups at E_n=0.42, 1.43, 1.80 and 2.91 MeV that are attributed to neutron decay from ^{17}C to $^{16}C_{g.s.}$. In later works, the E_n=1.43 MeV branch is attributed to decay to ^{16}C*(1766) while the E_n=0.42 MeV branch is not found. In 1996Ra02, the results are presented by normalizing to %β^- ^{1}n=(63 *1*)% from (1988Du09).

2013Ue01,1997YaZX: An E(^{22}Ne)=110 MeV/nucleon beam was fragmented in a 1.07 g/cm^2 ^{93}Nb target and the ^{17}B ions at θ_{lab}=1.5°−5.0° were accepted in the RIKEN/RIPS fragment separator. The ^{17}B beam was then implanted at the center of a stack of four 100 μm thick Pt stopper foils which were held in a 50 mT magnetic field. A β-NMR technique was implemented to maximize the sensitivity to spin dependent observables.

Two plastic scintillators were placed in positions above and below the Pt foil stack and were used to detect β-rays from decays in the foil. Coincidences among the two foils were used to reject events, for example, from cosmic-ray events.

Neutron bound and neutron unbound states in ^{17}C could be populated in the decay, and furthermore the neutron-unbound levels can decay with low-energy or high-energy neutron emission. A 12 element plastic scintillator high-energy neutron detector array (E_n≈0.5-10 MeV) covered Ω_n=0.21×4π sr with a 5.6% efficiency for detecting 1 MeV neutrons. The neutron energies were determined by time-of-flight where the β-ray signal provided a start signal and the neutron array provided the stop signal (1.5 m flight path). A 10 element plastic scintillator low-energy neutron detector array (E_n≥0.01 MeV) covered Ω_n=0.037×4π sr with a 0.5 m flight path.

A HPGe clover detector and four NaI(Tl) detectors measured the emitted γ-rays. Plastic scintillator detectors covered the front faces of the detectors and helped reject β-rays entering the γ-ray detectors. The plastic scintillators plus NaI(Tl) detectors were also used to measure the β-ray energy spectrum.

The decay curve of photopeak counts is evaluated and constraints are placed to guide consideration of transitions resulting from levels fed by ^{17}B β-decay or ^{17}B β^-Xn decay. In the case of 0-n decay to neutron bound levels of ^{17}C, the γ-ray transitions with energies below the neutron separation energy, Sn≈730 keV (2012Wa38), were evaluated. Transitions with Eγ=217, 295 and 331 keV were identified as possible decays in ^{17}C. However because feeding to low-lying states of ^{17}C can be connected with emission of high energy β-rays the γ-ray spectra were analyzed with the condition of a coincident Eβ≥10 MeV β-ray; only peaks corresponding to Eγ=217 and 331 keV were found. Analysis of β-γ-γ coincidences yielded no results, so the ^{17}B 0n-β decay is found to decay to ^{17}C*(217, 331) which then γ-decay to the ^{17}C ground state.

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Numerous other time correlated γ-ray transitions (connected with decay of levels fed by β-xn decay) and time uncorrelated γ-transitions (connected with subsequent β-decay of daughters) are characterized.

The E_n=0.82 MeV neutron group is correlated with the neutron emission group from ^{16}N*(3353)→$^{15}N_{g.s.}$ that is populated in 84.4% (1976Al02) of ^{16}C decay events. This branching ratio is used with the presently observed intensity of the E_n=0.82 MeV neutron group to obtain %β^-1n=(67 *7*)% for ^{17}B decay.

The Eγ=5299 keV transition is identified in the γ-ray spectrum and is connected with β^-2n decay to ^{15}C, which then β-decays to ^{15}N. The Eγ=5299 keV γ-ray is populated in 63.2% of ^{15}C decays (1984Wa07); this branching ratio is used with the presently observed %Iγ(5290)=(7.5 *11*)% to deduce %β^-2n=(12 *2*)%.

^{17}C Levels

E(level)	J^π †	Γ	Comments
0	3/2+		
217 *2*	1/2+		
331 *2*	5/2+		
2710 *20*	1/2−	0.04 MeV *1*	E(level),Γ: from E_n=1.86 MeV *1* that populated $^{16}C_{g.s.}$ (2013Ue01). See also E_n=1.80 MeV *2* (1996Ra02).
3930 *20*	3/2−	0.16 MeV *4*	E(level),Γ: from E_n=3.01 MeV *1* that populated $^{16}C_{g.s.}$ (2013Ue01). See also E_n=2.91 MeV *5* (1996Ra02).
4050 *20*	(5/2−)	0.06 MeV *6*	E(level),Γ: from E_n=1.46 MeV *1* that populated ^{16}C*(1766).
4780 *20*		0.3 MeV *3*	E(level),Γ: from E_n=3.81 MeV *1* that populated $^{16}C_{g.s.}$.
6080 *30*		2.5 MeV *7*	E(level),Γ: from E_n=5.04 MeV *2* that populated $^{16}C_{g.s.}$.

† From (2013Ue01) for levels above 1 MeV. Below this energy assignments are from (2008Su12).

β^- radiations

E(decay)	E(level)	Iβ^- †	Log *ft*	Comments
(1.666×10^4 *17*)	6080	4 *1*	5.31 *11*	av Eβ=8069 *86*
(1.796×10^4 *17*)	4780	0.9 *1*	6.12 *6*	av Eβ=8714 *85*
(1.869×10^4 *17*)	4050	1.5 *2*	5.98 *7*	av Eβ=9076 *85* β asymmetry parameter A_β=−4 *15*.
(1.881×10^4 *17*)	3930	20 *3*	4.87 *7*	av Eβ=9135 *85* β asymmetry parameter A_β=+0.04 *99*.
(2.003×10^4 *17*)	2710	33 *4*	4.78 *6*	av Eβ=9740 *85* β asymmetry parameter A_β=−1.0 *5*.
(2.241×10^4 *17*)	331	2.1 *2*	6.22 *5*	av Eβ=10917 *85*
(2.252×10^4 *17*)	217	2.8 *11*	6.1 *2*	av Eβ=10974 *85*
(2.274×10^4 *17*)	0	17 *4*	5.34 *11*	av Eβ=11081 *84* Iβ^-: using the known ^{17}N*(1373, 1849) γ-transition intensities following ^{17}C decay (1993Ti03) permitted normalization of the present 0-n emission results so that %β^-0n=(22 *4*)% was deduced from the weighted average of (%β^-0n: from 1382)=(25 *9*)% and (%β^-0n: from 1855)=(21 *5*)%. Then Iβ(g.s.)=(22 *4*)% − (summed β feeding=(4.9 *11*)% to 217+331 levels)=(17 *4*)%.

† Absolute intensity per 100 decays.

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$\gamma(^{17}C)$

E_γ	I_γ †	E_i(level)	J_i^π	E_f	J_f^π
217 *2*	2.8 *11*	217	$1/2^+$	0	$3/2^+$
331 *2*	2.1 *2*	331	$5/2^+$	0	$3/2^+$

† Absolute intensity per 100 decays.

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Decay Scheme

Intensities: Relative $I_{(\gamma+ce)}$