^{23}Ne β^- decay 1974Al03,1963Ca06,1957Pe12

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	M. S. Basunia[#], A. Chakraborty[##]	NDS 171,1 (2021)	1-Jun-2020

Parent: ^{23}Ne: E=0.0; $J^\pi=5/2^+$; $T_{1/2}$=37.25 s *10*; Q(β^-)=4375.80 *10*; %β^- decay=100

Other references: 1972Ch41, 1968Mo03, 1965La10, 1940Po01.

1974Al03: ^{23}Ne was produced via ^{22}Ne(d,p) reaction, E(d)=3.0 MeV. ~0.4 atm of Ne target in a gas cell was bombarded for 10 sec, gas was expanded through the trap to the cylindrical counting cell, internal dimension of 7.5 cm diameter and 2 cm height. 70 cm^3 Ge(Li) detector, NE102 plastic scintillator. Measured Eγ, Iγ, ^{23}Ne half-life; Deduced beta feeding to excited states from γ-ray intensity balance, log *ft* values.

1963Ca06: ^{23}Ne was produced via ^{23}Na(n,p) reaction by bombarding 100 g of sodium aluminum silicate in the core of the Oak Ridge research reactor. Emanating ^{23}Ne was swept continuously by water vapor to the laboratory; vapor removed and contamination purged ^{23}Ne gas was allowed to decay in a source volume; some of the ions formed following β decay emerged from the volume as a beam, were analyzed by electrostatic and magnetic analyzer in tandem. Measured recoil energy spectrum from 100 to 500 eV; deduce electron-neutrino angular correlation coefficient; assuming *V-A* (Vector-Axial vector) interaction is valid – deduced g.s. and 1st excited state β feeding in ^{23}Na.

1957Pe12: ^{23}Ne was produced via ^{23}Na(d,2p) reaction by bombarding NaCl powdered target, E_d=22 MeV. Active gases were swept by flow of helium to a source chamber of small volume at 100 ft away from the target. Contaminating activities were removed by activated coconut charcoal trap cooled with LN_2. β particles were detected by a stilbene crystal, γ radiation was detected by two NaI(Tl) crystals. Measured Eγ, Iγ, γ-γ coincidence, Eβ spectrum; deduced β feeding to g.s. and excited states.

1972Ch41: Source from ^{22}Ne(d,p), E=2.5 MeV, beam chopper, 99.5% enriched ^{23}Ne gas target cell (dimension not mentioned). 200 cycles of irradiation and counting. 25.5 cm^3 Ge(Li) detector. Measured Eγ, Iγ, deduced log *ft*, decay scheme. Some of the reported γ in 1965La10 were not observed.

1968Mo03: Source from ^{22}Ne(n,γ), E=thermal, in a circulating volume. 10 and 30 cm^3 Ge(Li), NaI(Tl) detectors. Measured Eγ, Iγ, $\gamma\gamma$ coincidence. Deduced decay scheme. Some of the reported γ in 1965La10 were not observed.

1965La10: Source from ^{22}Ne(n,γ), E=thermal, in a large volume cell (dimension not mentioned). NaI(Tl) and anthracene crystal. Measured Eγ, Iγ, $\gamma\gamma$-coin, and Eβ. Proposed level scheme. Nine γ rays were placed from seven excited states. Four of the γ rays and four levels were not confirmed in later studies.

1940Po01: ^{23}Ne produced in ^{22}Ne(d,p), E(d)=2.6 MeV. Measured Eβ and half-life 43 s *3* of ^{23}Ne and β-endpoint energy=4.1 MeV.

Sum of decay energies of this dataset is 4378 keV *42*, as compared to Q(β^-)=4375.80 keV *10* (2017Wa10) for ^{23}Ne β^- decay.

^{23}Na Levels

E(level)[†]	J^π	$T_{1/2}$
0.0	$3/2^+$	stable
440.3 *9*	$5/2^+$	
2076.9 *7*	$7/2^+$	
2981.8 *7*	$3/2^+$	

[†] From a least-squares fit to the γ-ray energies.

β^- radiations

E(decay)	E(level)	Iβ^-[†‡]	Log *ft*	Comments
(1394.0 *7*)	2981.8	0.065 *4*	6.13 *3*	av Eβ=556.81 *32*
(2298.9 *7*)	2076.9	1.10 *6*	5.82 *2*	av Eβ=976.94 *34* E(decay),Iβ^-: Eβ=2.4 × 10^3 *1* (1957Pe12). Iβ=1.00 *15* (1957Pe12).
(3935.5 *9*)	440.3	31.9 *10*	5.38 *2*	av Eβ=1764.82 *45* E(decay),Iβ^-: Eβ=3950 *50* (1957Pe12). Iβ=32 *1* (1963Ca06) and 32 *3* (1957Pe12).
(4375.80 *10*)	0.0	67 *1*	5.27 *1*	av Eβ=1980.02

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^{23}Ne β^- decay 1974Al03,1963Ca06,1957Pe12 (continued)

β^- radiations (continued)

E(decay)	E(level)	Comments
		E(decay): 4383 *8* (1963Ca06) and 4390 *50* (1957Pe12). Iβ^-: 67 *1* (1963Ca06) and 67 *3* (1957Pe12).

† From γ-ray intensity balance.
‡ Absolute intensity per 100 decays.

$\gamma(^{23}Na)$

Iγ normalization: From Σ I(γ+ce) to g.s.=33 *1* (100 − 67 *1* (1963Ca06)), assuming 1% statistical uncertainty for the 440γ.

E$_\gamma$‡	I$_\gamma$#@	E$_i$(level)	J$_i^\pi$	E$_f$	J$_f^\pi$	Mult.‡	δ‡	α†	Comments
440.5 *6*	100	440.3	5/2$^+$	0.0	3/2$^+$	M1+E2	+0.065 *5*	5.45×10^{-5} *8*	%Iγ=32.9 *10* E$_\gamma$: 440 (1974Al03), 440.0 *6* (1968Mo03). I$_\gamma$: 33.0 (1974Al03).
1636.6 *8*	3.03 *12*	2076.9	7/2$^+$	440.3	5/2$^+$	M1+E2	+0.19 *1*	1.12×10^{-4}	%Iγ=1.00 *5* α(K)=4.20×10^{-6} *6*; α(L)=2.51×10^{-7} *4*; α(M)=5.63×10^{-9} *8* α(IPF)=0.0001071 *15* E$_\gamma$: 1636 (1974Al03). I$_\gamma$: 1.00 *4* (1974Al03).
2076.7 *8*	0.306 *18*	2076.9	7/2$^+$	0.0	3/2$^+$	E2(+M3)	−0.14 *14*	3.50×10^{-4} *15*	%Iγ=0.101 *7* α(K)=3.25×10^{-6} *20*; α(L)=1.95×10^{-7} *12*; α(M)=4.4×10^{-9} *3* α(IPF)=0.000346 *15* E$_\gamma$: 2076 (1974Al03). I$_\gamma$: 0.101 *6* (1974Al03).
2541.3 *9*	0.082 *6*	2981.8	3/2$^+$	440.3	5/2$^+$	M1+E2	−0.09 *3*	4.73×10^{-4}	%Iγ=0.0269 *22* α(K)=2.08×10^{-6} *3*; α(L)=1.243×10^{-7} *18*; α(M)=2.79×10^{-9} *4* α(IPF)=0.000470 *7* E$_\gamma$: 2542 (1974Al03). I$_\gamma$: 0.027 *2* (1974Al03).
2981.7 *8*	0.115 *6*	2981.8	3/2$^+$	0.0	3/2$^+$	M1		6.51×10^{-4}	%Iγ=0.0378 *23* α(K)=1.637×10^{-6} *23*; α(L)=9.81×10^{-8} *14*; α(M)=2.20×10^{-9} *3* α(IPF)=0.000650 *9* E$_\gamma$: 2982 (1974Al03). I$_\gamma$: 0.038 *2* (1974Al03).

† Additional information 1.
‡ From Adopted Gammas. γ-ray energy reported in 1974Al03 is listed in comments section.
# 1974Al03 present Iγ relative to Iγ(440)=33 (listed in comments). Evaluators present Iγ relative to Iγ(440)=100. The uncertainties of Iγ (1974Al03) are statistical only. A larger systematic uncertainty can be expected for the cylindrical gas cell (diameter 7.5 cm and height 2 cm) counting geometry. However, the recommend uncertainty of the absolute γ-ray emission

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$\gamma(^{23}Na)$ (continued)

probability is expected to be valid due to the unique feature of the decay scheme as I$\gamma(1+\alpha)(440)$ represents 99.6% of ΣI$\gamma(1+\alpha)$ to the g.s. from excited states and the β branching to the g.s. and 1st excited state dominate the total Iβ, (67+32)=99%, that yields the same uncertainties as %Iβ=67 *3*, 32 *3* (1957Pe12), 67 *1*, 32 *1* (1963Ca06), for the g.s. and 1st excited states, respectively. As a result, the uncertainty of the Iγ(440) can be considered equivalent to ΔIβ(1st excited state at 440).

@ For absolute intensity per 100 decays, multiply by 0.329 *10*.

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Decay Scheme

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