^{32}Na β^-n decay (13.2 ms) 2008Tr04,2007Ma04,1993Kl02

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Jun Chen and Balraj Singh	NDS 184, 29 (2022)	24-Jun-2022

Parent: ^{32}Na: E=0; J^π=(3$^-$,4$^-$); $T_{1/2}$=13.2 ms *4*; Q(β^-n)=13690 *40*; %β^-n decay=24 *7*

^{32}Na-J^π,$T_{1/2}$: From Adopted Levels of ^{32}Na in the ENSDF database (2011Ou01) (Aug 2011 update). No new measurements since the 2011 update. 2008Tr04 assign (3$^-$) based on comparison of experimental and calculated Gamow-Teller strengths but in the opinion of the evaluators there is a serious energy mismatch. $T_{1/2}$ from this dataset: 13.1 ms *5* (2008Tr04, implant-decay time correlation).

^{32}Na-Q(β^-n): From 2021Wa16.

^{32}Na-%β^-n decay: %β^-n=23.9 *68* (recommended by 1984Gu19 from weighted average of their value and in their previous work 1984La03). Other: value of 10% *4* (1980De26) is superseded by the 1984Gu19. The same authors measured delayed two-neutron probability as 8.3% *21* (1984Gu19), 5.1% *18* (1980De26). Total delayed neutron emission probability is reported as 39% *6* (1984La03), 20% *8* (1979De02).

2008Tr04: ^{32}Na parent was produced in reaction ^{9}Be(^{48}Ca,X) with 140 MeV/nucleon beam provided by the cyclotron at NSCL and separated by the A1900 spectrometer. Selected ions were implanted in double-sided silicon strip detector as part of Beta counting system. γ-rays were detected with the SeGA array of segmented Ge detectors. Measured Eγ, Iγ, time-of-flight, $\beta\gamma$-coin, γ(t). Deduced levels, parent $T_{1/2}$, γ-ray branching ratios.

2007Ma04: ^{32}Na source was produced by bombarding a 22.4 g/cm^2 tantalum Ta target with a 500 MeV proton beam from ISAC at TRIUMF, and delivered to the 8π experimental station. β particles were detected with the SCEPTAR array and γ rays were detected with a HPGe detector. Measured Eγ, Iγ, $\beta\gamma$-coin, $\gamma\gamma$-coin, $\beta\gamma\gamma$-coin. Deduced levels.

1993Kl02: Na isotopes were produced by bombarding an Uranium Carbide target with 600 MeV protons from the CERN synchrocyclotron and separated by the ISOLDE2 separator. β particles were detected with a thin plastic scintillator, neutrons were detected with an efficient detector, and γ rays were detected with two Ge detectors. Measured Eγ, Iγ, $\beta\gamma$-coin, $\beta\gamma\gamma$-coin, $\beta\gamma$-n-coin. Deduced levels.

1984Gu19: Na isotopes were produced by bombarding a 30 g/cm^2 Ir target with 10 GeV proton beam from the CERN synchrotron. Fragments were separated and collected into a thin stainless steel tube. γ rays were detected with two Ge(Li) detectors and β particles were detected with two plastic scintillators. Measured Eγ, Iγ, $\beta\gamma$-coin, $\beta\gamma\gamma$-coin. Deduced levels, γ-ray branching ratios, β-delayed neutron-emission probabilities. Other measurements from the same group: 1984La03, 1980De26, 1979De02.

2005Ma96: Na isotopes were produced by bombarding a UC_x target with 1.4 GeV protons at CERN. β particles were detected with a thin plastic scintillator and γ rays were detected with two fast-response BaF_2 detectors and two large-volume Ge detectors. Measured $\beta\gamma\gamma$(t). Deduced preliminary $T_{1/2}$.

^{31}Mg Levels

E(level)†	J^π‡	$T_{1/2}$‡	Comments
0.0	1/2$^+$	270 ms *2*	$T_{1/2}$: 230 ms *20* from (1984La03) using β-coincident neutron counting 4π liquid scintillator neutron detector.
50.0 *4*	3/2$^+$	12.0 ns *4*	
221.0 *4*	(3/2)$^-$	133 ps *8*	
461.0 *7*	(7/2$^-$)	10.5 ns *8*	$T_{1/2}$: adopted value is preliminary value from $\beta\gamma\gamma$(t) (2005Ma96).
944.3 *7*	5/2$^+$		
1154.5 *8*	(7/2$^+$)		J^π: 2005Ma96 proposed 11/2$^-$ based on another calculation.
1390.0 *12*			

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

‡ From Adopted Levels. Values from this dataset are given under comments where available.

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$\gamma(^{31}Mg)$

Iγ normalization: using 58 *3* (2008Tr04) for absolute intensity of 885 γ in ^{32}Mg and %β^-n=23.9 *68* (1984Gu19). %I(885γ)=59 *8* from 1993Kl02, 60 *9* from 1984Gu19, and 64 from 2007Ma04 are consistent.

E_γ	I_γ[‡]	E_i(level)	J_i^π	E_f	J_f^π	Mult.	α[†]	Comments
50.0 *5*	17 *1*	50.0	$3/2^+$	0.0	$1/2^+$	[M1]	0.0132 *4*	%Iγ=9.9 *29* α(K)=0.0123 *4*; α(L)=0.000807 *24*; α(M)=2.94×10^{-5} *9* E_γ,I_γ: from 2008Tr04 only.
171.0 *5*	13.6 *30*	221.0	$(3/2)^-$	50.0	$3/2^+$	[E1]	1.04×10^{-3} *2*	%Iγ=7.9 *29* α(K)=0.000975 *16*; α(L)=6.26×10^{-5} *11*; α(M)=2.31×10^{-6} *4* E_γ: weighted average of 170.8 *5* (2007Ma04), 171.2 *8* (1984Gu19), 171.0 *5* (2008Tr04). Other: 171 (1993Kl02). I_γ: unweighted average of 9.6 *6* (2007Ma04), 21.9 *35* (1993Kl02), 9.0 *25* (1984Gu19), 14 *1* (2008Tr04).
221.0 *5*	6.6 *14*	221.0	$(3/2)^-$	0.0	$1/2^+$	[E1]	0.000465 *7*	%Iγ=3.9 *14* α=0.000465 *7*; α(K)=0.000436 *7*; α(L)=2.80×10^{-5} *4*; α(M)=1.032×10^{-6} *16* E_γ: weighted average of 220.8 *5* (2007Ma04), 221.7 *9* (1984Gu19), 221.0 *5* (2008Tr04). Other: 221 (1993Kl02). I_γ: unweighted average of 3.9 *4* (2007Ma04), 8.9 *18* (1993Kl02), 4.4 *14* (1984Gu19), 9 *1* (2008Tr04).
240.0 *5*	16 *4*	461.0	$(7/2^-)$	221.0	$(3/2)^-$	[E2]	0.00231 *4*	%Iγ=9.3 *36* α(K)=0.002165 *35*; α(L)=0.0001393 *23*; α(M)=5.12×10^{-6} *8* E_γ: weighted average of 239.9 *5* (2007Ma04), 240.0 *5* (2008Tr04). Other: 240 (1993Kl02). I_γ: unweighted average of 9.5 *6* (2007Ma04), 9.7 *11* (1993Kl02), 27.6 *32* (1984Gu19), 16 *1* (2008Tr04).
693.5 *5*	<7.1	1154.5	$(7/2^+)$	461.0	$(7/2^-)$			%Iγ<4.1 E_γ: from 2007Ma04. Other: 694.4 *12* (1984Gu19), 696.0 *1* (2008Tr04). This γ is a doublet with the 693.5γ from 3552 level in ^{32}Mg. I_γ: from 6.4 *7*, weighted average of 6.9 *6* (2007Ma04), 3.8 *16* (1984Gu19), 6 *1* (2008Tr04), for a doublet of this γ and the 693.5γ from 3552 level in ^{32}Mg.
894.3 *5*	4.5 *4*	944.3	$5/2^+$	50.0	$3/2^+$			%Iγ=2.6 *8* E_γ: unweighted average of 894.1 *5* (2007Ma04), 894.7 *12* (1984Gu19), 895.0 *10* (2008Tr04). Other: 895 *1* (1993Kl02). I_γ: weighted average of 4.1 *5* (2007Ma04), 5.1 *26* (1993Kl02), 4.3 *10* (1984Gu19), 6 *1* (2008Tr04).
929	4.0 *19*	1390.0		461.0	$(7/2^-)$			%Iγ=2.3 *13* E_γ,I_γ: from 1993Kl02 only.

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$\gamma(^{31}Mg)$ (continued)

† Additional information 1.
‡ For absolute intensity per 100 decays, multiply by 0.58 *17*.

Delayed Neutrons (^{31}Mg)

E(^{31}Mg)	I(n)†‡	Comments
50.0	<1.4	
221.0	<5.5	I(n): other: 12.8 *30* (1993Kl02).
461.0	5.0 *42*	I(n): other: 3.5 *16* (1993Kl02).
944.3	2.6 *8*	I(n): other: 3.1 *16* (1993Kl02).
1154.5	<4.1	
1390.0	2.3 *13*	I(n): other: 2.4 *12* (1993Kl02).

† Deduced from γ-ray intensities by evaluators. Values deduced by 1993Kl02 from their measured γ-ray intensities are given under comments.
‡ Absolute intensity per 100 decays.

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Decay Scheme

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