Adopted Levels, Gammas

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	Jun Chen	NDS 201,1 (2025)	31-Oct-2024

Q(β^-)=10270 *8*; S(n)=5778 *4*; S(p)=20364 *14*; Q(α)=−1.455×10^4 *13* 2021Wa16
S(2n)=8090 *4*, S(2p)=38690 *250*, Q(β^-n)=6050 *4* (2021Wa16).
This nuclide is central and of prime relevance in the 'island of inversion' at or near N=20 semi-closed shell.
Mass measurements: 2013Ch49, 2006Ga04 (also 2006Lu09), 2001Lu20, 1991Zh24, 1991Or01, 1987Gi05, 1986Vi09, 1983De04.
Other measurements:
1979Sy01: first identification of ^{32}Mg in ^{12}C(^{40}Ar,X) reaction at 205 MeV/nucleon, deduced evidence for particle stability.
1983De04, 1984Gu19: identification and mass excess measurement in Ir(p,X) E=10 GeV.
1984La03: first study of decay characteristics and half-life measurement.
2004Gr08: ^{32}Mg formed in fragmentation of ^{36}S beam with ^{9}Be target at GANIL facility using LISE3 spectrometer. Measured isotopic half-life and delayed-neutron probability.
2011Ka01: E=900 MeV/nucleon secondary ^{32}Mg beam from Be(^{48}Ca,X) reaction. Target=CH_2. Fragment separator at GSI facility. Measured interaction cross sections by detecting unreacted Mg particles by Bρ-ΔE-tof method. Deduced matter radius by Glauber model analysis. Comparison with HF and RMF predictions. Interaction σ=1331 mb *24* for Carbon and 523 mb *47* for Hydrogen.
RMS radii: 1998Su07 (also 1997Su04), 2006Kh08, 2011Ka01.
Yield and cross sections: 2001Pe14, 1997Ta22.
Structure calculations:
2021In02,2021Ku13,2021Ta32,2016Su20: calculated deformation parameter.
2020Mi15: calculated levels, S(2n), B(E2).
2020Ts03,2019Sa23,2018Va09,2017De15,2016Ma10,2016Po03,2015Me06: calculated level, J, π, B(E2).
2016Ma73: calculated the first three 0$^+$ levels.
Additional information 1.

^{32}Mg Levels

Cross Reference (XREF) Flags

A	^{32}Na β^- decay (13.2 ms)	F	^{4}He(^{32}Mg,^{32}Mg′γ)	K	^{12}C(^{32}Mg,^{32}Mg′γ)
B	^{33}Na β^-n decay (8.0 ms)	G	^{9}Be(^{33}Mg,xγ)	L	^{12}C(^{33}Mg,^{32}Mgγ)
C	^{34}Na β^-2n decay (5.5 ms)	H	^{9}Be(^{34}Si,xγ)	M	^{28}Si(^{32}Mg,^{32}Mg′γ)
D	^{1}H(^{32}Mg,^{32}Mg′γ)	I	^{9}Be(^{36}S,Xγ),(^{48}Ca,Xγ)	N	Coulomb excitation
E	^{3}H(^{30}Mg,pγ)	J	^{9}Be(^{46}Ar,xγ)		

E(level)†	J$^\pi$	T$_{1/2}$#	XREF	Comments
0.0	0$^+$	80.4 ms *4*	ABCDEFGHIJKLMN	%β^-=100; %β^-n=5.5 *5* (2004Gr08) %β^-n: other: 2.4 *5* (1984La03). T$_{1/2}$: from implant-β(t) in 2017Ha23. Others: 86 ms *5* (2004Gr08), 120 ms *20* (1984La03) and 85 ms *13* (1995ReZZ). <r^2>$^{1/2}$=3.1863 fm *10* (stat) *161* (syst) (2012Yo01), 3.14 fm *7* (1998Su07). δ<r^2>(^{26}Mg,^{32}Mg)=+0.948 fm^2 *6* (stat) *101* (syst) (2012Yo01). rms matter radius=3.17 fm *11* (2011Ka01). Mean square reduced strong absorption radius=1.196 fm^2 *11* (2006Kh08) in Si(^{32}Mg,X) reaction at E=49.04 and 42.81 MeV/nucleon, also measured energy-integrated cross sections. Ground state configuration compared with that of ^{30}Ne in ^{9}Be(^{32}Mg,^{30}Ne) experiment (2010Fa04), where 4p4h component in ^{30}Ne g.s. is found to be higher than in ^{32}Mg g.s.
885.30 *10*	2$^+$	13.1 ps *10*	ABCDEFGHIJK MN	B(E2)↑=0.0440 *51* XREF: M(860) B(E2)↑: from Coulomb excitation.

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Adopted Levels, Gammas (continued)

^{32}Mg Levels (continued)

E(level)[†]	Jπ	$T_{1/2}$[#]	XREF	Comments
				Jπ: L(p,p′)=2 (inverse kinematics); Coulomb excitation from 0^+. Also systematics of even-A Mg isotopes. $T_{1/2}$: others: 16 ps *4* from $\beta\gamma\gamma$(t) in ^{32}Na β^- decay (2005Ma96,2005Ma81, preliminary result); 11.8 ps *+16–13* from B(E2)↑=0.0440 *51*;
1050 *5*	0^+	17 ns *10*	E H	Jπ: L(t,p)=0 in ^{3}H(^{30}Mg,p). $T_{1/2}$: from 10 ns<τ<38 ns given in 2019El09 in ^{9}Be(^{34}Si,Xγ). The lower limit of τ is taken from 2010Wi11, which is estimated from GEANT4 simulations. 2019El09 also deduce a lower limit of 8 ns from distribution of decay positions and 1.5 ns from the correlation between partial cross-section and lifetime for this 0^+ state, which also gives the upper limit τ<38 ns, based on 0.03 mb<σ(0^+)<0.10 mb with the upper limit of σ from 2003Ba52.
2288.3 *20*	$(0^+,2^+)$[‡]		GH	
2321.82 *30*	4^+	0.62 ps *15*	AB D FGHIJ MN	Jπ: L(p,p′)=4 (inverse kinematics).
2551.23 *28*	$(1^-,2^+)$[‡]		AB D GH J L	Jπ: also 2550.8γ to 0^+, giving $(1,2^+)$.
2846.4 *30*	$(0^+,2^+)$[‡]		GH	
2858.9 *4*	$(1^-,3^-)$		AB D GH J	Jπ: L(p,p′)=(1,3) (inverse kinematics).
3037.76 *14*	(2^-)[‡]		AB GH L	Jπ: also 2152.4γ to 2^+; possible allowed β feeding from (3^-).
3123.4 *30*	$(3^-,4^+)$		D GH J	Jπ: L(p,p′)=(3,4) (inverse kinematics).
3480 *4*	(2^+)		D GH L	Jπ: L(p,p′)=(1,2) (inverse kinematics); (2^+) from momentum distributions in ^{9}Be(^{33}Mg,Xγ).
3553.0 *5*	$(3^-,4^-)$		A D GH	Jπ: from shell-model predictions in 2008Tr04 in ^{32}Na β^- decay.
3678 *4*	$(2^+,4^+)$[‡]		GH	
3945.9 *30*			GH	
4094.9 *30*	(6^+)[‡]		GH J	
4154 *5*	(4^+)[‡]		GH	
4217 *13*	$(3^-,4^+)$		D	Jπ: L(p,p′)=(3,4) (inverse kinematics).
4707 *4*	(4^+)[‡]		GH	
4784.7 *7*			A L	
4820.0 *4*	$(2^-,3^-)$		A GH L	Jπ: 3934.5 γ to 2^+; possible allowed β feeding from (3^-). Also from shell-model predictions in 2008Tr04 in ^{32}Na β^- decay.
4919 *4*	$(2^+,4^+)$		GH	Jπ: $(0^+,2^+,4^+)$ from ^{9}Be(^{33}Mg,Xγ) based on measured momentum distributions; 1796γ to $(3^-,4^+)$ disfavors 0^+.
5168 *23*	$(2^+,3^-)$		D	Jπ: L(p,p′)=(2,3) (inverse kinematics).
5205 *16*	$(2^+,3^-)$		D	Jπ: L(p,p′)=(2,3) (inverse kinematics).
5233 *4*	(4^+)[‡]		GH	

[†] From a least-squares fit to γ-ray energies.
[‡] Proposed by 2022Ki08 in ^{9}Be(^{33}Mg,Xγ), based on measured momentum distributions.
[#] From RDDS in ^{9}Be(^{34}Si,Xγ) (2021El06), unless otherwise noted.

γ(^{32}Mg)

E_i(level)	J_i^π	E_γ[‡]	I_γ[‡]	E_f	J_f^π	Mult.	α[†]	Comments
885.30	2^+	885.3 *1*	100	0.0	0^+	[E2]	2.82×10^{-5} *4*	α(K)=2.64×10^{-5} *4*; α(L)=1.697×10^{-6} *24*; α(M)=6.28×10^{-8} *9* B(E2)(W.u.)=15 *3* E_γ: weighted average of 885.0 *5* from ^{32}Na β^- decay, 885.3

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Adopted Levels, Gammas (continued)

$\gamma(^{32}Mg)$ (continued)

E_i(level)	J_i^π	E_γ[‡]	I_γ[‡]	E_f	J_f^π	Mult.	α[†]	Comments
								1 from ^{33}Na β^-n decay, 887 *7* from (^{32}Mg,^{32}Mg′γ), 885 *15* from (^{36}S,Xγ), 886 *4* from (^{46}Ar,Xγ), and 885 *9* Coulomb excitation. Other: 860 *50* from (^{32}Mg,^{32}Mg′γ); 883.9 *3* from (^{32}Mg,^{32}Mg′γ) is discrepant.
1050	0^+	165 *5*	100	885.30	2^+	[E2]	0.0102 *14*	α(K)=0.0096 *13*; α(L)=0.00062 *8*; α(M)=2.26×10^{-5} *30* E_γ,I_γ: from ^{9}Be(^{33}Si,Xγ). Other: 172 from ^{3}H(^{30}Mg,pγ).
2288.3	$(0^+,2^+)$	1403[#] *2*	100	885.30	2^+			
2321.82	4^+	1436.7 *3*	100	885.30	2^+	[E2]	7.52×10^{-5} *11*	α(K)=8.38×10^{-6} *12*; α(L)=5.38×10^{-7} *8*; α(M)=1.994×10^{-8} *28* α(IPF)=6.63×10^{-5} *9* E_γ: weighted average of 1436.1 *5* from ^{32}Na β^- decay, 1437.0 *3* from ^{33}Na β^-n decay, 1433 *9* from (^{32}Mg,^{32}Mg′γ), 1434.9 *13* from (^{32}Mg,^{32}Mg′γ), 1437 *2* from (^{33}Mg,Xγ), and 1438 *4* from (^{46}Ar,Xγ). Others: 1430 *15* from (^{36}S,Xγ), 1460 *50* from (^{32}Mg,^{32}Mg′γ), and 1438 *12* from Coulomb excitation.
2551.23	$(1^-,2^+)$	1665.6 *5*	38 *4*	885.30	2^+			E_γ: other: 1666 *3* from (^{33}Mg,Xγ). I_γ: weighted average of 38 *6* from ^{32}Na β^- decay and 38 *4* from (^{33}Mg,Xγ). Other: 105 *12* from (^{34}Si,Xγ) is discrepant.
		2550.8 *5*	100 *7*	0.0	0^+			E_γ: weighted average of 2550.7 *5* from ^{32}Na β^- decay and 2551 *1* from ^{33}Na β^-n decay. Others: 2551 *4* from (^{33}Mg,Xγ). I_γ: from (^{33}Mg,Xγ). Others: 100 *9* from ^{32}Na β^- decay, 100 *12* from (^{34}Si,Xγ).
2846.4	$(0^+,2^+)$	1961[#] *3*	100	885.30	2^+			
2858.9	$(1^-,3^-)$	1972.9 *5*	100	885.30	2^+			E_γ: other: 1973 *3* from (^{33}Mg,Xγ).
3037.76	(2^-)	486.1 *5*	2.8 *6*	2551.23	$(1^-,2^+)$			
		2152.4 *1*	100 *4*	885.30	2^+			E_γ: from ^{33}Na β^-n decay. Others: 2151.7 *5* from ^{32}Na β^- decay, 2152 *3* from (^{33}Mg,Xγ).
3123.4	$(3^-,4^+)$	2238[#] *3*	100	885.30	2^+			E_γ: other: 2230 *14* from (^{32}Mg,^{32}Mg′γ).
3480	(2^+)	2595[#] *4*	100	885.30	2^+			E_γ: other: 2603 *16* from (^{32}Mg,^{32}Mg′γ).
3553.0	$(3^-,4^-)$	693.5 *5*		2858.9	$(1^-,3^-)$			I_γ: due to contamination, intensity is not established.

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Adopted Levels, Gammas (continued)

γ(^{32}Mg) (continued)

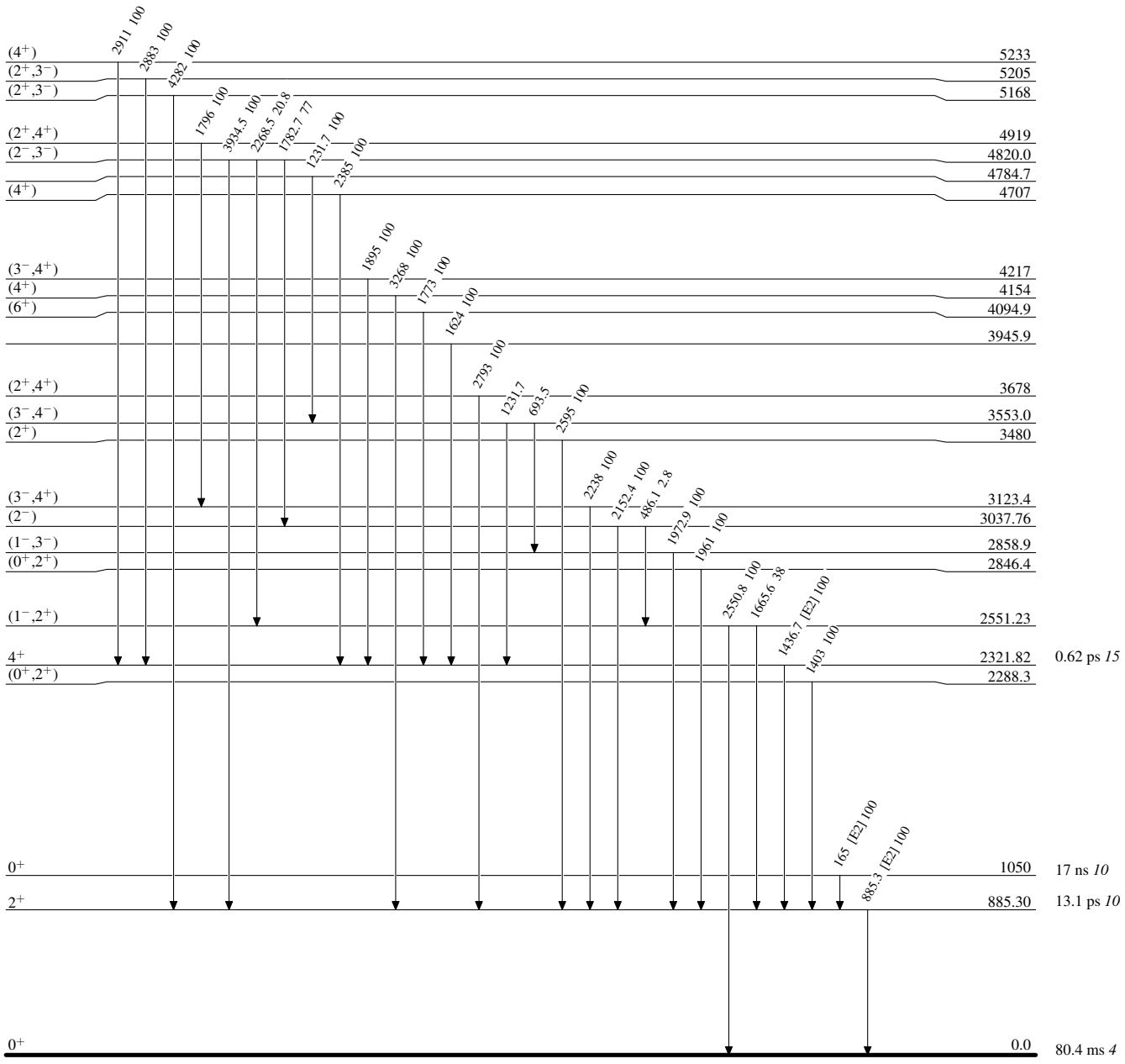
E_i(level)	J_i^π	E_γ[‡]	I_γ[‡]	E_f	J_f^π	Comments
3553.0	(3$^-$,4$^-$)	1231.7[@] *5*		2321.82	4$^+$	E_γ: others: 1233 *2* from (^{33}Mg,Xγ), 1232 *11* from (^{32}Mg,^{32}Mg′γ).
3678	(2$^+$,4$^+$)	2793[#] *4*	100	885.30	2$^+$	
3945.9		1624[#] *3*	100	2321.82	4$^+$	
4094.9	(6$^+$)	1773[#] *3*	100	2321.82	4$^+$	E_γ: other: 1773 *4* from (^{46}Ar,Xγ).
4154	(4$^+$)	3268[#] *5*	100	885.30	2$^+$	
4217	(3$^-$,4$^+$)	1895 *13*	100	2321.82	4$^+$	E_γ: from (^{32}Mg,^{32}Mg′γ) only.
4707	(4$^+$)	2385[#] *4*	100	2321.82	4$^+$	
4784.7		1231.7[@] *5*	100	3553.0	(3$^-$,4$^-$)	
4820.0	(2$^-$,3$^-$)	1782.7 *9*	77 *17*	3037.76	(2$^-$)	
		2268.5 *5*	20.8 *25*	2551.23	(1$^-$,2$^+$)	
		3934.5 *5*	100 *7*	885.30	2$^+$	E_γ: Other: 3934 *8* from (^{33}Mg,Xγ).
4919	(2$^+$,4$^+$)	1796[#] *3*	100	3123.4	(3$^-$,4$^+$)	
5168	(2$^+$,3$^-$)	4282 *23*	100	885.30	2$^+$	E_γ: from (^{32}Mg,^{32}Mg′γ) only.
5205	(2$^+$,3$^-$)	2883 *16*	100	2321.82	4$^+$	E_γ: from (^{32}Mg,^{32}Mg′γ) only.
5233	(4$^+$)	2911 *4*	100	2321.82	4$^+$	E_γ: from (^{34}Si,Xγ).

† Additional information 2.
‡ From ^{32}Na β^- decay, unless otherwise noted.
# From ^{9}Be(^{33}Mg,Xγ) (2022Ki08).
@ Multiply placed.

Adopted Levels, Gammas

Level Scheme

Intensities: Relative photon branching from each level



$^{32}_{12}Mg_{20}$