^{40}Ca(γ,γ') 2002Ha13,1982Mo05

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	Jun Chen	NDS 140, 1 (2017)	30-Sep-2015

2002Ha13 (also 2001Ba66,2000Ha34,2000Zi04): E=9.9 MeV bremsstrahlung source was produced from the superconducting linear electron accelerator S-DALINAC at Darmstadt University of Technology. Target was 4358 mg ^{nat}CaO. γ rays were detected with two HPGe detectors surrounded by a BGO scintillation detector. Measured Eγ, Iγ, $\gamma\gamma(\theta)$, strengths. Deduced levels, J, widths.

1982Mo05 (also 1977SaYN): E=8.5, 11.3, 11.7 MeV bremsstrahlung sources were produced from the MUSL-2 accelerator of the University of Illinois. Target was 3.0 g/cm^2 metallic Ca plate (96.97% in ^{40}Ca). γ rays were detected with Ge(Li) detectors. Measured Eγ, Iγ, $\gamma\gamma(\theta)$, strengths. Deduced levels, J, widths.

Others:

1987Gu01: E=9603.9, 9864.6, 9868.8, 10321.0 keV from ^{39}K(p,γ) resonances. Measured σ, Eγ. Deduced widths for four levels.

1977La15: E=6.95 MeV from ^{19}F(p,$\alpha\gamma$); measured σ, $\gamma(\theta)$ for two levels at 6914 and 6954.

1968Me06: E=6.91, 6.95 MeV from ^{19}F(p,$\alpha\gamma$); measured σ, deduced spin and widths for 6910, 6950 levels.

1962Ra07: ^{39}K(p,γ) resonances as source to measure.

Absorption lineshapes for 9866, 9869 doublet.

1961Ec03: E=10.3 MeV from ^{39}K(p,γ) resonances as source. Deduced widths for 10.3 MeV level.

1961De22: E=35 MeV bremsstrahlung source; measured $\sigma(\theta)$ for Eγ=17-23 MeV; deduced parameters for giant-dipole resonance.

1999Pr01: E=58, 74 MeV. Measured $\sigma(\theta)$. Deduced electromagnetic polarizability.

^{40}Ca Levels

E(level)[†]	J$^\pi$[‡]	$T_{1/2}$ or Γ[&]	Γ_0[@]	Comments
0	0^+			
3904.0 *1*	2^+	29 fs *+10−6*	0.016 *4*	
5249.6 *3*	2^+[#]	79 fs *+11−9*	0.0046 *5*	$T_{1/2}$ or Γ: using adopted branching Γ_0/Γ=0.796 *10*.
5628.9 *2*	2^+[#]	38 fs *+20−10*	0.0105 *35*	Γ_0: unweighted average of 0.0140 eV *13* (2002Ha13) and 0.007 eV *3* (1982Mo05). $T_{1/2}$ or Γ: using adopted branching Γ_0/Γ=0.877 *8*.
5902.5 *2*	1^-	15.2 fs *+23−18*	0.030 *4*	Γ_0: weighted average of 0.033 eV *4* (2002Ha13) and 0.025 eV *5* (1982Mo05).
6421.2 *9*	2^+[#]	12 fs *+5−3*	0.039 *12*	J$^\pi$: 2^+ from 1982Mo05, but measured intensity ratio in 2002Ha13 is consistent with J=1. Γ_0: unweighted average of 0.027 eV *7* (2002Ha13) and 0.050 eV *6* (1982Mo05).
6908.2 *1*	2^+	2.41 fs *+29−23*	0.189 *20*	Γ_0: weighted average of 0.221 eV *36* (2002Ha13), 0.190 eV *20* (1982Mo05), 0.13 eV *6* (1977La15), 0.18 eV *3* (1968Me06).
6949.9 *7*	1^-	1.01 fs *5*	0.452 *20*	Γ_0: weighted average of 0.49 eV *7* (2002Ha13), 0.450 eV *20* (1982Mo05), 0.41 eV *8* (1977La15), 0.47 eV *6* (1968Me06).
7871.9 *1*	2^+	2.44 fs *+24−20*	0.187 *17*	$T_{1/2}$ or Γ: using adopted branching Γ_0/Γ=1. 1982Mo05 report Γ_0/Γ=0.84 *6* without indicating the observation of other γ branches other than the ground transition and no such observation is from other studies. So this γ branching value is not considered in Adopted Gammas. Γ_0: weighted average of 0.176 eV *32* (2002Ha13) and 0.190 eV *17* (1982Mo05).
8091.5 *2*	2^+	2.94 fs *+20−18*	0.155 *10*	Γ_0: weighted average of 0.166 eV *16* (2002Ha13) and 0.150 eV *10* (1982Mo05).
8110.9 *6*	1^-	30 fs *+20−9*	0.015 *6*	Γ_0: weighted average of 0.025 eV *9* (2002Ha13) and 0.012 eV *5* (1982Mo05).
8578.7 *2*	2^+	3.6 fs *+13−8*	0.128 *34*	Γ_0: unweighted average of 0.161 eV *13* (2002Ha13) and 0.094 eV *12* (1982Mo05).
8749.4 *2*	2^+	5.8 fs *+11−8*	0.078 *12*	Γ_0: weighted average of 0.088 eV *11* (2002Ha13) and 0.065 eV *12* (1982Mo05).
8982.5 *5*	2^+	4.5 fs *+39−14*	0.101 *47*	Γ_0: weighted average of 0.148 eV *15* (2002Ha13) and 0.054 eV *10* (1982Mo05).

Continued on next page (footnotes at end of table)

^{40}Ca(γ,γ′) 2002Ha13,1982Mo05 (continued)

^{40}Ca Levels (continued)

E(level)[†]	Jπ[‡]	T1/2 or Γ[&]	Γ0[@]	Comments
9603.9		0.19 keV *5*	4.9 *18*	E(level),T1/2 or Γ,Γ0: from 1987Gu01.
9866.0 *20*		0.104 keV *24*	1.36 *25*	E(level): from 1982Mo05. Other: 9864.6 (1987Gu01). T1/2 or Γ: weighted average of 0.100 keV *24* (1987Gu01) and 0.110 keV *30* (1962Ra07). Most of the Γ is ascribed to proton decay (1962Ra07). Γ0: from 1962Ra07. Γ_0^2/Γ=44 meV *18* from (1982Mo05).
9868.9		0.90 keV *21*	0.80 *26*	E(level): from 1987Gu01. T1/2 or Γ: weighted average of 0.90 keV *21* (1987Gu01) and 1.06 keV *20* (1962Ra07). Most of the width is ascribed to proton decay (1962Ra07). Γ0: from 1962Ra07.
10318.0 *20*	1+	26 eV *7*	5.5 *8*	E(level),Jπ: from 1982Mo05. Other: 10321.0 (1987Gu01). $J^\pi=1^+$ in Adopted Levels. $J^\pi=2^+$ from 1961Ec03. Γ0: from 1982Mo05. Others: 6.6 eV *8* (1987Gu01), 3.60 eV *24* (1961Ec03). Γ from 1982Mo05. Others: 91 eV *15* (1987Gu01), 10.3 eV *17* (1961Ec03). Γ_γ=6.4 eV *9* (1982Mo05), 4.5 eV *6* (1961Ec03). Γ_p=20 eV *5* (1982Mo05), 5.8 eV *18* (1961Ec03). Γ_0/Γ=0.21 *2* (1982Mo05).
20×10^3				E(level): giant-dipole resonance (1961De22). Γ_γ/Γ=0.0053, 0.0058 (1961De22).

[†] From 2002Ha13, unless otherwise stated. Values available from 1982Mo05 are in general agreement with those from 2002Ha13.
[‡] Spins are from 2002Ha13 and 1982Mo05 based on measured ratios of intensities of the elastically scattered γ lines at 130° to those at 90°, with ratio=1.36 for J=1 and 0.44 for J=2 (1982Mo05); parities are from Adopted Levels; unless otherwise noted.
[#] From Adopted Levels.
[@] From 2002Ha13 (in eV), unless otherwise stated.
[&] Values of half-lives are deduced from Γ0 and adopted γ branching Γ0/Γ=1 assuming no particle decay, unless otherwise stated.

γ(^{40}Ca)

Eγ[†]	Ei(level)	Jiπ	Ef	Jfπ	Eγ[†]	Ei(level)	Jiπ	Ef	Jfπ	Eγ[†]	Ei(level)	Jiπ	Ef	Jfπ
3903.8 *1*	3904.0	2+	0	0+	6949.3 *7*	6949.9	1−	0	0+	8981.4 *5*	8982.5	2+	0	0+
5249.2 *3*	5249.6	2+	0	0+	7871.1 *1*	7871.9	2+	0	0+	9602.7	9603.9		0	0+
5628.5 *2*	5628.9	2+	0	0+	8090.6 *2*	8091.5	2+	0	0+	9864.7 *20*	9866.0		0	0+
5902.0 *2*	5902.5	1−	0	0+	8110.0 *6*	8110.9	1−	0	0+	9867.6	9868.9		0	0+
6420.6 *9*	6421.2	2+	0	0+	8577.7 *2*	8578.7	2+	0	0+	10316.6 *20*	10318.0	1+	0	0+
6907.6 *1*	6908.2	2+	0	0+	8748.4 *2*	8749.4	2+	0	0+					

[†] From level-energy difference with the uncertainty taken from level energy, unless otherwise noted. 2002Ha13 report level energies based on observed ground state transitions. Values available from 1982Mo05 are in general agreement with those from 2002Ha13 but with less precision.

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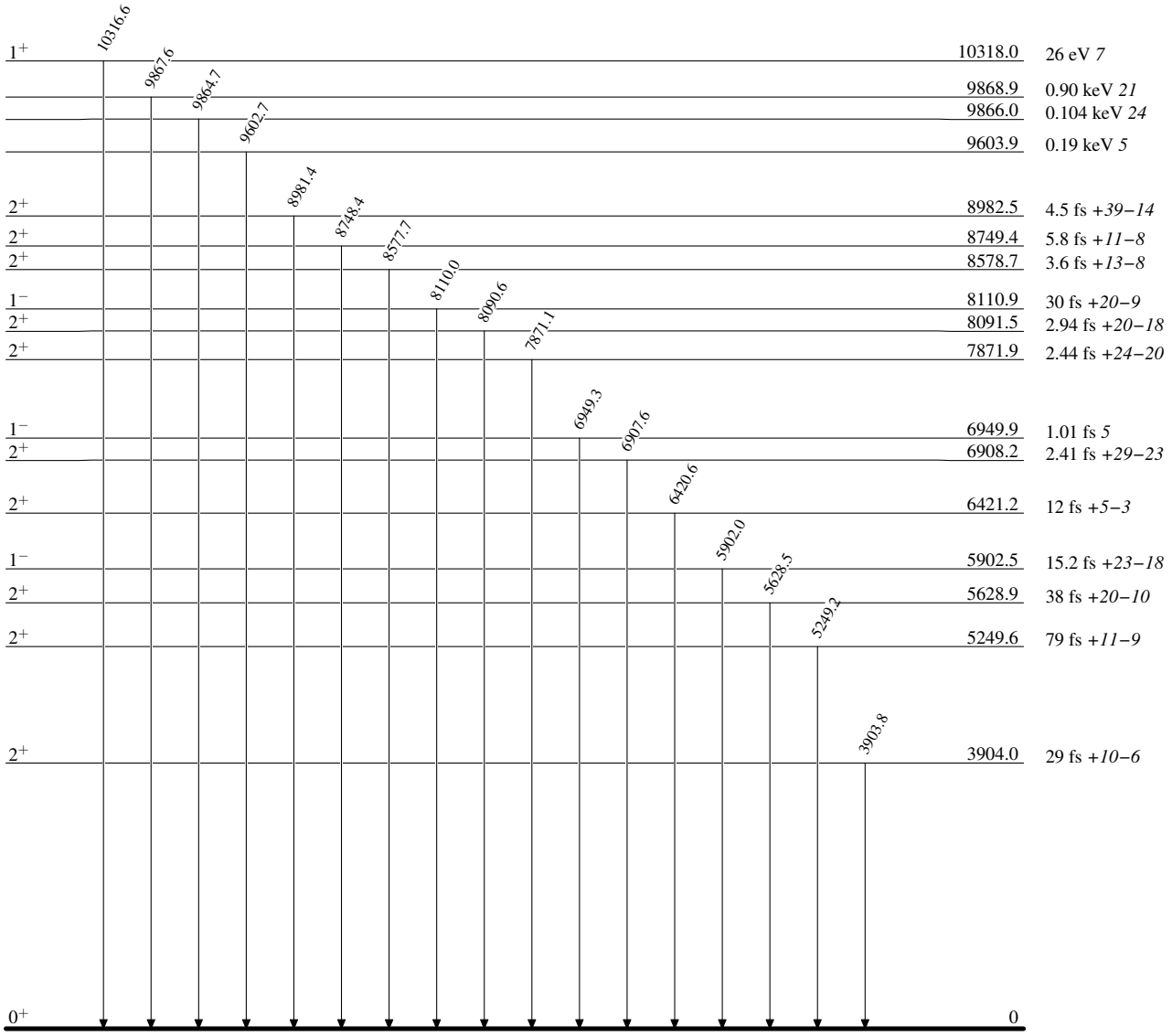
Level Scheme



$^{40}_{20}Ca_{20}$