^{10}B(α,p),(α,pγ)

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	J. H. Kelley, C. G. Sheu and J. E. Purcell	NDS 198,1 (2024)	1-Aug-2024

1953Sh64: ^{10}B(α,p) E=1-2 MeV; resonances for production of γ-rays and protons from the reaction were observed. Spins and parities of 3/2$^-$ and 5/2$^+$ were confirmed for the second and third excited levels of ^{13}C.

1954St20: ^{10}B(α,pγ); the angular distributions of the high energy γ-rays (a mixture of 3.7 and 3.9 MeV γ-rays) and of the low energy γ-rays (0.2 MeV) from the reaction, and the angular correlations of the high energy γ-rays with the emitted protons have been measured at five α-particle resonances E_α= 1.13, 1.51, 1.64, 1.68 and 1.83 MeV.

1956Ma52: A scintillation spectrometer and a magnetic lens spectrometer have been used to study gamma rays from excited states of ^{13}C at 3.84 and 3.68 Mev, produced in the reactions ^{12}C(d,p) and ^{10}B(α,p). Lines have been measured at 169.5 keV *4*, 3.844 Mev *15*, and 3.69 MeV *2*.

1960Ka13: ^{10}B(α,p); estimated the strength of the corresponding but non-mirror Ml transition from the ^{13}C*(3.68 MeV:3/2$^-$) state to the 1/2$^-$ ground state and compared it with the same IPM calculation as accounts for the transition in ^{13}N.

1960Pi09: ^{10}B(α,p) E=1.64 MeV; measured branching ratios of the ^{13}C*(3854) level.

1961Ya02: ^{10}B(α,p) E=27.5,33.1 MeV; measured angular distributions of ground state protons.

1962Ed01: ^{10}B(α,p), proton groups have been observed to the first four states of ^{13}C.

1967Od01: The ground-state Q values of the reaction ^{10}B(α,p) was measured.

1968Ri16: ^{10}B(α,p) E=2.9 MeV; measured Doppler-shift attenuation. ^{13}C, ^{13}N levels, deduced $T_{1/2}$.

1969Ga01: ^{10}B(α,pγ) E=1.0-3.5 MeV; measured σ(E;E_γ).

1969He22: ^{10}B(α,p) E=4.5 MeV; measured σ(E_γ, E(^{13}C)). ^{13}C*(3.85) level deduced τ=10.7 ps *10*. Recoil distance method.

1969Li07: ^{10}B(α,pγ) E=5.15 MeV; measured E_γ, I_γ. ^{13}C levels deduced γ-branching. Ge(Li) detector.

1970Ga01: ^{10}B(α,pγ) E=1.96 MeV; measured $E_\gamma(\theta(\gamma)=0°)$, Doppler shift, recoil distance. For ^{13}C*(3.85) they deduced τ=9.9 ps *9*.

1971HiZF: Studies of this reaction led to J^π=3/2$^-$ and 5/2$^+$ for ^{13}C*(3.68,3.85) states respectively.

1974WiZL: ^{10}B(α,p) E=2.1-10.75 MeV; measured σ(Ep).

1975Wi04: ^{10}B(α,p) E=2-10 MeV; measured σ(E,Ep,θ). Proton groups have been observed to the first four states of ^{13}C.

1980Wa24: ^{10}B(α,p) E=1.66 MeV; measured E_γ, I_γ, $\gamma\gamma$-coin, $\gamma(\theta)$. ^{13}C level deduced $T_{1/2}$, levels, γ-branching, B(λ). Shell model.

1981Ki08: ^{10}B(α,$p_1\gamma$) E=2.563-3.064 MeV; measured $\sigma(\theta_p)$. Legendre Polynomial analysis.

1983Cs03: ^{10}B(α,$p_1\gamma$) E=2.56-3.06 MeV; measured σ(E). See also (1983CsZY).

1983La17: ^{10}B(α,pγ) E=2.4 MeV; measured E_γ, I_γ, thick target γ yields.

1986Ba58: ^{10}B(α,p) E=2.3 MeV; measured $\sigma(E_p)$, $\sigma(E_\alpha)$. ^{13}C level deduced no neutral particle decay evidence, $\Gamma(\phi)/\Gamma_\gamma \leq 7\times10^{-5}$; upper limit of 10^{-6}. Fundamental symmetries.

1987MiZY: ^{10}B(α,p) E=48 MeV; measured $\sigma(E_p)$. ^{13}C deduced levels.

1988BrZY: ^{10}B(α,p) E=48 MeV; ^{13}C deduced levels, J, π.

1990JaZZ: ^{10}B(α,p) E=48 MeV; ^{13}C deduced level, possible T.

1991Br26: ^{10}B(α,p) E=48 MeV at 25° and 35°; measured particle spectra. ^{13}C deduced levels, possible isospin. Also reported the analog reaction ^{10}B(^{9}Be,^{6}Li) at E=40 MeV and θ=22.5° with low statistics. Compared with shell model predictions.

1995He40: ^{10}B(α,p) E=5.6-10 MeV; measured thick target γ yields; deduced γ production intensity distributions from materials related features.

1996Gi13: ^{10}B(α,p) E=4-5 MeV; measured $\sigma(E_p,\theta)$ for p_{0-3} at θ_{lab}=135°.

1997He11: ^{10}B(α,p) E=5.6-10 MeV; measured thick target residuals yields; deduced reaction mechanism related features.

1999Ki29: ^{10}B(α,p) E=1.2-4.0 MeV; measured Doppler broadened E_γ, $I_\gamma(\theta)$; deduced proton distributions; analyzed energy dependence of angular distribution parameters.

2003Ch44: ^{10}B(α,p) E=1.4-5.3 MeV; measured Ep, σ(E,θ). Application to boron depth profiling discussed.

2019Li42: ^{10}B(α,p) E=2.2-4.9 MeV; measured secondary E_γ, γ-ray yields, used for troubleshooting during the experiment.

2020Li08: ^{10}B(α,pγ) E=835-1665 keV; measured E_γ and I_γ.

2023Gu04: ^{10}B(α,$p_{0,1,2,3}$),(α,pγ) $E_{c.m.}$=0.19-1.43 MeV; measured $\sigma(E_p,\theta)$ for θ=90° and 135° at Notre Dame. R-matrix analysis of excitation function.

Theory:

2018Zh51: ^{10}B(α,p) E<10 MeV; analyzed available data; deduced σ, reaction rates. Comparison with TALYS calculations.

^{10}B(α,p),(α,pγ) (continued)

^{13}C Levels

E(level)[†]	J^{π}[&]	$T_{1/2}$ or Γ	Comments
0	1/2⁻		Q_0=4130 keV *20* (1953Sh64), 4063.4 keV *24* (1967Od01).
3089.443[‡] *20*	1/2⁺	<6.93 fs	$T_{1/2}$: From τ<10 fs (1968Ri16: Doppler shift method, ^{13}C(p,p′) and ^{12}C(d,p)). Total radiation width Γ_γ>0.066 eV (1968Ri16).
3684.482[#] *23*	3/2⁻	<18.02 fs	$T_{1/2}$: From τ<26 fs (1968Ri16: Doppler shift, ^{13}C(p,p′) and ^{12}C(d,p)); see also τ<300 fs (1956Ma52: Doppler shift). Total radiation width Γ_γ>0.025 eV (1968Ri16). See also Γ_γ=0.40-0.75 eV (1960Ka13: 3.68→g.s. M1 transition).
3853.783[@] *22*	5/2⁺	7.02 ps *+51−36*	$T_{1/2}$: From τ=10.13 ps *+73−52* which is the weighted value of τ=9.0 ps *+25−15* (1968Ri16: Doppler shift), τ_m=10.7 ps *10* (1969He22: recoil-distance method), τ_m=9.9 ps *9* (1970Ga01: recoil-distance method). See also 10.8 ps *10* (1968Fo12; ref. within 1970Ga01). Total radiation width Γ_γ=7.3×10^{-5} eV *16* (1968Ri16).
6860[b]			
7570[b]			
9500[ab]			
10800[ab]			E(level): Unresolved in (α,p).
11850[a]			
11900[b]			
13010[a]			
13400[ab]			E(level): Unresolved in (α,p).
14080[ab]		132[a] keV	J^{π}: Shell model predicts J^{π}=7/2⁺; However, the authors identified this strong state as the ^{13}C*(14.13; J^{π}=3/2⁻) state seen in the ^{12}C(n,n) reaction (1985To02).
14819[ab]			
15490[a]			E(level): Unresolved in (α,p).
16080[a]			E(level): Unresolved in (α,p).
17950[a]			
19560[ac]			
20100[ac]			
21400?[b]			T=(3/2,1/2) T: 3/2 is favorable over T=1/2 (1991Br26). Not strongly populated.
22520[ac]			

† For each level in ^{13}C*(0,3.09,3.68,3.85 MeV) reported by references: 1953Sh64, 1954St20, 1956Ma52, 1960Ka13, 1960Pi09, 1967Od01, 1968Ri16, 1969He22, 1969Li07, 1970Ga01, 1975Wi04, 1980Wa24, 1983La17, 1995He40, 1996Gi13, 1997He11, 2007Ma58, 2020Li08.

‡ From measured E_γ=3089.049 keV *20* with recoil energy E_R=394 eV where E_i-E_f=E_γ+E_R (1980Wa24).

From derived E_γ=3683.921 keV *23* with E_R=561 eV (1980Wa24).

@ From derived E_γ=3853.170 keV *22* with E_R=613 eV (1980Wa24).

& From angular distributions and p-γ angular correlations in (1953Sh64,1954St20,1971HiZF).

a Reported in ^{10}B(α,p) (1991Br26).

b Reported in ^{10}B(^{9}Be,^{6}Li) (1991Br26).

c Some states are not associated with Adopted Levels because inadequate details for association are given in the literature.

^{10}B(α,p),(α,pγ) (continued)

γ(^{13}C)

E_i(level)	J^π_i	E_γ	I_γ	E_f	J^π_f	Mult.	δ	Comments
3089.443	1/2+	3089.049 *20*		0	1/2−	E1		E_γ: Measured in (1980Wa24). E_γ also reported in (1960Pi09, 1968Ri16, 1983La17, 1997He11, 2020Li08). Mult.: (1960Pi09).
3684.482	3/2−	590 *15*	0.75 *4*	3089.443	1/2+	E1		E_γ: From (1960Ka13,1960Pi09). 595.013 keV *11* is deduced from results in (1980Wa24). Mult.: (1960Ka13). I_γ: From (1980Wa24). See also Iγ=6.5×10^{-3} *10* (1960Ka13) and 9.3×10^{-3} *20* (1960Pi09).
		(3690 *20*)	99.25 *4*	0	1/2−	E2+M1	−0.094 *9*	E_γ: From (1956Ma52). 3683.921 keV *23* is deduced in from results in (1980Wa24). See also E_γ=3730 keV *60* (1953Sh64: transitions from 3.68 or/and 3.85→g.s.). E_γ also reported in (1954St20: very weak except at the E_α(res)=1.51 MeV, where 16% of the total proton counts contributed to this decay, 1968Ri16, 1969Li07, 1983La17, 1997He11, 2007Ma58, 2020Li08). I_γ: From (1980Wa24). Mult.: (1980Wa24). See also (1960Ka13: M1). δ: From (1980Wa24: using B(E2)=3.63 *40* from (1970Wi04: ^{13}C(e,e′)) and τ_m=1.59 fs *13* from (1991Aj01)). Γ_γ=0.40-0.75 eV (1960Ka13: M1).
3853.783	5/2+	169.300 *4*	36.3 *6*	3684.482	3/2−	E1		E_γ: Measured in (1980Wa24). See also E_γ=210 keV *30* (1953Sh64: about 30% decays to g.s. via 3.68 state), 169.5 keV *4* (1956Ma52), 180 keV (1960Pi09), 170 keV (1983La17). I_γ: From (1980Wa24). See other values: I(3.85→3.68)/I(3.85→g.s.)=0.32 *7* (1960Pi09), 0.55 *3* (1969Li07). See also (1956Ma52: 3.85 MeV level decays through the 3.68 MeV level with a probability 0.24 *5*). Mult.: (1960Pi09;1956Ma52: though M1 is not excluded).
		764.316 *10*	1.20 *4*	3089.443	1/2+	E2		E_γ: Measured in (1980Wa24). See also E_γ=765 keV *8* (1960Ka13,1960Pi09). I_γ: From (1980Wa24). See other reported values: I(3.85→3.09)/I(3.85→g.s.)= 9.3×10^{-3} *20* (1960Pi09), 2.5×10^{-2} *5* (1969Li07). Transitions to the 3.09 MeV not observed in (1956Ma52) with the intensity <3% concluded. Mult.: (1960Pi09).
		3854 *1*	62.5 *6*	0	1/2−	M2		E_γ: From (1969Li07). 3853.170 keV *22* is deduced from results in (1980Wa24). See also E_γ=3844 keV *15* (1956Ma52). E_γ also reported in (1960Pi09, 1968Ri16, 1983La17, 1995He40, 1997He11,

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^{10}B(α,p),(α,pγ) (continued)

γ(^{13}C) (continued)

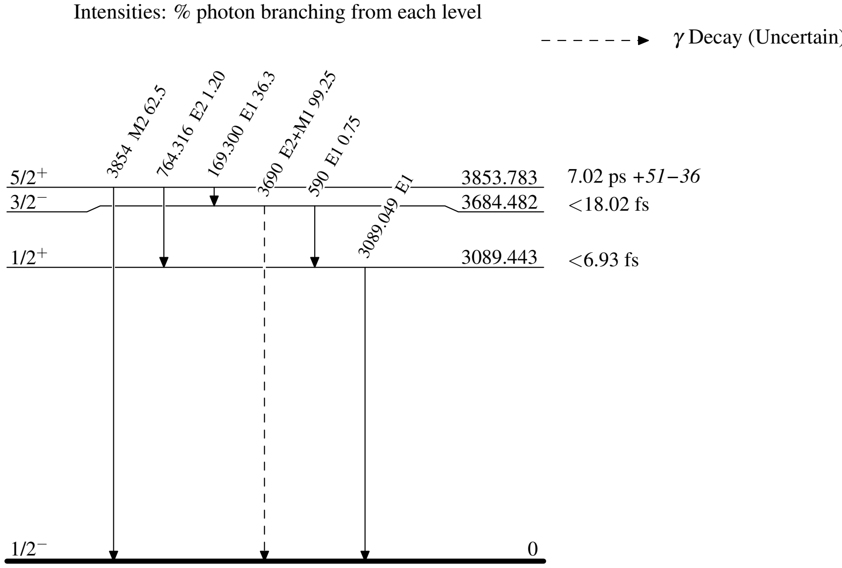
E$_i$(level)	E$_\gamma$	Comments
		2007Ma58, 2020Li08).
		I$_\gamma$: From (1980Wa24). See other reported values in (1960Pi09, 1969Li07) above and I(3.85→g.s.)/I(3.85→3.68→g.s.)=7:3 (1954St20).
		Mult.: (1960Pi09).
		Γ_γ(FWHM)=4.5 keV (1969Li07).

^{10}B(α,p),(α,pγ)

Legend

Level Scheme

Intensities: % photon branching from each level



$^{13}_{6}C_{7}$