^{13}C(p,p),(p,p′),(p,pn)

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

1957Ba29: ^{13}C(p,p′), angular distributions of the 3.09 MeV γ-rays are isotropic for Ep=3.7 to 4.2 MeV, consistent with the assignment J=1/2 to ^{13}C*(3.09). Angular distributions of the 3.68 MeV radiation have also been studied near the Ep=4.5 MeV resonance.

1957Zi09: ^{13}C(p,p) E=1.5-3.4 MeV; measured reaction products, Ep, Ip, $\sigma(\theta)$ for θ=45° to 148.9°.

1960Ba35: ^{13}C(p,p′γ) E=3.6-5 MeV; angular distributions of the 3.09 MeV γ-rays are isotropic for up to E_p=5 MeV consistent with the assignment J=1/2 for the ground state.

1966Ge03: ^{13}C(p,p_0) E=1.55-2.38 MeV; measured $\sigma(\theta)$ for $\theta_{c.m.}$=20° to 170°.

1968Ri16: ^{13}C(p,p′) E=4.1,4.125,4.55 MeV; measured Doppler-shift attenuation. Deduced $T_{1/2}$ of ^{13}C*(3.09, 3.68 MeV).

1969Gu02: ^{13}C(p,p) E=7 MeV; measured σ(Ep,θ), P(θ) for $\theta_{c.m.}\approx$25° to 160°; deduced optical parameters. Natural, enriched targets.

1971Ot02: ^{13}C(p,pn) E=7.9-12.5 MeV; measured σ(E;Ep,θ(p),θ(n)); deduced singlet deuteron contribution. One or more ^{13}C states at E_x=7.5 MeV seem to be involved in the sequential decay.

1971Ri13: ^{13}C(p,p′γ(3.09,3.68,3.85 MeV)) E=3-17 MeV; measured σ(E).

1971Va29: ^{13}C(p,p_1) E=6.36,6.48 MeV; measured σ(Ep′,θ).

1972Gr02: ^{13}C(pol. p,$p_{0,1}$) E=30.4 MeV; measured $\sigma(\theta)$, P(θ), analyzing power(θ) for $\theta_{c.m.}$=25° to 170°; formulated effective interaction. Enriched targets.

1973DeYW, 1975De26: ^{13}C(p,p),(p,p′γ),(p,d) E=6 MeV; measured σ(Ep,θ). Deduced level configurations.

1974Mi05: ^{13}C(p,pn) E=46 MeV; measured σ(Ep,θ).

1978Bl02: ^{13}C(p,p′) E=0.8 GeV; measured $\sigma(\theta)$ for $\theta_{c.m.}$=2° to 40°. Reported states up to 11.9 MeV. Discussed deformation length. Optical potential, DWBA analysis.

1978We13: ^{13}C(pol. p,p_0), measured σ(E,θ) for E=9.1-18.4 MeV and for θ=30° to 155°, measured A(E,θ) for E=10-17.5 MeV. See further discussion in (1985Pe10).

1979Al26: ^{13}C(p,p_0) E=1 GeV; measured $\sigma(\theta)$ for $\theta_{c.m.}$=5° to 25°. Deduced nuclear density parameters, quadrupole effects. Glauber theory.

1980Fa07: ^{13}C(p,p),(p,p′) E=35.2 MeV; measured $\sigma(\theta)$ for $\theta_{c.m.}\approx$30° to 180°; deduced optical-model parameters.

1981Me02: ^{13}C(pol. p,p) E=200 MeV; measured $\sigma(\theta)$, analyzing power vs θ for θ=10° to 120°.

1982Co08: ^{13}C(p,p),(p,p′) E=135 MeV; measured $\sigma(\theta)$ for θ=8° to 80° and for states below E_x=11 MeV. Deduced possible configurations of ^{13}C*(8.86, 11.08 MeV). Optical model, DWBA analyses.

1982Ri05: ^{13}C(p,p′) E=135 MeV; measured $\sigma(\theta)$ for $\theta_{c.m.}$=10° to 85°. Analyzed angular momentum transfer, configuration of ^{13}C*(9.50). Microscopic DWBA analysis. Deduced $J^{\pi}=9/2^{+}$.

1984Se12: ^{13}C(pol. p,p′) E=547 MeV; measured σ(Ep′), $\sigma(\theta)$, analyzing power vs θ for $\theta_{c.m.}$=5° to 35° and for ^{13}C*(0,3.09, 3.68,3.86,6.86,7.55,8.86,9.50). DWIA analysis, shell model transition densities.

1985Al16: ^{13}C(p,p_0) E=1 GeV; measured $\sigma(\theta)$; deduced model parameters, rms matter radii =2.394 fm.

1985Bl22: ^{13}C(p,p_0),(pol. p,p_0) E=0.8 GeV; measured $\sigma(\theta)$, analyzing power vs θ for $\theta_{c.m.}\approx$5° to 50°; deduced optical potential parameters.

1985Ki07: ^{13}C(p,p′γ) E=2.4-4.2 MeV; measured thick target relative γ yields, E_γ, I_γ. Particle induced prompt gamma emission analysis.

1986Oh03: ^{13}C(pol. p,p′) E=35 MeV; measured $\sigma(\theta)$, A(θ) for $\theta_{c.m.}\approx$20° to 120° and for ^{13}C*(0,3.09, 3.68,3.86). Compared with analogous (p,n) reactions, analyzed isoscalar component. Enriched target. DWBA analysis.

1988Ba30: ^{13}C(p,p_0) E=30.95 MeV; measured $\sigma(\theta)$ for θ=10° to 160°.

1988Co05: ^{13}C(p,p),(p,p′) E=135 MeV; ^{13}C(pol. p, p),(pol. p,p′) E=119 MeV; measured $\sigma(\theta)$, A(θ) for $\theta_{c.m.}\approx$5° to 90°. Analyzed states up to 23 MeV. Optical model, DWA analyses, density-dependent t-matrices.

1989Vo05: ^{13}C(pol. p,p_0) E=72 MeV; measured $\sigma(\theta)$, A(y)(θ) for $\theta\approx$20° to 160°; deduced optical model potential.

1990Ho06: ^{13}C(pol. p,p) E=494 MeV; measured $\sigma(\theta)$, analyzing powers, spin rotation depolarization observables for $\theta\approx$5° to 37°; deduced phenomenological Dirac optical potentials. Calculated retativistic impulse approximation optical potentials.

1990Ho22: ^{13}C(pol. p,p) E=497.5 MeV; measured spin correlation parameter, target analyzing power vs θ for $\theta\approx$12° to 30°. Dynamic nuclear polarization technique, polarized, cooled target, enriched ethylene glycol target.

1990Vo02,1991Vo03: ^{13}C(pol. p,p_0) E=72 MeV; measured depolarization parameter vs θ for $\theta_{c.m.}\approx$34° to 69°; deduced nucleon-nucleus, spin-spin interaction evidence and effects. Optical model.

^{13}C(p,p),(p,p′),(p,pn) (continued)

1993YuZX: ^{13}C(p,p) E=200 MeV; measured $\sigma(\theta)$ at backward angles; deduced optical potential parameters. DWIA analysis.
1996Ho08: ^{13}C(pol. p,p) E=500 MeV; measured polarization transfer parameter D(NN). Non-relativistic DWBA analysis, coupled-channels Dirac, relativistic DWBA analyses.
1996Yu02: ^{13}C(p,p) E=200 MeV; measured spectra, $\sigma(\theta)$ for $\theta_{c.m.}$=160° to 180°; deduced model parameters. DWIA analysis.
1998Hu29: ^{1}H(^{13}C,^{13}C),^{13}C(p,p) E=2.8-11.2 MeV; measured products, Deduced $\sigma(\theta)$. E_{res}=0.511 MeV. Thick Target Inverse Kinematics.
2003An11: ^{13}C(p,p) E=22 MeV; ^{13}C(p,p′) E=22 MeV; measured $\sigma(\theta)$ for θ=9° to 130°. Deduced ^{13}C*(3.09 MeV) neutron halo structure, related features. Microscopic DWBA analysis, compared with related data.
2013Ba56: ^{13}C(p,p) E=0.8-2.4 MeV; measured reaction products, Ep, Ip; deduced σ, yields; compared with available data.
2022Ci07: ^{13}C(p,p′) Ep=135 MeV at the CCB at IFJ PAN in Krakow. Populated the E_x=21.47 MeV stretched resonance in ^{13}C and analyzed its decay branches and structure. Scattered protons were measured at θ=36° using the KRATTA array, while branches for particle emission were deduced either by direct measurement with a position sensitive Si detector or by measurement of γ rays from the deexcitation of the ^{12}B or ^{12}C remnants. Evidence for neutron and proton decay branches was observed, but no evidence was found for *d* or α emission. Neutron emission to proceeds to ^{12}C(15.11 MeV: J=1^{+},T=1), suggesting T=3/2 for the ^{13}C state. Results were compared with a gamow Shell Model calculation; observed decay branches are consistent with J^{π}=7/2^{+}, but a 7/2^{+} + 9/2^{+} doublet cannot be excluded.
2023Hu21: ^{13}C(p,p′) E=800 MeV; analyzed small angle elastic scattering data; deduced matter density distributions and r.m.s. matter radii. The free-parameter fit for ^{13}C yielded $R_{m}^{r.m.s.}$=2.374 fm *12*.

Theory:
1973Ka04: ^{13}C(p,p′), calculated integral cross sections for low-lying levels.
1974Av02: ^{13}C(p,d),(p,pn) E=12,17 MeV; calculated σ(Ed,θ), σ(Ep,θ); deduced singlet deuteron effects.
1978Al36: ^{13}C(p,p) E=1 GeV; calculated $\sigma(\theta)$. Glauber theory, n, p-density parameters from electron scattering data.
1982Ba14: ^{13}C(p,p′) E=6 MeV; calculated $\sigma(\theta)$. Triangle diagram method, Coulomb effects.
1983Pe14: ^{13}C(p,p′) E=26.1 MeV; analyzed $\sigma(\theta)$. ^{13}C levels deduced differences in excitation probabilities from other charge exchange reaction data.
1986AmZX: ^{13}C(p,p), analyzed form factors, $\sigma(\theta)$; deduced structure effects.
1986Ra05: ^{13}C(pol. p,p) E=500 MeV; calculated $\sigma(\theta)$, polarization, other parameters vs θ; deduced relativistic effects role.
1988GoZH: ^{13}C(p,p) E=10-20 MeV; analyzed $\sigma(\theta)$; deduced optical model parameters.
1988KuZL: ^{13}C(p,p),(pol. p,p) E=0.8 GeV; calculated $\sigma(\theta)$, A(θ). Multi-scattering diffraction theory.
1988Ra08: ^{13}C(pol. p,p) E=500 MeV; calculated $\sigma(\theta)$, P(θ), spin observables; deduced target nucleus relativistic effects role. Relativistic dynamics, pseudovector coupling.
1989Am02: ^{13}C(p,p′) E=135 MeV; analyzed data; deduced degree of M1 quenching. Shell model, medium corrected DWA.
1989Am05: ^{13}C(pol. p,p) E=547 MeV; calculated $\sigma(\theta)$, analyzing power vs θ. Nonrelativistic optical model potential.
1989BeXT: ^{13}C(pol. p,p),(pol. p,p′) E=135,547,800 MeV; calculated σ(θ,E), analyzing power vs θ. Diffraction model.
1989Go14: ^{13}C(p,p) E=13.5-17.5 MeV; calculated $\sigma(\theta)$, P(θ); deduced model parameters. Phenomenological, folding model potentials.
1989Ku07: ^{13}C(pol. p,p) E=547-1000 MeV; calculated $\sigma(\theta)$, polarization observables vs θ. Multiple diffraction scattering theory.
1989Ku14: ^{13}C(p,p) E=550,800 MeV; calculated $\sigma(\theta)$, polarization observables vs θ. Polarized target.
1989Ku32: ^{13}C(pol. p,p) E=0.8,1 GeV; calculated $\sigma(\theta)$, analyzing power vs θ. Diffraction model.
1990Du01: ^{13}C(pol. p,p) E=1.13-1.17 MeV; calculated σ(E), analyzing power vs E.
1990He32: ^{13}C(pol. p,p) E=65 MeV; analyzed depolarization parameter; deduced nucleon-nucleus spin-spin interaction features.
1990St32: ^{13}C(pol. p,p) E=65,72 MeV; compiled data analysis; deduced Gamow-Teller type transition extraction possibility.
1991Br28: ^{13}C(p,p),(pol. p,p) E≤1.17 MeV; calculated $\sigma(\theta)$, analyzing power vs E. Double-folding interaction potential, multi-step direct compound nuclear reactions.
1991Mc03: ^{13}C(pol. p,p) E=497 MeV; compiled, reviewed data analyses; deduced nucleon-nucleus interaction features, spin-effects, spin-isospin modes role.
1992Ra02: ^{13}C(pol. p,p) E=497.5 MeV; calculated polarization observables. Shell model configurations. Pauli blocking.
1993By02: ^{13}C(p,p) E=72 MeV; calculated $\sigma(\theta)$; deduced nucleon-nucleon bound state role.
1993Ra05: ^{13}C(pol. p,p) E=500 MeV; calculated $\sigma(\theta)$, analyzing power, polarization transfer observables vs θ. Relativistic impulse approximation, density dependent nucleon-nucleon effective interaction.
1994Me14: ^{13}C(pol. p,p) E=500,574 MeV; calculated $\sigma(\theta)$, depolarization parameter, other spin observables vs θ. Relativistic Schrodinger equation, microscopic, momentum space optical potentials.

^{13}C(p,p),(p,p′),(p,pn) (continued)

1997Do01: ^{13}C(pol. p,p) E=200 MeV; analyzed $\sigma(\theta)$, polarization observables data. Microscopic model.
1998Ki17: ^{13}C(p,p) E=1 GeV; analyzed $\sigma(\theta)$; deduced neutron halo role. Glauber theory.
1998Kr25: ^{13}C(p,p) E=10,30,50 MeV; calculated optical potentials; deduced spin-orbit, spin-spin, tensor contributions. Hartree-Fock method, Skyrme forces.
1999Kr12: ^{13}C(p,p), calculated optical potential for nucleus-nucleon scattering. Hartree-Fock theory.
2000De61: ^{13}C(p,p) E=30 MeV; E=40 MeV; calculated $\sigma(\theta)$, Ay(θ). Optical potential, comparison with data.
2001Mi20: ^{13}C(pol. p,p), E*≈9 MeV; calculated longitudinal and transverse analyzing powers.
2002Mo28: ^{13}C(p,p) E=10 MeV; calculated $\sigma(\theta)$; deduced continuum effects. Continuum discretized coupled channels formalism.
2004Be16: ^{13}C(p,p) E=500,547,800 MeV; calculated $\sigma(\theta)$, polarization observables. Multiple diffractive scattering theory, comparison with data.
2004Be35: ^{13}C(p,p) E=500 MeV; calculated $\sigma(\theta)$, analyzing powers, other polarization observables.
2005Ko28: ^{13}C(p,p) E≈800-1100 MeV; analyzed $\sigma(\theta)$; deduced black-sphere radius parameters.
2009De02: ^{13}C(p,p) E=35 MeV; calculated $\sigma(\theta)$, binding energies. Momentum-space three-body Fadeev-like equations. Comparison with experimental data.
2009De07: ^{13}C(p,p) E=35 MeV; calculated differential cross sections, analyzing powers for polarized beam using local and nonlocal optical potentials parameters in the framework of Faddeev type scattering equations. Comparison with experimental data.
2009De13: ^{13}C(pol. p,p) E=17.5, 35 MeV; calculated $\sigma(\theta)$, analyzing powers using Faddeev-type model. Compared various optical potentials with experimental data.
2009We04: ^{13}C(p,p) E=25-155 MeV; analyzed σ, $\sigma(\theta)$ using isospin dependent global nucleon-nucleus optical model. ^{13}C(pol. p,p), E=30-152 MeV; analyzed vector analyzing powers using isospin dependent global nucleon-nucleus optical model.
2012Du11: ^{13}C(p,p) E=250-770 keV; analyzed $\sigma(\theta)$ measurements; deduced S-wave phase shift, triplet states in the resonance region.
2015Be12: ^{13}C(p,p),(p,p′) E<200 MeV; calculated charge radii and densities, form factors, $\sigma(\theta)$, scattering parameters, polarization. Multiple diffraction scattering theory (MDST) and the α-cluster model with dispersion, comparison with experimental data.
2017Ka45: ^{13}C(p,p) E=71,100,200,300,425,550,650 MeV; calculated σ, $\sigma(\theta)$. Comparison with available data.
2018We08: ^{13}C(p,p) E=70,72 MeV; calculated $\sigma(\theta)$, σ; deduced optical model parameters. Comparison with experimental data.
2018Zh31: ^{13}C(p,p′) E=0.6,0.8,1.0 GeV; calculated $\sigma(\theta)$, analyzing power to $(1/2)^+$ and $(5/2)^+$ levels using Glauber Multiple Scattering Theory and DWBA. Compared with available data.
2021An01, 2021An13: ^{13}C(p,p) E<5 MeV; calculated σ; deduced optical model potential, S-factors in the folding model, using a realistic density dependent nucleon-nucleon interaction.
2022Vo02: ^{13}C(p,p) E=200 MeV; calculated $\sigma(\theta)$ and $A_y(\theta)$.

^{13}C Levels

E(level)[†]	J^π[‡]	T or Γ[#]	L	Comments
0	$1/2^-$			E(level): See (1978Bl02,1982Co08,1984Se12,1985Ki07,1986Oh03,1988Co05,2003An11). Analyzing power A_y was also measured (1984Se12).
3089	$1/2^+$	<6.93 fs		B(E1)↑=0.00014 (1988Co05) E(level): See (1957Ba29, 1960Ba35, 1968Ri16, 1978Bl02, 1982Co08, 1984Se12, 1985Ki07, 1986Oh03, 1988Co05, 2003An11). The analysis in (2003An11) indicates the existence of neutron halo in this state. $T_{1/2}$: From τ<10 fs (1968Ri16).
3685	$3/2^-$	<18 fs	2	B(M1)↑=1.42 (1988Co05); B(E2)↑=0.131 (1988Co05) B(E2)↑: See also 0.066 (1982Co08). E(level): See (1957Ba29, 1960Ba35, 1968Ri16, 1978Bl02, 1982Co08, 1984Se12, 1986Oh03, 1988Co05, 2003An11). Analyzing power A_y was also measured (1984Se12). $T_{1/2}$: From τ<26 fs (1968Ri16). L: transfer L (1984Se12). Spin transfer ΔS=0 (1984Se12).
3854	$5/2^+$		3	B(E1)↑=0.0303 (1988Co05); B(M2)↑=0.131 E(level): See (1982Co08,1984Se12,1986Oh03,1988Co05,2003An11). Analyzing power A_y was also measured (1984Se12). L: transfer L (1984Se12). Spin transfer ΔS=0 (1984Se12).
6864	$5/2^+$			B(M2)↑=0.0153 (1988Co05) E(level): See (1978Bl02,1982Co08: weak,1984Se12,1988Co05). Analyzing power A_y was

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^{13}C(p,p),(p,p′),(p,pn) (continued)

^{13}C Levels (continued)

E(level)[†]	Jπ[‡]	T or Γ[#]	L	Comments
				also measured (1984Se12).
7547	5/2−		2	B(E2)↑=0.175 (1988Co05); B(M3)↑=0.518 B(E2)↑: See also 0.058 (1982Co08). E(level): See (1978Bl02,1982Co08,1988Co05). L: transfer L (1984Se12). Spin transfer ΔS=0 (1984Se12).
7686				
8200				
8860	1/2−		0	B(M1)↑=0.418 (1988Co05) E(level): See (1982Co08,1984Se12,1988Co05). Analyzing power A_y was also measured (1984Se12). L: Transfer L (1984Se12). Spin transfer ΔS=0 (1984Se12).
9500	9/2+		4	E(level): See (1982Co08,1982Ri05,1984Se12,1988Co05). Analyzing power A_y was also measured (1984Se12). Jπ: See also (1982Ri05). L: From (1982Ri05: a pure $1p_{3/2}$ to $1d_{5/2}$ neutron transition).
9897	3/2−			B(M1)↑=0.058 (1988Co05); B(E2)↑=0.0016 (1988Co05)
10753	7/2−			
10818				
10996				
11080	1/2−			B(M1)↑=0.065 (1988Co05)
11748				
11851	7/2+			Jπ: Assigned by (1988Co05).
11920 *60*	(5/2+)	200 keV		E(level): From (1978Bl02); see also (1988Co05). Jπ: Assigned by (1988Co05); see also Jπ=(5/2,7/2)+ (1978Bl02).
12106	≤5/2	80 keV		Jπ: Assigned by (1988Co05).
12190 *10*	≤5/2	110 keV *50*		E(level),Γ: from (1988Co05, S. Collins, Ph.D. thesis, and B. Spicer, private communication). Jπ: Assigned by (1988Co05).
12438		160 keV		
13280?				E(level): Possibly seen at Ep=135 MeV (1988Co05).
13410				
13570?				E(level): Possibly seen at Ep=135 MeV (1988Co05).
13760?				E(level): Possibly seen at Ep=135 MeV (1988Co05).
14130		210 keV		
14390		300 keV		
14582	(7/2,9/2)+	250 keV		Jπ: Assigned by (1988Co05).
14983	(5/2+)	410 keV		Jπ: Assigned by (1988Co05).
15108	3/2−			B(M1)↑=1.12 (1988Co05); B(E2)↑=0.0189 (1988Co05) T=3/2 T: Value listed in (1982Co08).
15526		220 keV		E(level): See (1982Co08,1988Co05). Γ: From (1988Co05).
16080	(7/2+)	220 keV		E(level),Γ: From (1988Co05). Jπ: Assigned by (1988Co05).
16150				E(level): Reported in (1982Co08) and possibly seen at Ep=135 MeV (1988Co05).
16950?				E(level): Possibly seen at Ep=135 MeV (1988Co05).
17360?				E(level): Possibly seen at Ep=135 MeV (1988Co05).
17699	(3/2−,5/2)			Jπ: Assigned by (1988Co05); L=2 or 3 was consistent, but 7/2+ was considered unlikely because of the shape at small angles.
18300?				E(level): Possibly seen at Ep=135 MeV (1988Co05).
18699	(3/2,5/2)+			E(level): See (1988Co05). Jπ: Assigned by (1988Co05).
19500				
19900?				E(level): Possibly seen at Ep=135 MeV (1988Co05).
20021				
20429				

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^{13}C(p,p),(p,p′),(p,pn) (continued)

^{13}C Levels (continued)

E(level)[†]	J$^{\pi}$[‡]	T or Γ[#]	Comments
20.93×10^3 *10*		0.24 MeV *10*	E(level),Γ: from (1988Co05, S. Collins, Ph.D. thesis, and B. Spicer, private communication).
21280			
21466	(7/2,9/2)$^+$	270 keV *20*	T=3/2 Γ_n/Γ=0.24 *5* $\Gamma_{p0}/\Gamma\leq$0.23; Γ_{p1}/Γ=0.69 *6* Γ: Γ and partial widths from (2022Ci07). Γ_p: Γ_{p2+3}/Γ=0.07 2. Γ_n: Decay is to ^{12}C(15.11 MeV: J^{π}=1$^+$, T=1). T: From (2022Ci07). J$^{\pi}$: Assigned by (1988Co05).
21810	≥5/2		J$^{\pi}$: Assigned by (1988Co05).
22.20×10^3 *10*	≤5/2	1.1 MeV *5*	E(level),Γ: from (1988Co05, S. Collins, Ph.D. thesis, and B. Spicer, private communication). J$^{\pi}$: Assigned by (1988Co05).
23000	≤5/2		J$^{\pi}$: Assigned by (1988Co05).

[†] Level-energy values listed in, for example, (1982Co08,1988Co05). Angular distributions were studied.
[‡] Values from, for example, DWBA analysis of (p,p′) and (pol. p,p′) angular distributions from (1982Co08,1988Co05) except where noted.
[#] Γ values from (1988Co05) except where noted.

γ(^{13}C)

E$_\gamma$	E$_i$(level)	J$_i^{\pi}$	E$_f$	J$_f^{\pi}$	Mult.	Comments
3089	3089	1/2$^+$	0	1/2$^-$		Γ_γ>0.066 eV (1968Ri16: Doppler shift method). E$_\gamma$: See also (1985Ki07). Angular distributions of E$_\gamma$=3.09 MeV are isotropic, consistent with the J=1/2 assignment for 3.09 MeV state (1957Ba29,1960Ba35).
3685	3685	3/2$^-$	0	1/2$^-$	E2	Γ_γ>0.025 eV (1968Ri16: Doppler shift method). Angular distributions of E$_\gamma$ were studied (1957Ba29, 1960Ba35).

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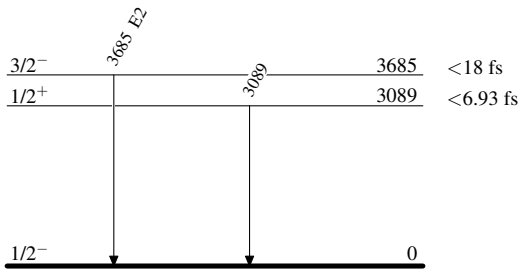
Level Scheme



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