^{13}C(γ,n),(γ,nγ),(γ,p)

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

1956Co72, 1957Co57: ^{13}C(γ,n),(γ,p); the neutron yield up to E_γ=41 MeV was measured using bremsstrahlung photons, and the photoproton yield was also measured using activation techniques. Measured σ(E). Deduced broad peaks at E_x=13.5 MeV *10* and 25.5 MeV *2* with Γ=5 MeV *1* and 10 MeV *2*, respectively.

1960Ed01: Using the mixture of E_γ=6.13, 6.9 and 7.1 MeV γ rays from the ^{19}F(p,αγ) reaction at E_p=874 keV, the E_γ≈6.4 MeV cross section for ^{13}C(γ,n) was found to be 94.1 mb *10*.

1961Ko01: ^{13}C(γ,n); measured not abstracted; deduced nuclear properties.

1964De12: ^{13}C(γ,p) E=17-32 MeV; measured σ(E) for photonproton emission using activation techniques. Deduced peaks at E_x=18.5, 20.0, 23.5, 26.0, 29 MeV.

1964Gr40: ^{13}C(γ,n) E=5.4-10.8 MeV; measured photoneutron production; deduced σ(E). Resonances near ≈7.7 MeV are evident.

1965Be48: ^{13}C(γ,n) $E_{brem.}$=13.6 MeV; measured σ(E,θ) for θ=77° and 157°. Observed peaks corresponding to E_x=7.8, 8.9, 10.9, 12.9 MeV.

1970Fu09: ^{13}C(γ,n) $E_{brem.}$=14.5 MeV; measured σ(E;θ), observed peaks corresponding to E_x=6.2, 7.5, 8.2, 9.1, 11 and 13 MeV; deduced integrated σ. Analyzed pygmy resonance region.

1971Mu11: ^{13}C(γ,nγ) $E_{brem.}$=21,28 MeV; measured σ(E;E_γ). Analyzed ^{12}C*(15.11) [J^π=1$^+$; T=1] population following neutron emission from the T=3/2 component of the ^{13}C giant resonance.

1975Pa09: ^{13}C(γ,nγ′),(γ,pγ′) E<44 MeV; measured σ(E,$E_{\gamma'}$), analyzed population of ^{12}C and ^{12}B states. Deduced giant resonance structure. ^{12}C*(4.4) is populated most strongly at ^{13}C*(13 MeV). A low-energy giant resonance component around 22 MeV decays to ^{12}B states, while a higher-energy component around 28 MeV decays to ^{12}C states.

1976Ko22: ^{13}C(γ,n) E=4.8-25 MeV; measured yield curve; deduced σ(E_γ,n), integrated σ. ^{13}C deduced resonances, Γ. Observed peaks at E_x=7.7, (8.2), (9.1), (10.0), 11, 13, 15, (16.5) 20.5, 24.0 MeV.

1977Wo04: ^{13}C(γ,n) E=6-35.5 MeV; measured σ(E). ^{13}C deduced resonances, Γ. Observed peaks at E_x=7.71, 7.88, 8.87, 9.49, 9.69, 11.0, 12.08, (13.62), (15.09), 15.13, 16.94, 17.95 MeV.

1979Ju01: ^{13}C(γ,n) E=7.6-41.8 MeV; measured 4π$^-$neutron yield, integrated σ(γ,n), σ(γ,2n); deduced isospin splitting of giant resonance. Observed peaks at E_x=7.8, 9, 10, 11, 10.5, 13.8, 16.5, 17.8,20.8, 24 (GR), 30, 37 MeV. Discussion on pygmy and giant resonance regions.

1979Wo06: ^{13}C(γ,n) E=7.6-24 MeV; measured photoneutron angular distributions, deduced σ(E_γ,n), angular distribution coefficients. E_{brem}≤12 MeV: θ=56° to 144°; E_{brem}≤16 MeV: θ=75° to 145° and E_{brem}≤18.4 to 24.6 MeV: θ=48° to 160°. Reported levels at E_x=7.70 MeV: J^π=3/2$^+$, 7.95: 3/2$^+$, 8.95: (1/2$^-$), 10.0: (3/2$^-$), 11.0: (1/2$^+$) and 12.05: (3/2$^+$).

1980Ho11: ^{13}C(γ,n_0) E=6.5-9.3 MeV; measured σ(θ), θ=90°, 135°; deduced Γ_γ. High-resolution R-matrix analysis. Reported on E_x=7.56, 7.69, 8.19, 8.89 MeV.

1982Ki09: ^{13}C(γ,n) E=5-25 MeV; analyzed σ(E). ^{13}C deduced GDR isospin splitting.

1983Zu02: ^{13}C(γ,p) E=17.5-28 MeV; measured σ(E) for photonproton emission using activation techniques. Deduced peaks at E_x=18.6, (19.7), 20.7, (22), 23.5, 24.5, (26) MeV. Compared with (1979Ju01).

See (1999Su12) for related discussion and analysis of the ^{13}C pygmy and giant resonances.

Theory:

1969Au06: ^{13}C(γ,n) E<17 MeV; analyzed σ(E) data, deduced resonant contributions.

1972Go27: ^{13}C(γ,n),(γ,p) E<30 MeV; calculated σ(E); analyzed giant resonance.

1972Ha16: ^{13}C(γ,n); derived isospin sum rules for photonuclear reactions.

1973KiZI, 1974Ki03: ^{13}C(γ,n); calculated σ(En) in GDR region.

1974Ma10: ^{13}C(γ,n); calculated giant dipole resonance, isospin splitting.

1977Al18: ^{13}C(γ,X); calculated σ. ^{13}C calculated resonances, T. Two-particle, one-hole shell model.

1977Ho32: ^{13}C(γ,np) E=10-35 MeV; calculated σ(E).

1977Ma06: ^{13}C(γ,n); calculated σ. ^{13}C calculated GDR decay properties.

1979Ho17: ^{13}C(γ,n) E=10-35 MeV; calculated σ(E). Continuum shell model, 3 particle-2 hole configurations.

1993Mc02: ^{13}C(γ,n) E<36 MeV; analyzed σ(E); deduced isospin component splitting.

2017Dz03: ^{13}C(γ,p) E=18-30 MeV; analyzed σ(E). Compared with experimental results.

2024Ut01: ^{13}C(γ,n) E<18 MeV; measured photoneutron cross sections at NewSUBARU. TALYS analysis.

^{13}C(γ,n),(γ,nγ),(γ,p) (continued)

^{13}C Levels

E(level)†	Jπ†	Γ‡	Comments
7560	5/2−		$\Gamma_{\gamma 0}$=0.110 eV *15* (1980Ho11) E(level): From (1980Ho11). E2 transition (1980Ho11).
7690	3/2+	60 keV	$\Gamma_{\gamma 0}$=0.6 eV *1* (1980Ho11); Γ_n=0.17 MeV (1980Ho11) E1 transition (1980Ho11). Γ: See also 0.6 MeV (1976Ko22).
8200	3/2+	375 keV	$\Gamma_{\gamma 0}$=7.0 eV *9* (1980Ho11); Γ_n=1.11 MeV (1980Ho11) E1 transition (1980Ho11).
8860	1/2−	175 keV	$\Gamma_{\gamma 0}$=5.4 eV *5* (1980Ho11); Γ_n=0.17 MeV (1980Ho11) M1 transition (1980Ho11).
9500	(3/2−)	<90# keV	E(level): From (1977Wo04). Jπ: From (1970Aj04).
9897	3/2−	<100# keV	
10996	1/2+	<150# keV	Γ: See also 0.4 MeV (1976Ko22).
12106	3/2+	150 keV	
13000?		3.3 MeV	Γ: From (1976Ko22).
13570		500 keV	E(level): See also 13.5 MeV *10* with Γ=5 MeV *1* (1956Co72, 1957Co57).
13760			E(level): From (1979Ju01).
14983		400 keV	Γ: See also 0.54 MeV (1976Ko22).
≈15120	3/2−	<135# keV	T=3/2 (1977Wo04,1979Ju03) $\Gamma_{\gamma 0}$=19.7 eV *20* (1979Ju01) E(level): See (1977Wo04,1979Ju03).
16950		<400# keV	
17920		<450# keV	
20.8×10^3		3.9 MeV	E(level): (1979Ju01). See also E_x=20.5 MeV (1976Ko22). Γ: From (1976Ko22). Γ value is uncertain.
24×10^3 *2*		10 MeV *2*	E(level),Γ: From (1957Co57). See also (1956Co72).
≈30×10^3			E(level): (1979Ju01).
≈37×10^3			E(level): weak resonance (1979Ju01). Not placed in Adopted Levels.

† From the R-matrix analysis of (1980Ho11) and the Legendre polynomial analysis of (1979Wo06). See (1976Ko22, 1977Wo04, 1979Ju01, 1979Wo06, 1980Ho11).

‡ From (1977Wo04) except where noted.

From (1977Wo04: system resolution).