^{14}C(^{3}He,X): res 1972Ke08,1976Ch04

History			
Type	Author	Citation	Literature Cutoff Date
Full Evaluation	C. G. Sheu, J. H. Kelley, J. Purcell	ENSDF	5-Aug-2021

^{14}C(^{3}He,γ):

1972VeZY: ^{14}C(^{3}He,γ), E=3.2-7.4 MeV; measured σ(E; E$_\gamma$,$\theta(\gamma)$). ^{17}O deduced resonances, J, π.

1976Ch04: E(^{3}He)=3.2-7.5 MeV ion beams, from the Stanford FN tandem Van de Graaff accelerator, bombarded a thin carbon film (enriched 50% ^{14}C). The γ-rays were detected by a 24×24 cm^2 NaI(Tl) crystal at θ=90° with respect to the incident beam. At some energies, the angular distributions were measured in the range θ=0°−135°. Energy levels at ^{17}O*(21.7 *1*,22.2 *1*,22.6 *2*,23.0 *1*,23.5 *1* and 24.4 *1*) were observed and J$^\pi$ values for the first levels were assigned as 5/2$^+$,7/2$^-$,3/2$^{(-)}$ and 1/2$^+$, respectively.

^{14}C(^{3}He,n):

1961Jo24: ^{14}C(^{3}He,n$_0$), E=1.6-3.25 MeV; observed two resonances at E(^{3}He)=2.1 and 2.8 MeV, corresponding to ^{17}O*(20.5,21.1 MeV).

1970Ho08: The ^{14}C(^{3}He,n) reaction was investigated using neutron time-of-flight spectrometry by bombarding a ^{14}C target with E(^{3}He)=3.5-6 MeV beams at the University of Alberta/Van de Graaff facility. DWBA calculations were used to analyze angular distributions. Energy levels at ^{16}O*(0, 6.05+6.13, 6.92+7.12 MeV) were observed. A resonance at E$_{res}$=4.1 MeV was observed in the 0° excitation function of the ^{16}O ground state and the second doublet which implies ^{16}O*(7.12 MeV:1$^-$) state is strongly participating in this region, which corresponds to a level or levels at 22.2 MeV in ^{17}O.

^{14}C(^{3}He,p),(^{3}He,d):

1970KeZY: ^{14}C(^{3}He,p),(^{3}He,d), E=2-7 MeV; measured σ(E; θ). ^{17}O deduced resonances, J, π.

1972Ke08: This experiment was performed at the University of Florida/ Van de Graaff accelerator using E(^{3}He)=2.2-7 MeV ion beams bombarding a ^{14}C target (70% enriched acetylene on 0.10 μm Ni foil). Two solid state detectors (1000 μm and 300 μm thick) placed 15 cm from the target were used to detect the reaction products. The absolute cross sections were obtained with a uncertainty of ±20%. Three levels at ^{17}O*(21.7 MeV *1*, 22.1 MeV *1*, 23.0 MeV *1*) were deduced with J$^\pi$=5/2$^+$, 7/2$^-$, 1/2$^+$, respectively, using a two-level analysis of the α-channel data and an optical-model-plus-resonance (OMPR) analysis of the elastic data.

^{14}C(^{3}He,^{3}He):

1970Du07: ^{14}C(^{3}He,^{3}He), E=4-18 MeV; measured σ(E; θ); deduced optical potential parameters.

1970KeZY: ^{14}C(^{3}He,^{3}He), E=2-7 MeV; measured σ(E; θ). ^{17}O deduced resonances, J, π.

1971Co14: ^{14}C(^{3}He,^{3}He), E=6.0,8.0,10.0 MeV; measured $\sigma(\theta)$; deduced optical model parameters.

1972Ke08: ^{14}C(^{3}He,^{3}He), see above.

^{14}C(^{3}He,α):

1970KeZY: ^{14}C(^{3}He,α), E=2-7 MeV; measured σ(E; θ). ^{17}O deduced resonances, J, π.

1971Co14: ^{14}C(^{3}He,α), E=6.0,8.0,10.0 MeV; measured $\sigma(\theta)$; deduced optical model parameters. Enriched targets.

1971Ke08: A ^{3}He ion beam from the University of Florida 4 MV Van de Graaff accelerator bombarded a ^{14}C target (70% enriched acetylene deposited on a 0.1 μm Ni foil). The α-particle angular distributions, measured in 5° step and covering θ=20°−160°, were fitted using a Legendre polynomial expansion. Two broad states at ^{17}O*(21.7 MeV *1*:5/2$^+$,22.1 MeV *1*:7/2$^-$) with $\Gamma_{cm}\approx$750 keV were obtained in both α_0 and α_1 channels with corresponding E$_{res}$=3.6 and 4.1 MeV. The 22.1-MeV level is suggested to be a 3p-2h quasi-bound state.

1972Ke08: ^{14}C(^{3}He,α), see above.

Theory:

Differential cross sections are calculated and analyzed in (1986Ze04: E=16-22 MeV), (1989Er05: E=72 MeV), (1990De31: E=39.6,12 MeV), (1992Ga26: E=72 MeV), (1996De49: E=72 MeV), (1996Go14: E(cm)=59,33 MeV), (2014El01: E=37.9 MeV), (2015Pa10: E=4-118.5 MeV; analyzed $\sigma(\theta)$ for 142 sets of experimental data; deduced optical model parameters). See also (1983Me18).

^{14}C(^{3}He,X): res 1972Ke08,1976Ch04 (continued)

^{17}O Levels

Notes:
(1972Ke08) also report excitation functions in the range E(^{3}He)=2.2-7.0 MeV (α_{0-3}), 3.2-4.4 MeV (p_{0-3}), 3.2-5.5 MeV (d) and 4.0-6.1 MeV (^{3}He): angular distributions for the α-groups have been measured at a number of energies.
For ^{17}O deduced resonances, J, π, see also (1970KeZY,1972VeZY).
The variation of the ^{3}He optical parameters has been studied for E(^{3}He)=10-18 MeV (1970Du07).
(Ke70): Keyser et al., Bull. Amer. Phys. Soc. 15 (1970) 1685.

E(level)	J^{π}[‡]	Γ[#]	E_{res}(lab) (MeV)[@]	Comments
0	$5/2^+$			E(level),J^{π}: from Adopted Levels.
871	$1/2^+$			E(level),J^{π}: from Adopted Levels.
20489[†&]			2.1[†]	%n>0 E(level): from E(^{3}He)=2.1 MeV (1961Jo24).
21066[†&b]			2.8[†]	%n>0 E(level): from E(^{3}He)=2.8 MeV (1961Jo24).
21725[@ab] *82*	$5/2^+$	0.75 MeV	3.6 *1*	%IT>0; %α>0 E(level): from E(^{3}He)=3600 keV *100* (1976Ch04). See also E_{res}=3600 keV (Ke70,1971Ke08,1972Ke08).
22136[@&abcd] *82*	$7/2^-$	0.75 MeV	4.1 *1*	%IT>0; %n>0; %α>0 E(level): From E(^{3}He)=4100 keV *100* (1976Ch04). See also E_{res}=4100 keV (Ke70,1970Ho08,1971Ke08,1972Ke08). J^{π}: (1970Ho08) however suggests ($1/2^-$,$3/2^-$).
22.55×10^3[@ab] *17*	$3/2^{(-)}$	≈1[@] MeV	4.6 *2*	%IT>0 E(level): from E(^{3}He)=4600 keV *200* (1976Ch04).
22960[@ae] *82*	$1/2^+$	≈0.4 MeV	5.1 *1*	%IT>0 E(level): from E(^{3}He)=5100 keV *100* (1976Ch04). See also E_{res}=5100 keV (Ke70,1972Ke08).
23454[@ab] *82*			5.7 *1*	%IT>0 E(level): from E(^{3}He)=5700 keV *100* (1976Ch04).
24442[@a] *82*			6.9 *1*	%IT>0 E(level): from E(^{3}He)=6900 keV *100* (1976Ch04).

† From (1961Jo24: ^{14}C(^{3}He,n_0)).
‡ From (1976Ch04: ^{14}C(^{3}He,γ)). See also (1971Ke08: ^{14}C(^{3}He,α), 1972Ke08: ^{14}C(^{3}He,α/d/p/^{3}He), Ke70: ^{14}C(^{3}He,^{3}He/α)).
# From (1972Ke08) except where noted.
@ From (1976Ch04) except where noted.
& Observed in (^{3}He,n).
a Observed in (^{3}He,γ).
b Observed in (^{3}He,α).
c Observed in (^{3}He,p).
d Observed in (^{3}He,d).
e Observed in (^{3}He,^{3}He).

^{14}C(^{3}He,X): res 1972Ke08,1976Ch04 (continued)

$\gamma(^{17}O)$

E_γ [†]	E_i(level)	J_i^π	E_f	J_f^π	Mult. [†]	Comments
20855 [‡]	21725	$5/2^+$	871	$1/2^+$	E2	
21679	22.55×10^3	$3/2^{(-)}$	871	$1/2^+$	E1	
21725	21725	$5/2^+$	0	$5/2^+$	M1+E2	The integrated E2 strength for 21725 and 22960 states was estimated to be about 1.5% of the E2 sum rule.
22136	22136	$7/2^-$	0	$5/2^+$	E1	
22550	22.55×10^3	$3/2^{(-)}$	0	$5/2^+$	E1	
22960	22960	$1/2^+$	0	$5/2^+$	E2	

† See (1976Ch04).
‡ Placement of transition in the level scheme is uncertain.

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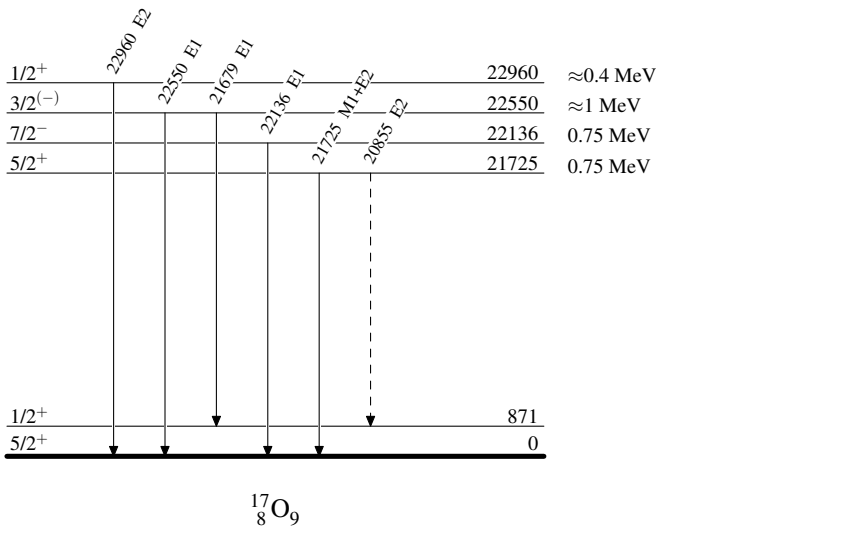
Level Scheme



$^{17}_{8}O_9$