^{13}C(^{7}Li,t) 1978Cl08

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

1970Be31: The ^{13}C(^{6}Li,d) and ^{13}C(^{7}Li,t) reactions were studied at the University of Pennsylvania tandem accelerator using 18-MeV ^{6}Li and 17-MeV ^{7}Li ion beams bombarding a self-supporting, 60±14 μg/cm^2 thick ^{13}C target. The deuterons and tritons were momentum-analyzed in a miltiangle spectrograph over an angular range θ=3.75°−172.5°. Fifteen energy levels below E$_x$=8.5 MeV were deduced from the angular distributions. Transitions to the negative-parity states at E$_x$=3.06, 3.85, and 4.55 MeV are the strongest observed. Comparison with those from the ^{12}C(^{7}Li,t) and ^{12}C(^{6}Li,d) reactions resolves the first K=0, ^{16}O rotational band. Strong transitions were also observed at E$_x$=7.38, (8.46,8.49), (8.87,8.95), and (9.14,9.20) MeV.

1970Go29: Beams of E=25.6 MeV/30.1 MeV ^{6}Li/^{7}Li ions from the Cyclotron of the Kurchatov Atomic Energy Institute at impinged on a self-supporting carbon foil (0.4 mg/cm^2, 75% ^{13}C isotope enriched). The reaction products were detected and identified with a ΔE/ΔX-E counter telescope. The energy spectra were analyzed using a multidimensional analyzer. The angular distributions of the deutrons were obtained at θ=0°−45°. Excitated states of ^{17}O*(0,0.87,3.06,3.85,4.56,7.56,8.88 MeV) were observed. The group of levels in the energy range E$_x$=5.0-6.4 MeV were masked by the ^{12}C impurity in the target and not observed. The J$^\pi$ value of the ^{17}O*(7.56 MeV) state was determined as 9/2$^-$. The hypothesis of the weak binding of the four particles in the sd shell and of several holes in the p shell is confirmed.

1971Sc21: The reactions ^{12}C(^{7}Li,d) and ^{13}C(^{7}Li,t) were studied at E$_{cm}$=13.3 MeV using a lithium beam from the E(n)-tandem-van-de-Graaff-Accelerator of the Max-Planck-Institut, impinged on a ^{13}C target (50% ^{13}C, 50% ^{12}C and ^{16}O). The reactions products were identified by the ΔE-E information. The overall resolutions for deutrons was about 90 keV.

The integrated cross sections σ_{int} were measured in both reactions. Spin assignments were extracted from σ_{int} in the reaction ^{12}C(^{7}li,d) and a modified DWBA code was used to analyze the reaction ^{13}C(^{7}Li,t). Energy levels and J$^\pi$ values of ^{17}O were deduced.

1978Cl08: Ion beams of ^{6}Li or ^{7}Li at E=34, 36 MeV, produced at the Florida State University/FN tandem Van de Graaff accelerator, impinged on 100 μg/cm^2 thick ^{13}C targets (enriched 99%). A telescope consisting of a ΔE and a Si(Li)E detector was used to detect particles with a subtended angle θ=0.2° with resolution 85 keV for tritons and 75 keV for deuterons. Angular distributions were measured at θ=5.0°−31.5°. Strongly populated excited levels of ^{17}O*(13.58 *2*: suggested J$^\pi$=11/2$^-$ or 13/2$^-$ or both,14.86,18.17,19.24 MeV) were observed.

1982Ta23: ^{13}C(^{7}Li,t), E=36,32,28 MeV; measured yield vs particle energy, $\sigma(\theta)$, fusion σ, breakup σ vs E; deduced reaction mechanism. Optical, simple breakup model analyses.

2008Pe09: The ^{13}C(α,n)^{16}O reaction was investigated through the direct α transfer reaction ^{13}C(^{7}Li,t). The experiment was performed at the Orsay Tandem using a ^{7}Li^{3+} beam at E=28, 35 MeV to bombard a self-supporting, 90% enriched ^{13}C target (72(4) or 133(7) μg/cm^2). The reaction products were analyzed with an Enge split-pole spectrometer and detected and identified by a position-sensitive gas chamber and a ΔE proportional gas counter. The tritons were detected at θ=0°−31°. Differential cross sections of ^{17}O*(3.055,4.55,6.356,7.37 MeV) states were measured and comapred with finite-range DWBA calculations. The spectroscopic factor, ANC (asymptotic normalization factor) and the α width of ^{17}O*(6.356 MeV:1/2$^+$) subthreshold state were deduced using DWBA analysis. The result confirms that the contribution of the 1/2$^+$ state is dominant at astropysical energies. See also (2007PeZZ).

2020Me09: The authors analyzed ^{17}O states populated in the ^{13}C(^{7}Li,t) reaction to evaluate the ^{17}F analog states that may influence stellar ^{13}N(α,p) reaction rates.

A beam of 34 MeV ^{7}Li ions, from the Tandem-ALTO facility at Orsay, impinged on a 90% ^{13}C enriched 80 μg/cm^2 carbon target. Tritons from reactions in the target were momentum analyzed for $\theta_{lab.}$=0°−33° using an Enge Split-Pole spectrometer. Angular distributions were analyzed via finite-range DWBA for states within E$_x$=5.6-7.7 MeV.

Spectroscopic factors and Γ_α widths were deduced. Using this information the analog states in ^{17}F are evaluated and the ^{13}N(α,p)^{16}O astrophysical reaction rate is obtained using the AZURE2 R-matrix code and found within a factor of two in comparison of previous estimates. Resonances at E$_{c.m.}$(α)=221, 741 and 959 keV (^{17}F*(6039,6560,6778 keV)) are found to contribute the most uncertainty to the reaction rate.

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^{17}O Levels

Γα: From (2020Me09) except where noted.

E(level)[†]	Jπ[‡]	$T_{1/2}$	L[#]	C^2S_α[b]	Comments
0	5/2		3		
870	1/2		1		
3055	1/2		0		S_α=0.32 at E(^{7}Li)=34 MeV, S_α=0.22 at E(^{7}Li)=28 MeV (2008Pe09).
3850	5/2		2		
4553	3/2		2		S_α=(0.10 *5*) (2008Pe09).
5080					
5220	7/2				
5690			4[a]	0.014	Unresolved (1970Be31,1971Sc21,1978Cl08).
5720			2[a]		Unresolved (1970Be31,1971Sc21,1978Cl08).
5870	5/2		1[a]		Unresolved (1970Be31,1971Sc21).
5940	1/2		0[a]	0.19	Unresolved (1970Be31,1971Sc21).
6356			1[a]	0.29	S_α=0.29 *11*, ANC^2=4.5 fm^{-1} *22* and γ^2_α (reduced α width)=13.5 keV *66* from (2008Pe09).
6870	7/2		3[a]	0.012	Γα=0.11×10^{-3} eV
6990	5/2		4[a]	0.020	Γα=0.082×10^{-3} eV
7170	5/2		2[a]	0.12	Γα=3.4 eV
7202			1[a]	0.24	Γα=73 eV E(level): from (1993Ti07). Γ_n=400 keV, Γ_α=0.09 keV (2008Pe09) which are consistent with the ^{16}O+n measurement in (1966Li03: Γ_n/Γ>0.99).
7379[&]	9/2		3[a]	0.16[&]	Γα=8.0 eV
7382[&]			2[a]	0.42[&]	Γα=131 eV
7560	9/2$^-$[#]		4		Jπ: See also 9/2 (1971Sc21).
7576	(7/2$^+$)	<0.1 keV	3[a]	0.029	Γα=7.3 eV E(level): From (2020Me09).
7690	(3/2,7/2,3/2)		4[a]	0.12	Γα=3.3 eV Unresolved (1970Be31,1978Cl08).
7750					Unresolved (1970Be31,1978Cl08).
8400	5/2				Unresolved (1971Sc21).
8470	9/2				Unresolved (1970Be31,1971Sc21,1978Cl08).
8510	5/2				Unresolved (1970Be31,1971Sc21,1978Cl08).
8679					
8873	3/2				Unresolved (1970Be31,1971Sc21).
8884	7/2		4		Unresolved (1970Be31,1971Sc21,1978Cl08).
8945	7/2				Unresolved (1970Be31,1971Sc21,1978Cl08).
9147					
9150					Unresolved (1970Be31).
9180					Unresolved (1970Be31).
9500					
9730					
9880					Unresolved (1971Sc21).
9950					Unresolved (1971Sc21).
10560					
10780					
11750					
11820					
12400					
13300?					
13580[@] *20*	(11/2$^-$,13/2$^-$)[#@]				

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^{17}O Levels (continued)

E(level)[†]
14600
14860
18170
19240

† Observed in (1970Be31, 1970Go29, 1971Sc21, 1978Cl08, 2008Pe09). See nominal level energy values listed in, for example, (1978Cl08).
‡ From (1971Sc21) except where noted.
# From (1970Go29), except where noted.
@ From (1978Cl08).
& Unresolved, the spectroscopic factor assumes all strength is in one state or the other.
a From (2020Me09).
b From (2020Me09).