$^{58}Ni(^{3}He,t),(^{3}He,t\gamma)$ 2007Fu04,2002Fu07,1973Ru03

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Caroline D. Nesaraja, Scott D. Geraedts and Balraj Singh	NDS 111, 897 (2010)	12-Jan-2010

All references, except 2003Ha43, deal with (^{3}He,t) measurements. 2003Ha43 study decay of excited states by protons and gamma rays.

2007Fu04, 2007Ze06: E=140 MeV/nucleon, enriched target. Tritons were analyzed with Grand Raiden magnetic spectrometer at rcnp facility and detected with multiwire drift chambers. FWHM=35 keV. Spectra measured with an acceptance angle of 0-0.8°. Excitation energy range covered in this work is from 8370 to 12880 keV. Shell-model calculations. 2007Ze06 report data for first three levels. 2009Fu15 conference report is by the same group.

Additional information 1.

2003Ha43 (also 2004Fu25): (^{3}He,t), (^{3}He,tγ) E=450 MeV. Measured triton spectra, tγ coin, pt coin, $\gamma\gamma$ coin, deduced γ and proton decay branching ratios. Grand Raiden spectrometer at 0° at RCNP facility. Protons from the excited states were measured using an array of 37 lithium-drifted silicon detectors. FWHM=300 keV in coin arrangement. Gamma rays were detected with four HPGe detectors.

2002Fu07: E=450 MeV. Measured triton spectra at four angles: 0°, 0.25-0.5°, 0.5-0.75° and ≤0.25° using the QQDD-type Grand Raiden spectrometer, FWHM=50 keV. Deduced Gamow-Teller strengths.

1973Ru03 (also 1971RuZX thesis) : E= 24 MeV, FWHM= 40-60 keV. Measured: $\sigma(\theta)$ from 10°−80° (lab), DWBA analysis. A total of 21 groups were observed up to an excitation energy of 4210 keV.

1972Be38 (also 1971Be29): E= 24.6 MeV, FWHM≈ 10 keV Measured: $\sigma(\theta)$, DWBA analysis. Total of seven groups reported at 0, 202, 441, 1051, 1436, 1558 and 1667.

Others:

1996Fu03: E=150 MeV/nucleon. Measured triton spectra at 0°, deduced Gamow-Teller strengths for isospin components in terms of groups of levels.

1994Ak02: E=450 MeV, FWHM=210 keV; observed strong excitation of Gamow-Teller (G-T) and spin flip (ΔL) resonances and fine structure of G-T strength in ^{58}Cu. The triton spectrum shows levels at 0, 204, 1051 and 5004, amongst other unlabeled peaks.

1989Va09 (also 1990Va08): E= 73 MeV, FWHM≈ 50 keV; deduced effective projectile-nucleon force. Data for g.s. and 204 level, DWBA analysis.

1971Ma06: E=24.6 MeV. Measured $\sigma(\theta)$, DWBA analysis for ^{58}Cu g.s.

1969Ku09: E=37.5 MeV. Measured $\sigma(\theta)$, DWBA analysis. Data for isobaric (0^{+}) ground state and isobaric first (2^{+}) excited state.

1966Sh02: E=22 MeV. Measured σ, deduced isobaric analog states. Data for isobaric (0^{+}) ground state.

Theoretical analysis: 2008Be23: analyzed isospin-spin excitations using isoscalar and isovector pairing vibrations, Gamow-Teller modes and their couplings.

^{58}Cu Levels

E(level)[†]	J$^{\pi}$[‡]	L[†b]	B(GT)[c]	Comments
0.0	1^{+}	0[a]	0.155 *1*	T=0 L: 0+2 (1973Ru03). B(GT): 2002Fu07 adopt this value from β decay and use this as a reference.
204[#] *10*	0^{+}	0[&]		T=1 Fermi β strength function=2 (2007Ze06). E(level): analog of g.s. of ^{58}Ni. Additional information 2.
444[#] *10*	(3^{+})	(2+4)[&]		Additional information 3.
1051[#] *10*	(1^{+})	0[a]	0.265 *13*	T=0 L: (0+2) (1973Ru03). Additional information 4.
1427[#] *10*	2^{+}	2		L: from 1973Ru03 and 1972Be38. Additional information 5.
1558 *15*		(4)		E(level),L: from 1972Be38; 1550 *10* In 1973Ru03; not listed by 2002Fu07.
1651[#] *10*	2^{+}	2[&]		T=1 E(level): analog of 1454, 2^{+} in ^{58}Ni.

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$^{58}Ni(^{3}He,t),(^{3}He,t\gamma)$ 2007Fu04,2002Fu07,1973Ru03 (continued)

^{58}Cu Levels (continued)

E(level)[†]	Jπ[‡]	L[†b]	B(GT)[c]	Comments
				Additional information 6.
2070[@] 20				
2170[@] 20				
2270[@] 20				
2690[@] 20	4+	4[&]		
2780[@] 20				
2840[@] 20				
2949[#] 10	(1+)	0[a]	0.025 3	T=0 L: (4+6) (1973Ru03). Additional information 7.
3230[@] 20				
3310[@] 20				
3460[#] 10	(1+)	0[a]	0.173 11	T=0 Additional information 8.
3570[@] 20				E(level): multiplet.
3678[#] 10	(1+)	0[a]	0.155 10	T=0 Additional information 9.
3717[#] 10	(1+)	0[a]	0.050 5	T=0 Additional information 10.
3820[@] 20				
3890[@] 20				
4210[@] 20				
4720 10	1+	0	0.042 4	T=0
5065 20	1+	0	0.040 4	T=0 Additional information 11.
5160 20	1+	0	0.250 14	T=0
5451 20	1+	0	0.082 7	T=0
5645 20	1+	0	0.016 3	T=0
6038 20	1+	0	0.029 4	T=0
6086 20	1+	0	0.033 4	T=0
6497 20	1+	0	0.061 7	T=0
6844 20	1+	0	0.044 5	T=0
7105 20	1+	0	0.057 6	T=0
7143 20	1+	0	0.014 4	T=0
7586 20	1+	0	0.073 7	T=1
7700 20	1+	0	0.021 4	T=0
7752 20	1+	0	0.028 5	T=0
7907 20	1+	0	0.052 5	T=1
7993 20	1+	0	0.049 5	T=0
8063 20	(1+)	0	0.035 5	T=(1).
8159 20	(1+)	(0)	0.037 5	T=(0).
8199 20	(1+)	(0)	0.033 4	T=(0).
8282 20	(1+)	(0)	0.016 4	T=(0).
8370 10	1+	0	0.045 5	T=1 E(level): analog of 8203 level in ^{58}Ni.
8421 10	1+	0	0.065 6	T=1 E(level): analog of 8276 level in ^{58}Ni.
8520 10	1+	0	0.029 5	T=1 E(level): analog of 8372 level in ^{58}Ni.
8566 10	1+	0	0.039 5	T=1 E(level): analog of 8433 level in ^{58}Ni.
8614 10	1+	0	0.059 7	T=1

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^{58}Ni(^{3}He,t),(^{3}He,tγ) 2007Fu04,2002Fu07,1973Ru03 (continued)

^{58}Cu Levels (continued)

E(level)[†]	J^{π}[‡]	L[†b]	B(GT)[c]	Comments
				E(level): analog of 8461 level in ^{58}Ni.
8725 *10*	1^{+}	0	0.068 *11*	T=1 E(level): analog of 8601 level in ^{58}Ni.
8837 *10*	1^{+}	0	0.190 *11*	T=1 E(level): analog of 8679 level in ^{58}Ni.
8959 *10*	1^{+}	0	0.040 *5*	T=0
9000 *10*	1^{+}	0	0.077 *7*	T=1 E(level): analog of 8856 level in ^{58}Ni.
9129 *10*	1^{+}	0	0.075 *6*	T=1 E(level): analog of 8957 level in ^{58}Ni.
9172 *10*	1^{+}	0	0.064 *7*	T=0
9209 *10*	1^{+}	0	0.048 *6*	T=1 E(level): analog of 9073 level in ^{58}Ni.
9307 *10*	1^{+}	0	0.054 *7*	T=1 E(level): analog of 9157 level in ^{58}Ni.
9371 *10*	1^{+}	0	0.047 *6*	T=1 E(level): analog of 9249 level in ^{58}Ni.
9444 *10*	1^{+}	0	0.044 *7*	T=1 E(level): analog of 9326 level in ^{58}Ni.
9567 *10*	1^{+}	0	0.032 *5*	T=0
9645 *10*	1^{+}	0	0.073 *6*	T=1 E(level): analog of 9526 level in ^{58}Ni. Note that negative parity (E1 excitation is also assigned to ^{58}Ni parent level in (γ,γ') work (2000Ba63). Thus.
9783 *10*	1^{+}	0	0.026 *6*	T=0
9861 *10*	1^{+}	0	0.031 *6*	T=2 E(level): analog of 9750 level in ^{58}Ni.
9989 *10*	1^{+}	0	0.055 *6*	T=1 E(level): analog of 9843 level in ^{58}Ni. A corresponding state reported in ^{58}Ni(e,e′) (1987Me16) with T=2.
10291 *10*	1^{+}	0	0.054 *6*	T=1 E(level): analog of 10107 level in ^{58}Ni.
10329 *10*	1^{+}	0	0.040 *7*	T=1 E(level): analog of 10157 level in ^{58}Ni. A corresponding state reported in ^{58}Ni(e,e′) (1987Me16) with T=2.
10388 *10*	1^{+}	0	0.027 *8*	T=2 E(level): analog of 10209 level in ^{58}Ni.
10554 *10*	1^{+}	0	0.033 *6*	T=0 E(level): analog of 10510 level in ^{58}Ni.
10597 *10*	1^{+}	0	0.028 *6*	T=2 E(level): analog of 10582 level in ^{58}Ni.
10825 *10*	1^{+}	0	0.120 *8*	T=2 E(level): analog of 10664 level in ^{58}Ni.
11137 *10*	1^{+}	0	0.027 *5*	T=2 E(level): analog of 11014 level in ^{58}Ni.
11358 *10*	1^{+}	0	(0.014) *5*	T=2 E(level): analog of 11266 level in ^{58}Ni.
11562 *20*	1^{+}	0	(0.021) *5*	T=(2)
11815 *20*	1^{+}	0	(0.017) *5*	T=2 E(level): analog of 11678 level in ^{58}Ni.
11903 *20*	1^{+}	0	(0.017) *5*	T=0
12034 *20*	1^{+}	0	0.033 *6*	T=2 E(level): analog of 11872 level in ^{58}Ni.
12.45×10^{3} *15*				E(level): wide structure in the energy range of 12.3-12.6 MeV.

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^{58}Ni(^{3}He,t),(^{3}He,tγ) 2007Fu04,2002Fu07,1973Ru03 (continued)

^{58}Cu Levels (continued)

E(level)[†]	Jπ[‡]	L[†b]	B(GT)[c]	Comments
12880 *20*	1+	0	0.026 *6*	T=2 E(level): analog of 12744 level in ^{58}Ni.

[†] From 1973Ru03 for levels below 4720, unless otherwise stated. Levels between 4720 and 8282 are from 2002Fu07 only; levels from 8370 to 12880 are from 2007Fu04 only. Uncertainty of 10 keV is assigned up to 11.5 MeV excitation in 2007Fu04. Above this energy, 20 keV is assigned by the evaluators. All levels in 2007Fu04 are proposed as candidates for M1 states ($J^{\pi}=1^{+}$), according to figures 3 and 4a of 2007Fu04.

[‡] From 'Adopted Levels' for levels below 4700. Above this energy, $J^{\pi}=1^{+}$ is based on L values from $\sigma(\theta)$ and/or association with parent analog states with $J^{\pi}=1^{+}$ in ^{58}Ni through comparison of (B(GT)) strengths of analog states (2002Fu07,2007Fu04).

[#] From 2002Fu07.

[@] From 1973Ru03 only.

[&] From 1973Ru03.

[a] From 2002Fu07.

[b] Decreasing trend of cross sections at scattering angles beyond 0° indicates L=0. Increasing trend is expected for L=1 and higher multipoles (2002Fu07).

[c] From 2002Fu07 for levels below 8300, using the value for g.s. as a reference. Values in arbitrary units from 2007Fu04 for levels above 8300.

γ(^{58}Cu)

The γ-ray data are from 2003Ha43.

E_{γ}	E_i(level)	J^{π}_i	E_f	J^{π}_f	Comments
203	204	0+	0.0	1+	
444	444	(3+)	0.0	1+	
848	1051	(1+)	204	0+	
(3234)	3678	(1+)	444	(3+)	$\Gamma_{\gamma}/(\Gamma_p+\Gamma_{\gamma})$=0.31 *6* (2003Ha43).
3257	3460	(1+)	204	0+	$\Gamma_{\gamma}/(\Gamma_p+\Gamma_{\gamma})$=0.38 *11* (2003Ha43). Additional information 12.
3475	3678	(1+)	204	0+	$\Gamma_{\gamma}/(\Gamma_p+\Gamma_{\gamma})$=0.54 *16* (2003Ha43).

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Level Scheme

Legend