

$^{48}\text{Ti}(^3\text{He,t})$  2016Ga23,1975Ma13,1972Be38

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	Jun Chen	NDS 179, 1 (2022)	30-Nov-2021

**2016Ga23:** E=140 MeV/nucleon  $^3\text{He}$  beam was produced from the K=400 Ring Cyclotron at RCNP, Osaka. Target was a self-supporting foil of 0.85 mg/cm<sup>2</sup> 99.1% enriched in  $^{48}\text{Ti}$ . Reaction products were momentum analyzed with the “Grand Raiden” spectrometer (FWHM=21 keV) and detected with two multiwire drift chambers (MWDCs) which allow track reconstruction. Measured  $\sigma(E_t, \theta)$  with five angle cuts ( $0^\circ-0.5^\circ$ ,  $0.5^\circ-0.8^\circ$ ,  $0.8^\circ-1.2^\circ$ ,  $1.2^\circ-1.6^\circ$ ,  $1.6^\circ-2.0^\circ$ ). Deduced levels, L-transfers,  $T_z=+2$  to +1 Gamow-Teller (GT) transitions, Gamow-Teller  $\beta$  (B(GT)) strengths. DWBA analysis. Comparisons with shell-model calculations using GXPF1J interaction.

**1975Ma13:** E=25 MeV  $^3\text{He}$  beam was produced from the ANL tandem Van de Graaff accelerator. Target was 103  $\mu\text{g}/\text{cm}^2$   $^{48}\text{Ti}$  (99.4% enriched). Reaction products were momentum-analyzed with a split-pole spectrograph (FWHM=25 keV) and detected with nuclear emulsions. Measured  $\sigma(\theta)$ ,  $\theta=7^\circ$  to  $70^\circ$ . Deduced levels, J,  $\pi$ , L-transfers from DWBA analysis. Comparisons with shell-model calculations. The uncertainty in absolute cross section is estimated to be 25%.

**1972Be38:** E=24.6 MeV  $^3\text{He}$  beam was produced from the J.H.Williams Laboratory tandem Van de Graaff accelerator. Target was 150  $\mu\text{g}/\text{cm}^2$   $^{48}\text{Ti}$  (99.4% enriched). Reaction products were momentum-analyzed with a split-pole spectrometer (FWHM=10 keV) and detected with an array of 500  $\mu\text{m}$  position-sensitive detectors. Measured  $\sigma(\theta)$ ,  $\theta(\text{c.m.})\approx 10^\circ$  to  $85^\circ$ . Deduced levels, J,  $\pi$ , L-transfers from DWBA analysis. Comparisons with available data.

**1962BI07:** E=25 MeV  $^3\text{He}$  from the Los Alamos variable-energy cyclotron. Tritons were detected with a gas ion chamber ( $\Delta E$ ) and a semiconductor detector (E). Measured  $\sigma(\theta)$ . Deduced levels.

Others: 2016Fu02, 2016Ru04, 2009Fa15, 1968Dz03, 1967Ro09, 1966Sh02,

$^{48}\text{V}$  Levels

Additional information 1.

E(level) <sup>†</sup>	L <sup>†</sup>	B(GT) strength <sup>@</sup>	Comments
0.0	4		
308 <sup>‡</sup>	2		E(level): other: 327 15 (1972Be38).
421 <sup>‡</sup>		0.224 13	E(level): others: 421 10 (2016Ga23), 413 15 (1972Be38). L: 0 from 2016Ga23, 2 from 1975Ma13. Additional information 2.
613 10			E(level): other: 615 15 in 1972Be38 could correspond to 613+629 in 1975Ma13.
629 10	6		
745 10	3		E(level): other: 757 15 in 1972Be38 could correspond to 745+767 in 1975Ma13.
767 10	4		
1057 10	3		E(level): other: 1068 15 (1972Be38).
1098 10	5,6		
1257 10	8		
1268 10			E(level): other: 1268 15 in 1972Be38 could correspond to 1257+1268 in 1975Ma13.
1333 10			
1522 10	(2)		E(level): other: 1535 15 (1972Be38).
1561 10			
1685 10			
1728 10	6		E(level): other: 1703 15 in 1972Be38 could correspond to 1685+1728 in 1975Ma13.
1767 10			
1781 <sup>‡</sup>	4		E(level): other: 1754 15 (1972Be38).
2098 10			
2120 10	2		E(level): other: 2140 15 (1972Be38).
2187 10		0.013 1	E(level): others: 2186 10 (2016Ga23), 2211 15 (1972Be38). L: 0 from 2016Ga23, but 3 from 1975Ma13, this could indicate a doublet. Additional information 3.
2258 10			
2287 10	0	0.076 5	E(level): others: 2288 10 (2016Ga23); 2278 15 in 1972Be38 could correspond to 2258+2287

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<sup>48</sup>Ti(<sup>3</sup>He,t) **2016Ga23,1975Ma13,1972Be38 (continued)**

<sup>48</sup>V Levels (continued)

<u>E(level)<sup>†</sup></u>	<u>L<sup>†</sup></u>	<u>B(GT) strength<sup>@</sup></u>	<u>Comments</u>
			in 1975Ma13. L: from 2016Ga23. <a href="#">Additional information 4.</a>
2324 10 2385 10 2408 <sup>‡</sup>		0.351 19	E(level): others: 2406 10 (2016Ga23); 2410 15 in 1972Be38 could correspond to 2385+2408 in 1975Ma13. L: 0 from 2016Ga23, 2 from 1975Ma13. <a href="#">Additional information 5.</a>
2456 10			E(level): others: 2458 15 in 1972Be38 and 2465 10 in 2016Ga23 could correspond to 2358+2473 in 1975Ma13. L: ≥1 for a group at 2465 10 in 2016Ga23. <a href="#">Additional information 6.</a>
2473 10 2580 10 2610 10	3	0.022 2	E(level): other: 2591 15 in 1972Be38 could correspond to 2580+2610 in 1975Ma13. E(level): other: 2611 10 (2016Ga23). L: 0 from 2016Ga23 but 2 from 1975Ma13 indicate a doublet. <a href="#">Additional information 7.</a>
2715 10 2760 10 2775 10 2793 10	5	0.024 2	E(level): other: 2673 15 (1972Be38).  E(level): other: 2773 15 in 1972Be38 could correspond to 2760+2775 in 1975Ma13. E(level): other: 2792 10 (2016Ga23). L: 0 from 2016Ga23, but 3 from 1975Ma13 is inconsistent. <a href="#">Additional information 8.</a>
2817 10 2893 10 2949 10 3021 <sup>‡</sup>	(5)   0		E(level): other: 2933 15 (1972Be38). E(level): IAS of <sup>48</sup> Ti 0 <sup>+</sup> ground state. Others: 3018 10 (2016Ga23), 3022 15 (1972Be38). L: also from 2016Ga23. <a href="#">Additional information 9.</a>
3071 <sup>#</sup> 15 3103 <sup>#</sup> 15 3198 <sup>#</sup> 15 3266 <sup>#</sup> 15 3310 <sup>#</sup> 15 3387 10		0 0.147 9	L: (0)+2 from 1972Be38. L: (0)+2 from 1972Be38. E(level): Other: 3400 15 (1972Be38). <a href="#">Additional information 10.</a>
3461 <sup>#</sup> 15 3490 <sup>#</sup> 15 3557 <sup>#</sup> 15 3633 <sup>#</sup> 15 3660 <sup>#</sup> 15 3722 <sup>#</sup> 15 3810 <sup>#</sup> 15 3864 10		0 0.213 12	E(level),L: other: 3898 15 with L=(0)+2 from 1972Be38. <a href="#">Additional information 11.</a> <a href="#">Additional information 12.</a>
3945 10 4030 <sup>#</sup> 15 4181 10	0 0 0	≤0.005 0.056 5	E(level): IAS of <sup>48</sup> Ti 983, 2 <sup>+</sup> (1972Be38). E(level): other: 4198 15 (1972Be38). <a href="#">Additional information 13.</a>
4201 10 4245 10	(0) 0	0.014 3 ≤0.005	E(level): other: 4218 15 (1972Be38). <a href="#">Additional information 14.</a> E(level): other: 4272 15 (1972Be38).

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${}^{48}\text{Ti}({}^3\text{He,t})$  **2016Ga23,1975Ma13,1972Be38 (continued)** ${}^{48}\text{V}$  Levels (continued)

E(level) <sup>†</sup>	L <sup>†</sup>	B(GT) strength <sup>@</sup>	Comments
4456 10	0	0.070 5	Additional information 15.
4554 10	0	0.101 6	Additional information 16.
4595 10	0	≤0.005	Additional information 17.
4678 10	0	0.107 7	Additional information 18.
4773 10	0	0.048 3	Additional information 19.
4857 10	0	0.012 1	Additional information 20.
4924 10	0	0.032 3	Additional information 21.
4971 10	0	0.013 2	Additional information 22.
5067 10	0	≤0.005	Additional information 23.
5130 10	0	0.057 4	Additional information 24.
5164 10	0	0.011 2	Additional information 25.
5199 10	0	0.030 3	Additional information 26.
5246 10	(0)	≤0.005	Additional information 27.
5277 10	0	0.0075 25	Additional information 28.
5388 10	0	0.0075 25	Additional information 29.
5430 10	0	0.019 2	Additional information 30.
5477 10	≥1		Additional information 31.
5516 10	≥1		Additional information 32.
5567 10	0	≤0.005	Additional information 33.
5702 10	0	0.0075 25	Additional information 34.
5739 10	0	0.067 5	Additional information 35.
5766 10	0	0.016 2	Additional information 36.
5820 10	0	0.042 3	Additional information 37.
5913 10	≥1		Additional information 38.
5965 10	0	0.033 3	Additional information 39.
6005 10	0	0.0075 25	Additional information 40.
6085 10	≥1		Additional information 41.
6192 10	0	0.064 7	Additional information 42.
6208 10	0	0.040 5	Additional information 43.
6280 10	0	0.032 3	Additional information 44.
6401 10	0	0.060 4	Additional information 45.
6464 10	0	≤0.005	Additional information 46.
6501 10	0	0.0075 25	Additional information 47.
6516 10	(0)	0.0075 25	Additional information 48.
6548 10	0	0.014 3	Additional information 49.
6568 10	(0)	0.0075 25	Additional information 50.
6603 10	(0)	0.0075 25	Additional information 51.
6641 10	0	0.031 3	Additional information 52.
6697 10	0	0.022 2	Additional information 53.
6748 10	≥1		Additional information 54.
6770 10	0	0.018 3	Additional information 55.
6819 10	0	0.093 6	Additional information 56.
6874 10	0	0.012 2	Additional information 57.
6924 10	0	0.019 2	Additional information 58.
6950 10	0	≤0.005	Additional information 59.
6982 10	0	0.014 2	Additional information 60.
7038 10	0	0.025 3	Additional information 61.
7061 10	0	0.0075 25	Additional information 62.
7106 10	0	0.0075 25	Additional information 63.
7163 10	0	0.0075 25	Additional information 64.
7219 10	0	0.030 3	Additional information 65.
7247 10	≥1		Additional information 66.
7308 10	0	0.033 3	Additional information 67.
7350 10	(≥1)		Additional information 68.
7374 10	0	0.0075 25	Additional information 69.
7398 10	0	0.011 3	Additional information 70.
			Additional information 71.

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${}^{48}\text{Ti}({}^3\text{He,t})$  **2016Ga23,1975Ma13,1972Be38** (continued) ${}^{48}\text{V}$  Levels (continued)

E(level) <sup>†</sup>	L <sup>†</sup>	B(GT) strength <sup>@</sup>	Comments
7428 10	0	0.031 4	<a href="#">Additional information 72.</a>
7455 10	0	0.050 4	<a href="#">Additional information 73.</a>
7496 10	0	0.010 2	<a href="#">Additional information 74.</a>
7520 10	0	0.015 2	<a href="#">Additional information 75.</a>
7558 10	0	0.017 3	<a href="#">Additional information 76.</a>
7580 10	0	0.011 2	<a href="#">Additional information 77.</a>
7639 10	0	0.015 2	<a href="#">Additional information 78.</a>
7693 10	0	0.0075 25	<a href="#">Additional information 79.</a>
7728 10	0	0.015 3	<a href="#">Additional information 80.</a>
7749 10	0	0.019 3	<a href="#">Additional information 81.</a>
7810 10	0	0.037 4	<a href="#">Additional information 82.</a>
7838 10	0	0.052 5	<a href="#">Additional information 83.</a>
7862 10	≥1		<a href="#">Additional information 84.</a>
7909 10	0	0.034 3	<a href="#">Additional information 85.</a>
7955 10	(≥1)		<a href="#">Additional information 86.</a>
7990 10	(0)	0.0075 25	<a href="#">Additional information 87.</a>
8049 10	0	≤0.005	<a href="#">Additional information 88.</a>
8086 10	0	0.0075 25	<a href="#">Additional information 89.</a>
8119 10	(0)	0.010 2	<a href="#">Additional information 90.</a>
8161 10	0	≤0.005	<a href="#">Additional information 91.</a>
8216 10	(0)	0.0075 25	<a href="#">Additional information 92.</a>
8262 10	0	0.010 3	<a href="#">Additional information 93.</a>
8279 10	0	0.022 4	<a href="#">Additional information 94.</a>
8316 10	0	0.013 2	<a href="#">Additional information 95.</a>
8353 10	0	0.0075 25	<a href="#">Additional information 96.</a>
8401 10	(0)	0.0075 25	<a href="#">Additional information 97.</a>
8440 10	0	0.023 3	<a href="#">Additional information 98.</a>
8465 10	0	0.014 2	<a href="#">Additional information 99.</a>
8505 10	0	0.015 2	<a href="#">Additional information 100.</a>
8530 10	(0)	0.014 2	<a href="#">Additional information 101.</a>
8572 10	(0)	0.0075 25	<a href="#">Additional information 102.</a>
8600 10	(0)	≤0.005	<a href="#">Additional information 103.</a>
8645 10	0	0.022 3	<a href="#">Additional information 104.</a>
8666 10	(0)	0.0075 25	<a href="#">Additional information 105.</a>
8744 10	(0)	0.0075 25	<a href="#">Additional information 106.</a>
8767 10	0	0.023 3	<a href="#">Additional information 107.</a>
8821 10	≥1		<a href="#">Additional information 108.</a>
8887 10	0	0.040 6	<a href="#">Additional information 109.</a>
8904 10	(0)	0.017 5	<a href="#">Additional information 110.</a>
8967 10	0	0.010 2	<a href="#">Additional information 111.</a>
8998 10	(0)	0.0075 25	<a href="#">Additional information 112.</a>
9027 10	0	0.032 3	<a href="#">Additional information 113.</a>
9061 10	0	0.010 2	<a href="#">Additional information 114.</a>
9105 10	0	0.013 2	<a href="#">Additional information 115.</a>
9157 10	(0)	0.0075 25	<a href="#">Additional information 116.</a>
9198 10	(0)	0.0075 25	<a href="#">Additional information 117.</a>
9220 10	0	0.0075 25	<a href="#">Additional information 118.</a>
9232 10	0	0.0075 25	<a href="#">Additional information 119.</a>
9268 10	(≥1)		<a href="#">Additional information 120.</a>
9301 10	0	0.021 3	<a href="#">Additional information 121.</a>
9333 10	0	0.028 3	<a href="#">Additional information 122.</a>
9362 10	≥1		<a href="#">Additional information 123.</a>
9397 10	0	0.021 3	<a href="#">Additional information 124.</a>
9446 10	0	0.0075 25	<a href="#">Additional information 125.</a>
9492 10	0	0.014 2	<a href="#">Additional information 126.</a>
9606 10	0	0.025 3	<a href="#">Additional information 127.</a>
9651 10	(0)	0.033 3	<a href="#">Additional information 128.</a>

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${}^{48}\text{Ti}({}^3\text{He,t})$  **2016Ga23,1975Ma13,1972Be38** (continued) ${}^{48}\text{V}$  Levels (continued)

E(level) <sup>†</sup>	L <sup>†</sup>	B(GT) strength <sup>@</sup>	Comments
9699 <i>IO</i>	≥1		<a href="#">Additional information 129.</a>
9732 <i>IO</i>	0	0.017 2	<a href="#">Additional information 130.</a>
9770 <i>IO</i>	0	0.016 2	<a href="#">Additional information 131.</a>
9808 <i>IO</i>	0	0.011 2	<a href="#">Additional information 132.</a>
9846 <i>IO</i>	0	0.014 2	<a href="#">Additional information 133.</a>
9891 <i>IO</i>	0	0.015 2	<a href="#">Additional information 134.</a>
9930 <i>IO</i>	0	0.018 3	<a href="#">Additional information 135.</a>
9962 <i>IO</i>	0	0.019 3	<a href="#">Additional information 136.</a>
10008 <i>IO</i>	0	0.033 3	<a href="#">Additional information 137.</a>
10038 <i>IO</i>	≥1		<a href="#">Additional information 138.</a>
10073 <i>IO</i>	(0)	0.0075 25	<a href="#">Additional information 139.</a>
10107 <i>IO</i>	0	0.014 3	<a href="#">Additional information 140.</a>
10133 <i>IO</i>	0	0.017 3	<a href="#">Additional information 141.</a>
10179 <i>IO</i>	≥1		<a href="#">Additional information 142.</a>
10237 <i>IO</i>	0	0.063 5	<a href="#">Additional information 143.</a>
10258 <i>IO</i>	(0)	0.022 4	<a href="#">Additional information 144.</a>
10286 <i>IO</i>	≥1		<a href="#">Additional information 145.</a>
10334 <i>IO</i>	0	0.0075 25	<a href="#">Additional information 146.</a>
10373 <i>IO</i>	0	0.010 2	<a href="#">Additional information 147.</a>
10446 <i>IO</i>	(0)	0.0075 25	<a href="#">Additional information 148.</a>
10470 <i>IO</i>	0	0.010 2	<a href="#">Additional information 149.</a>
10509 <i>IO</i>	0	0.017 2	<a href="#">Additional information 150.</a>
10564 <i>IO</i>	0	0.0075 25	<a href="#">Additional information 151.</a>
10585 <i>IO</i>	0	0.015 3	<a href="#">Additional information 152.</a>
10626 <i>IO</i>	0	0.019 3	<a href="#">Additional information 153.</a>
10653 <i>IO</i>	≥1		<a href="#">Additional information 154.</a>
10707 <i>IO</i>	0	0.018 3	<a href="#">Additional information 155.</a>
10735 <i>IO</i>	0	0.014 3	<a href="#">Additional information 156.</a>
10777 <i>IO</i>	0	0.012 2	<a href="#">Additional information 157.</a>
10823 <i>IO</i>	0	0.023 3	<a href="#">Additional information 158.</a>
10856 <i>IO</i>	≥1		<a href="#">Additional information 159.</a>
10901 <i>IO</i>	≥1		<a href="#">Additional information 160.</a>
10955 <i>IO</i>	≥1		<a href="#">Additional information 161.</a>
10984 <i>IO</i>	(0)	0.013 2	<a href="#">Additional information 162.</a>
11017 <i>IO</i>	0	0.017 2	<a href="#">Additional information 163.</a>
11061 <i>IO</i>	(0)	0.0075 25	<a href="#">Additional information 164.</a>
11102 <i>IO</i>	(0)	0.0075 25	<a href="#">Additional information 165.</a>
11139 <i>IO</i>	0	0.014 2	<a href="#">Additional information 166.</a>
11174 <i>IO</i>	0	0.013 2	<a href="#">Additional information 167.</a>
11207 <i>IO</i>	≥1		<a href="#">Additional information 168.</a>
11280 <i>IO</i>	(0)	0.016 3	<a href="#">Additional information 169.</a>
11302 <i>IO</i>	0	0.019 3	<a href="#">Additional information 170.</a>
11335 <i>IO</i>	0	0.015 5	<a href="#">Additional information 171.</a>
11349 <i>IO</i>	0	0.023 5	<a href="#">Additional information 172.</a>
11419 <i>IO</i>	≥1		<a href="#">Additional information 173.</a>
11466 <i>IO</i>	≥1		<a href="#">Additional information 174.</a>
11512 <i>IO</i>	≥1		<a href="#">Additional information 175.</a>
11565 <i>IO</i>	≥1		<a href="#">Additional information 176.</a>
11636 <i>IO</i>	0	0.012 2	<a href="#">Additional information 177.</a>
11669 <i>IO</i>	0	0.020 3	<a href="#">Additional information 178.</a>
11707 <i>IO</i>	≥1		<a href="#">Additional information 179.</a>
11768 <i>IO</i>	≥1		<a href="#">Additional information 180.</a>
11794 <i>IO</i>	≥1		<a href="#">Additional information 181.</a>
11858 <i>IO</i>	≥1		<a href="#">Additional information 182.</a>
11883 <i>IO</i>	≥1		<a href="#">Additional information 183.</a>
11942 <i>IO</i>	0	0.054 6	<a href="#">Additional information 184.</a>
11991 <i>IO</i>	(0)	0.011 4	<a href="#">Additional information 185.</a>

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${}^{48}\text{Ti}({}^3\text{He,t})$  **2016Ga23,1975Ma13,1972Be38 (continued)** ${}^{48}\text{V}$  Levels (continued)

<u>E(level)<sup>†</sup></u>	<u>L<sup>†</sup></u>	<u>B(GT) strength<sup>@</sup></u>	<u>Comments</u>
12008 2I	(0)	0.017 4	<a href="#">Additional information 186.</a>
12046 2I	(0)	0.0075 25	<a href="#">Additional information 187.</a>
12133 2I	(0)	0.0075 25	<a href="#">Additional information 188.</a>
12169 2I	(0)	0.0075 25	<a href="#">Additional information 189.</a>
12233 2I	(0)	0.018 3	<a href="#">Additional information 190.</a>
12275 2I	0	0.020 3	<a href="#">Additional information 191.</a>
12321 2I	≥1		<a href="#">Additional information 192.</a>
12346 2I	0	≤0.005	<a href="#">Additional information 193.</a>
12398 2I	(0)	≤0.005	<a href="#">Additional information 194.</a>
12482 2I	0	0.010 2	<a href="#">Additional information 195.</a>
12538 2I	0	0.0075 25	<a href="#">Additional information 196.</a>
12618 2I	≥1		<a href="#">Additional information 197.</a>
12646 2I	(0)	0.018 3	<a href="#">Additional information 198.</a>
12675 2I	≥1		<a href="#">Additional information 199.</a>

<sup>†</sup> Values for levels up to 3021 are from [1975Ma13](#) and values for levels above 3021 are from [2016Ga23](#), unless otherwise noted.

L-transfers in [1975Ma13](#) are extracted from DWBA fit to measured angular distributions while L-transfers in [2016Ga23](#) are from comparisons of measured angular distributions with that of the 2408 level which is identified with a L=0,  $J^\pi=1^+$  pattern.

<sup>‡</sup> Calibration points with uncertainty=1 keV in [1975Ma13](#). Values are taken by [1975Ma13](#) from [1973Hu08](#) and [1974SaZV](#).

<sup>#</sup> From [1972Be38](#) only.

<sup>@</sup> From [2016Ga23](#), with L=0 transitions assumed as Gamow-Teller.