

$^{32}\text{S}(^3\text{He,t}),(^3\text{He,t}\gamma)$ 1989Je07,2011Ma69,1994Vo12

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	Jun Chen	NDS 201,1 (2025)	31-Oct-2024

Target $J^\pi(^{32}\text{S})=0^+$.

1989Je07: E=34.5 MeV ^3He beam was produced from the Orsay Tandem Van de Graaff accelerator. Target was a $\approx 200 \mu\text{g}/\text{cm}^2$ self-supporting foil of indium sulphide. Reaction products were momentum-analyzed with a split-pole magnetic spectrometer (FWHM=15 keV) and detected with position-sensitive detectors. Measured $\sigma(E_t, \theta)$ at $\theta_{\text{lab}}=5^\circ$ to 90° . Deduced levels, J, π , L-transfers from analysis of measured $\sigma(\theta)$. Comparisons with Coulomb displacement energy (CDE) calculations.

2011Ma69: E=30 MeV ^3He beam was produced from the Extended Stretched TansUranium (ESTU) tandem Van de Graaff accelerator at Wright Nuclear Structure Laboratory (WNSL) at Yale University. Targets of $240 \mu\text{g}/\text{cm}^2$ and $350 \mu\text{g}/\text{cm}^2$ ZnS on $5 \mu\text{g}/\text{cm}^2$ carbon backings and a $150 \mu\text{g}/\text{cm}^2$ CdS on a $20 \mu\text{g}/\text{cm}^2$ carbon backing. Reaction products were momentum analyzed with the Enge split-pole spectrograph and detected by a position-sensitive ionization drift chamber and a thick plastic scintillator and decay protons were detected by the Yale Lamp Shade Array (YLSA) of four 16-strip silicon detectors. Measured $\sigma(E_t, \theta)$, proton-triton coin, $\text{tp}(\theta)$, proton yields. Deduced levels, proton branching ratios, $^{31}\text{S}(p,\gamma)^{32}\text{Cl}$ reaction rates.

1994Vo12: E=22.5-25 MeV ^3He beam was produced from the FN-Tandem accelerator at the Nuclear Structure Laboratory of the University of Notre Dame. Targets were $\approx 650 \mu\text{g}/\text{cm}^2$ CdS evaporated onto carbon backings and 70-keV ^{32}S ions implanted into $40 \mu\text{g}/\text{cm}^2$ carbon foils. Reaction products were momentum-analyzed with the 100-cm broad-range magnetic spectrograph (FWHM=40 keV). Measured triton spectra. Deduced reaction rates for $^{31}\text{S}(p,\gamma)$ reaction of astrophysical interest. Total of eight groups analyzed from g.s. to 2284 keV.

1997Le14 (from same group as **1994Vo12**): E=24 MeV ^3He beam was produced from the Orsay Institut de Physique Nucleaire Tandem accelerator. Tritons were detected with a superconducting solenoid spectrometer SOLENO combined with ΔE -E telescope and γ rays were detected with a set of 8 large-volume Ge detectors. Measured E_γ , (triton) γ -coin. Deduced levels. Four energy levels reported from 1736 to 2281 keV.

2010Wr02 (also **2010Wr01**): E=32 MeV ^3He beam from the MP tandem Van de Graaff accelerator at Maier-Leibnitz-Laboratorium (MLL). Tritons were momentum-analyzed by Munich Q3D magnetic spectrograph. Measurements at 10° and 20° . Q value=1581.3 6 (**2010Wr02**) as compared to 1581.1 5 in **2021Wa16**. A total of six levels from 1168 to 2284 keV measured in this work.

Other: **1991Gr03**.

 ^{32}Cl Levels

Additional information 1.

Proton branching ratios %p given under comments are from **2011Ma69**.

E(level) [†]	J π &	L@	Comments
0	1 ⁺	2	
87 3	2 ⁺	2	E(level): from 1989Je07 . Others: 90 (2011Ma69), 90 (1994Vo12).
462.0 [#] 20	0 ⁺	0	E(level): other: 447 7 (1989Je07).
1167 [#] 4	1 ⁺	2	E(level): others: 1157 5 (1989Je07), 1168 (1994Vo12 , used as reference); 1168.5 2 used as reference in 2010Wr02 .
1331.2 [‡] 5	2 ⁺	2	E(level): others: 1327 5 (2011Ma69), 1326 5 (1989Je07), 1329 3 (1994Vo12).
1736.7 [‡] 6	3 ⁺	(4)	E(level): others: 1734 5 (2011Ma69), 1736 2 (1997Le14), 1735 3 (1994Vo12), 1719 4 (1989Je07). Additional information 2. $\Gamma_\gamma/\Gamma=0.92$ 20 (1997Le14).
2131.1 [‡] 4	3 ⁺	4	%p=7 4 E(level): others: 2128 5 (2011Ma69), 2130 2 (1997Le14), 2129 3 (1994Vo12), 2122 5 (1989Je07). Additional information 3. J $^\pi$: proposed by 1994Vo12 and 1997Le14 . L: other: 0 from $\text{tp}(\theta)$ (2011Ma69). $\Gamma_\gamma/\Gamma=0.52$ 28 (1997Le14).
2209.5 [‡] 5	1 ⁺	(2)	%p=54 7 L: other: 0 from $\text{tp}(\theta)$ (2011Ma69).

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$^{32}\text{S}(\text{}^3\text{He,t}),(\text{}^3\text{He,t}\gamma)$ 1989Je07,2011Ma69,1994Vo12 (continued) ^{32}Cl Levels (continued)

<u>E(level)[†]</u>	<u>J^π&</u>	<u>L[@]</u>	<u>Comments</u>
			E(level): others: 2203 5 (2011Ma69), 2213 3 (1994Vo12,1997Le14), 2193 7 (1989Je07). Additional information 4.
			J ^π : proposed by 1994Vo12.
			Γ _γ /Γ<0.08 (1997Le14).
2283.5 [‡] 5	2 ⁺	2	%p=66 13
			E(level): others: 2279 5 (2011Ma69), 2281 3 (1994Vo12,1997Le14), 2270 5 (1989Je07). Additional information 5.
			J ^π : proposed by 1994Vo12.
			L: other: 0 from tp(θ) (2011Ma69).
2611 5	(1 ⁺)		Γ _γ /Γ<0.05 (1997Le14).
			%p>62
			E(level),J ^π : new level reported in 2011Ma69.
			Additional information 6.
			L: other: 0 from tp(θ) (2011Ma69).
2675 5			%p: fit result is 95 32 (2011Ma69).
			%p>78
			E(level): average of 2665 10 (1989Je07), 2677 5 (2011Ma69). Additional information 7.
			L: other: 0 from tp(θ) (2011Ma69).
2859 4		2	%p: fit result is 94 16 (2011Ma69).
			%p>70
			E(level): average of 2858 5 (1989Je07), 2859 4 (2011Ma69). Additional information 8.
			L: others: 1 from tp(θ) (2011Ma69).
2936 5	3 ⁺	(4)	%p>88
			E(level): average of 2941 5 (1989Je07), 2932 5 (2011Ma69). Additional information 9.
			L: other: 0 from tp(θ) (2011Ma69).
3055 5		3	%p>97
			E(level): average of 3056 5 (1989Je07), 3055 5 (2011Ma69). Additional information 10.
			L: other: L=2 from tp(θ) (2011Ma69).
3165 4		3	%p>96
			E(level): average of 3166 5 (1989Je07), 3164 4 (2011Ma69). Additional information 11.
			L: other: 2 from tp(θ) (2011Ma69).
3283 5		2	%p>88
			E(level): average of 3290 10 (1989Je07), 3281 5 (2011Ma69). Additional information 12.
			L: other: 2 from tp(θ) (2011Ma69).
3694 4	(2 ⁺)	3(+2)	%p>96
			E(level): average of 3692 7 (1989Je07), 3695 4 (2011Ma69). Additional information 13.
			J ^π : based on mirror symmetry argument (2011Ma69).
			L: other: 2 from tp(θ) (2011Ma69).
3878 4	(3 ⁺)	(4+5)	%p>94
			E(level): average of 3883 5 (1989Je07), 3875 4 (2011Ma69). Additional information 14.
			J ^π : based on mirror symmetry argument (2011Ma69).
			L: other: 2 from tp(θ) (2011Ma69).
4001 4			E(level): average of 4002 6 (1989Je07), 4000 4 (2011Ma69).
4075 4		2	E(level): average of 4080 7 (1989Je07), 4074 4 (2011Ma69).
4352 5		0	E(level): average of 4356 7 (1989Je07), 4350 5 (2011Ma69).
4581 6			E(level): average of 4590 8 (1989Je07), 4577 5 (2011Ma69).
4757 9		4	
5018 6			

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$^{32}\text{S}(^3\text{He,t),(}^3\text{He,t}\gamma)$ 1989Je07,2011Ma69,1994Vo12 (continued) ^{32}Cl Levels (continued)

<u>E(level)[†]</u>	<u>L[@]</u>	<u>E(level)[†]</u>	<u>E(level)[†]</u>	<u>L[@]</u>	<u>E(level)[†]</u>
5166 5	(6)	5813 7	6076 8	(6)	6680 15
5466 6		5905 7	6178 8		6820 15
5578 8	(6)	5990 7	6360 15	(6)	

[†] Weighted average of available values given under comments, unless otherwise stated. Above 4.6 MeV, levels are reported only in 1989Je07.

[‡] Precise value from 2010Wr02.

Value from 2011Ma69 is adopted by the evaluators as it agrees better with that from γ -ray data in ^{32}Ar decay.

@ From comparisons of measured $\sigma(\theta)$ with theoretical predictions (1989Je07).

& From comparisons of $\sigma(\theta)$ with Coulomb displacement energy (CDE) calculations (1989Je07), unless otherwise noted.

 $\gamma(^{32}\text{Cl})$

<u>E_{γ}</u>	<u>E_i(level)</u>	<u>J_i^{π}</u>	<u>E_f</u>	<u>J_f^{π}</u>
1646	1736.7	3 ⁺	87	2 ⁺
2043	2131.1	3 ⁺	87	2 ⁺

 $^{32}\text{S}(^3\text{He,t),(}^3\text{He,t}\gamma)$ 1989Je07,2011Ma69,1994Vo12Level Scheme