

<sup>164</sup>Er(d,p) 1969Tj01

Type	Author	History	Citation	Literature Cutoff Date
Full Evaluation	Balraj Singh and Jun Chen		NDS 194,460 (2024)	31-Oct-2022

**1969Tj01:** E(d)=12.1 MeV. Measured triton spectra at 60°, 90°, and 125° using targets of 40 μg/cm<sup>2</sup> thickness on 40 μg/cm<sup>2</sup> carbon foils, and analysis of outgoing tritons by a magnetic spectrograph and photographic emulsion plates at the EN Tandem Van de Graaff accelerator of the Niels Bohr Institute. FWHM≈12 keV. A total of 31 levels reported up to 1383 keV. DWBA analysis.

Band assignments based on Nilsson configurations made on the basis of “finger-print” method of population intensity of levels.

Others:

**1963Is01:** E(d)=15 MeV, natural target, magnetic spectrograph and photographic plates, measured σ(θ) at 12 angles from 9° to 90°. FWHM=80 keV. Four groups in <sup>165</sup>Er reported at 0, 77, 243, 296+298.

**1984Pe03:** E(d)=12 MeV, analyzed σ(θ), coupled-channel analysis for ν11/2[505] state at 547 keV.

<sup>165</sup>Er Levels

Band assignments by **1969Tj01** are based on ‘fingerprint’ method of comparison of experimental differential cross sections with those calculated from DWBA for members within a band.

E(level) <sup>†</sup>	J <sup>π</sup> &	dσ/dΩ (μb/sr) <sup>@</sup>	Comments
0 <sup>a</sup>	5/2 <sup>-</sup>	6	dσ/dΩ (μb/sr): 9 (60°).
76 <sup>a</sup> 3	7/2 <sup>-</sup>	7	dσ/dΩ (μb/sr): 3 (125°).
99 <sup>g</sup> 3	9/2 <sup>+</sup>	21	dσ/dΩ (μb/sr): 8 (125°).
176 <sup>a</sup> 3	9/2 <sup>-</sup>	11	dσ/dΩ (μb/sr): 13 (60°), 5 (125°).
240 <sup>b</sup> 3	3/2 <sup>-</sup>	57	dσ/dΩ (μb/sr): 80 (60°), 44 (125°).
298 <sup>c</sup> 3	1/2 <sup>-</sup>	121	dσ/dΩ (μb/sr): 256 (60°), 48 (125°).
356 <sup>c</sup> 3	3/2 <sup>-</sup>	13	dσ/dΩ (μb/sr): 8 (60°), 6 (125°).
373 <sup>b</sup> 3	7/2 <sup>-</sup>	122	dσ/dΩ (μb/sr): 198 (60°), 44 (125°).
≈382 <sup>c</sup>	5/2 <sup>-</sup>	27	dσ/dΩ (μb/sr): 21 (125°).
470 <sup>b</sup> 3	(9/2 <sup>-</sup> )	4	dσ/dΩ (μb/sr): 2 (125°).
514 <sup>c</sup> 3	7/2 <sup>-</sup>	60	dσ/dΩ (μb/sr): 89 (60°), 27 (125°).
533 <sup>h</sup> 3	3/2 <sup>+</sup>	27	dσ/dΩ (μb/sr): 43 (60°), 14 (125°).
575 <sup>d</sup> 3	7/2 <sup>-</sup>	175	dσ/dΩ (μb/sr): 288 (60°), 83 (125°).
593 <sup>‡</sup> 3		42	dσ/dΩ (μb/sr): 17 (125°).
608 3		18	dσ/dΩ (μb/sr): 26 (60°), 5 (125°).
684 <sup>d</sup> 3	9/2 <sup>-</sup>	7	dσ/dΩ (μb/sr): 3 (125°).
700 3		5	dσ/dΩ (μb/sr): 9 (60°), 3 (125°).
728 3		24	dσ/dΩ (μb/sr): ≈29 (60°), 9 (125°).
746 <sup>i</sup> 3	1/2 <sup>+</sup>	7	dσ/dΩ (μb/sr): ≈13 (60°), 5 (125°).
761 3		6	dσ/dΩ (μb/sr): 3 (125°).
820 <sup>d</sup> 3	11/2 <sup>-</sup>	7	dσ/dΩ (μb/sr): 2 (125°).
846 3		4	dσ/dΩ (μb/sr): 4 (125°).
873 3		10	dσ/dΩ (μb/sr): 5 (125°).
896 3		8	dσ/dΩ (μb/sr): 6 (60°), 5 (125°).
925 <sup>#e</sup> 3	1/2 <sup>-</sup>	≈2	dσ/dΩ (μb/sr): ≈1 (125°).
961 <sup>e</sup> 3	3/2 <sup>-</sup>	119	dσ/dΩ (μb/sr): 205 (60°), 46 (125°).
1024 <sup>e</sup> 5	(5/2 <sup>-</sup> )	48	dσ/dΩ (μb/sr): 74 (60°), 28 (125°).
1043 5		42	dσ/dΩ (μb/sr): 70 (60°), 10 (125°).
1073 5		11	dσ/dΩ (μb/sr): 9 (60°), 2 (125°).
1110 <sup>e</sup> 5	(7/2 <sup>-</sup> )	31	dσ/dΩ (μb/sr): 30 (60°), 10 (125°).
1145 5		4	dσ/dΩ (μb/sr): 6 (60°), 6 (125°).
1177 5		5	dσ/dΩ (μb/sr): 14 (60°), 6 (125°).
1198 5		3	dσ/dΩ (μb/sr): 5 (60°), 5 (125°).
1233 5		7	dσ/dΩ (μb/sr): 4 (60°), 6 (125°).

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<sup>164</sup>Er(d,p) **1969Tj01** (continued)

<sup>165</sup>Er Levels (continued)

E(level) <sup>†</sup>	J <sup>π&amp;</sup>	dσ/dΩ (μb/sr) <sup>@</sup>	Comments
1285 5		82	dσ/dΩ (μb/sr): 114 (60°), 36 (125°).
1378 5		14	dσ/dΩ (μb/sr): 14 (60°), 9 (125°).
1413 5		35	dσ/dΩ (μb/sr): 65 (60°), 14 (125°).
1474 <sup>f</sup> 5	(3/2 <sup>-</sup> )	49	dσ/dΩ (μb/sr): 99 (60°), 22 (125°).
1490 5		14	dσ/dΩ (μb/sr): 5 (125°).
1539 <sup>f</sup> 5	(5/2 <sup>-</sup> )	82	dσ/dΩ (μb/sr): 123 (60°), 44 (125°).
1564 5		21	dσ/dΩ (μb/sr): 44 (60°), 7 (125°).
1612 5		≈28	dσ/dΩ (μb/sr): 39 (60°), 7 (125°).
1631 <sup>f</sup> 5	(7/2 <sup>-</sup> )	≈28	dσ/dΩ (μb/sr): 56 (60°), 13 (125°).
1656 5		63	dσ/dΩ (μb/sr): 79 (60°), 26 (125°).
1728 5		44	dσ/dΩ (μb/sr): 77 (60°), 9 (125°).
1761 5		51	dσ/dΩ (μb/sr): 112 (60°), 22 (125°).
1780 5		45	dσ/dΩ (μb/sr): 66 (60°), 16 (125°).
1805 5		45	dσ/dΩ (μb/sr): 83 (60°), 21 (125°).
1819 5		63	dσ/dΩ (μb/sr): 102 (60°), 25 (125°).
1851 5		23	dσ/dΩ (μb/sr): 56 (60°), 14 (125°).
1889 5		35	dσ/dΩ (μb/sr): 65 (60°), 20 (125°).
1901 5		53	dσ/dΩ (μb/sr): 90 (60°), 22 (125°).
1940 5		78	dσ/dΩ (μb/sr): 173 (60°), 47 (125°).
1951 5		38	dσ/dΩ (μb/sr): 33 (125°).
1968 5		86	dσ/dΩ (μb/sr): 176 (60°), 39 (125°).
2004 5		22	dσ/dΩ (μb/sr): 33 (60°), 7 (125°).
2018 5		23	dσ/dΩ (μb/sr): 11 (125°).
2033 5		45	dσ/dΩ (μb/sr): 107 (60°), 11 (125°).
2047 5		35	dσ/dΩ (μb/sr): 24 (125°).
2057 5		30	dσ/dΩ (μb/sr): 75 (60°), 23 (125°).

<sup>†</sup> ΔE=3 keV for E(level)<1 MeV and 5 keV for others (1967Tj01).

<sup>‡</sup> Assigned by 1969Tj01 as 11/2[505], but 11/2[505] is located at 547 keV by 1970Hj02 in (α,3nγ). This group may correspond to doublet at 589 in 'Adopted Levels', one component of which is assigned as 3/2<sup>+</sup> member of configuration= K<sup>π</sup>=1/2<sup>+</sup> band from ν1/2[660]+K-2 γ vibration built on ν5/2[642].

# Band assignment uncertain.

@ At 90°. Values for 60° and 125° are listed under comments.

& Based on relative intensity pattern, absolute σ, σ(θ). All the assignments are consistent with those in the Adopted Levels.

<sup>a</sup> Band(A): ν5/2[523]. A=11.0. Experimental cross sections are smaller than those from theoretical calculations.

Predicted/experimental cross sections for 5/2, 7/2, 9/2, 11/2, respectively are: 44/9, 45/10, 63/16, 5/-. Relative (C<sub>j,l</sub><sup>2</sup>) coefficients respectively are: 0.07/0.07, 0.08/0.07, 0.79/0.86, 0.06/-. The 11/2<sup>-</sup> member is obscured by strong 298 group from 1/2[521].

<sup>b</sup> Band(B): ν3/2[521]. A=10.8.

<sup>c</sup> Band(C): ν1/2[521]. A=12.3, a=0.56. Experimental cross sections are smaller than those from theoretical calculations.

Predicted/experimental cross sections for 1/2, 3/2, 5/2, 7/2, 9/2, 11/2, respectively are: 377/181, 38/19, 107/39, 136/82, 21/12, 4/≈6. Relative (C<sub>j,l</sub><sup>2</sup>) coefficients respectively are: 0.25/0.21, 0.02/0.02, 0.18/0.12, 0.23/0.25, 0.27/26, 0.05/0.13. It should be noted that 9/2 and 11/2 members are not identified by 1969Tj01 in the proton spectra, thus are not listed here as levels.

<sup>d</sup> Band(D): ν5/2[512]. A=12.2. Experimental cross section for 7/2<sup>-</sup> member is smaller than that from theoretical calculations.

Predicted/experimental cross sections for 5/2, 7/2, 9/2, 11/2, respectively are: 6/-, 463/220, 11/8, 5/8. Relative (C<sub>j,l</sub><sup>2</sup>) coefficients respectively are: 0.01/-, 0.79/0.65, 0.14/0.17, 0.06/0.17.

<sup>e</sup> Band(E): ν1/2[510]. A=12.5, a=-0.01. Experimental cross sections are smaller than those from theoretical calculations.

Predicted/experimental cross sections for 1/2, 3/2, 5/2, 7/2, 9/2, 11/2, respectively are: 13/2, 615/174, 172/50, 113/22, 6/5, 1/-. Relative (C<sub>j,l</sub><sup>2</sup>) coefficients respectively are: 0.01/0.005, 0.40/0.35, 0.29/0.34, 0.19/0.30, 0.09/-, 0.01/-.

<sup>f</sup> Band(F): ν3/2[512] (?). A=13.0. Experimental cross sections are smaller than those from theoretical calculations.

Predicted/experimental cross sections for 3/2, 5/2, 7/2, 9/2, 11/2, respectively are: 120/48, 376/80, 70/≈27, 11/-, 1/-.

<sup>g</sup> Band(G): ν5/2[642] (?).

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 $^{164}\text{Er}(\text{d,p})$  **1969Tj01** (continued) $^{165}\text{Er}$  Levels (continued)

- <sup>h</sup> Band(H):  $\nu_3/2[402]$ . As stated by [1969Tj01](#), rotational states built on  $3/2[402]$  are expected but not seen.
- <sup>i</sup> Band(I):  $\nu_1/2[400]$ . As stated by [1969Tj01](#), rotational states built on  $3/2[402]$  are expected but not seen.

$^{164}\text{Er}(\text{d,p})$  1969Tj01

				<b>Band(F): v3/2[512] (?)</b>
				<u>(7/2<sup>-</sup>)      1631</u>
				<u>(5/2<sup>-</sup>)      1539</u>
				<u>(3/2<sup>-</sup>)      1474</u>
				<b>Band(E): v1/2[510]</b>
				<u>(7/2<sup>-</sup>)      1110</u>
				<u>(5/2<sup>-</sup>)      1024</u>
				<u>3/2<sup>-</sup>        961</u>
				<u>1/2<sup>-</sup>        925</u>
				<b>Band(D): v5/2[512]</b>
				<u>11/2<sup>-</sup>       820</u>
				<u>9/2<sup>-</sup>        684</u>
				<u>7/2<sup>-</sup>        575</u>
				<b>Band(C): v1/2[521]</b>
				<u>7/2<sup>-</sup>        514</u>
				<u>(9/2<sup>-</sup>)       470</u>
				<u>7/2<sup>-</sup>        373</u>
				<u>5/2<sup>-</sup>        ≈382</u>
				<u>3/2<sup>-</sup>        356</u>
				<u>1/2<sup>-</sup>        298</u>
				<u>3/2<sup>-</sup>        240</u>
				<b>Band(A): v5/2[523]</b>
				<u>9/2<sup>-</sup>        176</u>
				<u>7/2<sup>-</sup>        76</u>
				<u>5/2<sup>-</sup>        0</u>

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 $^{164}\text{Er}(\text{d,p})$  1969Tj01 (continued)Band(I):  $\nu 1/2[400]$ 1/2<sup>+</sup> 746Band(H):  $\nu 3/2[402]$ 3/2<sup>+</sup> 533Band(G):  $\nu 5/2[642]$  (?)9/2<sup>+</sup> 99 $^{165}_{68}\text{Er}_{97}$