

$^{234}\text{U}(\text{pol d,t}),(\text{d,t})$ **2011Ko30,1978Jo05**

Type	Author	History	Citation	Literature Cutoff Date
Full Evaluation	B. Singh, J. K. Tuli, E. Browne		NDS 170, 499 (2020)	8-Oct-2020

2011Ko30: polarized deuteron beam, $E=22$ MeV from the tandem accelerator at the Maier-Leibnitz-Laboratorium in Garching near Munich. Target= $160 \mu\text{g}/\text{cm}^2$ thick ^{234}U evaporated on a thin carbon backing. Tritons analyzed by the Munich Q3D magnetic spectrometer, then detected in the focal plane by a multiwire proportional chamber. Resulting spectra analyzed using the HDTV software package. Measured $E(\text{triton})$, angular distributions and analyzing powers. Deduced levels, J, π . Comparison with DWBA calculations. FWHM ≈ 6 keV.

1978Jo05: (d,t), $E(d)=14$ MeV. Measured triton spectra, $\sigma(\theta)$ at $50^\circ, 60^\circ, 90^\circ, 105^\circ$ and 120° . using Enge split-pole magnetic spectrograph at the University of Rochester MP tandem Van de Graaff accelerator. FWHM ≈ 9 keV. Levels reported up to 1276 keV.

All data are from **2011Ko30** unless otherwise stated.

 ^{233}U Levels

Only the states that were observed in at least eight of the fourteen measured spectra were included in the analysis (**2011Ko30**).

$E(\text{level})^\dagger$	$J^\pi^\#$	$d\sigma/d\Omega$ ($\mu\text{b}/\text{sr}$) $\&$	Comments
$0^\ddagger b$	$5/2^+ \ddagger$	2.4 4	J^π : from 1978Jo05 . $d\sigma/d\Omega=6 \mu\text{b}/\text{sr}$ 1 (60°), $4 \mu\text{b}/\text{sr}$ 1 (90°), $4 \mu\text{b}/\text{sr}$ 1 (105°), $3 \mu\text{b}/\text{sr}$ 1 (120°).
40.5^b 2	$7/2^+$	17.5 6	$E=40$ 1, $J^\pi=7/2^+$ (1978Jo05). $d\sigma/d\Omega=40 \mu\text{b}/\text{sr}$ 10 (50°), $29 \mu\text{b}/\text{sr}$ 2 (60°), $41 \mu\text{b}/\text{sr}$ 2 (90°), $33 \mu\text{b}/\text{sr}$ 2 (105°), $24 \mu\text{b}/\text{sr}$ 2 (120°).
92.3^b 7	$9/2^+$	11.9 5	$E=94$ 2, $J^\pi=9/2^+$ (1978Jo05). $d\sigma/d\Omega=24 \mu\text{b}/\text{sr}$ 6 (50°), $15 \mu\text{b}/\text{sr}$ 2 (60°), $22 \mu\text{b}/\text{sr}$ 2 (90°), $19 \mu\text{b}/\text{sr}$ 1 (105°), $16 \mu\text{b}/\text{sr}$ 1 (120°).
155.3^b 9	$11/2^+$	5.7 3	$E=156$ 2, $J^\pi=11/2^+$ (1978Jo05). $d\sigma/d\Omega=15 \mu\text{b}/\text{sr}$ 4 (50°), $14 \mu\text{b}/\text{sr}$ 2 (60°), $29 \mu\text{b}/\text{sr}$ 2 (90°), $35 \mu\text{b}/\text{sr}$ 2 (105°), $29 \mu\text{b}/\text{sr}$ 2 (120°).
174 1	$1/2^-, 3/2^+$	2.4 2	
$231^\ddagger b$ 2	$(13/2^+)^\ddagger$		$E=228$ 3, $J^\pi=13/2^+$ (1978Jo05). $d\sigma/d\Omega=2 \mu\text{b}/\text{sr}$ 1 (60°), $4 \mu\text{b}/\text{sr}$ 1 (90°), $8 \mu\text{b}/\text{sr}$ 1 (105°), $6 \mu\text{b}/\text{sr}$ 1 (120°).
$300@$ 3	$(5/2^-)$		$d\sigma/d\Omega=3 \mu\text{b}/\text{sr}$ 2 (60°), $4 \mu\text{b}/\text{sr}$ 1 (90°), $4 \mu\text{b}/\text{sr}$ 1 (105°), $2 \mu\text{b}/\text{sr}$ 1 (120°).
311.7^c 10	$3/2^+$	9.8 5	$E=312$ 2, $J^\pi=(3/2^+)$ (1978Jo05). $d\sigma/d\Omega=20 \mu\text{b}/\text{sr}$ 3 (50°), $24 \mu\text{b}/\text{sr}$ 2 (60°), $26 \mu\text{b}/\text{sr}$ 2 (90°), $17 \mu\text{b}/\text{sr}$ 2 (105°), $12 \mu\text{b}/\text{sr}$ 1 (120°).
$319@$ 4	$(7/2^- \& 15/2^+)$		$d\sigma/d\Omega=4 \text{ mb}/\text{sr}$ 1 at 120° . Assumed a doublet.
340.3^c 3	$5/2^+$	104 1	$E=341$ 1, $J^\pi=(5/2^+)$ (1978Jo05). $d\sigma/d\Omega=236 \mu\text{b}/\text{sr}$ 11 (50°), $330 \mu\text{b}/\text{sr}$ 13 (60°), $326 \mu\text{b}/\text{sr}$ 14 (90°), $234 \mu\text{b}/\text{sr}$ 6 (105°), $161 \mu\text{b}/\text{sr}$ 5 (120°).
380.1^c 6	$7/2^+$	5.9 4	$E=379$ 2, $J^\pi=7/2^+$ (1978Jo05). $d\sigma/d\Omega=6 \mu\text{b}/\text{sr}$ 2 (60°), $5 \mu\text{b}/\text{sr}$ 1 (90°), $5 \mu\text{b}/\text{sr}$ 2 (105°), $4 \mu\text{b}/\text{sr}$ 2 (120°).
398.1^e 4	$1/2^+ \& 11/2^-$	39.8 9	$E(\text{level})$: unresolved doublet. $E=398$ 2, $J^\pi=(1/2^+ \& 11/2^-)$ (1978Jo05). $d\sigma/d\Omega=56 \mu\text{b}/\text{sr}$ 4 (50°), $82 \mu\text{b}/\text{sr}$ 6 (60°), $99 \mu\text{b}/\text{sr}$ 26 (90°), $68 \mu\text{b}/\text{sr}$ 5 (105°), $56 \mu\text{b}/\text{sr}$ 23 (120°).
415.8^d 4	$3/2^+$	32.1 8	$E=415$ 2, $J^\pi=3/2^+$ (1978Jo05). $d\sigma/d\Omega=121 \mu\text{b}/\text{sr}$ 7 (50°), $111 \mu\text{b}/\text{sr}$ 42 (60°), $78 \mu\text{b}/\text{sr}$ 4 (90°), $52 \mu\text{b}/\text{sr}$ 22 (105°).
433.5^c 5	$9/2^+$	154 2	$E=432$ 1, $J^\pi=9/2^+$ (1978Jo05). $d\sigma/d\Omega=112 \mu\text{b}/\text{sr}$ 6 (50°), $186 \mu\text{b}/\text{sr}$ 9 (60°), $279 \mu\text{b}/\text{sr}$ 19 (90°), $231 \mu\text{b}/\text{sr}$ 5 (105°), $175 \mu\text{b}/\text{sr}$ 8 (120°).

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$^{234}\text{U}(\text{pol d,t}),(\text{d,t})$ **2011Ko30,1978Jo05 (continued)** ^{233}U Levels (continued)

E(level) [†]	J ^π [#]	dσ/dΩ (μb/sr) ^{&}	Comments
455.9 ^d 4	5/2 ⁺	7.5 8	E=456 2, J ^π =(5/2 ⁺) (1978Jo05). dσ/dΩ=11 μb/sr 2 (50°), 17 μb/sr 3 (60°), 14 μb/sr 1 (90°), 11 μb/sr 2 (105°), 6 μb/sr 1 (120°).
495.5 ^d 7	7/2 ⁺	14.1 5	E(level),J ^π : from σ(θ) and A _y (θ), this state is consistent with 7/2 ⁺ and not 11/2 ⁺ , thus it is not the 11/2 ⁺ member of 3/2[631] band. E=497 2, J ^π =(11/2 ⁺) (1978Jo05). dσ/dΩ=10 μb/sr 2 (50°), 11 μb/sr 2 (60°), 14 μb/sr 1 (90°), 17 μb/sr 2 (105°), 16 μb/sr 6 (120°).
521 ^e 2	15/2 ⁻	3.4 3	E=522 2, J ^π =15/2 ⁻ (1978Jo05). dσ/dΩ=9 μb/sr 2 (50°), 14 μb/sr 2 (60°), 45 μb/sr 9 (90°), 50 μb/sr 3 (105°), 45 μb/sr 3 (120°).
546? [@] 3			dσ/dΩ=2 mb/sr 2 at 90° and at 120°.
572.2 ^f 3	1/2 ⁻	442 3	E=572 1, J ^π =1/2 ⁻ (1978Jo05). dσ/dΩ=696 μb/sr 31 (50°), 1300 μb/sr 130 (60°), 1256 μb/sr 62 (90°), 982 μb/sr 50 (105°), 808 μb/sr 32 (120°).
609.6 ^f 3	5/2 ⁻	80 2	J ^π : (7/2 ⁺) is less likely, but not ruled out. E=610 3, J ^π =(3/2 ⁻ ,5/2 ⁻) (1978Jo05). dσ/dΩ=38 μb/sr 13 (50°), 58 μb/sr 19 (60°), 144 μb/sr 10 (90°), 140 μb/sr 9 (105°), 131 μb/sr 9 (120°).
619.2 ^f 3	3/2 ⁻	73 2	E=620 3, J ^π =(3/2 ⁻ ,5/2 ⁻) (1978Jo05). dσ/dΩ=103 μb/sr 18 (50°), 176 μb/sr 27 (60°), 214 μb/sr 12 (90°), 188 μb/sr 9 (105°), 149 μb/sr 10 (120°).
658.8 6	9/2 ⁺ ,7/2 ⁻	7.9 4	E=660 2 (1978Jo05). dσ/dΩ=26 μb/sr 6 (60°), 21 μb/sr 3 (90°), 19 μb/sr 2 (105°), 16 μb/sr 2 (120°).
700 1	1/2 ⁺	1.1 2	J ^π : (9/2 ⁻) is less likely, but not ruled out. If 9/2 ⁻ , then it could be a member of 1/2[501] band. E=700 3 (1978Jo05), uncertain level. dσ/dΩ=3 μb/sr 1 (90°), 3 μb/sr 1 (105°), 6 μb/sr 1 (120°).
718.2 ^f 7	7/2 ⁻	5.7 3	J ^π : (5/2 ⁺) is less likely, but not ruled out. E=717 3 (1978Jo05). dσ/dΩ=12 μb/sr 1 (90°), 12 μb/sr 1 (105°), 12 μb/sr 9 (120°).
749.1 ^a 4	5/2 ⁻	97 1	E=749 2 (1978Jo05). dσ/dΩ=56 μb/sr 5 (50°), 117 μb/sr 15 (60°), 180 μb/sr 9 (90°), 176 μb/sr 6 (105°), 147 μb/sr 5 (120°).
774 [@] 3			dσ/dΩ=10 μb/sr 3 (50°), 8 μb/sr 2 (90°), 4 μb/sr 1 (105°), 2 μb/sr 1 (120°).
804.1 9		4.8 3	E=802 3 (1978Jo05). dσ/dΩ=10 μb/sr 2 (90°), 10 μb/sr 1 (105°), 9 μb/sr 2 (120°).
839? [@] 4			dσ/dΩ=3 μb/sr 1 (90°), 5 μb/sr 1 (105°), 24 μb/sr 21 (120°).
865.6 3	3/2 ⁻	49.1 10	E=865 2 (1978Jo05). dσ/dΩ=60 μb/sr 5 (50°), 102 μb/sr 10 (60°), 119 μb/sr 17 (90°), 103 μb/sr 8 (105°), 73 μb/sr 14 (120°).
893.6 ^a 3	5/2 ⁻	29.3 8	E=894 2 (1978Jo05). dσ/dΩ=18 μb/sr 3 (50°), 45 μb/sr 7 (60°), 61 μb/sr 30 (90°), 61 μb/sr 6 (105°), 48 μb/sr 24 (120°).
914.3 ^a 5	5/2 ⁻	149 2	E=916 1, J ^π =(5/2 ⁻) (1978Jo05). dσ/dΩ=71 μb/sr 6 (50°), 156 μb/sr 13 (60°), 279 μb/sr 25 (90°), 316 μb/sr 13 (105°), 278 μb/sr 22 (120°).
938.4 3	5/2 ⁺	17.8 7	E=938 2 (1978Jo05). dσ/dΩ=31 μb/sr 4 (50°), 52 μb/sr 8 (60°), 136 μb/sr 6 (90°), 40 μb/sr 4 (105°), 23 μb/sr 8 (120°).
963.8 3	1/2 ⁺	40.0 9	E=964 3 (1978Jo05). dσ/dΩ=61 μb/sr 15 (50°), 94 μb/sr 9 (60°), 76 μb/sr 6 (90°), 58 μb/sr 6 (105°), 40 μb/sr 7 (120°).
1001.8 3	5/2 ⁺	51 1	E=1003 3 (1978Jo05).

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$^{234}\text{U}(\text{pol d,t}),(\text{d,t})$ **2011Ko30,1978Jo05** (continued) ^{233}U Levels (continued)

E(level) [†]	J^π [#]	$d\sigma/d\Omega$ ($\mu\text{b/sr}$) ^{&}	Comments
1017.0 ⁸ 3	3/2 ⁻	266 2	$d\sigma/d\Omega=72 \mu\text{b/sr}$ 7 (50°), 98 $\mu\text{b/sr}$ 15 (60°), 120 $\mu\text{b/sr}$ 60 (90°), 84 $\mu\text{b/sr}$ 9 (105°), 66 $\mu\text{b/sr}$ 32 (120°). E=1016 1, $J^\pi=(3/2^-)$ (1978Jo05). $d\sigma/d\Omega=246 \mu\text{b/sr}$ 13 (50°), 439 $\mu\text{b/sr}$ 6 (60°), 523 $\mu\text{b/sr}$ 34 (90°), 568 $\mu\text{b/sr}$ 29 (105°), 454 $\mu\text{b/sr}$ 24 (120°).
1054.5 ⁸ 3	5/2 ⁻	35.8 8	E=1053 2 (1978Jo05). $d\sigma/d\Omega=13 \mu\text{b/sr}$ 2 (50°), 40 $\mu\text{b/sr}$ 8 (60°), 54 $\mu\text{b/sr}$ 5 (90°), 55 $\mu\text{b/sr}$ 4 (105°), 48 $\mu\text{b/sr}$ 6 (120°).
1079? [@] 4			$d\sigma/d\Omega=4 \mu\text{b/sr}$ 1 (90°), 3 $\mu\text{b/sr}$ 1 (105°).
1090? [@] 4			$d\sigma/d\Omega=4 \mu\text{b/sr}$ 1 (90°), 4 $\mu\text{b/sr}$ 1 (105°).
1104.7 ⁸ 6	7/2 ⁻ , 5/2 ⁺	16.3 6	E=1103 3 (1978Jo05). $d\sigma/d\Omega=6 \mu\text{b/sr}$ 2 (60°), 26 $\mu\text{b/sr}$ 5 (90°), 27 $\mu\text{b/sr}$ 3 (105°), 26 $\mu\text{b/sr}$ 5 (120°).
1114? [@] 4			$d\sigma/d\Omega=7 \mu\text{b/sr}$ 2 (60°), 4 $\mu\text{b/sr}$ 2 (105°).
1126 1	3/2 ⁻ , 5/2 ⁺	1.8 3	E=1125 3 (1978Jo05). $d\sigma/d\Omega=6 \mu\text{b/sr}$ 2 (60°), 8 $\mu\text{b/sr}$ 1 (90°), 7 $\mu\text{b/sr}$ 2 (105°), 6 $\mu\text{b/sr}$ 2 (120°).
1155? [@] 4			$d\sigma/d\Omega=4 \mu\text{b/sr}$ 1 (90°), 5 $\mu\text{b/sr}$ 1 (105°).
1167.8 ⁸ 9	(9/2 ⁻)		E=1169 4 (1978Jo05). $d\sigma/d\Omega=6 \mu\text{b/sr}$ 3 (90°), 6 $\mu\text{b/sr}$ 2 (105°).
1191.8 7	1/2 ⁺	14.2 5	E=1193 3 (1978Jo05). $d\sigma/d\Omega=18 \mu\text{b/sr}$ 6 (50°), 27 $\mu\text{b/sr}$ 4 (60°), 26 $\mu\text{b/sr}$ 11 (90°), 18 $\mu\text{b/sr}$ 3 (105°), 15 $\mu\text{b/sr}$ 8 (120°).
1214.4 7	3/2 ⁻	51 1	E=1216 3 (1978Jo05). $d\sigma/d\Omega=47 \mu\text{b/sr}$ 9 (50°), 79 $\mu\text{b/sr}$ 6 (60°), 87 $\mu\text{b/sr}$ 7 (90°), 75 $\mu\text{b/sr}$ 6 (105°), 60 $\mu\text{b/sr}$ 13 (120°).
1227? [@] 4			$d\sigma/d\Omega=21 \mu\text{b/sr}$ 5 (90°), 24 $\mu\text{b/sr}$ 5 (105°).
1233.9 7	5/2 ⁺	27.4 9	E=1236 3 (1978Jo05). $d\sigma/d\Omega=35 \mu\text{b/sr}$ 7 (50°), 45 $\mu\text{b/sr}$ 5 (60°), 56 $\mu\text{b/sr}$ 6 (90°), 46 $\mu\text{b/sr}$ 5 (105°), 40 $\mu\text{b/sr}$ 14 (120°).
1262.1 6		49.3 10	E=1263 3 (1978Jo05). $d\sigma/d\Omega=41 \mu\text{b/sr}$ 6 (50°), 68 $\mu\text{b/sr}$ 6 (60°), 113 $\mu\text{b/sr}$ 13 (90°), 106 $\mu\text{b/sr}$ 8 (105°), 86 $\mu\text{b/sr}$ 12 (120°).
1276? [@] 4			$d\sigma/d\Omega=20 \mu\text{b/sr}$ 2 (90°), 14 $\mu\text{b/sr}$ 4 (105°).
1286.0 6		9.4 5	
1301.2 8	3/2 ⁻	11.6 5	
1369 1	3/2 ⁻	14.9 6	
1476 1	3/2 ⁻	9.7 5	
1493 2	3/2 ⁻	9.2 6	
1520 2		59 1	
1575 2	5/2 ⁻ , 3/2 ⁺	39 1	
1599 2	3/2 ⁻	30.6 9	
1635 2	3/2 ⁻	23.5 9	
1651 2	3/2 ⁻	38 1	
1663 1	3/2 ⁻ , 5/2 ⁺	9 2	
1671 2	7/2 ⁺	7 1	

[†] Determined by the average peak position for each state in all measured spectra (2011Ko30). Levels from 1978Jo05 are given in comments.

[‡] Too weak in this reaction to be analyzed for J^π assignment.

[#] From $\sigma(\theta)$, $A_y(\theta)$ and fingerprint method for bands (2011Ko30). Assignments by 1978Jo05 were based on indication of L-transfers from $d\sigma(\text{d,t})/d\sigma(^3\text{He},\alpha)$ ratios and angular distributions, and on a comparison of measured cross sections with theoretical ones (fingerprint method). L-values were not given by 1978Jo05.

 $^{234}\text{U}(\text{pol d,t}),(\text{d,t})$ [2011Ko30,1978Jo05](#) (continued)

 ^{233}U Levels (continued)

@ Level from [1978Jo05](#) only.

& Values for 22 MeV at 20° from [2011Ko30](#). Cross section data at 14 MeV at 50°, 60°, 105° and 120° from [1978Jo05](#) are given under comments.

^a $\nu 5/2[503]$ bandhead is uncertain, possible candidates include the levels at 749.1, 893.6 and 914.3 keV, all with $J^\pi=5/2^-$.

^b Band(A): $\nu 5/2[633]$ band. Weakly populated band.

^c Band(B): $\nu 3/2[631]$ band. The $13/2^+$ member is expected at 570 keV which is probably obscured by strong 572.2, $1/2^-$ peak.

^d Band(C): $\nu 1/2[631]$ band. $A=6.96$ keV, $a=-0.15$.

^e Band(D): $\nu 5/2[752]$ band. Only the $11/2^-$ and $15/2^-$ members are reported.

^f Band(E): $\nu 1/2[501]$ band. $A=6.87$ keV, $a=1.28$.

^g Band(F): $\nu 3/2[501]$ band. $A=7.34$ keV.

$^{234}\text{U}(\text{pol d,t}),(\text{d,t})$ 2011Ko30,1978Jo05Band(F): $\nu 3/2[501]$ band $(9/2^-)$ 1167.8 $7/2^-, 5/2^+$ 1104.7 $5/2^-$ 1054.5 $3/2^-$ 1017.0Band(E): $\nu 1/2[501]$ band $7/2^-$ 718.2 $3/2^-$ 619.2 $5/2^-$ 609.6 $1/2^-$ 572.2Band(D): $\nu 5/2[752]$ band $15/2^-$ 521Band(C): $\nu 1/2[631]$ band $7/2^+$ 495.5Band(B): $\nu 3/2[631]$ band $5/2^+$ 455.9 $9/2^+$ 433.5 $3/2^+$ 415.8 $1/2^+ \& 11/2^-$ 398.1 $1/2^+ \& 11/2^-$ 398.1 $7/2^+$ 380.1 $5/2^+$ 340.3 $3/2^+$ 311.7Band(A): $\nu 5/2[633]$ band $(13/2^+)$ 231 $11/2^+$ 155.3 $9/2^+$ 92.3 $7/2^+$ 40.5 $5/2^+$ 0