

¹⁶⁴Dy(α ,t) 1975Wa12,1974Le27

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

1975Wa12: E(α)=27 MeV. Measured σ at 60° using Elbek magnetic spectrograph and photographic emulsion plates at Los Alamos Scientific Laboratory FN tandem Van de Graaff accelerator. Enriched (98.43%) target on a 50 $\mu\text{g}/\text{cm}^2$ carbon backing. FWHM \approx 12 keV. DWBA analysis.

1974Le27: E(α)=45.5 MeV. Measured σ at 10° using magnetic spectrograph and photographic emulsion plates at the University of Michigan S3-inch cyclotron. FWHM-17.5 keV. DWBA analysis.

Other:

1984Bu14: E=27 MeV, measured reaction Q value=85.7 22.

¹⁶⁵Ho Levels

NSF=Nuclear Structure Factor=[$d\sigma/d\Omega(\text{exp})$]/[$2N((d\sigma/d\Omega)(\text{DWBA}))$], N=23. Theoretically NSF=[$\sum_i C_{ij}^i a_i U_i$]², where

C_{ij}^i =coefficients to describe Nilsson orbitals in terms of spherical states, a_i =Coriolis mixing amplitudes of states with same spin, U_i =emptiness factors for the target. The experimental Nuclear Structure Factors from **1975Wa12** are listed under comments; for theoretical values, see **1975Wa12**.

E(level) [†]	J^π #	L@	$d\sigma/d\Omega$ ($\mu\text{b}/\text{sr}$) [‡]	Comments
0 ^a	7/2 ⁻			NSF=0.023. L: 1,0,2 from $\sigma(^3\text{He,d})(60^\circ)/\sigma(\alpha,t)(45^\circ)$ (1975Wa12) are inconsistent with $J^\pi=7/2^-$.
94 ^a 1	9/2 ⁻	(5)	5.8	NSF=0.092.
210 ^a 1	11/2 ⁻	(5)	121	NSF=1.40.
\approx 346 ^a	13/2 ⁻		\approx 0.8	
362 ^b 1	3/2 ⁺		3.0	NSF=0.025.
420 ^b 1	5/2 ⁺		<69 ^{&}	L: 2,3,4 from $\sigma(^3\text{He,d})(60^\circ)/\sigma(\alpha,t)(45^\circ)$ (1975Wa12); L=2 consistent with $J^\pi=5/2^+$. NSF \approx 0.52.
\approx 432 ^c	1/2 ⁺		<69 ^{&}	NSF \approx 0.03.
450 ^c 1	3/2 ⁺	(2)	76	L: 2,3 from $\sigma(^3\text{He,d})(60^\circ)/\sigma(\alpha,t)(45^\circ)$ (1975Wa12); L=2 consistent with $J^\pi=3/2^+$. NSF \approx 0.73.
\approx 498 ^b	7/2 ⁺ & 15/2 ⁻		3.0	NSF \leq 0.017. E(level): doublet of 491+499 seen in γ -ray studies.
540 ^c 1	5/2 ⁺	(2)	22	NSF=0.21.
\approx 560			\approx 1.2	
592 ^c 1	7/2 ⁺		7.0	L: 3 from $\sigma(^3\text{He,d})(60^\circ)/\sigma(\alpha,t)(45^\circ)$ (1975Wa12) inconsistent with $J^\pi=7/2^+$. NSF \approx 0.13.
639 1			\approx 1.1	Possible $J^\pi=7/2^-, 3/2^-, \pi 7/2[523]\otimes 2^+$.
680 ^d 1	1/2 ⁻		\approx 3.6	L: 0 from $\sigma(^3\text{He,d})(60^\circ)/\sigma(\alpha,t)(45^\circ)$ (1975Wa12) inconsistent with $J^\pi=1/2^-$. NSF=0.046.
701 ^d 1	5/2 ⁻	(3)	48	NSF=0.39.
715 ^e 1	7/2 ⁺	(4)	82	L: 4,5 from $\sigma(^3\text{He,d})(60^\circ)/\sigma(\alpha,t)(45^\circ)$ (1975Wa12); L=4 consistent with $J^\pi=7/2^+$. NSF=1.67.
\approx 792 ^d	3/2 ⁻	(1)	\approx 8.2	L: 0,1 from $\sigma(^3\text{He,d})(60^\circ)/\sigma(\alpha,t)(45^\circ)$ (1975Wa12); L=1 consistent with $J^\pi=3/2^-$. NSF=0.080.
802 ^d 1	9/2 ⁻	(5)	69	NSF=1.22. Also L=4,5 from $\sigma(^3\text{He,d})/\sigma(\alpha,t)$ (1974Le27).
\approx 821 ^e	9/2 ⁺		\leq 4.2	L: 4,5 from $\sigma(^3\text{He,d})/\sigma(\alpha,t)$ (1974Le27); L=4 consistent with $J^\pi=9/2^+$.

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$^{164}\text{Dy}(\alpha,t)$ **1975Wa12,1974Le27 (continued)**

^{165}Ho Levels (continued)

E(level) [†]	J ^π #	L [@]	dσ/dΩ (μb/sr) [‡]	Comments
956 ^d 1	7/2 ⁻		18.8	NSF≤0.04. L: 4 from σ(³ He,d)(60°)/σ(α,t)(45°) (1975Wa12) is inconsistent with J ^π =7/2 ⁻ . NSF=0.13.
995 ^h 1	5/2 ⁺	(2)	2.7	NSF=0.034.
1057 ^f 2	5/2 ⁺	(2)	88	NSF=1.22.
≈1081 ^h	7/2 ⁺		≤3.6	NSF≤0.08.
≈1129			1.8	
1142 ^f 3	7/2 ⁺		1.8	NSF≈0.032.
1192 2			7.0	
1287 3			1.2	
1337 3			3.6	
1391 3			2.6	
≈1470	(9/2 ⁻)	(5)	2.6	L: 5 from σ(³ He,d)(60°)/σ(α,t)(45°) (1975Wa12); L=4 is not ruled out. Possible π9/2[514].
≈1484	(7/2 ⁻)	(3)	1.1	Possible π5/2[532]. L: 3 from σ(³ He,d)(60°)/σ(α,t)(45°) (1975Wa12); L=1,2 are not ruled out.
1534 3			2.0	
1594 ^g 3	11/2 ⁻	(5)	38	L: 5,6 from σ(³ He,d)/σ(α,t) (1974Le27). NSF=0.80.
1615 3		(0)	3.5	L: 0 from σ(³ He,d)(60°)/σ(α,t)(45°) (1975Wa12); L=1 is not ruled out. Possible J ^π =1/2 ⁺ , π1/2[400].
≈1652			≤1.7	L: 1,0,2 from σ(³ He,d)(60°)/σ(α,t)(45°) (1975Wa12); L=4 is not ruled out.
≈1675			2.2	L≥5 (1975Wa12); possible J ^π =11/2 ⁻ , π5/2[532].
1760 3		(3)	9.0	
1844 3			1.1	L: 0,1 from σ(³ He,d)(60°)/σ(α,t)(45°) (1975Wa12).
1939 3		(4)	4.2	
2086 3		(2)	4.5	
2106 3		(3)	4.2	L: 3 from σ(³ He,d)(60°)/σ(α,t)(45°) (1975Wa12); L=2,4 is not ruled out.
2121 3		(2)	2.6	L: 2 from σ(³ He,d)(60°)/σ(α,t)(45°) (1975Wa12); L=3 is not ruled out.

[†] From 1975Wa12, unless otherwise stated. There is general agreement between results 1975Wa12 and 1974Le27, however, there are some differences. Groups in (α,t) spectrum at 232, 469, and 733 reported in 1974Le27 are not seen by 1975Wa12. The authors of 1975Wa12 suggest that some of these strong peaks seen by 1974Le27 may be the shoulders (within 15-25 keV) of the nearby strong peaks. These groups have been omitted here.

[‡] From 1975Wa12 at 45°. Absolute cross sections accurate to ≈20% and relative cross sections to ≈10%.

As given by 1975Wa12, based on L-transfer assignments, cross section ratio: σ(³He,d)(60°)/σ(α,t)(45°), and band assignments.

@ Estimated from σ(³He,d)(60°)/σ(α,t)(45°) (1975Wa12).

& 69 for 420+432.

^a Band(A): π7/2[523] band.

^b Band(B): π3/2[411] band.

^c Band(C): π1/2[411] band.

^d Seq.(H): π1/2[541] Sequence.

^e Band(D): π7/2[404] band.

^f Band(E): π5/2[402] band.

^g Band(F): π9/2[514] band.

^h Band(G): π5/2[413] band.

$^{164}\text{Dy}(\alpha,t)$ 1975Wa12,1974Le27

		Band(F): $\pi 9/2[514]$ band	
		<u>11/2⁻</u>	<u>1594</u>
		Band(E): $\pi 5/2[402]$ band	
		<u>7/2⁺</u>	<u>1142</u>
		Band(D): $\pi 7/2[404]$ band	
		<u>5/2⁺</u>	<u>1057</u>
		<u>9/2⁺</u>	<u>≈821</u>
		<u>7/2⁺</u>	<u>715</u>
		Band(C): $\pi 1/2[411]$ band	
		<u>7/2⁺</u>	<u>592</u>
		<u>5/2⁺</u>	<u>540</u>
Band(A): $\pi 7/2[523]$ band	Band(B): $\pi 3/2[411]$ band		
<u>7/2⁺ & 15/2⁻</u>	<u>7/2⁺ & 15/2⁻</u>		
<u>≈498</u>	<u>≈498</u>		
		<u>3/2⁺</u>	<u>450</u>
		<u>5/2⁺</u>	<u>420</u>
		<u>1/2⁺</u>	<u>≈432</u>
		<u>3/2⁺</u>	<u>362</u>
<u>13/2⁻</u>			
<u>≈346</u>			
		<u>11/2⁻</u>	<u>210</u>
		<u>9/2⁻</u>	<u>94</u>
		<u>7/2⁻</u>	<u>0</u>

 $^{164}\text{Dy}(\alpha,t)$ 1975Wa12,1974Le27 (continued)Band(G): $\pi 5/2[413]$ band $7/2^+$ ≈ 1081 $5/2^+$ 995Seq.(H): $\pi 1/2[541]$
Sequence $7/2^-$ 956 $9/2^-$ 802 $3/2^-$ ≈ 792 $5/2^-$ 701 $1/2^-$ 680 $^{165}_{67}\text{Ho}_{98}$