^{166}Er(^{3}He,d) 1974Ch44

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Balraj Singh and Jun Chen	NDS 191,1 (2023)	22-Aug-2023

1974Ch44: E(^{3}He)=24 MeV. Targets of 96.24% enriched ^{166}Er oxide. Analyzed deuterons using Enge split-pole magnetic spectrograph, and analyzed particles recorded on nuclear emulsion plates at the McMaster University FM Tandem accelerator facility. Measured $\sigma(\theta)$ distributions at nine angles. FWHM=16-18 keV. Deduced differential cross sections and (^{3}He,d)/(α,t) cross-section ratios. Interpreted level structure in terms of Nilsson orbitals using 'fingerprint' method of comparison of spectroscopic factors from DWBA analysis with Nilsson-model predictions, with pairing corrections and Coriolis couplings included. Uncertainties in measured absolute cross sections are stated by 1974Ch44 as ≈20%, whereas relative intensities within a spectrum are ≈10%, and relative uncertainty for a peak at different angles is ≈15%.

^{167}Tm Levels

E(level)	J^{π}[‡]	Nuclear Structure Factor[#]	Comments
0[@]	1/2^{+}		E(level): obscured by strongly populated 10-keV level. Measured dσ/dΩ(μb/sr)=41.2 (30°), 43.5 (60°) for 0+10 levels. σ(^{3}He,d)(60°)/(α,t)(60°)=2.2 for 0+10 levels.
10[@] *2*	3/2^{+}		E(level): doublet of 0+10 levels, with dominant population of the 10−keV level. S=0.64 if total dσ/dΩ for 0+10 is assigned to the 10−keV level. Measured dσ/dΩ(μb/sr)=41.2 (30°), 43.5 (60°) for 0+10 levels. σ(^{3}He,d)(60°)/(α,t)(60°)=2.2 for 0+10 levels.
116[@] *2*	5/2^{+}	0.37	Nuclear Structure Factor: 1974Ch44 noted that this value was two to three times larger than the predicted value for the 5/2^{+}, π1/2[411] state, as is also the case for this configuration in ^{165}Tm, ^{169}Tm and ^{171}Tm. Authors further stated that their Coriolis mixing calculations could not explain this strength in terms of admixtures of other Nilsson states. Measured dσ/dΩ(μb/sr)=34.9 (30°), 28.3 (60°). σ(^{3}He,d)(60°)/(α,t)(60°)=2.6.
142[@] *2*	7/2^{+}	0.22	Measured dσ/dΩ(μb/sr)=2.1 (30°), 4.0 (60°). σ(^{3}He,d)(60°)/(α,t)(60°)=1.5.
183 *2*			E(level): complex peak. S=3.71 if total dσ/dΩ is assigned to 7/2^{+},π7/2[404] configuration; 1.05 if entire cross section is assumed to be for the 5/2^{-},π1/2[541] level. Measured dσ/dΩ(μb/sr)=73.5 (30°), 66.9 (60°). σ(^{3}He,d)(60°)/(α,t)(60°)=1.8.
290 *2*			E(level): complex peak. S=0.15 if total dσ/dΩ is assigned to 3/2^{-},π1/2[541] configuration; 2.10 if assigned to 9/2^{-},π1/2[541] configuration; S=0.33 if assigned to 7/2^{-},7/2[523] configuration. Measured dσ/dΩ(μb/sr)=44.7 (30°), 25.7 (60°). σ(^{3}He,d)(60°)/(α,t)(60°)=1.1.
325[@] *2*	9/2^{+}		Measured dσ/dΩ(μb/sr)≈2 (30°), ≈2 (60°). σ(^{3}He,d)(60°)/(α,t)(60°)≈2.
463 *2*	7/2^{-}	0.10	Proposed configuration=π1/2[541] (1974Ch44). Large decoupling parameter (≈3) leads to strongly perturbed ordering of level energies. Measured dσ/dΩ(μb/sr)=11.5 (30°), 8.2 (60°). σ(^{3}He,d)(60°)/(α,t)(60°)=1.5.
471[&] *2*	3/2^{+}	0.04	Measured dσ/dΩ(μb/sr)=5.3 (30°), 3.2 (60°). σ(^{3}He,d)(60°)/(α,t)(60°)=2.7.
497 *2*	11/2^{-}	0.86	Proposed configuration=π7/2[523] (1974Ch44). Measured dσ/dΩ(μb/sr)=7.8 (30°), 14.8 (60°). σ(^{3}He,d)(60°)/(α,t)(60°)=1.1.
522[†] *2*	5/2^{+}	0.33	Proposed configuration=π5/2[402] (1974Ch44).

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^{166}Er(^{3}He,d) 1974Ch44 (continued)

^{167}Tm Levels (continued)

E(level)	J^{π}‡	L	Nuclear Structure Factor#	Comments
				Measured dσ/dΩ(μb/sr)=101.4 (30°), 105.1 (60°).
				σ(^{3}He,d)(60°)/(α,t)(60°)=4.5.
558†& *2*	5/2+		1.17	Measured dσ/dΩ(μb/sr)=37.3 (30°), 29.7 (60°).
				σ(^{3}He,d)(60°)/(α,t)(60°)=3.8.
604 *2*				Measured dσ/dΩ(μb/sr)=3.9 (30°), 2.4 (60°).
701 *2*				Measured dσ/dΩ(μb/sr)=3.2 (30°), 5.1 (60°).
717 *2*				Measured dσ/dΩ(μb/sr)=3.7 (30°), 2.5 (60°).
771 *2*				Measured dσ/dΩ(μb/sr)=10.5 (30°), 9.5 (60°).
1044 *2*	11/2−		0.88	Proposed configuration=π9/2[514] (1974Ch44).
				Measured dσ/dΩ(μb/sr)=11.2 (30°), 17.1 (60°).
				σ(^{3}He,d)(60°)/(α,t)(60°)=1.2.
1125 *2*	1/2+	0		Measured dσ/dΩ(μb/sr)=45.2 (30°), 39.0 (60°).
				σ(^{3}He,d)(60°)/(α,t)(60°)≈39.
				L: from σ(θ) distribution and DWBA analysis.
1168 *2*				Measured dσ/dΩ(μb/sr)=7.7 (30°), 8.1 (60°).
1235 *2*				Measured dσ/dΩ(μb/sr)=7.9 (30°), 10.2 (60°).
1374 *2*				Measured dσ/dΩ(μb/sr)=12.0 (30°), 16.1 (60°).
1403 *2*	1/2+	0		L: from σ(θ) distribution and DWBA analysis.
				Measured dσ/dΩ(μb/sr)=121.2 (30°), 73.3 (60°).
				σ(^{3}He,d)(60°)/(α,t)(60°)≈73.
1528 *2*		(3)		E(level): 1974Ch44 suggested that 1528 level might be the 7/2−,π1/2[530] state. See the Adopted Levels for (5/2−) assignment for 1527.5 level.
				Measured dσ/dΩ(μb/sr)=51.2 (30°), 47.0 (60°).
				L: from σ(^{3}He,d)(60°)/(α,t)(60°)=5.9.
1549 *2*				Measured dσ/dΩ(μb/sr)=5.0 (30°), 5.9 (60°).
1582 *2*				Measured dσ/dΩ(μb/sr)=8.3 (30°), 2.7 (60°).
1597 *2*				Measured dσ/dΩ(μb/sr)=5.3 (30°), 2.9 (60°).
1630 *2*				Measured dσ/dΩ(μb/sr)=4.7 (30°), 2.8 (60°).
1644 *2*				Measured dσ/dΩ(μb/sr)=12.2 (30°), 10.1 (60°).
1672 *2*				Measured dσ/dΩ(μb/sr)=5.2 (30°), 2.0 (60°).
1701 *2*				Measured dσ/dΩ(μb/sr)=27.2 (30°), 28.7 (60°).
1718 *2*				Measured dσ/dΩ(μb/sr)=30.6 (30°), 33.4 (60°).

† Note that in (α,2nγ) study, 1980Ol05 assigned reversed configurations: π3/2[411] for the 522, 5/2+ level and π5/2[402] for the 578, 5/2+ level, based on initial proposed assignments in decay study by 1971Fu10. This reversal was adopted in the 2000 evaluation. Present evaluators adopt assignments for these two levels from 1974Ch44, considering that 'finger-print' method in particle-transfer reaction is more sensitive to the configuration assignment than the γ-ray studies by 1980Ol05 and 1971Fu10. Additionally, 1980Ol05 point out that the two 5/2+ levels likely have a mixed configuration (π3/2[411]+π5/2[402]), thus assignment of a single configuration to each of these two levels is not meaningful.

‡ From 1974Ch44, based on σ(θ) distributions in (^{3}He,d) and (^{3}He,d)/(α,t) cross-section ratios, 'finger-print' method.

$(\Sigma a_i C^{l}_{ji} U_i)^2$, with normalization factor N=4.2 (from theory).

@ Band(A): π1/2[411] band.

& Band(B): π3/2[411] band.

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Band(B): π3/2[411] band

5/2$^+$ 558

3/2$^+$ 471

Band(A): π1/2[411] band

9/2$^+$ 325

7/2$^+$ 142

5/2$^+$ 116

3/2$^+$ 10

1/2$^+$ 0

$^{167}_{69}Tm_{98}$