^{64}Zn(p,p′),(pol p,p′) 1987Ja04,1977Th05,1967Br10

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Balraj Singh and Jun Chen	NDS 178, 41 (2021).	12-Nov-2021

1987Ja04: (p,p′): E=22 MeV. FWHM=14 keV. Measured $\sigma(\theta)$ from 10° to 110° (lab) in steps of 2.5° to 10° using a split-pole magnetic spectrometer at Orsay tandem Van de Graaff facility. DWBA and coupled-channel calculations; 56 levels reported up to 5190 keV. See also 1987Ja05 for systematics of even-A Zn isotopes.

1977Th05 (also 1975Th05): (pol p,p′): E=15.0 MeV, FWHM=40 keV, $\sigma(\theta)$ at Los Alamos laboratory. Analyzing power of 992, 2737, 3002, 3085 and 4152 levels. A total of 34 groups reported in a spectrum Fig. 1 up to 5227 keV.

1967Br10: (p,p′): E=10.9 MeV. Measured proton spectra using a single-channel spectrograph at AERE Harwell. FWHM=10 keV, 147 levels reported up to 5941 keV. Level energy uncertainty given as 10 keV.

Others:

1993Mo15: ^{64}Zn(pol p,p′) E=20.4 MeV, measured $\sigma(\theta)$.

1968Jo16: E=26.0 MeV, FWHM=50 keV, $\sigma(\theta)$, DWBA.

1973Ta03 (also 1971Ta24): (pol p,p′), E=30.5 MeV, FWHM=100 keV, $\sigma(\theta)$, analyzing power of first 2^+ and 3^- levels, DWBA.

1973An28: (p,p′) E=6.02 MeV, FWHM=90 keV. Measured $\sigma(\theta)$ for nine groups up to 3.2-MeV excitation. Spin assignments proposed from comparison with Hauser-Feshbach calculations.

1968Jo16: (p,p′) E=26.0 MeV, FWHM=50 keV, $\sigma(\theta)$, DWBA, 23 groups reported up to 6 MeV. See also 1965Jo16.

1965Di12, 1965Di11 (also 1967Di03): (p,p′) E=11.0, 12.0 MeV. About 40 groups reported. Cross sections given in 1967Di03.

1963Be13 (also 1964Be07,1963Be07): (p,p′) E=9.6, 11.7 MeV; 14 levels up to 4.7 MeV.

Other experimental references: 1985MaZO ((pol p,p′) E=65 MeV); 1982WoZT ((pol p,p′) E=800 MeV); 1980Fa07 ((p,p′) E=29.7 MeV); 1977ChYN ((pol p,p) E=15 MeV); 1971Pa14, 1970Pr03 ((p,p′) E=6.9 MeV); 1970Li21 ((p,p′) E=39.6 MeV); 1968Pe20 ((p,p) E=11 MeV); 1967Le11 ((pol p,p′) E=50 MeV); 1967Ed01, 1967Ca19, 1967Ca15 ((p,p′) E=49.1 MeV); 1966Ga14 ((p,p′) E=2.1-4.1 MeV); 1962Ma20 ((p,p′) E=14.6 MeV); 1959Be65 ((p,p′) E=10.5 MeV); 1958Co73 ((p,p′) E=12.5-22.5 MeV); 1957Va04 ((p,p′) E=3.7-4.7 MeV).

Additional information 1.

^{64}Zn Levels

E(level)[†]	Jπ[‡]	L[#]	S	Comments
0	0^+[a]	0		
990 *5*	2^+	2	0.260 *18*	β_2=0.260 *18* (1987Ja04), 0.26, 0.25 (1993Mo15). Other β_2=0.268 (1977Th05), 0.232 (1973Ta03), 0.28 (1973An28), 0.27 or 0.31 (1970Pe09), 0.29 (1968Jo16), 0.235 (1968Le23), 0.243 (1967Ed02), 0.27 or 0.29 (1964Be07), 0.235 (from stiffness parameter given by 1962Ma20). 1992Ke07 give β_2=0.27 to 0.34.
1802 *5*				
1912 *5*	(0^+)[b]	(0)		L: from 1968Jo16.
2309 *5*	(4^+)[b]	4		L: from 1968Jo16. β_4=0.06 (1968Jo16).
2615 *5*	(0^+)[b]	(0)		
2740 *5*	4^+[a]	4		L: L=2 in 1968Jo16 is probably for a complex group.
2800 *5*	2^+[a]	2		
2975 *5*				
3003[&] *5*	$3^-,2^+$[a]	3+2		β_3=0.235 *16* (1987Ja04), 0.22, 0.21 (1993Mo15). Other β_3= 0.218 (1977Th05), 0.248 (1973Ta03), 0.19 or 0.22 (1970Pe09), 0.235 (1968Le23), 0.24 (1968Jo16), 0.127 (from stiffness parameter given by 1962Ma20). 1992Ke07 give β_3=0.18, 0.24.
3075 *5*	4^+	4		β_4=0.132 (1977Th05).
3092[@] *10*				
3184[@] *10*				
3192[&] *5*		(1)+2		
3206[@] *10*				
3260[@] *10*				
3300 *5*	$(2,1,3)^+$[a]	2		

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^{64}Zn(p,p′),(pol p,p′) 1987Ja04,1977Th05,1967Br10 (continued)

^{64}Zn Levels (continued)

E(level)†	Jπ‡	L#	Comments
3305@ *10*			
3367& *5*		(1)+2	
3422 *5*			
3465 *5*	(5,4,6)$^{-a}$	5	
3544@ *10*			
3552@ *10*			
3576 *5*			E(level): from 1987Ja04. May be composite of 3552+3595.
3595@ *10*			
3633 *5*	(4,3,5)$^{+a}$	4	
3697@ *10*			
3715@ *10*			
3750& *5*		(0)+3	L: 1968Jo16 also give L=(0) for a 3690 group. E(level): from 1987Ja04. May be composite of 3697+3715+3800.
3800 *5*			
3815@ *10*			
3850@ *10*			
3860 *5*	(2,1,3)$^{+a}$	2	
3895@ *10*			
3922 *5*	5^{-a}	5	L: for a 3910 group, 1968Jo16 give L=3.
3931@ *10*			
3957 *5*	$(4^+,3^+,5^+)^a$	4	
3991 *5*	6^{+a}	6	
4024 *10*	2^{+a}	2	
4036@ *10*			
4073 *10*	5^{+a}	4	
4107 *10*	2^{+a}	2	
4132 *10*	(2,1,3)$^{+a}$	2	L: 1968Jo16 give L=3 for a 4140 group.
4154@ *10*			
4159@ *10*			
4164 *10*	5^-	5	β_5=0.142 (1977Th05).
4179@ *10*			
4198 *10*	$(4^+,3^+,5^+)^a$	4	
4219 *10*	4^{+a}	4	
4240 *10*	6^{+a}	6	E(level): probably same as 4248 in 1967Br10.
4290 *10*	4^{+a}	4	
4324 *10*	(4,3,5)$^{+a}$	4	
4351 *10*	(2,1,3)$^{+a}$	2	
4385 *10*		(1)	E(level): from 1987Ja04.
4420 *10*	(4,3,5)$^{+a}$	4	
4453 *10*	(1,0,2)$^{-a}$	1	
4467@ *10*			
4488 *10*	(4,3,5)$^{+a}$	4	
4504@ *10*			
4522@ *10*			
4538 *10*	(4,3,5)$^{+a}$	4	
4556@ *10*			
4573 *10*		(1)	
4593@ *10*			
4615 *10*	(4,3,5)$^{+a}$	4	
4626@ *10*			

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^{64}Zn(p,p′),(pol p,p′) 1987Ja04,1977Th05,1967Br10 (continued)

^{64}Zn Levels (continued)

E(level)†	Jπ‡	L#	E(level)†	E(level)†
4637@ *10*			5197 *10*	5588 *10*
4648 *10*	7−a	7	5211 *10*	5601 *10*
4662@ *10*			5224 *10*	5613 *10*
4702 *10*			5234 *10*	5628 *10*
4715@ *10*			5256 *10*	5642 *10*
4729@ *10*			5267 *10*	5652 *10*
4751 *10*	(4,3,5)+a	4	5292 *10*	5665 *10*
4761@ *10*			5307 *10*	5676 *10*
4786 *10*	(4,3,5)+a	4	5319 *10*	5689 *10*
4797@ *10*			5329 *10*	5699 *10*
4816 *10*	(2,1,3)+a	2	5337 *10*	5719 *10*
4831@ *10*			5351 *10*	5729 *10*
4851 *10*	(4,3,5)+a	4	5361 *10*	5737 *10*
4902 *10*	(4,3,5)+a	4	5375 *10*	5760 *10*
4935 *10*	(3,2,4)−a	3	5384 *10*	5770 *10*
4947@ *10*			5398 *10*	5780 *10*
4970 *10*	7−a	7	5413 *10*	5792 *10*
5005 *10*	2+a	2	5425 *10*	5812 *10*
5038 *10*			5443 *10*	5822 *10*
5050@ *10*			5457 *10*	5833 *10*
5071 *10*			5474 *10*	5844 *10*
5081@ *10*			5485 *10*	5860 *10*
5111@ *10*			5495 *10*	5872 *10*
5121 *10*	(2,1,3)+a	2	5517 *10*	5882 *10*
5138@ *10*			5530 *10*	5893 *10*
5148@ *10*			5545 *10*	5909 *10*
5160@ *10*			5553 *10*	5920 *10*
5171@ *10*			5564 *10*	5933 *10*
5191 *10*	(3,2,4)−a	3	5576 *10*	5948 *10*

† From 1987Ja04 for levels below 5195. Above this energy levels are reported by 1967Br10 only. Values from 1967Br10 have been increased by 7 keV since these are systematically lower (up to ≈3 MeV excitation energy) when compared with γ-ray studies. Above 3 MeV, it is difficult to make a comparison due to high level density in (p,p′).

‡ From analyzing power in (pol p,p′) (1977Th05), except where noted.

From comparison with DWBA calculations (1987Ja04), except where noted.

@ From 1967Br10. Value quoted by 1967Br10 is increased by 7 keV.

& Doublet (1987Ja04).

a From 1987Ja04, based on their L-transfer assignment from experimental σ(θ) distribution and DWBA calculations. For several levels above 3.2 MeV, 1987Ja04 considered spin of L-1, L, L+1 (allowing for spin-flip transitions, although J=L is most likely). Evaluators list J=L as the first value, followed by less likely J=L−1 and J=L+1.

b From comparison of σ(θ) with Hauser-Feshbach calculations (1973An28).