

## Global features of band moment of inertia and softness parameter of superdeformed bands

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The superdeformed (SD) shapes whose existence was predicted first by V.M. Strutinsky [1] have been observed experimentally by Twin et al., [2]. A large number of SD bands have been observed on whole chart of the nuclides [3, 4].

The 4-parameter formula has been used to calculate the band moment of inertia  $J_0$  and softness parameter ( $\sigma$ ) [5, 6] by fitting the E2 gamma ray energies of all the SD bands listed in the Table of SD bands [3] and the continuously updated ENSDF and XUNDL databases [4]. We have considered only those SD bands for which some kind of estimates of spin assignments are available. We have calculated the average values of  $J_0$  and  $\sigma$ , mass region wise and the type of nuclide wise, and listed these values in the Table I. Instead of spread, these values give an overall trend across the three types of nuclei viz., even-even, odd-A and odd-odd. The most systematic trend is observed in the A=190 mass region where the  $J_0$  values increase as we go from even-even to odd-A, and odd-A to odd-odd nuclei. The softness parameter  $\sigma$  exhibits a decline in the value as we go from even-even to odd-A, and odd-A to odd-odd nuclei. This feature is in accordance with the known behavior of pairing correlations in even-even, odd-A and odd-odd nuclei. A similar trend, although not so strong, is seen for the SD bands in A=150 mass region also. Here the change in  $\sigma$ -values is not so dramatic because, as pointed out above, all the nuclei belong to 2:1 shape cat-

egory and the  $\sigma$ -values converge to a small spread. This strongly suggests that the SD bands become much more regular in the heavy mass region where the single particle level density is high.

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### References

- [1] V. M. Strutinsky Nucl. Phys. A **122**, 1 (1968).
- [2] P.J. Twin et al., Phys. Rev. Lett. **57**, 811 (1986).
- [3] B. Singh, R. Zywna and R. B. Firestone, Table of superdeformed Nuclear Bands and Fission Isomers, Nuclear Data Sheets **97**, 241 (2002) and references therein.
- [4] Evaluated Nuclear Structure Data File (ENSDF) and Experimental Unevaluated Nuclear Data List (XUNDL) databases maintained at the National Nuclear Data Centre, Brookhaven National Laboratory, Upton, NY.
- [5] Neha Sharma and H.M. Mittal, Int. J. of Mod. Phys. E **24**, 1550054 (2015).
- [6] Neha Sharma, H.M. Mittal, A.K. Jain, Phys. Rev. C **87**, 024322 (2013).

TABLE I: Average values of the band moment of inertia  $J_0(\hbar^2 MeV^{-1})$  and the softness parameter  $\sigma$  with RMSD (keV) for yrast and excited SD bands. The italic font in the brackets shows the number of SD bands in the even-even, odd-A and odd-odd cases of each mass region.

A=80 Yrast	$J_0$	$\sigma * 10^{-5}$	RMSD	A=80 Excited	$J_0$	$\sigma * 10^{-5}$	RMSD
Even-even	-	-	-	Even-even (3)	20.71	80.54	2.92
Odd-A (5)	21.04	50.14	3.04	Odd-A (3)	21.97	48.55	3.47
Odd-odd (1)	23.96	23.43	3.58	Odd-odd (2)	23.21	72.02	2.18
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A=100 Yrast							
Even-even (1)	31.73	39.48	2.91				
Odd-A (1)	28.79	80.56	3.92				
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A=130 Yrast				A=130 Excited			
Even-even (5)	47.77	27.91	3.04	Even-even (1)	53.36	9.84	1.71
Odd-A (7)	44.34	55.38	3.01	Odd-A (2)	49.83	18.85	4.17
Odd-odd (5)	42.38	37.13	3.44	Odd-odd	-	-	
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A=150 Yrast				A=150 Excited			
Even-even (4)	66.80	16.94	2.42	Even-even (10)	74.65	9.31	1.99
Odd-A (4)	76.99	10.31	1.06	Odd-A (15)	76.23	8.37	1.40
Odd-odd (1)	78.77	0.54	0.79	Odd-odd (2)	70.82	15.15	0.82
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A=190 Yrast				A=190 Excited			
Even-even (10)	84.95	26.88	0.62	Even-even (10)	88.61	25.29	0.48
Odd-A (4)	90.56	15.27	0.73	Odd-A (36)	95.64	9.64	0.61
Odd-odd (2)	99.83	4.89	0.50	Odd-odd (6)	97.45	10.11	1.33