Shape coexistence and octupole correlations in ^{72}Se.

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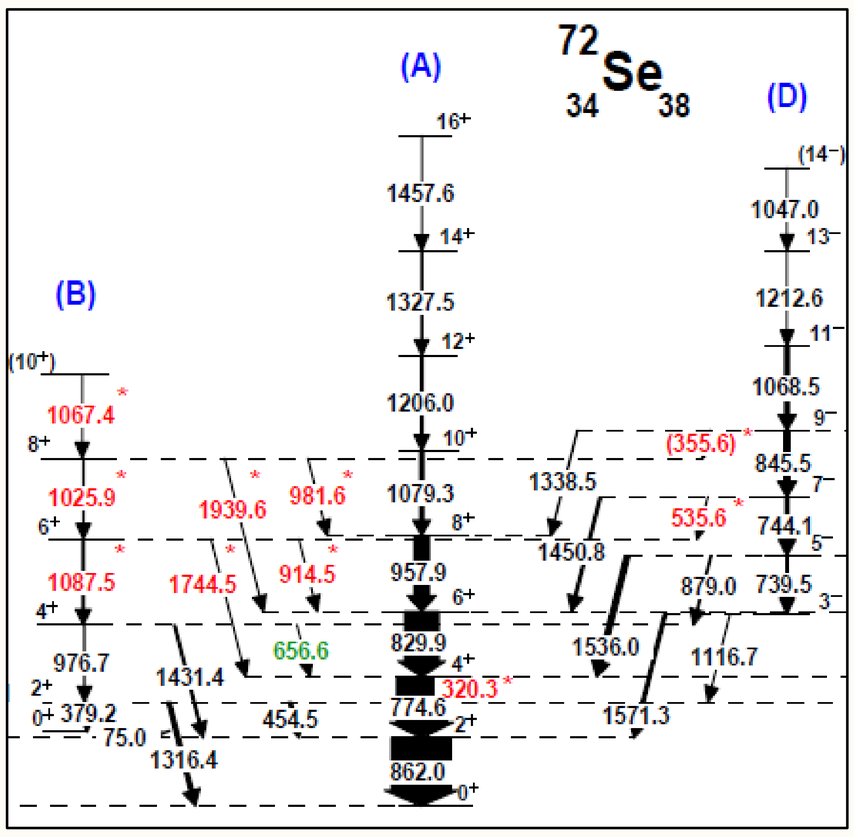
In atomic nuclei nearly all the shape related phenomena such as shape coexistence, shape evolution, octupole correlations are influenced by a favorable shell structure and the unique parity intruder orbitals near the Fermi energy. In particular, the presence of intruder $g_{9/2}$ orbital in 70 mass region triggers the presence of coexisting shapes and octupole correlations in the low-lying states .

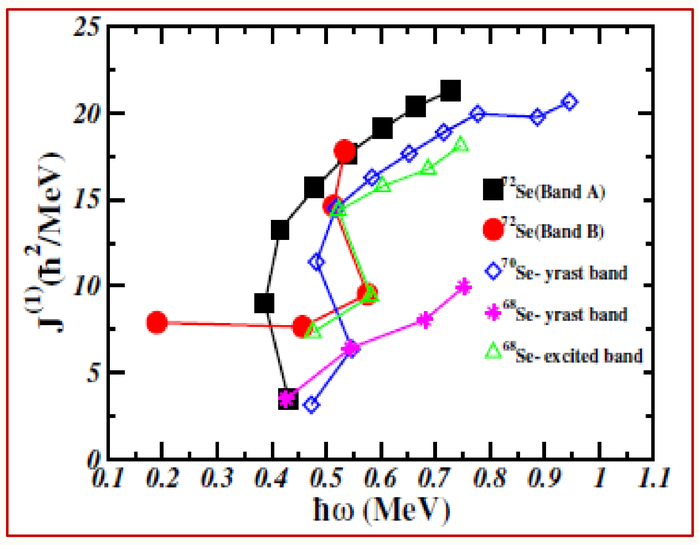
INGA setup:

^{50}Cr(^{28}Si, α2p)^{72}Se @ 90 MeV

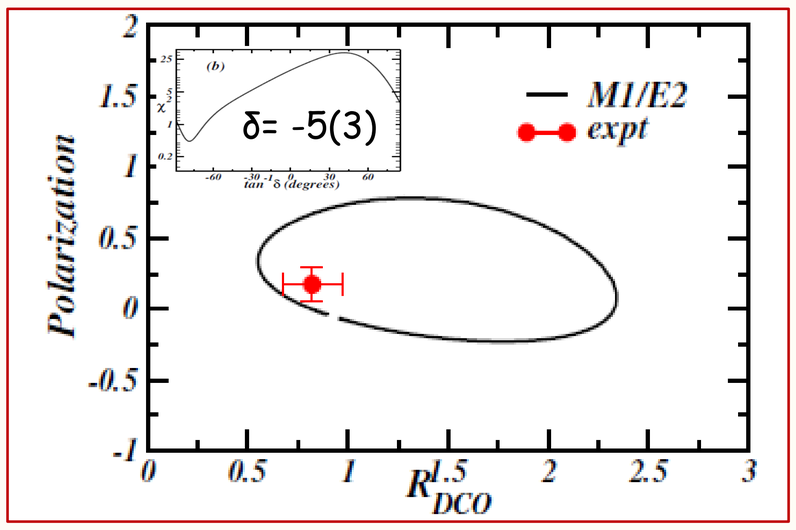
Result & Discussion:



Shape coexistence

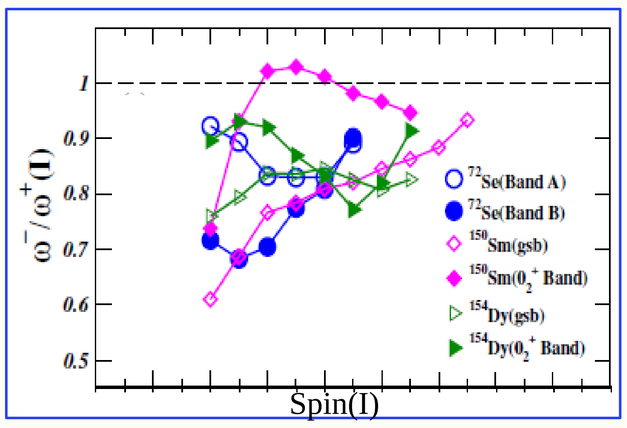


- Coexistence of oblate ground state with a probable prolate deformed excited 0^+ state.
- The mixing ratio of ΔI=0,454.5 keV transition shows its nearly pure E2 character.

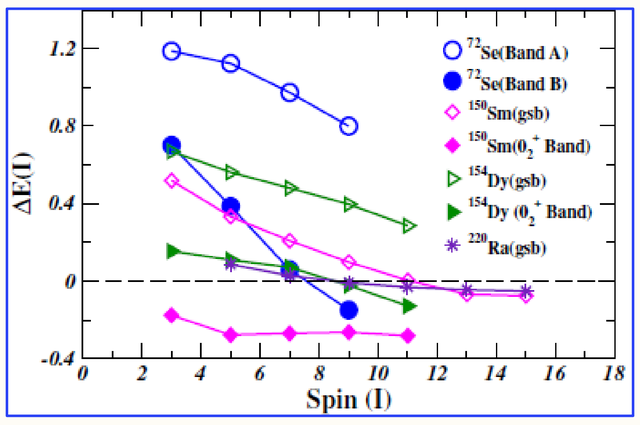


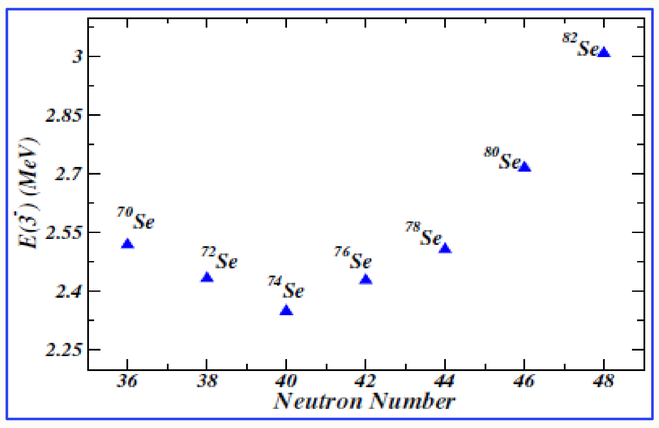
Octupole correlations

- The Z = 34 involves the role of intruder $g_{9/2}$ orbital and normal $p_{3/2}$ orbital with an angular momentum difference of 3ħ.
- The values of B(*E1*)/B(*E2*) ratio and transition strength B(*E1*) of ^{72}Se supports the enhancement of inter-connecting *E1* transitions.

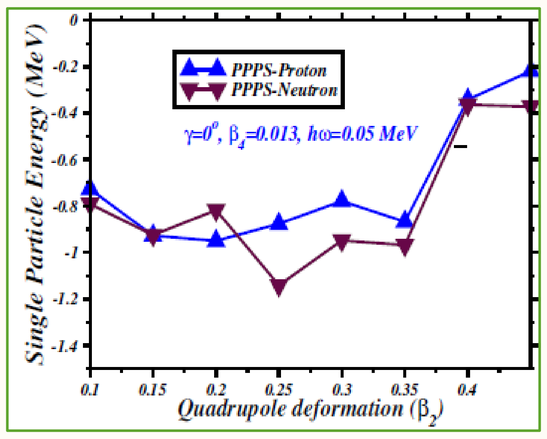


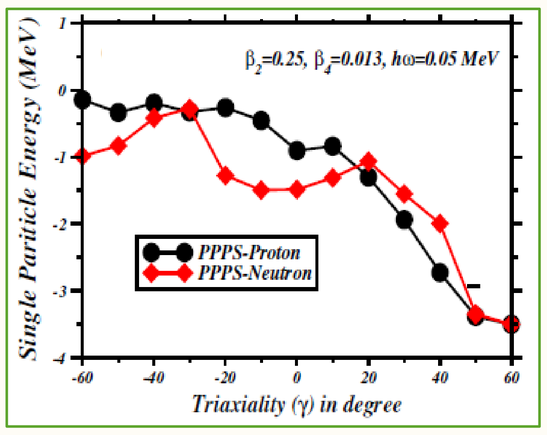
E_γ (keV)	I_i^π	I_f^π	$\frac{B(E1)}{B(E2)}$ 10^{-6} fm^{-2}	B(E1) 10^{-4} W.U.
879.0	5^-	4^+_2	0.204(6)	---
535.6	7^-	6^+_2	0.04(11)	0.85(10)
1535.8	5^-	4^+_1	0.16(11)	---
1450.8	7^-	6^+_1	0.03(11)	0.72(10)
1338.5	9^-	8^+_1	0.012(13)	0.20(3)





TRS calculation:





- The $\nu g_{9/2}$ orbital plays the most crucial role to create a shape driving force at low frequency.
- It generates the three minima with γ= 60⁰; 0⁰ and -60⁰, respectively. The third minimum is comparatively weaker than other two minima.

Summary:

- Coexisting oblate ground state with prolate deformed excited states with linking *E0* and *E2* transitions between two *shape coexistence* band.
- First observation of decaying enhanced *E1* transition from negative parity band to both $K^\pi = 0^+$ bands, in 70 mass region, showing *octupole correlation* in ^{72}Se nucleus.

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