

Structural evolution and octupole correlations in transitional nuclei

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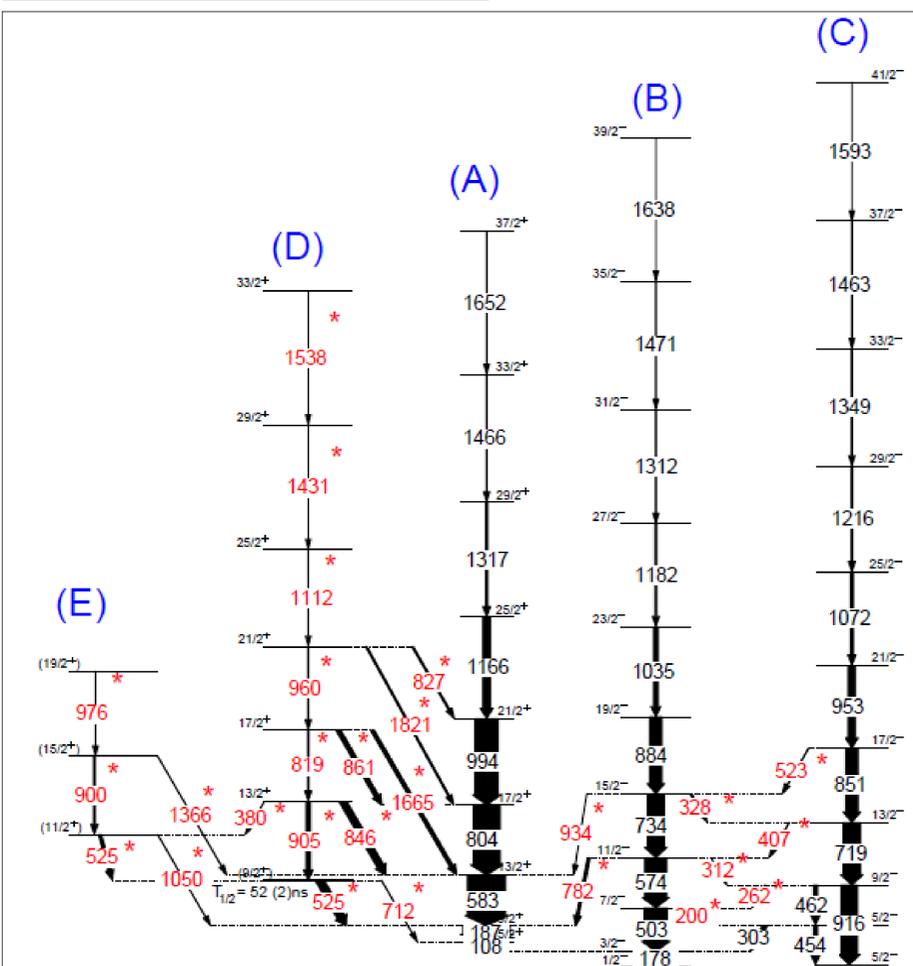
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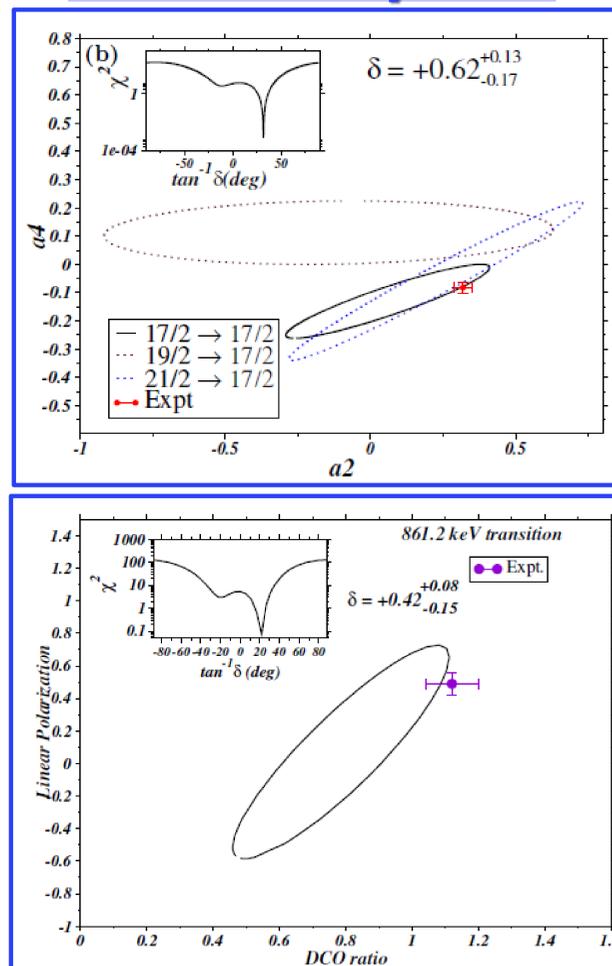
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Atomic nuclei are examples of extremely complicated finite quantum many-body systems. The nucleons inside the nucleus interact via nucleon-nucleon interactions, giving rise to a variety of shapes and phenomena. In particular ⁷³Br nucleus, the presence of intruder g_{9/2} orbital and p_{3/2} normal orbitals make it an ideal candidate to find the octupole correlations and shape coexistence phenomena at low excitation energy. The excited states of ⁷³Br have been populated via fusion-evaporation reaction ⁵⁰Cr(²⁸Si,αp)⁷³Br at an incident beam energy of 90 MeV. The de-exciting γ-rays were detected utilizing the Indian National Gamma Array (INGA) with 17 clover detector.

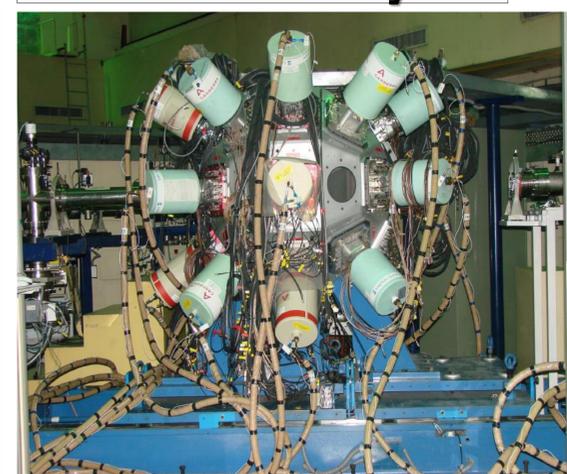
Level scheme



Data analysis



INGA-array

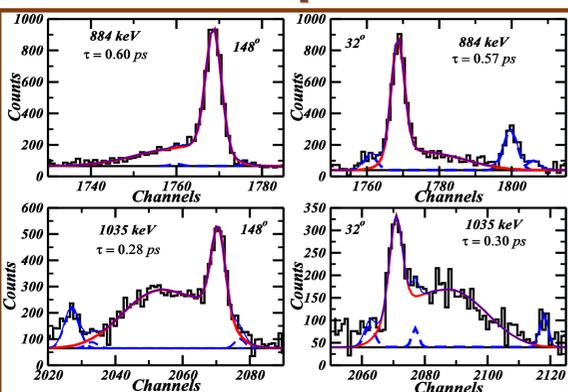


❖ Experiment was performed at IUAC using INGA facility with 17 clover detector.

- ❖ Mixing ratio of 861.2 keV ΔI = 0, E2/M1 transition has been determined through the angular distribution and R_{DCO}-linear polarization measurements.
- ❖ Such measurements confirm the spin-parity of the band-D in ⁷³Br nucleus.

Octupole correlation

Lifetime measurements using DSAM techniques



Lineshape fitting of 884 keV & 1035 keV transitions.

I _i	I _f	E _γ (MeV)	B(E1)/B(E2) × 10 ⁻⁸ fm ⁻²	B(σ _L) W.U
(11/2) ⁻	(9/2) ⁺	782	1.7(6)	0.46(9) × 10 ⁻⁴
(11/2) ⁺	(7/2) ⁻	574	-----	168.3(12)
(11/2) ⁺	(9/2) ⁻	312	-----	0.003(6)
(15/2) ⁻	(13/2) ⁺	934	0.4(6)	0.64(6) × 10 ⁻⁴
(15/2) ⁻	(11/2) ⁻	734	-----	160.01(25)
(15/2) ⁻	(13/2) ⁻	327	-----	0.002(6)

The table represents the B(E1)/B(E2) ratios along with the B(E1) transition strength in ⁷³Br nucleus.

➤ The measured B(E1)/B(E2) ratio lies in the range of 10⁻⁸ fm⁻² indicating the existence of octupole correlations in ⁷³Br.

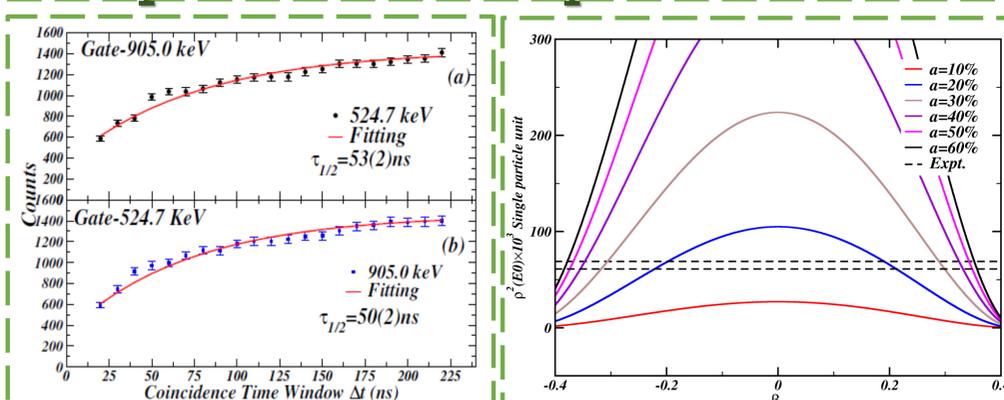
➤ Lifetime of six different states in band B have been measured using DSAM technique.

➤ The B(E1) transition strength, calculated from the lifetime value, band shows the enhancement of for the inter-connecting E1 transitions between yrast and positive parity bands.

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Shape isomer & shape coexistence



- ❖ An isomeric 9/2⁺ state is identified in the level scheme.
- ❖ The τ_{1/2} = 52(2) ns of the isomeric state is measured from the variation of intensity using different time windows for the delayed γ-ray transitions.
- ❖ The lifetime of isomeric state provides the monopole transition strength ρ²(E0) is around 73(6) × 10³ single particle unit. Here, electronic factor Σ_j Ω(Z,K) is taken as 2.640(0.132) 10⁸ s⁻¹.
- ❖ The presence of several inter-linking E0 and E2 transitions between the yrast band and K^π = 9/2⁺ band as well as shape isomeric 9/2⁺ state confirms the presence of shape coexistence in ⁷³Br.

Summary

- ❑ Twenty-seven new γ-ray transitions has been placed in the level scheme of ⁷³Br isotope using γ-γ coincidence technique.
- ❑ The enhancement of inter-connecting E1 transitions ensures the presence of octupole correlations.
- ❑ The shape isomeric 9/2⁺ state along with the interlinking E0 and E2 transitions between two positive parity bands gives a conclusive evidence of shape coexistence in ⁷³Br nucleus.