Nuclear structure study with light particle tagging

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Investigation of nuclear structure near N=82 and Z=82

Octupole correlations in Cs, Ba, La, Ce isotopes

Seniority scheme and low-lying states in Hg, Pb, Po isotopes

Heavy projectiles on lower Z targets (¹²C, ⁹Be, ⁷Li and ¹⁸O)

Octupole correlations near N=82



S. M. Burnett et al., NPA432, 51 (1985).
B. Bucher et al., PRL116 112503 (2016).
B. Bucher et al., PRL118 152504 (2016).
http://nndc.bnl.gov.in

Measuring Lifetime using LaBr₃(Ce) array for $11/2^{-1}$ state in 137La



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Particle-core coupling in ¹³⁷La

4(



H. J. Wollersheim (GSI)



Md S R Laskar et al.,

RPA Calculation for B(E3) strength in ¹³⁷La

Filling approximation for reproducing excited 5/2+ state (with assuming spherical La isotopes)

T. Inakura

Ground state (7/2+) 5/2+ state

-00000 d5/2 -00000 occupation prob. 1/6 g7/2 -000000 occupation prob. 6/8

7 protons occupy g7/2 orbit.

8 protons with occupation prob. 6/8 occupy g7/2 orbit and 6 protons with occupation prob. 1/6 occupy d5/2 orbit.

Same for neutron. 12 neutrons with occupation prob. 10/12 occupy h11/2 orbit in 137La.

Enhanced B(E3) strength in ¹³⁷La



RPA calculations with Skyrme SLy4 interaction Role of g9/2 proton with increasing occupancy of neutron in h11/2 Investigation of structure of La, Ba isotopes using different reactions Neutron

Md S R Laskar et al., PRC104, L011301 (2021) 7

Generalized Seniority around Z=82 Closed Shell

The Generalized Seniority Scheme with multi-j configurations explains

- 1) the electromagnetic properties of nuclei
- 2) origin of seniority isomers in semi-magic nuclei

2⁺ states in Hg, Pb and Po have been investigated with GS and the inverted parabola for the B(E2) with increasing neutron number Has been suggested.

Lifetime of other low-lying states will be important for understanding the evolution of collectivity in this region.

New data on Pb are required to probe the validity of the GS

B. Maheshwari, D. Choudhury, , A.K. Jain NPA 1014, 122277 (2021).

Generalized Seniority around Z=82 Closed Shell



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Example: Low-lying excitation in ²⁰⁸Po

Expt@ University of Cologne



Example: Low-lying Structure in ¹⁹⁴Os



GSB

Example: Reaction mechanism from Particle gated gamma-ray spectra



α-gated γ-ray spectra ^{94,95}Mo : *t*-capture, *xn*-evaporation

t-capture

 $\alpha + {}^{96}Mo*$

⁹⁵Mo (1n)

• ⁹⁴Mo (2n)



Expt@ BARC-TIFR PLF

Experimental Set-up





20 micron Au foil in front of Si detector Ta Oxide target for ¹⁸O Particle energy:

 12 C: Two correlated alphas : E ~ 80 MeV 7 Li: 3 H : E ~ 100 MeV

Ref: LoI on Nuclear Spectroscopy at UNILAC

Prompt and delayed spectroscopy with heavy projectile on light target will provide new opportunity to study various nuclear structure aspects in heavy nuclei

Octupole collectivity in Cs, Ba, La, Ce isotopes beyond N=80

Seniority scheme in Pb isotopes below N=126

Reaction trigger with Si detector for the surrounding gamma detectors will provide new possibilities for these studies.

Thank you all for your attention

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