Contribution ID: **156** Type: **Poster**

Intruder band structures in neutron deficient odd-odd Tl nuclei

The investigation of nuclei near the proton shell closure at \(Z = 82\) remains a vibrant field of research, as these nuclei exhibit a rich interplay of shapes driven by shape coexistence, and proton-neutron interactions. In the (A $\sim$ 190) mass region, odd-odd thallium (Tl) isotopes serve as an exemplary testing ground where both symmetric oblate and triaxial configurations have been identified. While the proton Fermi level in these nuclei is nominally positioned near the $3s_{1/2}$ orbital, the emergence of the strongly shape-driving $h_{9/2}$ and $i_{13/2}$ Nilsson orbitals at moderate deformations adds layers of complexity to the nuclear structure. The neutron Fermi level, located near the $i_{13/2}$ orbital above the \(N = 100\) semi-magic shell closure, plays a pivotal role in shaping the observed band structures.

Our comprehensive study was designed to investigate the structural evolution in Tl isotopes, particularly focusing on the relatively unexplored odd-odd nuclei ^{190}Tl and ^{192}Tl. Previous work in this mass region has revealed that while neutron-rich ^{202,204}Tl [1,2] nuclei tend toward near sphericity, their neutron-deficient counterparts display a spectrum of deformed shapes, including signatures of triaxiality manifested as chiral and t-band structures in nuclei such as ^{193,194,195,198}Tl [3,4,5,6]. In addition, Magnetic Rotational (MR) bands have been observed in ^{194,197}Tl [7,8], and the coexistence of prolate-oblate shapes is clearly observed in ^{189,191}Tl [9]. The scant experimental information on ^{190,192}Tl, however, has left its nuclear structure, particularly its transitional behaviour between axial and non-axial configurations, largely unresolved.

To address these uncertainties, we conducted two complementary fusion evaporation experiments. The first used ^{30}Si beam of 157 MeV energy delivered by the BARC-TIFR Pelletron LINAC in Mumbai, while the second used ^{16}O beam of 142 MeV energy from the K-130 cyclotron at VECC, India. Both experiments successfully populated high-spin states in the nuclei of interest, with prompt gamma-ray detection achieved using the INGA array equipped with up to 17 clover HPGe detectors. Through meticulous measurements of directional correlation ratios (R_{DCO}) and linear polarization asymmetry (Δ_{IPDCO}), we were able to establish definitive spin and parity assignments.

In our study, in ^{190}Tl the $\pi h_{9/2} \otimes \nu i_{13/2}$ oblate band has been expanded upto $21\hbar$ i.e beyond the band crossing which can be compared with its neighbours. In addition, a new positive parity band, with a 4-quasiparticle configuration, has also been identified. It is characterised as MR band with a proposed particle-hole configuration of $\pi i_{13/2} \otimes \nu(i_{13/2})^{-1}(p_{3/2})^{-2}$ and described using a semi-classical framework [10]. In ^{192}Tl an updated levelscheme is constructed in which indications of octuple correlations have been observed. These findings offer critical insights into the evolution of nuclear shapes near the \(Z = 82\) shell closure. Further analysis and theoretical modelling are underway to explore the potential presence of chiral bands in these nuclei. We look forward to discussing these results and their implications at the conference.

References:
[1] N. Fotiades, et al., Phys. Rev. C 76, 014302 (2007).
[2] N. Fotiades, et al., Phys. Rev. C 77, 024306 (2008).
[3] J. Ndayishimye et al., Phys. Rev. C 100, 014313 (2019).
[4] E.A. Lawrie et al.,Eur. Phys. J. A 45, 39–50 (2010).
[5] T. Roy et al., Physics Letters B 782, 768–772 (2018).
[6] P. L. Mastieng et al., Eur. Phys. J. A 50, 119 (2014).
[7] H. Pai et al., Phys. Rev. C 85, 064313 (2012).
[8] S. Nandi et al., Phys. Rev. C 99, 054312 (2019).
[9] W. Reviol et al., ,Physica Scripta. T56, 167-174 (1995).
[10] A. O. Macchiavelli et al., Phys. Rev. C 57, R1073(R) (1998).

Author: PAL, SNIGDHA (Variable Energy Cyclotron Centre, Kolkata, India,)

Co-authors: MUKHERJEE, Gopal (Variable Energy Cyclotron Centre, Kolkata); NAYAK, S. S. (Variable Energy Cyclotron Centre, Kolkata, India,); BASU, S. (Variable Energy Cyclotron Centre, Kolkata, India,); PAUL, Suchorita (Variable Energy Cyclotron Centre, Kolkata, India,); DAR, Shabir (Variable Energy Cyclotron Centre, Kolkata, India,); DAS, Sneha (Variable Energy Cyclotron Centre, Kolkata, India,); CHAKRABORTY, S. (Variable Energy Cyclotron Centre, Kolkata, India,); PANWAR, S. (Variable Energy Cyclotron Centre, Kolkata, India,); BHATTACHARYA, Soumik (Variable Energy Cyclotron Centre, Kolkata, India,); BHATTACHARYYA, S. (Variable Energy Cyclotron Centre, Kolkata, India,); BASAK, S. (Variable Energy Cyclotron Centre, Kolkata, India,); PAL, A. (Variable Energy Cyclotron Centre, Kolkata, India,); KUMAR, D. (Variable Energy Cyclotron Centre, Kolkata, India,); SADHUKHAN, Saumanti (Variable Energy Cyclotron Centre, Kolkata, India,); ROY, S. (Variable Energy Cyclotron Centre, Kolkata, India,); BANIK, R. (Institute of Engineering and Management, Saltlake, Kolkata-700091, India); MAJUMDER, C. (IIT Bombay, Mumbai); DAS GUPTA, S. (Victoria Institution (College), Kolkata, India); RAJBANGSHI, S. (Department of Physics, Presidency University, Kolkata 700043, India); SHIL, R. (Department of Physics, Visva-Bharati, Santiniketan-731235, India); PANT, P. (Variable Energy Cyclotron Centre, Kolkata, India,); MANNA, S. (Variable Energy Cyclotron Centre, Kolkata, India,); BANERJEE, K. (Variable Energy Cyclotron Centre, Kolkata, India,); GIRI, Pankaj K. (UGC-DAE-CSR, Kolkata); KUNDU, S. (UGC-DAE-CSR, Kolkata); SHARMA, A. (UGC--DAE-CSR, Kolkata); RAUT, R. (UGC-DAE-CSR, Kolkata); GHUGRE, S. (UGC-DAE-CSR, Kolkata); KARMAKAR, A. (Saha Institute of Nuclear Physics, 1/AF Bidhannagar, Kolkata 700064, India); PALIT, R. (Tata Institute of Fundamental Research, Homi Bhaba Road, Colaba, Mumbai-05, India); DEY, P. (Tata Institute of Fundamental Research, Homi Bhaba Road, Colaba, Mumbai-05, India); KUNDU, A. (Tata Institute of Fundamental Research, Homi Bhaba Road, Colaba, Mumbai-05, India); DAS, Biswajit (Tata Institute of Fundamental Research, Homi Bhaba Road, Colaba, Mumbai-05, India); MALIK, Vishal (Tata Institute of Fundamental Research, Homi Bhaba Road, Colaba, Mumbai-05, India); KUMAR, R. (Bhaba Atomic Research Centre, Mumbai); NAIDU, B. S. (Tata Institute of Fundamental Research, Homi Bhaba Road, Colaba, Mumbai-05, India); JADHAV, S.K. (Tata Institute of Fundamental Research, Homi Bhaba Road, Colaba, Mumbai-05, India); VAZHAPPILY, A. T. (Tata Institute of Fundamental Research, Homi Bhaba Road, Colaba, Mumbai-05, India)

Presenter: PAL, SNIGDHA (Variable Energy Cyclotron Centre, Kolkata, India,)

Session Classification: Poster session

Track Classification: Nuclear Structure, Spectroscopy and Dynamics