Near-yrast exotic structure in ^{199}Hg

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Introduction

Nuclei close to ^{208}Pb in mass 200 region show variety of band structures generating from the coupling of odd valance particles with the core. In this region, the ground and first few excited states are dominated by the pure single particle orbitals near Fermi level. Whereas the available high-j intruder orbital both for proton and neutron brings deformations into the system and various exotic structural phenomena like magnetic rotational band in ^{194}Tl [1] and Chiral band in ^{194,195,198}Tl [2,3,4] has been reported. The band structure of even mass Hg nuclei (Z=80) are described as to generate from rotation-aligned $(\pi h_{9/2}^{-2})$ states in ^{190}Hg to ^{196}Hg and $(\nu i_{13/2}^{-2})$ states in ^{198}Hg onwards [5]. For odd Hg nuclei around mass 200, the odd neutron ($\nu i_{13/2}$) orbital coupled to the slightly oblate neighbouring even Hg core and decoupled positive parity band structure on $(\nu i_{13/2}^{-1})$ $13/2^+$ has been observed in all of them[6,7]. In higher spin, negative parity structure based on 5^- and $21/2^-$ band head is described as semi decoupled band [8] in odd and even mass Hg nuclei respectively. The latest work on ^{199}Hg and ^{197}Hg, produced by heavy ion inelastic scattering[9], has mainly extend the negative parity band structure upto higher spin and establish a new structure on $33/2^+$ in ^{199}Hg. Though the yrast $\nu i_{13/2}$ band has been extended upto $49/2^+$ in ^{197}Hg and in other lower odd mass Hg nuclei, which indicates pair breaking in all of them, the decoupled band in ^{199}Hg is only known upto $25/2^+$ spin. The exotic structures, like triaxiality has been reported in these region (in Thallium isotopes) with less deformation. The appearance of exotic structures as non-yrast states are expected in the moderate spin region and the light ion induced reaction are the most favorable one to populate this type of near-yrast structures.

Experiment and analysis:

The excited levels of ^{199}Hg were populated via ^{198}Pt(α,2n)^{199}Hg reaction at a beam energy of 36 MeV with almost negligible production of the neighbouring isotopes. A thick 7.2mg/cm^2 self supported enriched ^{198}Pt foil was used as the target and the decaying γ rays from the excited states were detected using **VE**CC array for **NU**clear **S**pectroscopy (VENUS) at VECC, consisting of six Compton suppressed Clover HPGe detectors. Details of the experimental set up can be found in Ref [10]. The signals from the Clover detectors were processed with 16 channel Mesytec amplifiers and the list mode data were taken using VME based data acquisition system in singles and coincidence trigger condition. Lamps and Radware software packages has been used to form a symmetric γ–γ matrix to verify the coincidence relations and a asymmetric matrix for calculating the DCO ratio of different transitions for the information of multipolarity. For the parity information of the weekly populated non-yrast levels, INGA set up at VECC [11] has been used with more (4) Clover detectors at 90^o angle which

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were used to deduce the Polarization asymmetry ratio. Time stamped data from the INGA-VECC experiment were taken using the 250MHz digital data acquisition system and analyzed using the IUCPIX sorting package developed by UGC-DAE-CSR (Kolkata) [12]. Standard ^{152}Eu and ^{133}Ba radioactive sources were used for energy calibration and efficiency calculations.

Results and discussion:

The level scheme of ^{199}Hg has been extended with the placement of 33 new transitions with respect to the last work by Negi. et. al [9].

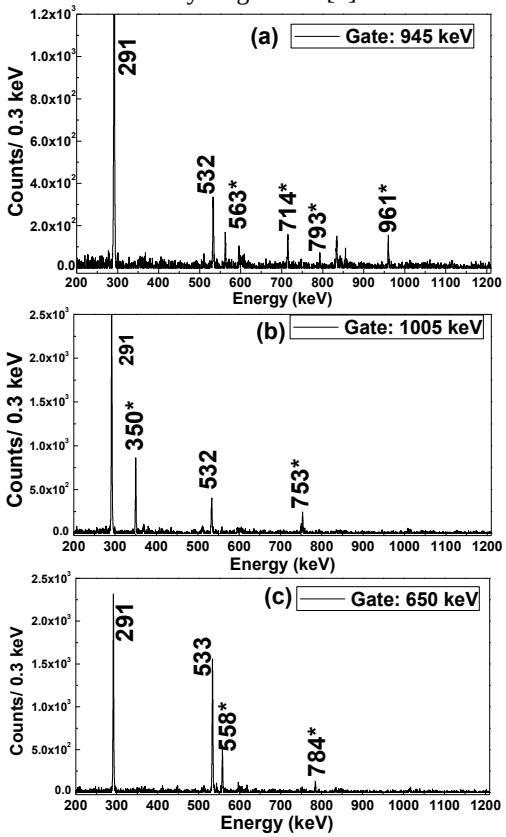

Fig 1. Coincidence spectra of ^{199}Hg from γ–γ matrix, gated by (a) 945 (b) 1005 & (c) 650 keV transitions. New transitions are marked with *.

The alpha beam populates many non-yrast single particle structure as well as few collective side bands. Fig. 1 is showing the coincidence spectra of the connecting transitions to different side bands with the yrast $\nu i_{13/2}$ band. The spectra show many new transitions identified as the part of the newly established side bands in ^{199}Hg. The alignment (i_x) plot in Fig. 2 for the yrast $13/2^+$ band shows a back bending for all the lower odd mass Hg isotopes which is interpreted as the pair breaking in $\nu i_{13/2}$ orbital leading to a three-quasi particle band structure after band crossing. But for ^{199}Hg, as the $\nu i_{13/2}$ orbital is almost full, a pair breaking in this orbital is blocked by the last odd neutron and the band become non-yrast leading to the non observation of the transitions beyond 25/2+ in heavy ion reaction. In the present work, two new E2 transitions, belongs to the $\nu i_{13/2}$ band, has been observed which extends the yrast band up to $31/2^+$ spin.

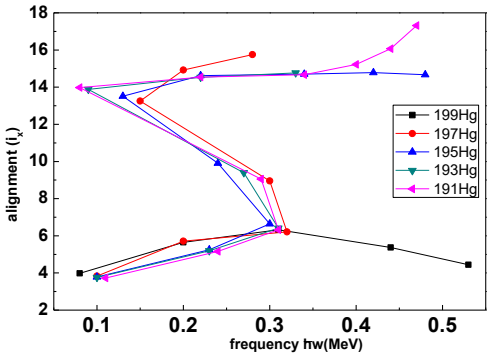

Fig 2. Alignment plot for ^{199}Hg along with all the odd mass Hg isotopes for the $\nu i_{13/2}$ band.

Acknowledgement

The efforts of the personnel of VECC K130 cyclotron are gratefully acknowledged.

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