

Spectroscopic study of ^{197}Hg

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Introduction

Mass 190 region is a rich testing ground for the detail study of nuclear collective motion and its coupling with single particle. In order to study the shape driving effects caused by the intruder orbitals (mainly $\pi h_{11/2}$ and $\nu i_{13/2}$) knowledge of definite spin parity of the levels are very important. Some of the common features of odd mass Hg isotopes are: a $(\nu i_{13/2}^-)$ decoupled positive parity band built on an isomeric $13/2^+$ level [1,2]. Another negative parity semi decoupled band of $\Delta I=2$ sequence is also observed starting from $21/2^-$ state [3]. The levels of $13/2^+$ band of odd mass Hg isotopes around 190 mass region have similar feature with the levels of their even core isotopes respectively. But this trend has not been observed in ^{197}Hg as the levels of $13/2^+$ band are at much higher energy than their cores, which can be explained as a result of the blocking effect if the configuration of ground band of the ^{198}Hg core is $(\nu i_{13/2}^-)$ [4]. In the latest work the band built on $13/2^+$ is extended up to $49/2^+$ and the negative parity band built on $21/2^-$ state are observed up to $45/2^-$ for ^{197}Hg along with several other bands [5] but many of the levels are assigned with tentative spin-parity. Our work aims to enrich the spectroscopic data and to assign definite spin-parity which will help to explain the generation of the high spin states by the intruder orbitals.

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Experiment

The levels of ^{197}Hg were populated via the fusion evaporation reaction where a $7\text{mg}/\text{cm}^2$ thick self supported enriched ^{198}Pt foil was used as the target and alpha beam @ 52 MeV from the K-130 Cyclotron of VECC was the projectile. This experiment was a part of the VECC-INGA phase II campaign where 8 Compton suppressed Clover detectors and 2 LEPS detectors were used to detect the gamma rays. The set up is shown in Fig 1. 5 Clovers were set at 90° , two at 125° and the other at 40° . And the two LEPS were set at 40° and 90° respectively. Time stamped list mode data both in singles and coincidence mode were taken using the digital data acquisition system developed by UGC-DAE-CSR (Kolkata). For energy and efficiency calibration standard ^{152}Eu and ^{133}Ba sources were used.



Fig 1. Experimental Set up of VECC INGA Phase II.

Analysis

Gain matching and construction of adback spectra for each clover detector are done using the sorting package called IUCPIX developed by UGC-DAE-CSR (Kolkata) [6]. And then from the adback data symmetric γ - γ matrix and γ - γ - γ cube are formed to check the coincidence relationship. RADWARE software is used for this purpose [7]. Asymmetric DCO and IPDCO matrices are formed to assign the multipolarity of the transitions.

Results

Preliminary analysis of coincidence relations is quite satisfactory with the indication of many new transitions. Use of alpha beam in this experiment leads to the population of several non-yrast side bands. New gammas of 708 keV and 1345 keV are observed in parallel branch above the 3464 keV level. In the ground band two parallel gamma rays with respect to 896 keV are also observed whose energies are 875 keV and 1240 keV respectively. This indicates a structural change in that particular region. These new gammas are represented in Fig 2, in the gate of 419 keV transition.

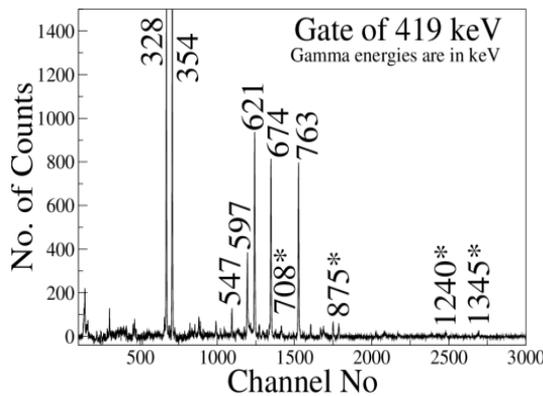


Fig 2. Spectrum showing new gammas in coincidence with the 419 keV transition. New transitions are marked with *.

A new connecting transition of 276 keV has been identified between the 3045 keV level of the $\nu_{13/2}$ ground band and 2769 keV level of the -ve parity band build on $21/2^-$ level.

263, 268 and 203 keV gammas are newly observed in this work which is shown in Fig 3 in the gate of 151 keV.

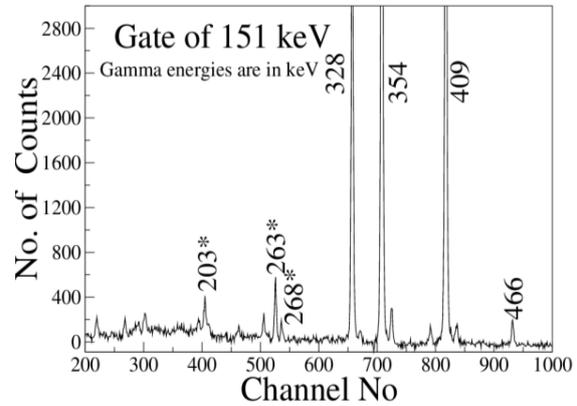


Fig 3. Gated spectrum of ^{197}Hg , where * marks indicate new gammas and the gating is done on 151 keV.

531 keV transition is found to be the cross over transition of 263 keV and 268 keV transitions. Another new 1022 keV transition is observed in parallel with the 621 keV gamma. 981 keV transition which is in the parallel cascade of 409 keV transition is also a newly found one. Further analysis to find DCO and IPDCO ratio are in progress which will help us to assign the definite spin parity of the levels for better understanding of the structure of ^{197}Hg .

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