Spectroscopy of ^{202}Po

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Introduction

Spectroscopy of nuclei in the A∼200 region is of interest in different contexts. The experimental data are expected to provide for a validation of the model calculations in the heavy nuclei and facilitate constraining the parameters therein. For instance, there have been recent endeavours (for example, Ref. [1]) towards interpreting the level structure of such nuclei in the shell model framework. The reasonable compliance between the theoretical and the experimental level energies is indicative of the credibility of the model in representing the excitation schemes of heavier systems. The modifications in the interaction Hamiltonian and other parameters of the calculations, for better overlap between the theory and the measurements, can be pursued with inputs from spectroscopy data. This work reports spectroscopic investigation of the ^{202}Po (Z = 84, N = 118) nucleus in the backdrop of the aforementioned objectives. The previous study on the excitation scheme of the nucleus was around three decades ago by Fant *et al.* [2] and carried out with a modest detection setup of few Ge detectors. The level scheme therefrom was extended upto ∼ 5.5 MeV and spin $21\hbar$, albeit with tentative spin-parity assignments for a number of states particularly at higher excitation energies. The observed level structure was interpreted from the sytematics of the even-Po isotopes wherein the excited states of the nucleus were ascribed to protons in $\pi(h_{9/2})^2$ configuration and neutrons in the $\nu(p_{3/2})^{-1}(f_{5/2})^{-1}$ or $\nu(p_{3/2})^{-1}(i_{13/2})^{-1}$ or $\nu(f_{5/2})^{-1}(i_{13/2})^{-1}$ configurations. The present study aspires to extend the level structure information on the ^{202}Po nucleus using contemporary experimental facilities, such as large array of detectors, and (eventually) interpret it in the framework of the shell model.

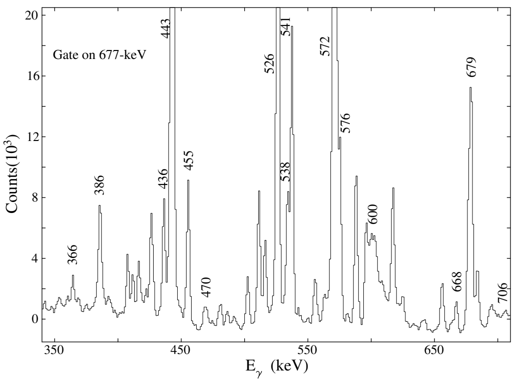

FIG. 1: Spectrum corresponding to gate on 677 keV transition of ^{202}Po.

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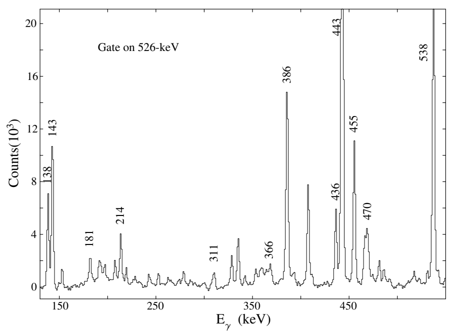

FIG. 2: Spectrum corresponding to gate on 526 keV transition of ^{202}Po.

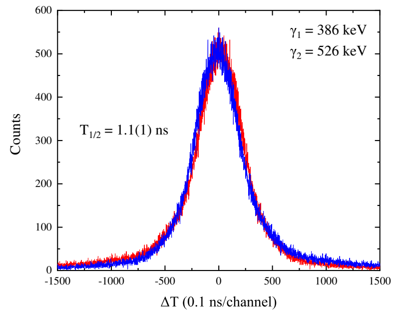

FIG. 3: Centroid shift analysis [1] for determining the lifetime of the 9^- isomeric state of ^{202}Po. The literature (NNDC) value of the $T_{1/2}$ is $\approx$ 1.5ns.

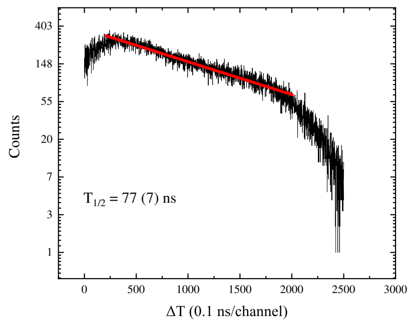

FIG. 4: Time difference spectrum between the feeding and the decaying transitions of the 8^+ isomer of ^{202}Po.

Experiment and Data Analysis

The excited states of the ^{202}Po were populated using ^{194}Pt(^{13}C,5n) reaction at E_{lab} = 74 MeV. The beam was delivered by the 15 UD Pelletron at IUAC, New Delhi. The target was 13 mg/cm^2 thick self-supporting foil of enriched (99%) ^{194}Pt. The detection setup was the Indian National Gamma Array (INGA) at IUAC, then consisting of 16 Compton suppressed HPGe clover detectors positioned at angles 148^o (4), 123^o (4), 90^o (6), 57^o (2) and 32^o (2). Data were acquired, primarily under γ-γ (multiplicity ≥ 2) coincidence trigger, using a CAMAC based acquisition system controlled through the CANDLE (@IUAC) software. The acquired data have been sorted into symmetric and asymmetric γ-γ matrices using the SPRINGZ [3] code and into γ-γ-γ cube using the RADWARE [4] package. The analysis of the data is being carried out using RADWARE.

Preliminary Results and Outlook

Figs. 1 and 2 illustrate the representative spectra projected out of symmetric γ-γ matrix with gate on different transitions in ^{202}Po. All the previously [2] reported transitions of the nucleus have been observed in the present data. Efforts are in progress to identify the new transitions and place them in the level scheme. The analysis is also being carried out to re-examine the lifetimes of the isomeric states reported in the nucleus. Fig. 3 and Fig. 4 illustrate some of the preliminary results respectively obtained for the 9^- level using the centroid shift method [1] and for the 8^+ state using the time difference spectrum of the feeding and the de-exciting transitions. The lifetimes are in overlap with the literature values, within the uncertainties.

References

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