Target Coulex and the Production of Po Isotopes by Fusion Evaporation Reaction

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Introduction

In order to investigate the high spin states in neutron deficient Po (Z=84) nuclei in the 190-200 mass region, we have used ^{32}S + ^{169}Tm reaction. The estimated (by PACE-IV) cross-sections for the above Po isotopes are small (about 10 mb) in the above reaction. To increase the yeild a thick (10 mg/cm^2) ^{169}Tm target was used. As a result large amount of Coulomb excitation data for ^{169}Tm were obtained. Here we are presenting the data obtained for the Po isotopes as well as the Coulomb excitation lines of ^{169}Tm.

Experimental Procedure and Data Analysis

The γ-ray spectroscopy experiment has been carried out at the 14-UD BARC-TIFR Pelletron Linac Facility at Mumbai, India, using 19 clover HPGe detectors with BGO anti-Compton shields of INGA collaboration. ^{196,197}Po nuclei were populated in the fusion-evaporation ^{169}Tm(^{32}S,pxn) reaction at a beam energy of 164 MeV (optimized for ^{197}Po) using ^{169}Tm (10 mg/cm^2) target. The clover detectors were arranged at six angles with three clovers each at $\pm 40^o$ and $\pm 65^o$ and -23^o while four clovers were at 90^o angles. A digital data acquisition system [1] was used for collecting the in-beam data. Two and higher folds coincidence data were taken. γ-γ matrix and γ-γ-γ cube have been formed and analyzed by RADWARE and MARCOS codes.

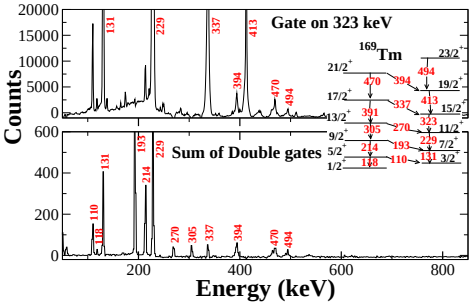

FIG. 1: Single gated spectrum at 323keV(top panel)and sum of double gated(bottom panel) spectrum confirms the Coulomb excitation lines in ^{169}Tm.

Results and Discussion

Single and double gated spectra corresponding to the gamma lines in ^{169}Tm are shown in Fig.1. The spectrum in the top panel is obtained by gating on 323 keV γ transition projected from $\gamma - \gamma$ matrix and the spectrum in the bottom panel is the sum of double gated spectrum projected from $\gamma - \gamma - \gamma$ cube. The level scheme of ^{169}Tm is shown as the inset in Fig.1. The Coulomb excitation γ lines in ^{169}Tm [2] can be clearly seen and identified. Two high-lying γ lines namely, 394 and 494 keV, which were tentative in a previous work [3] and observed in a later work [2] have been confirmed in the present work. In the very preliminary analysis on ^{196,197}Po, the previously known γ-lines of ^{197}Po [4], except the tentative ones, have been confirmed and indication of

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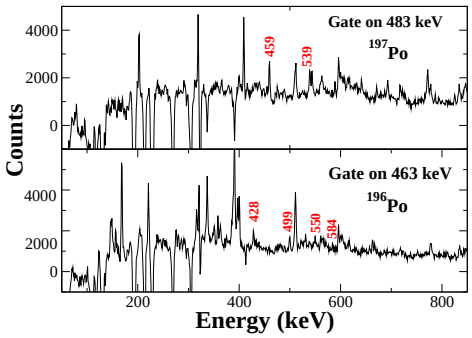

FIG. 2: Single gated spectra at 483 keV (Top) and 463 keV (Bottom) showing the known γ transitions in ^{197,196}Po.

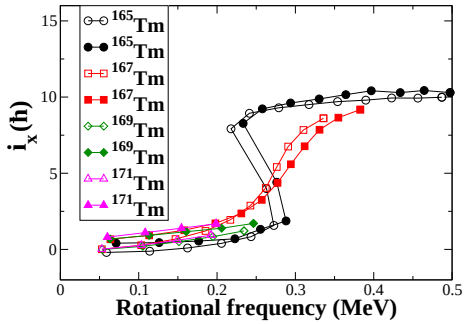

FIG. 3: Aligned angular momenta (i_x) as a function of rotational frequency ($\hbar\omega$) for odd-A Tm isotopes. $J_0 = 35\ \hbar^2$/MeV and $J_1 = 43\ \hbar^4$/MeV^3.

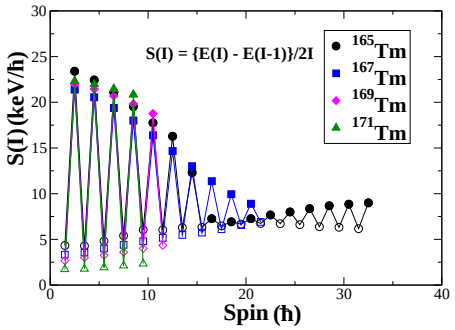

FIG. 4: Signature splitting S(I) of rotational bands as a function of spin(I) in odd-A Tm isotopes.

new γ-transitions in this nucleus has been observed. A few low lying γ-transitions in ^{196}Po [5] have also been observed. Two gated spectra are shown in Fig.2, corresponding to ^{197}Po (top) and ^{196}Po (bottom).

The aligned angular momentum (i_x) for odd-A Tm nuclei are shown in Fig.3. It can be seen that there is a backbending corresponding to a pair of neutron alignment in ^{165}Tm at rotational frequency of $\sim$ 0.3 MeV with a gain in alignment of $\sim 9\hbar$. In the contrary, the alignment in ^{167}Tm is rather gradual and approaching the same gain in alignment. However, the data on the heavier Tm isotopes ^{169,171}Tm are limited to below their band-crossing region. The energy staggering S(I) for the odd-A Tm isotopes are plotted in Fig. 4. It also shows somewhat different behaviour for the heavier Tm isotopes compared to ^{165}Tm after the backbending. However, for a better comparison, more data on ^{169,171}Tm are needed. In the present work, we are trying to extend the level scheme of ^{169}Tm.

Conclusion

In our preliminary analysis the known Coulomb excitation lines of ^{169}Tm have been confirmed. Information on the high spin states in ^{169}Tm are very important for the systematic comparison of the Tm isotopes. Most of the known γ-transitions in ^{197}Po have been observed along with some of the γ-transitions in ^{196}Po. The detailed analysis is in progress.

Acknowledgement

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