Spectroscopy of ^{207}Rn across isomeric state

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Introduction

The nuclei around Z=82 and N=126 offer a fertile ground to study the single particle excitations and test the validity of large scale shell model calculations. However, spectroscopic information on the nuclei with Z>82 and N<126 are limited. The unique parity orbital $i_{13/2}$ plays an important role for generation of the level structure of nuclei in this region [1]. The lowest unique parity states in the odd-A nuclei in this region are often isomeric, which makes study of states above the isomer difficult. Lighter Rn isotopes with four protons and few neutron holes with respect to ^{208}Pb core can yield valuable information about the interaction between neutron holes and proton particles around Z=82 and N=126 doubly magic region. For ^{207}Rn, the lowest $i_{13/2}$ state is an isomer with a half-life of 181μs, above which very few states are known so far [2]. Recently, a tentative level scheme above the isomer has been proposed by Luo et al. [3], on the basis of excitation function measured with ten single crystal HpGe detectors.

Experiment

The excited states of ^{207}Rn have been produced as a bye-product in the ^{130}Te(^{14}N,xn) reaction at E=75 MeV from the 5mg/cm^2 backing used in the ^{130}Te target, though the projectile energy was not optimized for ^{197}Au(^{14}N,4n)^{207}Rn reaction. This reaction channel actually opened up in another reaction with ^{130}Te target to populate Pr isotopes, where ^{197}Au was present as backing. The data were taken with 13 Clover Ge detectors with Anti Compton shields, setup as a campaign of Indian Nation Gamma Array (INGA) at IUAC, New Delhi. The hardware trigger was set as γ-γ-γ and time of each Clover Ge was recorded with respect to the RF signal. After the preliminary analysis of the above data, a 4kx4k γ-γ coincidence matrix, as well as γ-RF TAC, was generated from the data.

Results

Fig.1 shows the coincidence spectrum corresponding to the ground state transition 665 keV. The 234 keV transition, in coincidence with 665 keV is known to be decaying from the 181μs isomer. The other gamma rays visible in the spectrum of Fig.1, are therefore, must originate from higher lying states and decaying across the long lived isomer to 665 keV state.

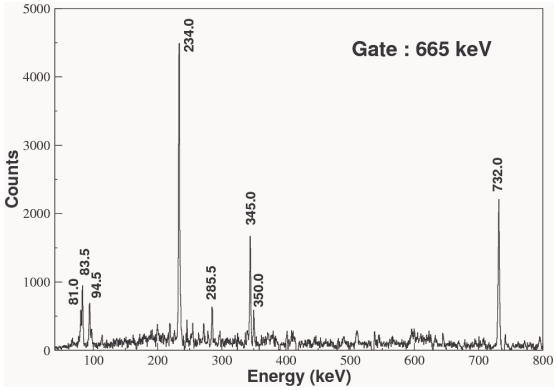

Fig. 1: Gamma ray spectrum in coincidence with 665 keV ground state transition.

Fig.2 shows another spectrum corresponding to the gating transition of 732 keV, which is found to be in coincidence with 665 keV and most probably can be placed on top of it. The data indicates the possibility of significant extension of the level structure of ^{207}Rn to higher spin states. As the present data have been taken with pulsed beam, it will be possible to establish a prompt-delayed coincidence relationship of the decaying transitions. Further data analysis is in progress. The data will be also analyzed to look for the presence of any other isomer for higher lying states. Future experiments to study the detail prompt-delayed spectroscopy by tagging these Rn residual nuclei at the focal plane of the gas filled separator Heavy Ion Reaction Analyzer (HYRA), available at IUAC, New Delhi, have been planned.

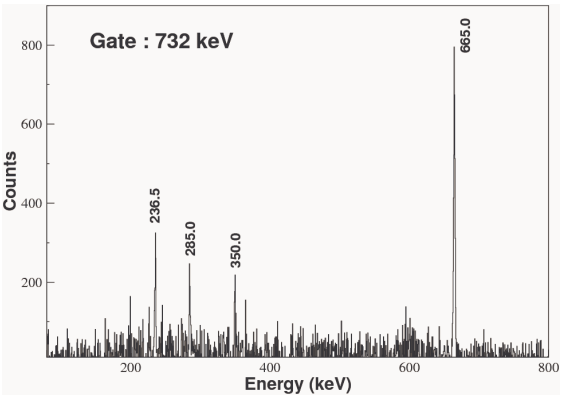

Fig. 2 Gamma ray spectrum corresponding to 732 keV gate

Acknowledgement

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References

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