Evaporation-residue cross-section and spin distribution measurements for ^{48}Ti+^{142,150}Nd,^{144}Sm systems

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Introduction

For understanding the reaction mechanism of heavy compound nucleus (CN), study of evaporation residue (ER) cross-section and spin distribution plays a key role. It is conjectured that [1] shell effect can lead to enhanced ER production and helps in the synthesis of heavy nuclei. A high spin population can also be possible due to deformation effect. Such effects can be deciphered by studying the high spin region of spin distribution. The effect of shell closure, deformation and fission competition can be studied through the spin distribution measurements. Keeping these points in mind, a systematic study of ER cross-section and spin distribution for ^{48}Ti+^{142,150}Nd,^{144}Sm systems was performed. Here, ^{150}Nd is deformed in nature (β_2 = 0.2681) but ^{142}Nd is spherical (β_2 = 0.090). By comparing the spin distribution of first two systems, deformation effect can be disentangled. In the third system, ^{144}Sm target is also spherical (β_2 = 0.0864), but leads to CN with Z_c = 84. We also want to see the role of shell effect around Z_c = 82 by comparing the spin distribution of second and third system.

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Experimental Set-up

The experiment was carried out in HYbrid Recoil mass Analyzer (HYRA) [2] + TIFR 4π spin spectrometer [3] by using 15 UD Pelletron + LINAC accelerator facility at IUAC, New Delhi. ER cross-section measurements were taken using pulsed beam of ^{48}Ti with 1 μs separation at laboratory energies ranging from 185 - 270 MeV (including energy loss from 650 μg/cm^2 carbon window foil and half thickness of target) with an average current of 0.5 pnA. Thin isotopically enriched targets ^{142,150}Nd (thickness = 150 μg/cm^2 and 100 μg/cm^2, respectively) and ^{144}Sm (thickness = 120 μg/cm^2) sandwiched [4] between two very thin carbon layers were used in the experiment. Two silicon surface barrier detectors (SSBD) were placed inside the target chamber kept at 45 mm from the target ladder subtending an angle of ±25°. The helium gas pressure in the HYRA was set at 0.30 Torr. HYRA magnetic field settings were done by a simulation program. The ERs were separated from the other contaminants using HYRA and were detected by position sensitive multi wire proportional counter (MWPC) of dimension 6 inch × 2 inch followed by a strip detector telescope of dimension 6 cm × 6 cm kept at the focal plane chamber. The spin distribution measurements were taken using TIFR 4π spin spectrometer with 29 NaI detectors. A time of flight (TOF) spectrum was generated us-

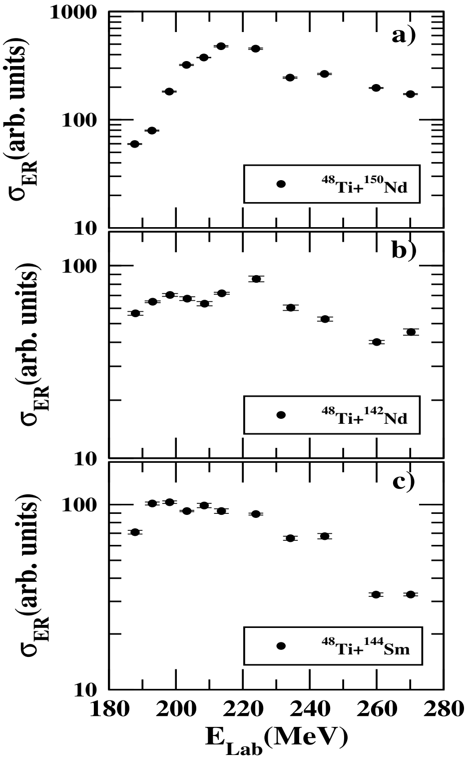

FIG. 1: Preliminary ER cross-section (in arbitrary units) for a) ^{48}Ti+^{150}Nd b) ^{48}Ti+^{142}Nd and c) ^{48}Ti+^{144}Sm systems.

ing anode of MWPC as start and RF of beam as stop. A two dimensional plot was generated using TOF and energy loss (dE) signal of MWPC which provides clean separation of ERs. A time to amplitude (TAC) spectrum was generated using MWPC anode as a start and timing OR as a stop.

Preliminary Results

For measuement of transmission efficiency of HYRA, we have performed calibration run for ^{48}Ti+^{122}Sn,^{154}Sm systems at two energy points. The ER angular distribution was calculated using the semi-microscopic Monte Carlo simulation code TERS [5] and compared within the angular acceptance of HYRA (9.5° half angle). Then, efficiency was further normalized by the calibration reaction to obtain the ER cross-section. Experimentally extracted ER cross-section in arbitrary units for the three systems are shown in Fig. 1. To reject the non-ER events, the γ-fold distribution was generated after putting the TAC-gate on raw γ-fold spectra using CANDLE software. Fig. 2 shows the ER-gated γ-fold distribution for three systems at 61 MeV excitation energy. The detailed data analysis is in progress.

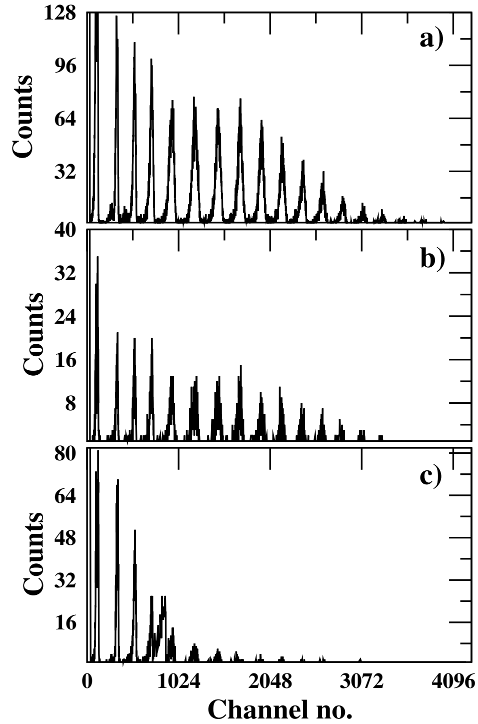

FIG. 2: ER-gated γ-fold distribution obtained for a) ^{48}Ti+^{150}Nd b) ^{48}Ti+^{142}Nd and c) ^{48}Ti+^{144}Sm systems at 61 MeV excitation energy.

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