Measurement of neutron transfer reaction cross section for the ^{18}O + ^{165}Ho system

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Introduction

In the recent past, study of nuclear reaction involving loosely bound projectiles, inclined to undergo multi-nucleon transfer reaction has emerged as an important topic of research. Multi-nucleon transfer reaction emerging as an important tool to explore the nuclear structure and its prominence reflected from the anticipation that neutron transfer takes place beyond the Coulomb barrier, influencing significantly the subsequent fusion process. Among the nucleon, neutron transfer reaction was found to be more important than proton transfer reaction to study the effect of transfer channel on fusion owing to non existence of Coulomb barrier for it. The role of neutron transfer in heavy ion induced reaction at and above the barrier energies still remains unresolved mainly due to lacking of theoretical model codes, efficient enough to incorporate the complex mechanism of transfer channels. Another constraint in the experimental study of neutron transfer is that we require comparison of fusion cross section data of different systems and it is quite difficult to single out the role of neutron transfer effect as other parameters of different projectile-target system also influences the fusion cross section data. Beckerman *et al.* [1] wear first to discover that sub barrier fusion enhancement observed experimentally in the case of ^{58,64}Ni + ^{58,64}Ni system could be due to neutron transfer reaction with positive Q value. Following the footprint of Beckerman *et al.*, Broglia *et al.* [2] and Zagerbaev [3] further confirmed that suppression of fusion cross section arising most probably due to neutron transfer reaction with positive Q value (PQNT). Neutron transfer reaction provided an additional thrust and favours the subsequent fusion reaction and is considered as an important entrance parameter. Although there is plenty of work carried out so far to explore the role of PQNT on enhancement of fusion cross section at sub barrier energies, but there is very limited work carried out so far to study the role of PQNT on above barrier fusion suppression. In order to bridge this gap, measurement of fusion excitation function for the ^{18}O + ^{165}Ho system was carried out to observe the role of PQNT on above barrier fusion suppression. In the present work, we have carried out the measurement of neutron transfer reaction cross section for ^{18}O + ^{165}Ho system in the light of code Grazing_9 [4].

Experimental Details

Experiment was carried out at Inter University Accelerator Centre (IUAC), New Delhi using ^{18}O ion beam by employing the activation foil technique. Irradiation of stack, comprising of three target-degrader foil assemblies, was done by ^{18}O ion beam at energies ≈ 87 MeV and 104 MeV in the General

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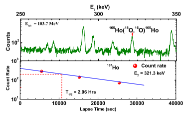

FIG. 1: (a) Recorded γ-ray spectrum of ^{167}Ho (b) Half-life decay curve of ^{167}Ho.

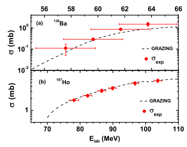

FIG. 2: Experimentally measured and theoretically calculated 2n transfer reaction cross section for the system (a) ^{18}O + ^{138}Ba [6] (b) ^{18}O + ^{165}Ho system (Present work).

Purpose Scattering Chamber (GPSC). Further details related to experimental setup is given in Ref.[5].

Results and Analysis

In the present work, measurement of 2n transfer reaction cross section having positive Q value was carried for the ^{18}O + ^{165}Ho system at $E_{lab} \approx$ 78-104 MeV.

$$^{18}\mathrm{O} + ^{165}\mathrm{Ho} \Rightarrow ^{16}\mathrm{O} + ^{167}\mathrm{Ho},$$
$$Q_{2n} = +1.335 \text{ MeV}.$$

2n transfer reaction from ^{18}O projectile to ^{165}Ho target leads to the formation of ^{167}Ho, having a half-life of 2.96 hrs. Fig. 1(a) shows the recorded γ-ray spectrum of ^{167}Ho and (b) depicts the half-life decay curve of ^{167}Ho. In order to further strengthen the finding of experimental results, theoretical calculations were performed using the code Grazing_9.

References

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