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Does positive Q-value neutron transfer channels influence sub-barrier fusion?

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In heavy-ion induced reactions, sub-barrier fusion plays a crucial role in studying the static and dynamic properties of the nucleus and understanding the astrophysical processes in the steller environment [1]. However, the sub-barrier mechanism is not yet fully explored due to insufficient systematic studies and experimental measurements [2,3]. To unravel the role of positive Q-value neutron transfer channels in sub-barrier fusion enhancement, the fusion cross-sections of 35,37Cl + 130Te systems have been measured from 10 % below to 15% above the barrier using Heavy-Ion Reaction Analyzer at Inter-University Accelerator Centre (IUAC), New Delhi, India. 130Te targets were prepared by employing resistive evaporation techniques [4]. Experimentally measured fusion excitation functions of 35,37Cl + 130Te systems were compared to probe the role of neutron transfer channels in sub-barrier fusion. The comparison particularly interesting because 35Cl + 130Te system has six positive Q-value neutron transfer channels compared to none in 37Cl + 130Te system [5].

In comparison, it has been found that the reduced fusion excitation function of 35Cl + 130Te system shows a significant enhancement over the 37Cl + 130Te system at sub-barrier energies, which suggests the strong influence of positive Q-value of neutron transfer channels in sub-barrier fusion enhancement. Further, the analysis of the excitation functions, including inelastic excitations of interacting nuclei in coupled-channels calculations, indicates the importance of neutron transfer channels in sub-barrier fusion enhancement [6,7]. The experimental findings and detailed analysis of this work will be discussed during the presentation.

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Field of your work

Experiental nuclear physics

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