Measurements of cross-section data for fusion-fission residues in light and heavy ion induced reactions

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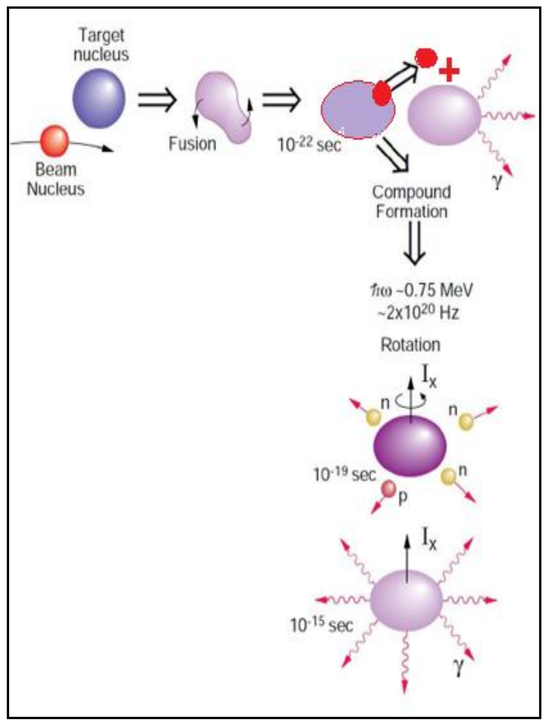


Pictorial representation of compound nuclear reactions

Systems studied

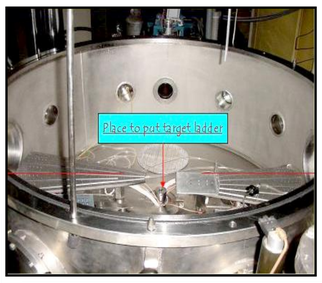
p+ ^{51}V, p+ ^{113}In, α +^{51}V, α+^{55}Mn, α+^{93}Nb, α+^{121,123}Sb, α+^{191}Au, ^{12}C+^{128}Te, ^{12}C+^{165}Ho, ^{12,13}C+^{159}Tb, ^{12,13}C+^{169}Tm, ^{14}N+^{159}Tb, ^{14}N+^{169}Tm,, ^{14}N+^{171}Lu, ^{16,18}O+^{159}Tb ^{16,18}O+^{169}Tm, ^{19}F+^{159}Tb ^{19}F+^{169}Tm, ^{19}F+^{171}Lu and ^{19}F+^{181}Ta.

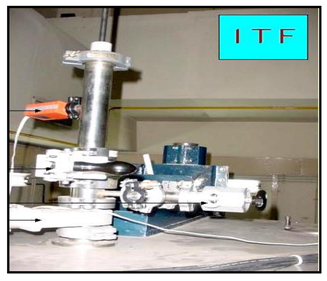
Objectives of present study

- In order to study fusion-fission dynamics, the cross-sections for several residues produced both by evaporation and fission processes have been measured for many systems in light (p, α) and heavy ion (^{12,13}C, ^{14}N, ^{16,18}O, ^{19}F) induced reactions.
- The cross-section data is not only of prime importance in nuclear applications such as reactor core design calculations, shielding problem etc., but also in reaction mechanism studies, such as compound, pre-compound emission and fission processes
- A very large numbers of experiments was performed to obtain cross-section data to understand the reaction dynamics but no systematic study has been performed
- In order to utilize cross-section data, a systematic study of pre-compound emission process has been performed in light and heavy induced reactions.

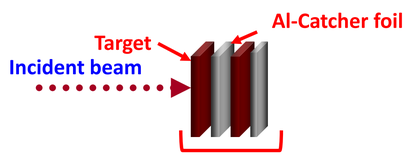
Experimental Details & Data Analysis Procedure

Experiments have been carried out using Cyclotron Accelerator facility of at the VECC, Kolkata, and IUAC, New Delhi INDIA.

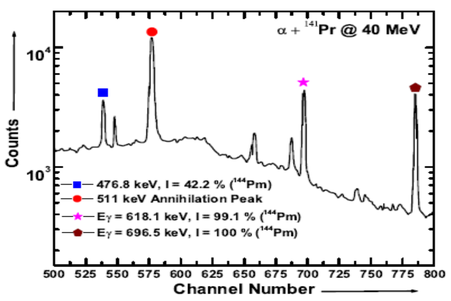




Experimental setup at IUAC, New Delhi, INDIA



Typical stack arrangement for EF measurements



Typical γ-ray spectrum : α+^{141}Pr system

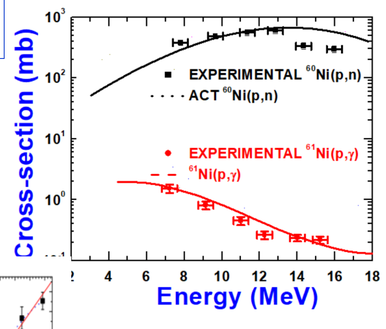
Experimental Signatures of PCN over CN

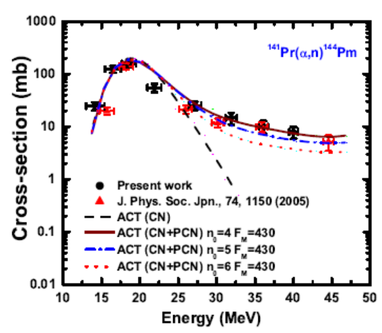
- The enhancement in the flux of emitted PCN particles in forward direction over the backward direction
- Forward peaked angular distribution of emitted particles,
- Slowly descending tails of excitation functions

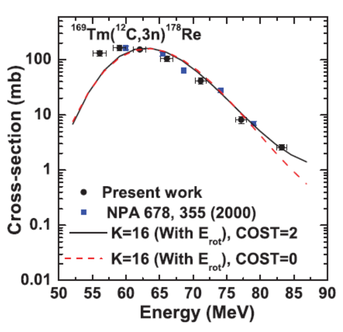
Method to Probe PCN reactions

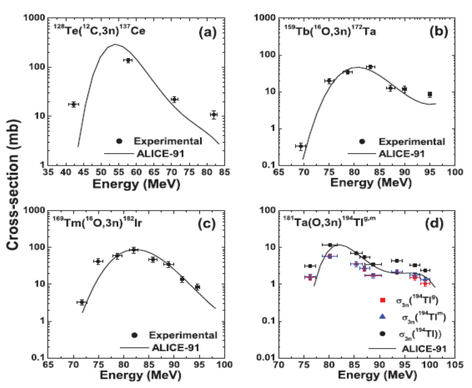
Measurement and analysis of Excitation Functions

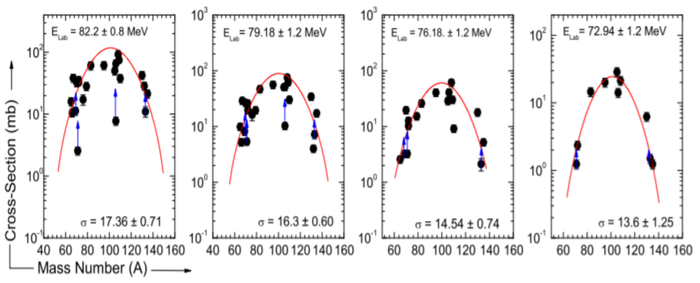
Results and Discussion











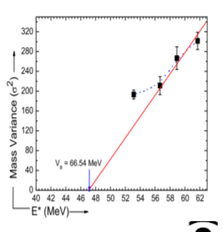
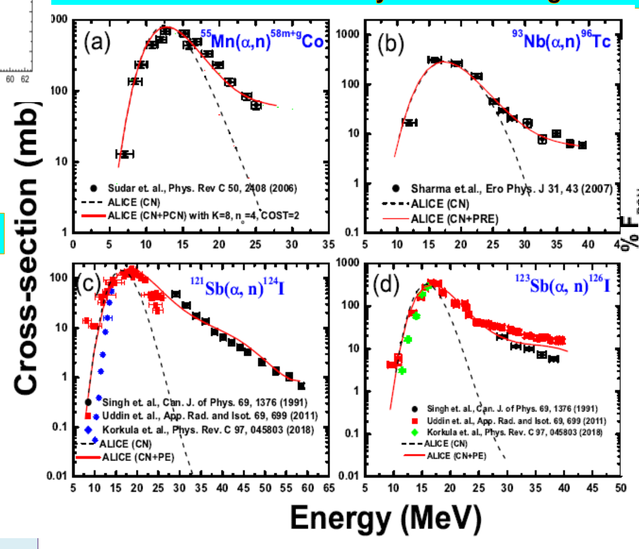


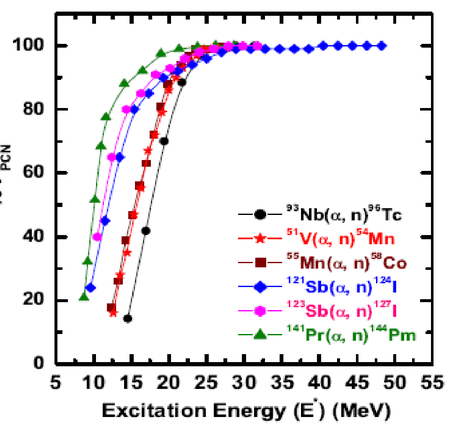
Figure 4. (Color Online) The plots of experimentally determined production cross-sections of various fission fragments at four different energies. The solid red line is the Gaussian fitting. The size of the filled circles includes the uncertainty in the yield values.

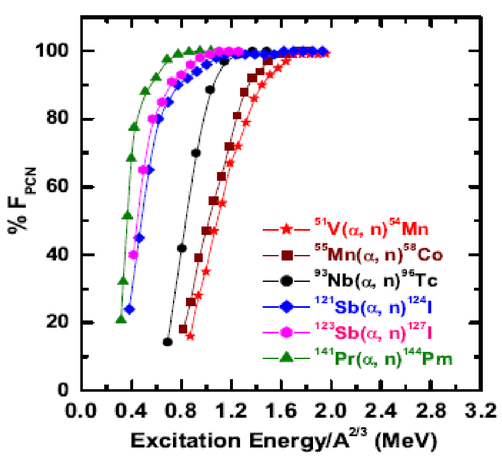
Mass distribution of fission events in the ^{14}N+^{181}Ta

Measurement and analysis EFs using codes PACE, ACT, ALICE, EXFON



Measurement and Analysis of EFs





Developed systematics

Conclusions

- The cross-sections for several residues produced both by evaporation and fission processes have been measured for many systems in light (p, α) and heavy ion (^{12,13}C, ^{14}N, ^{16,18}O, ^{19}F) induced reactions.
- The developed systematics for α-induced reactions on target nuclei ^{51}V, ^{55}Mn,^{93}Nb, ^{121}Sb, ^{123}Sb and ^{141}Pr indicates that the pre-compound process is governed by the excitation energy available to the nucleons at the surface the composite systems.
- Furthermore, mass number of the target nuclei may also play an important role in pre-compound process at low projectile energies.
- The systematics obtained from the present analysis is interesting and throw an additional insight on our existing understanding to the precompound emission process.

Acknowledgements

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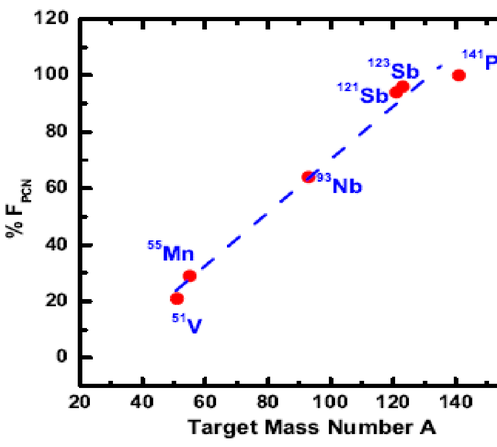

Developed systematics