# Study of fragment emission in $^{32}S+^{12}C$ reaction

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## Introduction:

Study of fragment emission mechanisms for light heavy-ion ($A_{proj.}+A_{target} \leq 60$) collisions, at energies≤( 10MeV/u) is subject of great interest. The origin of these fragments extends from quasi-elastic, deep-inelastic transfer and orbiting, to fusion–fission processes; and in some cases the structure of the nuclei has been found to play an important role [1]. Many interesting features, e.g., quasi molecular resonance, super deformed bands, orbiting etc. have been seen for nuclear reactions involving α-like nuclei. Although, there is no apparent link between these phenomena, they are believed to originate from highly deformed configuration of these systems. The fragment (5≤ Z ≤ 16) emission has been studied in the α-cluster system $^{32}$S(280MeV) +$^{12}$C [2], and the main reaction mechanism for the fragment emission was found to be symmetric splitting followed by evaporation. A large deformation has been observed in the study of light charged particle (LCP) emission from the same system $^{16}$O (76, 96, 112 MeV) +$^{28}$Si [3] which produces the same composite $^{44}$Ti*.

The motivation of the present experiment was to study the effect of deep inelastic orbiting in fragment emission of α-clustered system $^{32}$S + $^{12}$C. Earlier [2] angular distribution have been measured for the fragment (7≤ Z ≤ 13) to study the emission mechanism. In the present study our aim was to explore the emission mechanism of the fragments from the study of energy and angular distribution of elements Z < 7 and also from LCP with 220 MeV $^{32}$S beam. Here, we Report the preliminary results of this measurement.

## Experimental setup

Experiment has been performed in Pelletron-Linac facility, Mumbai, using (200, 220) MeV $^{32}$S beam on ~390 μg/cm$^2$ self-supported $^{12}$C target. Two ΔE-E-E [Si Strip-Si strip-CsI (Tl))] telescopes were used for

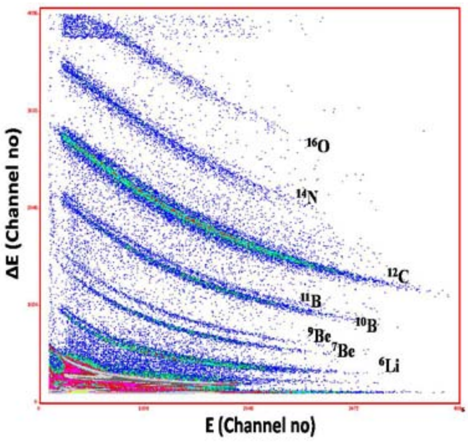


**Fig.1** Typical E-ΔE spectrum obtained by first two detectors of the telescope.

measurement of fragments up to $^{16}$O including light charged particles. Each three element telescope consists of a single sided ~50 μm thick Si (ΔE)strip detector, followed by a double sided ~525μm Si (E) strip and 4 CsI(Tl) detectors of thickness 6 cm. the distance between target and detector was ~22.4 cm. The typical ΔE vs E spectrum is shown in Fig. 1 where fragments from $^{6}$Li to $^{16}$O are clearly identified.

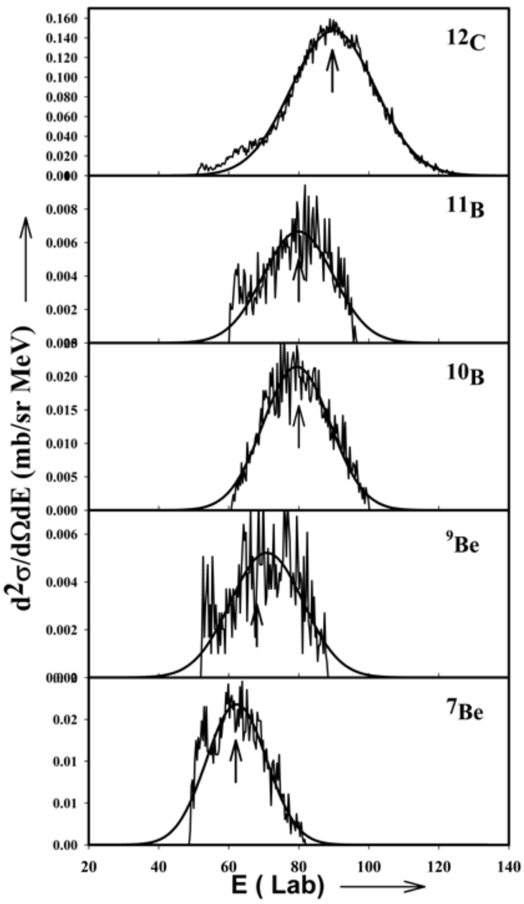


**Fig. 2** Measured energy distributions of the fragments emitted in the reaction $^{32}S+^{12}C$ at $\theta_{lab}$= $15.8^0$, arrow corresponds to the peak position of the Gaussian distribution.

## Results and discussion:

Inclusive energy distributions for various fragments have been measured in angular range $15.8^0$ to $28.3^0$. Fig.2 shows the typical energy spectrum obtained at an angle $\theta_{lab}=15.8^0$ for different isotopes of the fragments of $^7$Be to $^{12}$C respectively, It is clear from Fig. 2 that the energy spectra of the fragments are typically Gaussian in shape. The Gaussian fit are shown by solid lines with centroides by solid arrows in Fig. 2. The centroides are close to the expected kinetic energies for the fission obtained from the Viola systematic [4]. The differential cross sections for each fragment $^7$Be and $^{12}$C

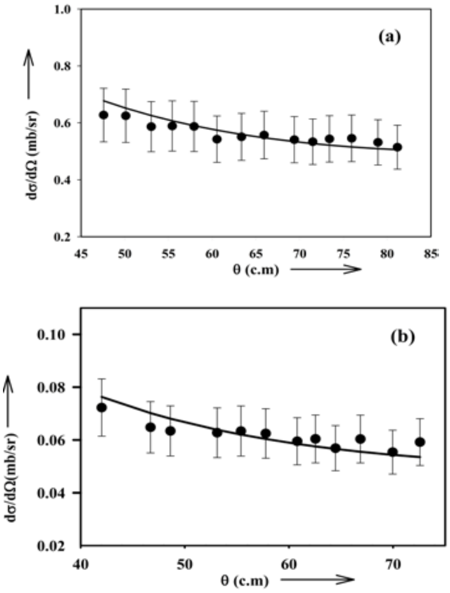


**Fig.3** Angular distribution of (a) $^{12}$C and (b) $^7$Be in c.m.

were obtained by integrating the respective energy distributions under the fitted Gaussian and shown in Fig. 3. The transformation from the laboratory to center of mass (c.m.) systems has been done assuming a two-body kinematics averaged over total kinetic energy distributions. The angular distribution of the fragments $^7$Be and $^{12}$C obtained at all bombarding energies are found to follow 1/ sin $\theta_{c.m.}$ dependence in c.m. frame (shown by solid lines in Fig. 3.), which is characteristic of the fission like decay of an equilibrated composite system. The total cross section yield for fragments $^{12}$C and $^7$Be are 9.9 mb and 1.0 mb, respectively. Respective cross section obtained from Statistical model code CASCADE [5] is ~7.1 and ~3.0mb, respectively. Further analysis of data is in progress.

## References:

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