Influence of incomplete fusion on complete fusion in ^{16}O+^{115}In interaction

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I. INTRODUCTION

In recent years, extensive efforts have been employed to understand the influence of incomplete fusion (ICF) on complete fusion (CF) just above the Coulomb barrier [1, 2]. In the ICF processes, there are particles which can be emitted either very fast (much faster than those coming from an evaporation process) or possibly very slow if they are emitted from the excited compound nucleus termed as CF particles. The fast particles having forward peaks consist of nucleons as well as the clusters of nucleons, like an alpha particle. These kinds of reactions were first of all observed by Britt and Quinton in early sixties [3]. In their work, Inamura et al. [4] measured charged particle-γ coincidences and found that at least a fraction of the fast α-particles observed in the ^{14}N+^{159}Tb reaction at 95 MeV may produced in ICF reactions .

There has been a lot of interest in studying the reaction mechanism in the medium and high energy ranges, say, in the energy range up to 10 MeV/nucleon or so. With this view in mind, The present work has been carried out with the extention of our earlier measurements and a part of the analysis of this system has already been presented [5]. In this work, the influence of ICF on CF has been studied in ^{16}O+^{115}In system below 7 MeV/nucleon.

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II. EXPERIMENTAL DETAILS

The experiment was performed at the Inter University Accelerator Centre (IUAC), New Delhi, India. The experimental details of the present work have already been presented earlier [5].

III. RESULTS AND DISCUSSION

To study the influence of ICF on CF reactions, excitation functions (EFs) of several channels have been measured. The measured EFs have been compared with theoretical predictions of statistical model code PACE4 [6]. In this code, the level density parameter constant K may be varied to match the experimental data. In the present work, a value of K=8 has been found suitable. In Fig.1(a), measured EFs of ^{128}Ba has been shown, which is produced via emission of p2n. The possibility of formation of this residue may be via both CF of ^{16}O with ^{115}In and/or via the β^+ decay of its higher charge isobar precursor. Thus the measured activities of ^{128}Ba may have contributions from both the independent production and from precursor decay modes. Again as a representative case, an attempt has been made to separate out the independent yield [7] of residue ^{128}Ba. The cumulative (σ_C) and independent (σ_i) yields for residue ^{128}Ba are related by the equation (1).

$$\sigma_c(^{128}Ba) = \sigma_i(^{128}Ba) + 1.051\ \sigma_i(^{128}La) \quad (1)$$

In Fig.1(b-d), the EFs of residues ^{122}Xe, ^{121}I and ^{117}Sb are shown, respectively. The

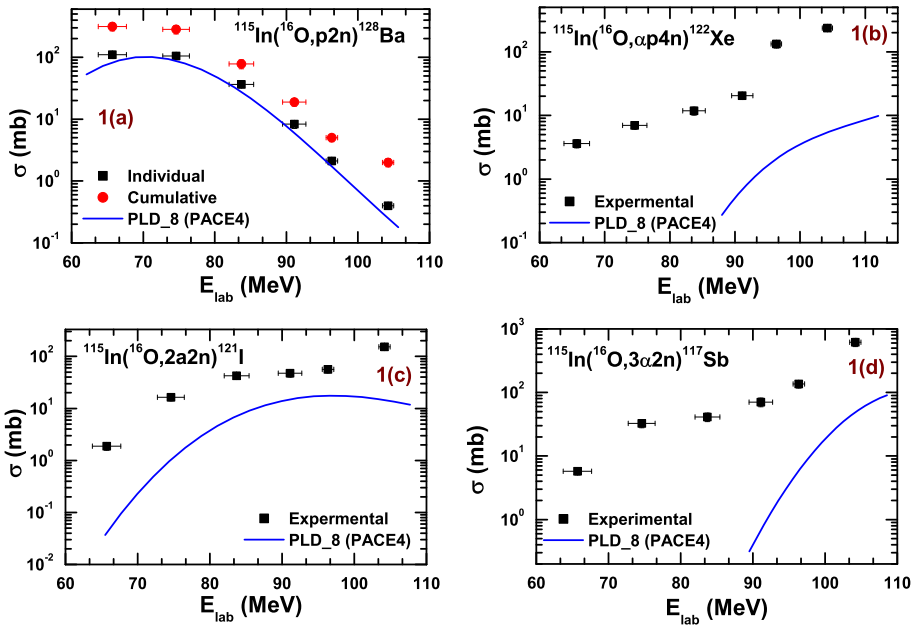

FIG. 1: Measured excitation functions of p2n, αp4n, 2α2n and 3α2n channels in ^{16}O+^{115}In interaction with theoretical prediction of model code PACE4 (K=8).

theoretical predictions of these residues do not match with the experimentally measured values. experimental results are under predicted by PACE4 [6] calculations. Since, ICF is not considered in PACE4 [6] calculations, enhancement in the measured EFs values over PACE4 [6] predictions can be attributed to the fact that these channels may be populated not only by CF of ^{16}O with ^{115}In but also by ICF, where emission of alpha particle(s) in the break up of projectile may takes place.

IV. CONCLUSION

The independent yield of ^{128}Ba residue agrees with the PACE4 [6] predictions, which shows that this residue is populated via CF of ^{16}O with ^{115}In along with higher charge isobar precursor. The analysis of EFs of ^{122}Xe, ^{121}I and ^{117}Sb residues show that not only CF but ICF also plays an important role in the production of these residues. Moreover, in these EFs, it can also observed that with the increase in projectile energy, the probability of ICF also increases.

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