Contribution ID: **32** Type: **Oral report**

Superasymmetric fission mode in 254Fm nucleus populated by 16O+238U reaction

Thursday 15 October 2020 14:55 (25 minutes)

The search for super-asymmetric fission, has been receiving increasing interest due to its possible interest in producing exotic neutron rich nucleus [1]. Among the four main fission modes prescribed by Brosa [2], the supershort mode manifests itself only when light and heavy fission fragments are close to the double magic tin with A˜132 in their nucleon composition. Though the possibility of the fission asymmetry of the pre-actinides had been predicted in 70's [3], it took a decade to substantiate this prediction experimentally [4]. Recently, the superasymmetric mode due to the influence of double magic Ca (Z = 20, N = 28) and double magic Pb (Z = 82, N = 126) has been observed at a mass yield level of 10-3 and 10-5, in fission of excited 260No compound nucleus, populated by the reactions 12C+248Cm and 22Ne+238U, respectively [5, 6]. The fission mass distributions of the fermium isotopes showed a marked transition from asymmetric to symmetric as the mass number increases from 254 to 258 [7]. Additionally, Lustig et al. [8] predicted super-asymmetric fission modes in 253Fm(n,f) 254Fm(sf). So, further investigations at the lower excitation energies of Fm isotope and to discern super-asymmetric fission mode and its characteristics out of all other fission modes, was of paramount importance.

The mass-energy distributions of fission fragments of 254Fm compound nucleus formed in the reaction 16O+238U have been measured at two lab energies Elab = 89 and 101 MeV, using the two-arm time-of-flight spectrometer CORSET [9]. The contribution from quasifission is negligible in the reaction 16O+238U [10]. At the energy close to the Coulomb barrier (corresponding excitation energy E*CN˜ 45 MeV), where the shell effects still exist, the enhancement of the mass yield in the region 60-70 u for the light fragment is observed. This can be explained by the influence of double magic Ni (Z=28, N=50). The mass yield is found to be around 10-2 %. This signature of super-asymmetric fission goes away at the higher excitation energy (E*CN˜ 56 MeV).

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Session Classification: Section 2. Experimental and theoretical studies of nuclear reactions

Track Classification: Section 2. Experimental and theoretical studies of nuclear reactions.