Study of Pre-scission Neutron Multiplicity in $^{32}S + ^{184}W$ system

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Introduction

Since last decade an extensive research has been carried out to measure the neutrons in coincidence with fission fragments with the optimum selection of projectile-target combinations to understand the nature of viscosity in the fusion-fission (FF) dynamics. An observation of excess number of measured pre-scission neutrons compared to the predictions of compound nucleus statistical model clearly indicates the dynamical effect of the fission process. Pre-scission multiplicity is the most efficient probe to investigate saddle to scission dynamics. By measuring the number of neutrons emitted in pre-saddle and post-saddle cofigurations the total fission time (τ_{tot}) can be estimated. The (τ_{tot}) includes the transient time (τ_{tr}), formation time (τ_{fr}) of the compound nucleus and the saddle to scission time (τ_{ssc}).

In this article, we report the analysis and results of neutron multiplicity measurements in ^{32}S + ^{184}W system at an excitation energy (E^*) = 71.31 MeV. The details of experiment set up and facility used are given in [1,2]. This system also provides an opportunity to study the fission-fragment mass distributions and shell effects in FF dynamics.

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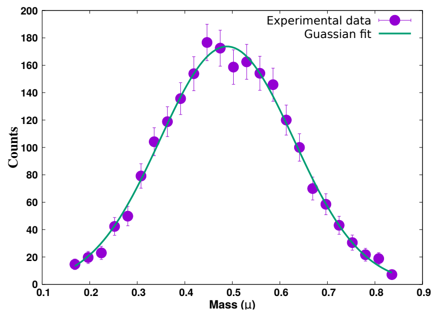

FIG. 1: Mass ratio distributions of ^{32}S + ^{184}W system. E^* = 71.31 MeV, σ_M = 0.13.

Data analysis

In the present work, time difference method [3] has been adopted to obtain fission-fragment mass distributions. Any one of the triggered signals from two strip detectors (S1, S2) detectors filtered with RF formed the master strobe for the data acquisition system. Now with respect to the filtered RF signal all the timing signals have been recorded. Thus applying the time difference method the mass ratio (M_R) distributions for the system $^{32}S + ^{184}W$ at E^* = 71.31 MeV have been obtained and (M_R) versus mass yield of fission-fragments has shown in Fig. 1.

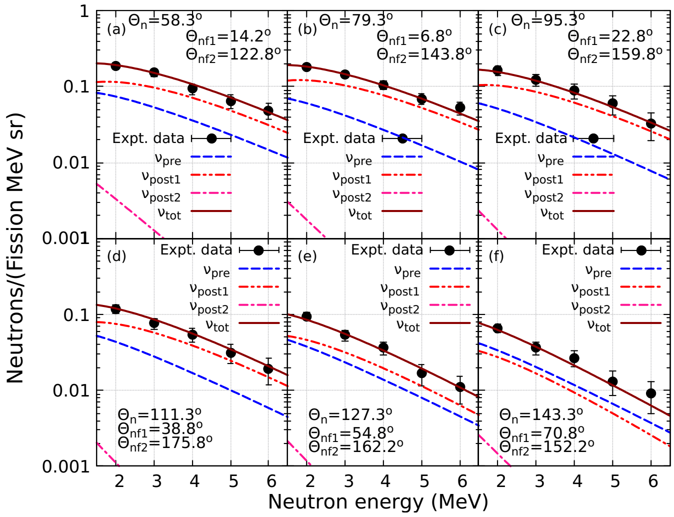

FIG. 2: Experimental neutron spectra compared with results from moving source fit for the system $^{32}S + ^{184}W$.

With reference to time of filght (TOF) of neutrons in coincidence with the fission-fragments the neutron energy was measured. After correction to the neutron detection efficiency to each neutron detector, neutron energy spectra were obtained from TOF spectra. From moving source fits [4] to the measured neutron energy spectra, the pre-scission (ν_{pre}) and post-scission neutron (ν_{post}) components have been deduced. (ν_{pre}) components emitted from CN before its decay and (ν_{post}) components emitted from the fast moving fission-fragments. Thus moving source model decomposed the measured neutron energy spectra into three components. The moving source model assumes the neutrons are emitted isotropically in their respective center of mass frames.

Results and Discussion

The mass ratio (M_R) distributions for the system $^{32}S+^{184}W$ at $E^* = 71.31$ MeV can be fitted well with a single Gaussian. The standard deviation (σ_M) of the Gaussian fits to the (M_R) distribution results the value $\sigma_M = 0.13$. From Fig.1 symmetric (M_R) distributions for the above said system has observed.

Simulteneous fitted plot of $^{32}S + ^{184}W$ system for various corelation angles is shown in Fig. 2. The simulteneous fitting has done in two approaches. In the first approach, (ν_{pre}), (ν_{post}) and their corresponding temperatures (T_{pre}, T_{post}) are treated as free parameters. The simulteneous fitting is also done by fixing the value of T_{pre} and the best fit values of ν_{pre}=3.28±0.10, ν_{post}=1.50±0.02, T_{pre}=1.67±0.08 and T_{post}=1.16±0.02 were obtained.

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