Neutron Multiplicity studies in case of $^{30}Si + ^{232}Th$ reaction

Prashant N. Patil[1],* N. M. Badiger[1,2], M. M. Hosamani[1], A. Vinayak[1], S. K. Duggi[3], Neeraj Kumar[4], N. K. Rai[5], D. Arora[6], R. N. Sahoo[7], A. Gandhi[5], S. Dhuri[8], C. V. Midhun[9], K. Hajara[9], F. S. Shana[9], A. Kaur[10], P. Sherpa[4], Mohit Kumar[6], N. Saneesh[6], K. S. Golda[6], A. Jhingan[6], K. Ramachandran[8], P. Sugathan [6], and B. K. Nayak[8]

[1]*Department of Studies in Physics, Karnatak University, Dharwad - 580 003, INDIA*
[2]*School of Advanced Sciences, KLE Technological University, Hubli, Karnataka -580 031, INDIA*
[3]*Department of Nuclear Physics, Andhra University, Visakhapatnam-530003, INDIA*
[4]*Department of Physics and Astrophysics, University of Delhi-110 007, INDIA*
[5]*Department of Physics, Banaras Hindu University, Varanasi-221 005, INDIA*
[6]*Inter University Accelerator Centre, Aruna Asif Ali Marg, New Delhi-110 067, INDIA*
[7]*Department of Physics, Indian Institute of Technology Ropar, Rupnagar, Punjab 140 001, INDIA*
[8]*Nuclear Physics Division, Bhabha Atomic Research Centre, Mumbai - 400 085, INDIA.*
[9]*Department of Physics, University of Calicut, Malappuram-673 635, INDIA. and*
[10]*Department of Physics, Panjab University, Chandigarh-160014, INDIA.*

Introduction

The fission fragment-mass-TKE distributions along with neutron multiplicities in the system $^{50}Ti + ^{208}Pb$ forming the compound nucleus (CN) ^{258}Rf at 294 MeV bombarding energy have been studied [1]. Authors in this paper reported that observed results are consistent with fusion-fission process with possible small contribution coming from quasi-fission events. More recently, Thakur et al., have studied the mass-gated neutron multiplicity at 273 MeV bombarding energy in the system $^{48}Ti + ^{208}Pb$ forming the CN ^{256}Rf and found non-negligible quasi-fission events [2]. In the present experiment mass-gated neutron multiplicity measurements have been carried out for the system $^{30}Si + ^{232}Th$, forming similar but more asymmetric CN ^{262}Rf to understand the reaction mechanism of fusion-fission and quasi-fission in the near super heavy nucleus.

Experimental Details and Data Analysis

The experiment was carried out using NAND facility [3] available at IUAC, New Delhi in the beam energy range 165-210 MeV. Pulsed beam of ^{30}Si with a pulse separation of 250 ns was bombarded on the ^{232}Th target of thickness 1.1 mg/cm^2 . The target was kept at the centre of the scattering chamber of 4 mm thickness and 100 cm diameter. The target ladder was tilted to an angle of 30° with respect to beam axis in order to minimize the shadowing to position-sensitive multi-wire proportional counters (MWPC). One of the

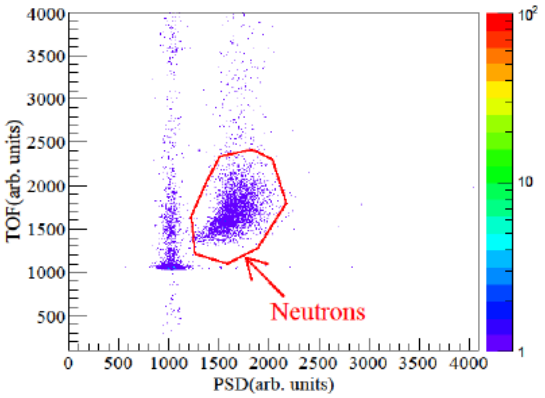

FIG. 1: Pulse shape discrimination (PSD) versus time-of-flight spectra (TOF) of one of the neutron detectors.

MWPC detectors kept at an angle of 40° with

*Electronic address: prashant.patil0032@gmail.com

respect to beam direction was at a distance of 26 cm where as the other MWPC detector kept at an angle of 112° is at a distance of 22 cm from the target and were operated with isobutene gas of 3.5 mbar gas pressure. Two silicon surface barrier detectors (SSBD) kept at ± 12.5° with respect to the beam direction were used to monitor the beam flux. Time of flight (TOF) of the fission fragments with reference to the onset of the beam were obtained from fast timing signals of MWPC detectors, from which it is possible to isolate the fission events from projectile and target like events. 49 organic liquid scintillators (5" dia and 5"

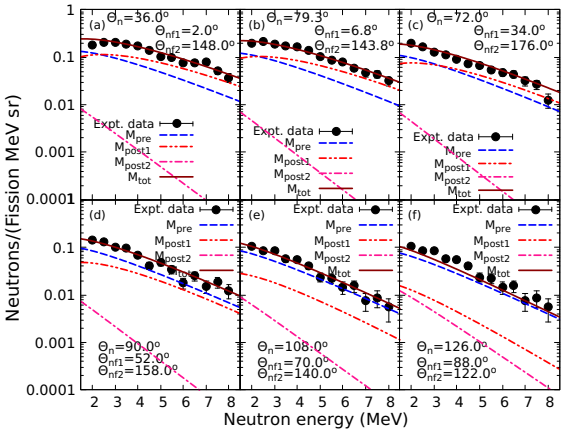

FIG. 2: Experimental double differential neutron energy spectra obtained at 210 MeV beam energy.

thick cylindrical) situated at a distance of 175 cm from the target were used to record the neutrons in coincidence with the binary fission fragments detected using two large area (20 cm × 10 cm) MWPCs [4]. The beam dump is placed at 4 m downstream from the target and beam line was well shielded with layers of lead bricks and borated paraffin to block scattered neutrons from reaching neutron detector. The neutron was discriminated from γ ray by generating two dimensional correlation plot of pulse shape discrimination (PSD) versus TOF as shown in Fig. 1.

The detectors signals were acquired by using VME based data acquisition system. The filtered RF (logical OR of the two fission fragments AND-gated with RF of the pulsed beam) was used as trigger of the data acquisition system for list mode data collection with multiparameter acquisition root based storage (MARS) acquisition software.

TABLE I: Experimentally obtained pre-(M_{pre}) and post-scission (M_{post}) neutron multiplicities and corresponding temperatures.

Mpre	Mpost	Tpre	Tpost
4.21±0.23	2.56±0.14	1.87±0.13	1.16±0.09

Pre-and post-scission neutron multiplicities were extracted (Fig. 2) at 210 MeV beam energy using the procedure as described in the Ref. [5] and are given in table I. The detailed analysis of the data is being carried out to obtain the conclusions on the experiment.

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