Study of neutron rich nuclei produced in collisions of very heavy ions

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Studying nuclei far from the valley of β-stability is now a well established field of nuclear physics. While the proton dripline has been studied in considerable detail due to its accessibility by fusion-evaporation reactions, the other two extremes, namely the superheavy one and the neutron dripline, remain elusive. We performed an experiment that aimed at both of these in April 2007 at iThemba LABS. The reaction employed was ^{86}Kr on ^{238}U. The separated sector cyclotron delivered krypton beams with energies of 484 and 497 MeV, which bring the compound nucleus ^{324}128 to a calculated excitation energy of about 25 and 35 MeV, respectively. The experimental setup consisted of the Afrodite detector array of 8 Ge clover detectors coupled to an array of 32 photovoltaic cells placed at forward angles. Such a setup was used to detect fission fragments in coincidence with γ rays. The role of the photovoltaic cells was to allow the reconstruction of reaction kinematics and Doppler correction of γ-ray energies. The experiment had two main objectives. The first one was to detect compound nucleus creation through its fission in order to investigate the possibility of using the above reaction to produce superheavy nuclei. The second and even more important objective of the experiment was to identify excited states of fission fragments produced. Since the reactants are neutron rich, the fission fragments were also expected to be neutron rich, which could possibly bring us into an uncharted territory above the well studied ^{283}U fission fragments. In the online analysis, the elastic, inelastic, deep-inelastic and asymmetric fission processes were observed, but we could not identify symmetric fission (see Figure 1). However, at low excitation energies the compound nucleus fission may still be asymmetric due to the fission fragment shell structure [1]. The analysis is in progress and first results will be presented at the conference.

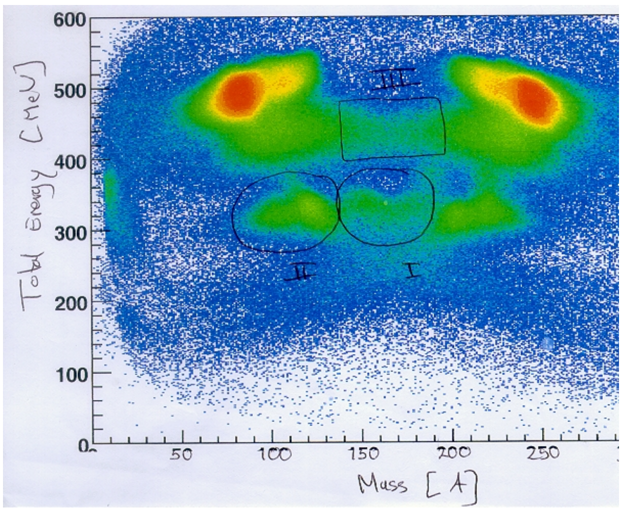

Figure 1: Reconstructed mass versus total energy detected in photovoltaic cells (preliminary).

[1] M. G. Itkis *et al.*, Nucl. Phys. A734 (2004) 136.