Alternative mechanisms for heavy element production

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The synthesis of superheavy elements (SHE) has been an important field in both theoretical and experimental nuclear physics for many years. Fusion of the doubly-magic neutron-rich ^{48}Ca projectiles with transuranium target nuclei has led during the past 6 years to the synthesis of elements with Z = 113-116 and 118 [1]. Our aim is to investigate possible alternative reactions to produce such elements. For example, one of the reactions might be one in which the fissile target nucleus (e.g. ^{238}U and ^{232}Th) would fission as the projectile approaches and where one of the fragments would fuse with the projectile nucleus. The fission fragments being neutron-rich and close to shell closure, they should enhance the fusion and survival probabilities of the formed superheavy nucleus [2].

The present experiments on BigSol beam line performed on August and December of 2006 are in continuation of the previous experiments carried out in 2003 and 2004 in collaboration with the Instituto Nazionale di Fisica Nucleare (INFN, Italy) and other university as listed in the headings. The superconducting solenoid BigSol was used to collect and focus the reaction products towards a segmented Ionization chamber (IC), with a back plane covered with scintillators, at about 4 meters from the magnet. Two position-sensitive PPACs and a multi-wire proportional counter were placed before the IC, allowing time of flight measurement and trajectory reconstruction. The IC is split into 8 segments. In addition another PPAC was placed near the target area to catch the complementary fragment.

In the experiment of 2003-04, a few tens of events consistent with the expected signature of superheavy ions, appeared mostly in systems at lower energy (7.5 A.MeV), in ^{197}Au + ^{232}Th and ^{238}U + ^{64}Zn reactions, therefore in the last experiment, we took the whole beam time with the more promising case of Au+Th at 7.5 A. MeV bombarding energy to produce a reasonable number of superheavy candidates.

The data analysis is in progress, we have calibrated all the detectors, and still optimizing the various methods for pileup rejection. The charge distributions were estimated from the time of flight between MWPC and PPAC separated by 1.05 meter and energy loss information in IC from direct beams (Ar, Kr, Xe, Yb, Au, and U) as shown in Figure.1, where the blue lines are the spline through the data that were used for charge estimation, these two lines were first used to reproduce the charge distributions of direct beams (Beam directly going to detectors without targets).

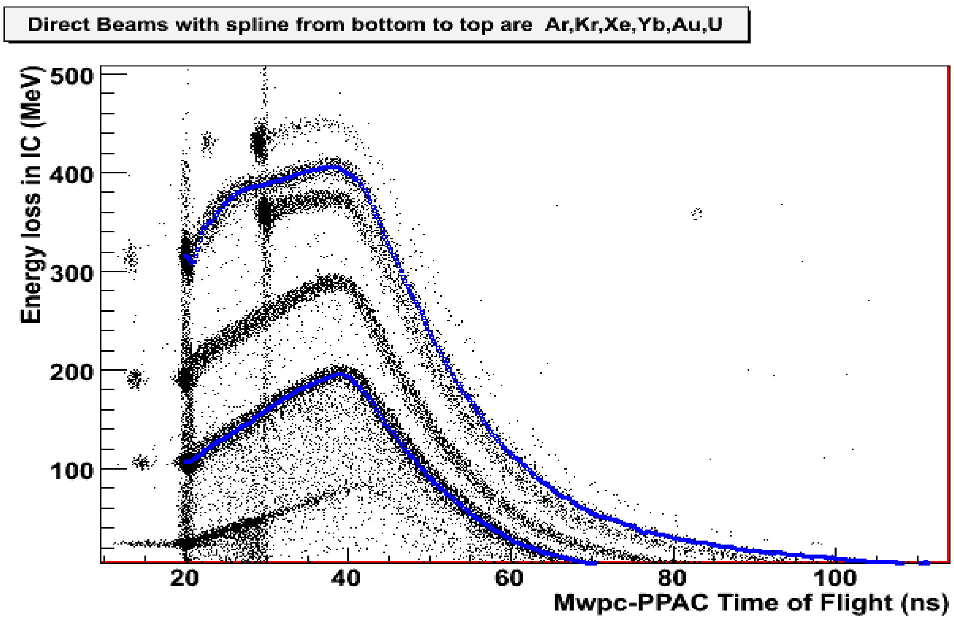

Figure 1. Time of flight versus Energy loss in IC.

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[2] Y.Aritomo, Nucl. Phys. **A780**, 222 (2006), Y. Aritomo, T. Wada, M. Ohta, and Y. Abe, Phys. Rev. C **59**, 796 (1999).