A dE/dx-E charged particle spectrometer based on hybrid pixel detector -Timepix

G. Ahmadov[1,4,5*], M. Holik [2,3], D. Berikov[1,6], F. Ahmadov[4,5], R. Akbarov[1,4,5], N. Abbaszada[4], Y. Mora[3], S. Nuruyev[1,5], P. Pridal[3], A. Sadigov[4,5], J. Zich[2]

[1.]Joint Institute for Nuclear Researches, Dubna, Russia
[2.]Faculty of Electrical Engineering, UWB in Pilsen, Czech Republic
[3.]Institute of Experimental and Applied Physics, CTU, Prague, Czech Republic Country
[4.]National Nuclear Research Centre, Baku, Azerbaijan
[5.]Institute of Radiation Problems- ANAS, Baku, Azerbaijan
[6.]The Institute of Nuclear Physics, 1 Ibragimova, Almaty, Kazakhstan

Hybrid pixel detectors- Timepix are very promising detectors considering their advantages getting simultaneously information about the position, energy, and time of arrival of a particle hitting the detector. These types of multi-parameter detectors can be effectively used to study and/or reinvestigate some fission processes such as the rare fission modes (ternary, quaternary, quinary), which are planned. In studying nuclear reactions, it is necessary to consider the following features: the energy resolution of the detecting system, angular distribution information, coincident timing, discrimination of different particles, background problem etc. Silicon solid-state detectors are commonly used for measuring the specific ionization (dE/dx), in instruments designed for identifying energetic nuclei using the dE/dx versus total energy technique. Using Timepix detector as E detector in this method gives the possibility to get simultaneous measurement of energy, coordinate, interaction time and the type of charged particles. This work is devoted to application of multi-parameter detectors- Timepix in dE/dx-E particle identification measurements. In constructing tailor-made dE/dx-E spectrometers, our requirement is the measurement of angular distributions, energy spectra, coincident time, yield of rare fission mode products. In order to test the spectrometers, a spontaneous fission source ^{252}Cf was used as a light particle source, since LCPs (mainly alpha particles) are formed along with the heavy fragments in ternary fission. The tailor-made dE/dx-E spectrometers consist of transmission type ΔE detectors and the Timepix detector. The particles (^{1}H, ^{3}H, ^{4}He, ^{7}Li, and ^{8}Be) have been identified by the method dE/dx-E, since the dE/dx-E value is unique to the type of particle. The specific energy loss (dE/dx) is measured using the transmission type ΔE detector (16 or 150 um thicknesses) ordered from the company Micron Semiconductors, while the residual energy (E) is measured by a Timepix detector with thicknesses of 300 and 600 um. Timepix is assembled with the special FITPix COMBO device which is used to read out a signal from a common and pixel part of Timepix (both in parallel). A special developed Spectrig device (a modified version of FITPix COMBO), however, is used for the acquisition of signal from ΔE detectors. The Timepix detector is powered and controlled by the integrated readout interface FITPix which is plugged directly to any PC via USB port. The interface and the detector are controlled via Pixelman software. The Spectrig device, however, is controlled by IEAP spectrometry (software). Moreover, a synchronization bus has been developed to realize coincidence triggering and acquisition.