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Characterization of a hybrid pixel silicon detector Timepix in particle identification measurements

Hybrid pixel detectors- Timepix are multi-parameter detectors that gives 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 the rare fission mode processes, light charged particles (LCP) are emitted as third and fourth fission products. For these purposes, it is necessary to investigate the response of the Timepix detector to LCPs. The aim of this work is to study the response of the Timepix hybrid pixel silicon detector to light particle isotopes. A spontaneous fission source 252Cf was used as a light particle isotope source, since LCPs (mainly alpha particles) are formed along with the heavy fragments in ternary fission. Timepix response was investigated registering LCPs (1H, 3H, 4He, 7Li, and 8Be) using tailor-made ΔE-E particle telescopes consisting of transmission type ΔE detectors and the Timepix detector. The particles (isotopes of interest) were identified by the method ΔE-E, since the (ΔE/Δx)×E value is unique to the type of particle. The specific energy loss (ΔE/Δx) was measured using the transmission type ΔE detector (15 or 150 um thicknesses) purchased from the company Micron Semiconductors, while the residual energy (E) measured by a Timepix detector with thicknesses of 600 um. The Timepix was used simultaneously as a common single-pad silicon detector (processing back-side-pulse signal) and as a pixel detector working in Time over Threshold mode. In addition to ΔE-E method individual cluster analysis from the pixel part was performed to identify the charge particles, the related energy, and isotopes using the pattern recognition method. These results were compared to the results obtained from the ΔE-E method. The comparison of the experimental activities of the radioactive source with its expected activity allowed the test of the detector efficiency.

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