

## **Measurement of double differential cross sections of secondary heavy particles induced by 70 MeV protons**

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Energy and angular double differential cross-section data of fragments are important for dosimetry and evaluation of radiation effects in devices or instruments, such as single event upset (SEU) by cosmic rays, since fragments cause a large local ionization. Up to now, experimental data of the fragment production are very scarce due to experimental difficulties of fragment detection. Thus, almost all experimental data were obtained by the activation method that does not provide energy and angle information. Furthermore, theoretical calculation treating fragment production is very few, at present. Therefore, it is important to accumulate reliable experimental DDX data for fragment production.

In this study, we adopted for fragment measurement an energy-time of flight (E-TOF) method having the capability of mass discrimination in almost whole energy region for charged particle beam. We perform mass discrimination by measuring TOF of secondary fragments. For a start detector of TOF, plastic scintillator (10  $\mu$ m thick) coupled with photomultipliers which has good time resolution and low energy loss for fragments and for a stop detector (E detector) SSD (200  $\mu$ m thick) which has good energy resolution were adapted, respectively. For measurements of fragments induced by charged particles, we installed the scattering chamber equipped with the 1 m flight tube. The data were compared and compensated with previous work by Bragg curve spectrometer (BCS).