

Energy Calibration of Timepix Detector with GaAs Sensor

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Abstract. Radiation camera with Medipix or Timepix readout chip is a new type of hybrid pixelated detector that belongs to a group of single-photon-counting pixelated detectors. It consists of three main parts – semiconductor sensor, ASIC readout chip, and detector-computer interface. As a sensor material, silicon is widely used because of its homogeneity and high quality in imaging applications. However, silicon is a low-Z material with low stopping power, and for this reason, high-Z materials are being investigated. Both CdTe and CZT (CdZnTe) sensors have been developed, however, due to their inherent X-ray fluorescence and the high polarization effect that leads to performance degradation Ref. [1], new materials are desired. Semi-insulating (SI) GaAs is a high-Z material that provides high detection efficiency, fast charge collection due to the high-mobility of charged carriers and with no or minimal polarization effect. The prototype of SI GaAs sensor of 350 μm thickness for Timepix readout chip has been manufactured at SAS and the performance of the final radiation camera was tested Ref. [2]. The limitation of this prototype is a maximal bias that can be applied to the sensor before causing crosstalk or charge sharing between individual pixels, which omits further measurements Ref. [3]. As a result, only a part of the sensor depth is depleted. Due to this, the detector response must be studied for each applied bias, as the energy calibration differs depending on the applied bias. In this work, we perform energy calibration of the Timepix hybrid pixelated detector with GaAs sensor at 60V and 100V using ²⁴¹Am and ¹³³Ba radioisotopes.