Contribution ID: **100** Type: **Oral**

Gamma and X-ray imaging with Timepix3 pixel detectors: Spectrum and image reconstruction using subpixel hit mapping and depth of interaction determination

Tuesday 9 July 2019 11:30 (15 minutes)

The gamma or hard X-ray imaging systems are often used in various application fields such as: medical imaging (radiography, tomography, scintigraphy, SPECT, PET), non-destructive testing, environment protection (nuclear waste storage, radiation monitoring), back-scatter imaging etc. The common effort in all these applications is oriented towards a maximal reduction of radiation dose preserving good quality of images. The key property in this direction is sensitivity of detection system and its ability to record maximal information for each detected radiation quantum (e.g. gamma photon). In this sense the Timepix3 type detectors are nearly optimal.

The state-ot-the-art particle tracking hybrid detectors of Timepix3 type have excellent properties: High granularity (256 x 256 pixels with pitch of 55 μm), spectral and temporal sensitivity. These detectors can be coupled with high-Z sensors such as CdTe, CZT or GaAs for imaging applications with gamma or hard X-rays where the scintillator based imagers have dominated so far.

Very small pixels of Timepix3 detector of 55 μm connected to relatively thick CdTe or CZT sensor (2 mm) present very interesting combination: The ionization charge created by interacting gamma photon expands significantly during the charge collection process causing so called charge-sharing effect when multiple pixels (cluster) react to single photon. This effect is considered as negative in most cases since it causes image blurring and degradation of spectrum quality. If properly understood and modelled the charge-sharing effect can be used in positive way: The hit position with subpixel precision including depth of interaction can be determined, the influence of incomplete charge collection can be reduced as well as charge loses due to nonzero threshold energy in border pixels of the cluster. This way the image and energy spectrum are reconstructed. The reconstruction method is based on comparison of measured data to theoretical model.

The proper function of image and spectrum reconstruction method will be illustrated using several practical examples.

Author: JAKUBEK, Jan (ADVACAM s.t.o.)

Presenter: JAKUBEK, Jan (ADVACAM s.t.o.)

Session Classification: X-Ray, Timepix, chair Seppo Nenonen

Track Classification: general