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Spectroscopic X-ray Imaging with improved sub-pixel resolution and spectral fidelity thanks to probability distribution maps for initial position and energy for Timepix3 detectors using Allpix squared

Wednesday 22 May 2024 16:10 (25 minutes)

Using the simulation tool Allpix squared,
the center of mass (c.m) deposition maps were simulated for a wide range of monochromatic X-ray beams irradiating Silicon and Cadmium Telluride sensors of Timepix3.

More specifically, the coupling of the diffusion and repulsion of the charge carriers inside the sensor material, following the model of Benoit et al, were simulated as an Allpix^2 plugin.
Both the experimental measurements and the simulations generated the Time over Threshold (ToT) values, which were properly calibrated to energy values (keV). These energy values were used as weight for the calculation of the center of mass deposition maps of the different clusters sizes from 1 to 4 pixels. By matching the cluster energy and sub-pixel position calculated from the cluster shapes obtained by the Timepix3 simulation with the respective values derived from the GEANT4 charge deposition information it was possible to generate probability maps for each cluster position and energy.

To experimentally verify the simulated correction maps the initial position probability maps were applied to experimental data acquired with an Am-241 source. The c.m correction maps lead to a more uniformly irradiated final image. Furthermore, the initial energy probability maps were applied to experimental energy spectra acquired with an Am-241 source.

This research includes the calculation of the probability maps for Timepix3 with Cadmium Telluride semiconductor material, which is of interest for medical applications.

Will the talk be given in person or remotely?

In person

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