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Stack of Timepix-based detectors with Si, GaAs:Cr and CdTe sensors with optimized thickness for spectral micro-CT

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Hybrid pixel detectors based on Medipix chips have proven themselves as a good tool for spectral X-ray imaging. An important advantage of such detectors is the possibility to use different sensor materials (Si, GaAs:Cr, CdTe etc.). Each of these materials has own advantages and disadvantages. The higher Z materials provide the higher photon registration efficiency, and the greater energy of the fluorescent photons distorting the detector's energy response. The thickness of the sensor affects the same way: the thicker sensor means the higher photon registration efficiency, but the worse energy resolution. At the same time, photons that have passed through the detector without interacting in it can be registered by the next detector. Combining several detectors with different sensor materials, allows increasing the overall photon registration efficiency. In this case, each detector will operate in the optimal energy range. In this paper, we consider a system based on three Timepix detectors with sensors made from Si, GaAs:Cr, CdTe. The Monte Carlo simulation was used for the sensors thickness optimization. The results of measuring spatial resolution, energy resolution, photon registration efficiency in each layer are presented. The possibility and advantages of using such imaging system for spectral micro-CT are demonstrated.

Primary authors: Mr KOZHEVNIKOV, Danila (Joint Institute for Nuclear Research); Mr SMOLYANSKIY, Petr (Joint Institute for nuclear Research)

Presenter: Mr KOZHEVNIKOV, Danila (Joint Institute for Nuclear Research)

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