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Edge-on illuminated silicon pixel detector for medical imaging

Aim of our project is to contribute in the improvement of X-ray Computed Tomography, making the detection process more efficient, in order to reduce the dose delivered to the patient. The benefits of switching from indirect to direct detection of photons and from Charge Integrating to Photon Counting mode have already been proven by several groups. Counting the number of photons instead of measuring the total deposited energy enhances the quality of the image, especially for soft tissues. Our goal is to prove the feasibility and assess the experimental advantages of such a setup in Computed Tomography.
We use a 500 um thick silicon sensor in edge-on illumination coupled to a Medipix readout chip. This geometry consists in illuminating the detector from the side and it is required in order to compensate for the low attenuation efficiency of silicon for photons of energy above 30 keV. In addition to increasing the volume per unit area, with this configuration, partial energy discrimination is obtained. Spectral energy measurements may form a powerful tool in this field.
A custom reconstruction algorithm has been developed in collaboration with CWI. Using the attenuation model and the detector energy response function, it is possible to exploit the depth segmentation, to obtain a reconstructed image for different energy intervals. This result will be more enhanced when switching to a readout chip (the Medipix3 chip) that allows different energy threshold to be set.

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