MATTER AND TECHNOLOGIES

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Development of CoRDIA: An Imaging Detector for Next-Generation Synchrotron Rings and Free Electron Lasers

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The current or planned upgrades of most radiation sources –for Free Electron Lasers towards faster continuous operation at a few 100kHz, and for synchrotron rings towards the diffraction limit, require a new generation of detectors to profit from this step. For diffraction limited sources like Petra IV an increase in brightness by two orders of magnitude is expected compared to Petra III. To cope with this increase, an extension of the dynamic range by the same factor or a frame rate about 100 times higher than current systems can be derived as specification.
The acronym CoRDIA stands for Continuous Readout Digitising Imager Array, and is a hybrid pixel detector development targeted on these next-generation synchrotron sources and Free Electron Lasers. Serving the latter it builds upon the concept of the AGIPD detector, employing a charge sensitive preamplifier with adaptive gain switching. The further signal path comprises of a Correlated Double Sampling stage and an 11bit Analogue to Digital Converter (ADC), serving a sub array of 16 pixels. 128 ADCs connect to a multi-gigabit serial link to drive the images off chip. For this part CoRDIA adopts the implementation on the Timepix4 chip by Nikhef. An Application Specific Integrated Circuit with 256 × 192…224 pixels will implement 24…28 of the previously described blocks. Since the links conform to industry standards (IEEE 802.3ae), the subsequent data acquisition can be based on commercial components (e.g. Field Programmable Gate Array cards connected via multi-fibre optical links). Performance targets are a continuous frame rate of ≈150kHz, and singe-photon sensitivity at ≪12keV, and a dynamic range of a few thousand photons (@ 12keV) with a silicon sensor. The energy range could be extended using active sensors or sensors from ”high-Z”materials towards lower and higher photon energies.

Presenter: TRUNK, Ulrich (FS-DS (Detektorsysteme))

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