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Fast, low-noise, and low-power, electronics for the analog readout of non-linear DEPFET pixels

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We present the analog front-end for the readout of non-linear DEPFET pixels designed in the framework of the European X-ray Free Electron Laser (XFEL). The facility is under construction in Hamburg (Germany). The proposed electronics is developed to be implemented in a 1-Megapixel X-ray detector system with single photon resolution at 1keV operating at a maximum frame-rate of 4.5MHz.
Due to the high intensity of the laser pulses, it is fundamental that the system has a huge dynamic-range since up to 104 1KeV-photons con be delivered per pixel. The project of a new type of DEPFET Sensor with Signal Compression (DSSC) is under development to obtain a manageable signal range at the input of the front end electronics.
In this presentation the requirements for the readout electronics and the implementation in a 130-nm CMOS technology will be discussed. Due to the very high frame rate, full parallel readout is a must; this imposed severe limitations in power budget and in space occupancy of the 1 million electronic channels. The proposed architecture is based on the Flip Capacitor Filter (FCF), which implements the DEPFET drain-current readout and filtering with only one amplifying stage. The readout process consists in measuring the current at the output of the pixel before and after the signal arrival. The difference of the two measurements give the information on the charge collected in the pixel and therefore on the number of absorbed photons.
Spectroscopic performance of the implemented FCF connected to a single pixel linear detector will be presented. Measurements with a 55Fe calibration source show an equivalent noise charge (ENC) of 48 electrons at 4.5MHz, which is adequate for single photon identification and counting. Moreover, measurement with a highly focused infrared laser will be presented as well.

Preferred medium (Oral/poster)

oral

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