



WoRiD 2022

23rd International Workshop on Radiation Imaging Detectors

26 – 30 June 2022

Riva del Garda, Italy

Contribution ID: 28

Type: Poster

Design and optimization of the read-out electronics for high energy resolution X-ray strip detectors

Monday 27 June 2022 16:59 (1 minute)

Semiconductor strip sensors applied as solid-state radiation or particle detectors can be used in radiation detection and measurement for various applications in particle physics experiments, X-ray imaging (e.g. medical), or material science. The X-ray imaging devices with spectroscopic and position resolution features are a very important research topic at many research institutes and companies worldwide [1-3]. Short strip silicon detectors are good candidates for X-ray spectroscopy, because of their relatively small capacitance and leakage current. If additionally, strip pitch is below 100 μm , then the high spatial resolution is also possible.

In this paper, the analysis and design of the read-out electronics for short silicon strip detectors with Charge Sensitive Amplifier and shaper are presented. The CSA is optimized for the detector capacitance of around 1.5 pF, and the shaper peaking time is about 1 μs (controlled by the sets of switches). We take into account the sources of noise in a radiation imaging system (current parallel noise, voltage series noise, and 1/f or flicker series noise) both internal (related to the front-end electronics itself) but also external, stemming from a sensor, interconnect, or printed circuit board parasitic components [4]. We target the noise level below 30 e.l. rms, considering low power consumption (a few mW) and limited channel area. To increase the speed of analog front-end electronics we take into account both continuous-time resistive CSA feedback and the application of digitally assisted analog techniques such as a digital feedback reset.

[1] P. O'Connor and G. De Geronimo, "Prospects for charge sensitive amplifiers in scaled CMOS," Nucl. Instruments Methods Phys. Res. Sect. A Accel. Spectrometers, Detect. Assoc. Equip., vol. 480, no. 2-3, pp. 713-725, 2002, doi: 10.1016/S0168-9002(01)01212-8.

[2] R. Ballabriga, et al., "Photon counting detectors for X-ray imaging with emphasis on CT," IEEE Trans. Radiation and Plasma Medical Science, vol. 5, no. 4, p. 422-440, 2021.

[3] P. Wiącek et al., "Position sensitive and energy dispersive x-ray detector based on silicon strip detector technology," J. Instrum., vol. 10, no. 4, pp. P04002-P04002, 2015, doi: 10.1088/1748-0221/10/04/P04002.

[4] W. Zubrzycka and K. Kasiński, "Noise considerations for the STS/MUCH readout ASIC," GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, 2018. doi: 10.15120/GSI-2018-00485.

The authors acknowledge funding from the National Science Centre (Research Project 2020/37/N/ST7/01546).

Primary author: ZUBRZYCKA, Weronika

Presenter: ZUBRZYCKA, Weronika

Session Classification: Poster