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## Evaluation of data acquisition system based on FPGA and continuous readout for the J-PET detector

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Recently, Field Programmable Gate Arrays (FPGAs) have become the best platforms for data acquisition, providing both high capacity of logic resources and unique pipelined processing in real-time capabilities. The talk will present details of the FPGA-based data acquisition system and readout electronics, designed for the Jagiellonian Positron Emission Tomography (J-PET) detector [1-4]. The system works in a continuous readout mode, allowing the collection and pre-processing of all signals registered by the tomograph, which in particular allows for subsequent filtration of the signals for targeted analysis of various types of events like for example multi-photon imaging [5] and positronium imaging [6]. Data processing by programmable logic opens the possibility of initial analysis, coincidence building, as well as on the fly, preliminary image reconstruction [1,2]. It also allows for a significant reduction of data when extracting only the valuable parameters of the collected signals, estimated during processing.

[1] G. Korcyl et al., "Evaluation of Single-Chip, Real-Time Tomographic Data Processing on FPGA SoC Devices", *IEEE Trans. Med. Imaging* 37 (2018) 2526-2535

[2] M. Pałka et al., "Multichannel FPGA based MVT system for high precision time (20 ps RMS) and charge measurement" *JINST* 12 (2017) P08001

[3] P. Moskal et al., "Synchronisation and calibration of the 24-modules J-PET prototype with 300 mm axial field of view", *IEEE Trans. Instrum. Measur.* 70 (2021) 2000810

[4] S. Niedźwiecki et al., "J-PET: A New Technology for the Whole-body PET Imaging", *Acta Phys. Pol. B* 48 (2017) 1567

[5] P. Moskal et al., "Testing CPT symmetry in ortho-positronium decays with positronium annihilation tomography" *Nature Comm.* 12 (2021) 5658

[6] P. Moskal, K. Dulski et al., "Positronium imaging with the novel multiphoton PET scanner", *Science Adv.* 7 (2021) eabh4394

### Collaboration

J-PET

**Primary authors:** DULSKI, Kamil (Jagiellonian University); KAPŁON, Łukasz (Jagiellonian University); SHIVANI, Shivani (Jagiellonian University)

**Presenter:** KAPŁON, Łukasz (Jagiellonian University)

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