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# DAQ system for energy dispersive gamma and X-ray detectors

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We present a new data acquisition system for energy dispersive X-ray and gamma detectors based on the MicroTCA.4 standard, which has been developed for photon science applications at DESY's brilliant X-ray source PETRA III.

At the center of this development is a new real-time pulse shape analysis algorithm and trigger system. Due to the noise reducing properties of the algorithm, the data are very clean and a very low threshold value can be achieved. With a previously developed firmware framework[1] we have implemented the new algorithm in the Field Programmable Gate Array (FPGA) of the commercialized SIS8300L card[2]. This ten-channel, fast ADC card was used in conjunction with an amplifier rear transfer module (DRTM-AMP10) developed by the authors and optimized for energy dispersive detectors. In combination with our control software, this data acquisition system offers a high energy resolution of 130 eV FWHM at 5.4 KeV with a peaking time of 560 nanoseconds (measured with an Amptek detector) and supports counting rates of more than 10^6 counts per second and enables continuous data acquisition without conversion time. It provides highly accurate time information for a wide range of detector types up to one clock cycle (8 ns), independent of the deposited energy, thanks to the constant fraction discriminator similar features of the algorithm. In supported file formats such as HDF5 and ROOT, various data is provided, ROI, histogram, extended event information up to the total pulse shape for each event. Thanks to the MicroTCA.4 standard, advanced clocking and triggering as well as high data throughput via PCIe and scalability are possible.

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References

1] L. Butkowski et al., "FPGA Firmware Framework for MTCA.4 AMC Modules" Proc. 15th Int. Conf. on Accelerator and Large Experimental Physics Control Systems (ICALEPCS'15), Melbourne, Australia, Oct. 2015, paper WEPGF074, p. 876–880

2] Struck Innovative Systems. 2018 SIS8300-L MTCA.4 Digitizer. [ONLINE] Available at: http://www.struck.de/sis8300-l.html. [accessed November 2, 2018].

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