Software system for data acquisition and real-time analysis operating the ATLAS-TPX network

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Abstract—TODO

I. Introduction

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II. Timepix Detector

Each ATLAS-TPX device consists of two Timepix [1] readout chips with silicon sensor layers of thicknesses $300\,\mu$m and $500\,\mu$m facing each other. They are interlaced by a set of neutron converters. The Timepix ASIC (application specific integrated circuit) divides the sensor area into a square matrix of 256×256 contiguous pixels with a pixel dimension of $55\,\mu$m. It allows a configuration of each pixel in either of the three modes of operation:

- In the spectroscopic Time-over-Threshold (ToT) mode the energy deposition in the sensor material is measured.
- In the Time-of-Arrival (ToA) mode the time from an interaction with respect to the end of the exposure is recorded (precision up to $25\,$ns).
- In the counting mode, the number of interactions with energies above $5\,$keV during the exposure time are counted.

Data are taken in so-called frames, representing the counter contents of all individual pixels after an adjustable exposure time (often also referred to as frame acquisition time). In each frame, interacting quanta of ionizing radiation can be seen as tracks on the pixel matrix, which have characteristic shapes, depending on the particle range in silicon, its deposited energy, angle of incidence, and particle type.

III. Hardware Architecture

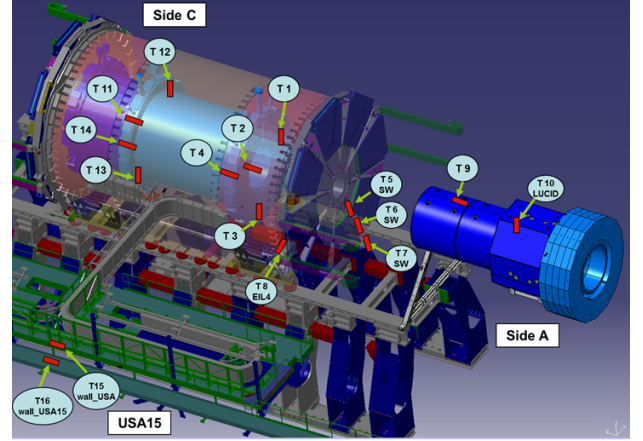TODO

IV. Data Acquisition Software

TODO

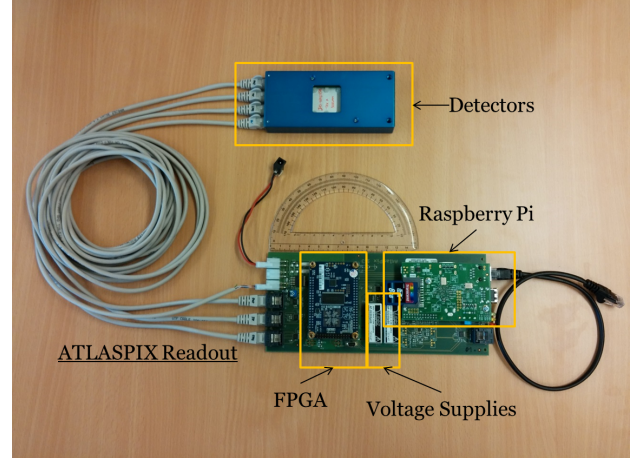Fig. 1. Artistic view of the device positions of the ATLAS-TPX network in the ATLAS experiment.

Fig. 2. ATLAS-TPX device, connected to its readout system through three Ethernet cables. The readout system consists of an FPGA, handling the device settings and operation, and a Raspberry Pi minicomputer for sending the data to the control PC in human readable format. Two voltage supplies are used for feeding the proper bias to each of the sensor layers.

V. Data Analysis Software

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VI. Visualization Application
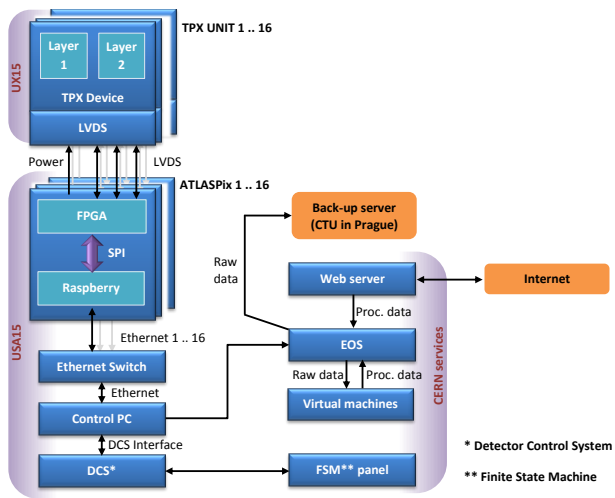
TODO

VII. Conclusion

TODO

Fig. 3. Scheme of the readout, detector control, and data flow.

REFERENCES

[1] X. Llopart *et al.*, "Timepix, a 65k programmable pixel readout chip for arrival time, energy and/or photon counting measurements," *Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment*, vol. 581, no. 1-2, pp. 485 – 494, 2007, VCI 2007: Proceedings of the 11th International Vienna Conference on Instrumentation . [Online]. Available: http://www.sciencedirect.com/science/article/pii/S0168900207017020