

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

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Abstract—TODO

I. INTRODUCTION

TODO

II. TIMEPIX DETECTOR

Each ATLAS-TPX device consists of two Timepix [?] readout chips with silicon sensor layers of thicknesses $300\text{ }\mu\text{m}$ and $500\text{ }\mu\text{m}$ 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 $55\text{ }\mu\text{m}$. 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

A read-out interface is a special dedicated hardware device that reads data and controls acquisition of the detector. [?] Given the harsh radiation environment within the ATLAS machine, the ATLASPIX interface was developed by modifying a regular FITPix interface. [?]

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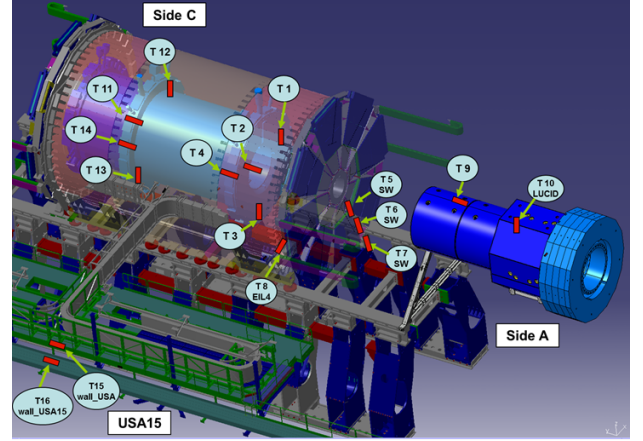


Fig. 1. Artistic view of the device positions of the ATLAS-TPX network in the ATLAS experiment.

The interface has two parts connected by four cables. The detector itself is positioned and oriented within the ATLAS machine, whereas the rest of the interface is placed in a nearby server room, shielded against ionizing radiation. Cables connect both parts, allowing protected hardware to control detectors remotely¹ during operation of the machine. To manage multiple detectors simultaneously, a computer is directly connected to all read-out interfaces. This computer, also known as *the control PC*, gathers all measured data and forwards commands from the system operator to the detectors through the ATLASPIX interface. This configuration is shown in Figure ??.

At the time of writing this work, the control PC is being operated manually from a remote location. The automation of the operation is under investigation (for more information, see Section ??).

IV. ACQUISITION & CONTROL SOFTWARE

TODO Jakub

V. DATA ANALYSIS SUBSYSTEM

The data analysis subsystem is comprised of virtual machines hosted at CERN Meyrin data center and managed by OpenStack private cloud. Each machine provides multitude of *worker nodes* responsible for parallel execution of queued *jobs* – mutually independent operations that interact with data files.

¹The software used to control and process results of data acquisition is fundamentally similar to the software used in the MPX network. [?]

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