HV-MAPS
(High Voltage Monolithic Active Pixel Sensors)
Readout for the PANDA Luminosity Detector

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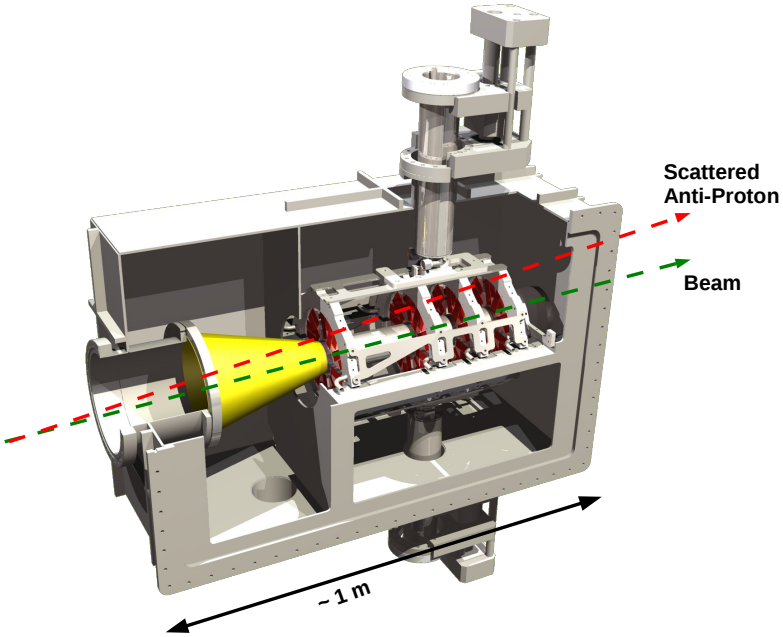
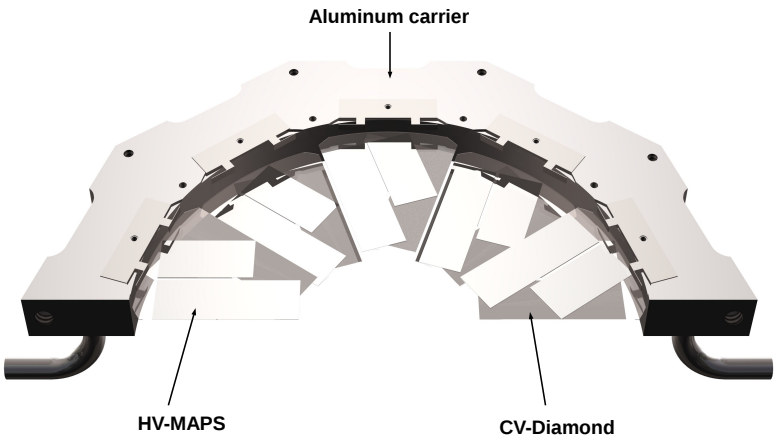
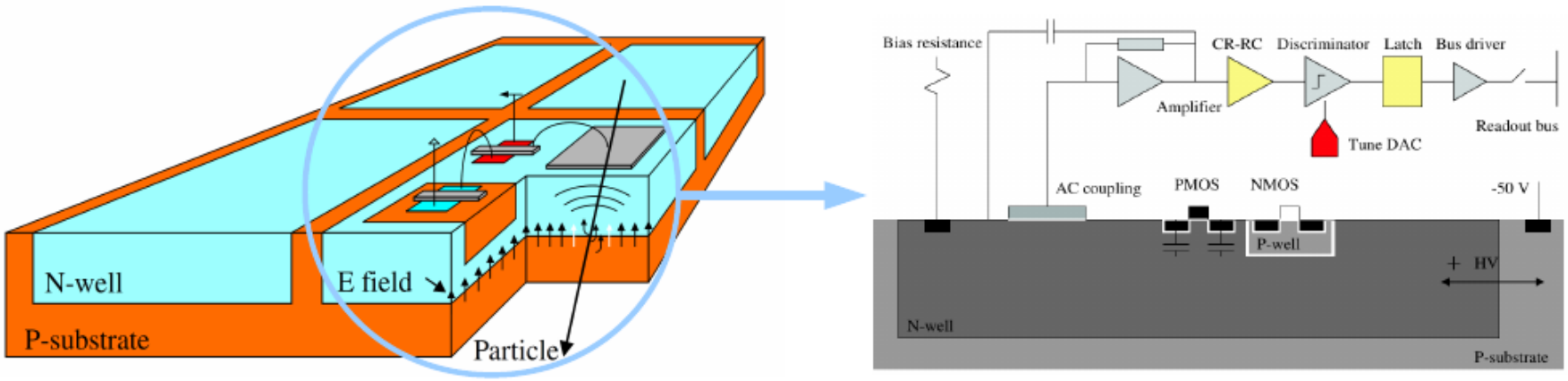
Luminosity Detector





- reconstruction of angle of the elastically scattered antiprotons
- four silicon tracker stations
- 400 HV-MAPS in total

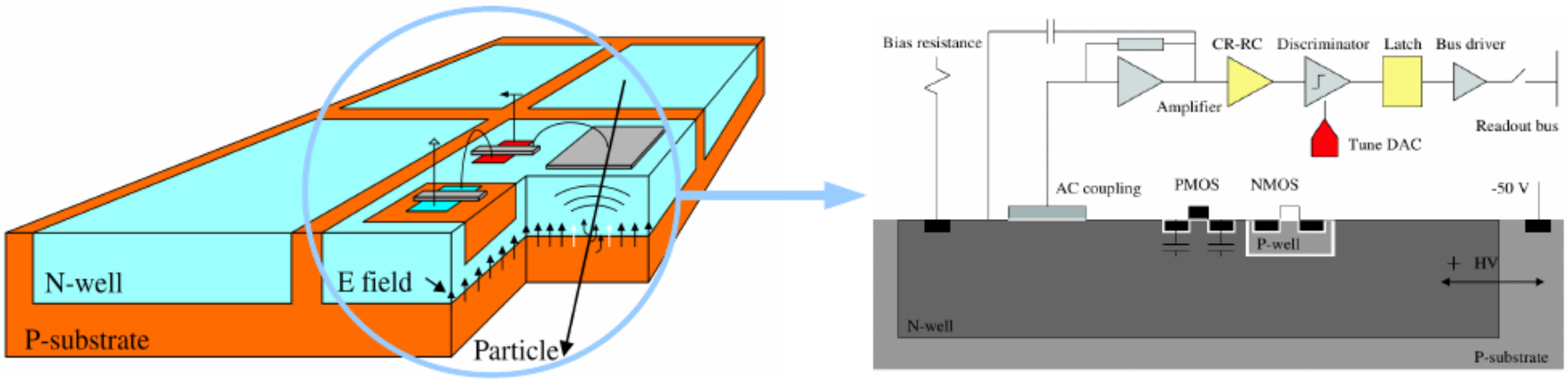
High Voltage Monolithic Active Pixel Sensors



developed by Ivan Perić for the Mu3e Experiment

- 180 nm technology
- bias voltage (≈60V)
  - 14 µm depletion layer
  - fast charge collection
- radiation tolerant
- leading edge discriminator
- thinable to less than 50 µm

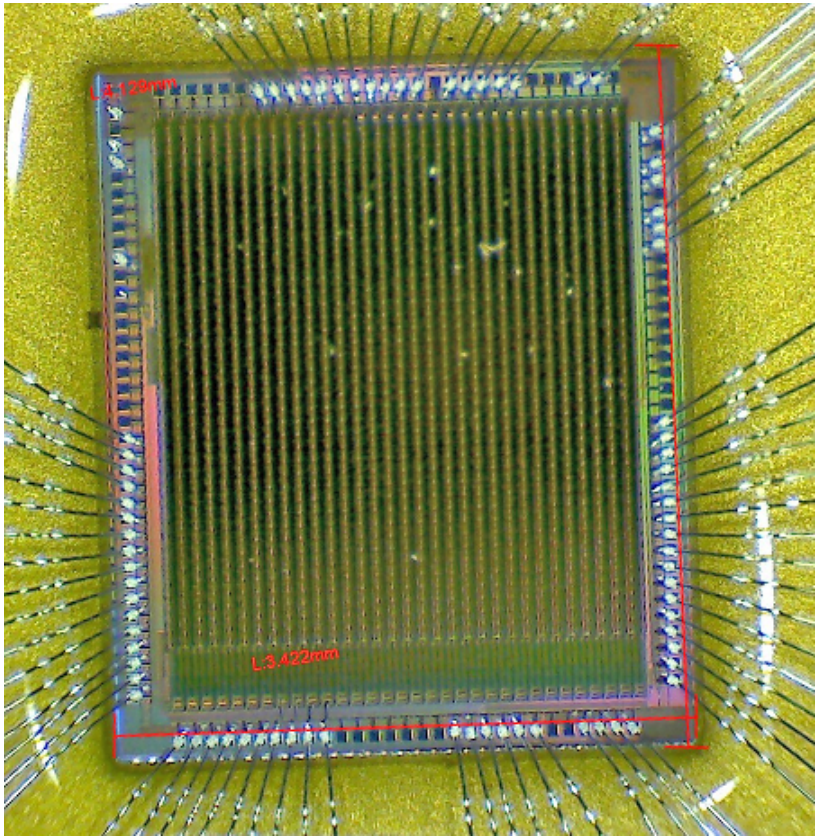
High Voltage Monolithic Active Pixel Sensors



developed by Ivan Perić for the Mu3e Experiment

- size of 2x2 cm with 80x80 µm pixels
- digital part on one chip side, active area >90%
- time stamp frequency up to 40 MHz
- LVDS-Link @ 400-800 Mbps

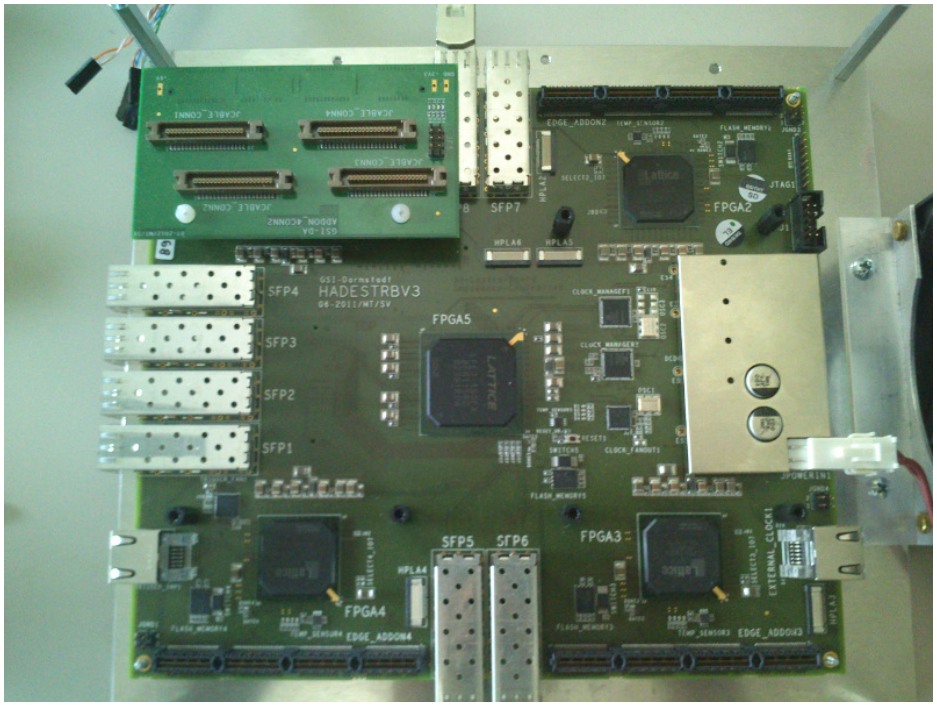
High Voltage Monolithic Active Pixel Sensors



MuPix 6 Prototype

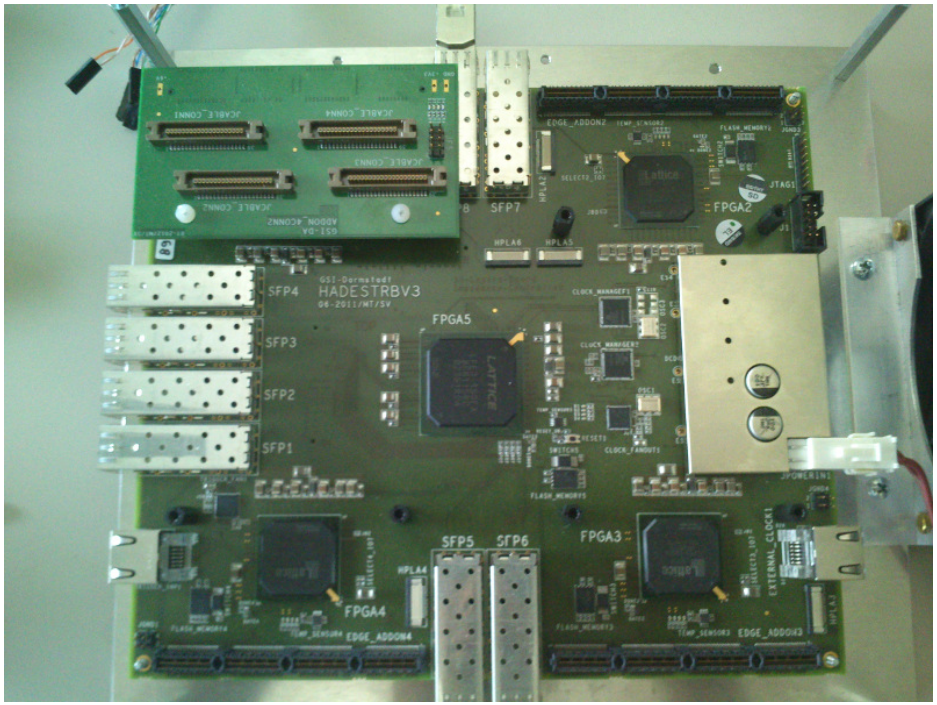
- 40x32 pixels with 80 µm x 92 µm
- column logic on chip
- parallel data readout (no serial link)
- readout and slow control by FPGA-Board

Luminosity Detector Frontend Board



- HADES Trigger and Readout Board
  (M. Traxler et al 2011 JINST 6 C12004)
- 5x Lattice ECP3-150 FPGAs
- main FPGA for UDP connection with PC
- four peripheral FPGAs for sensor I/O

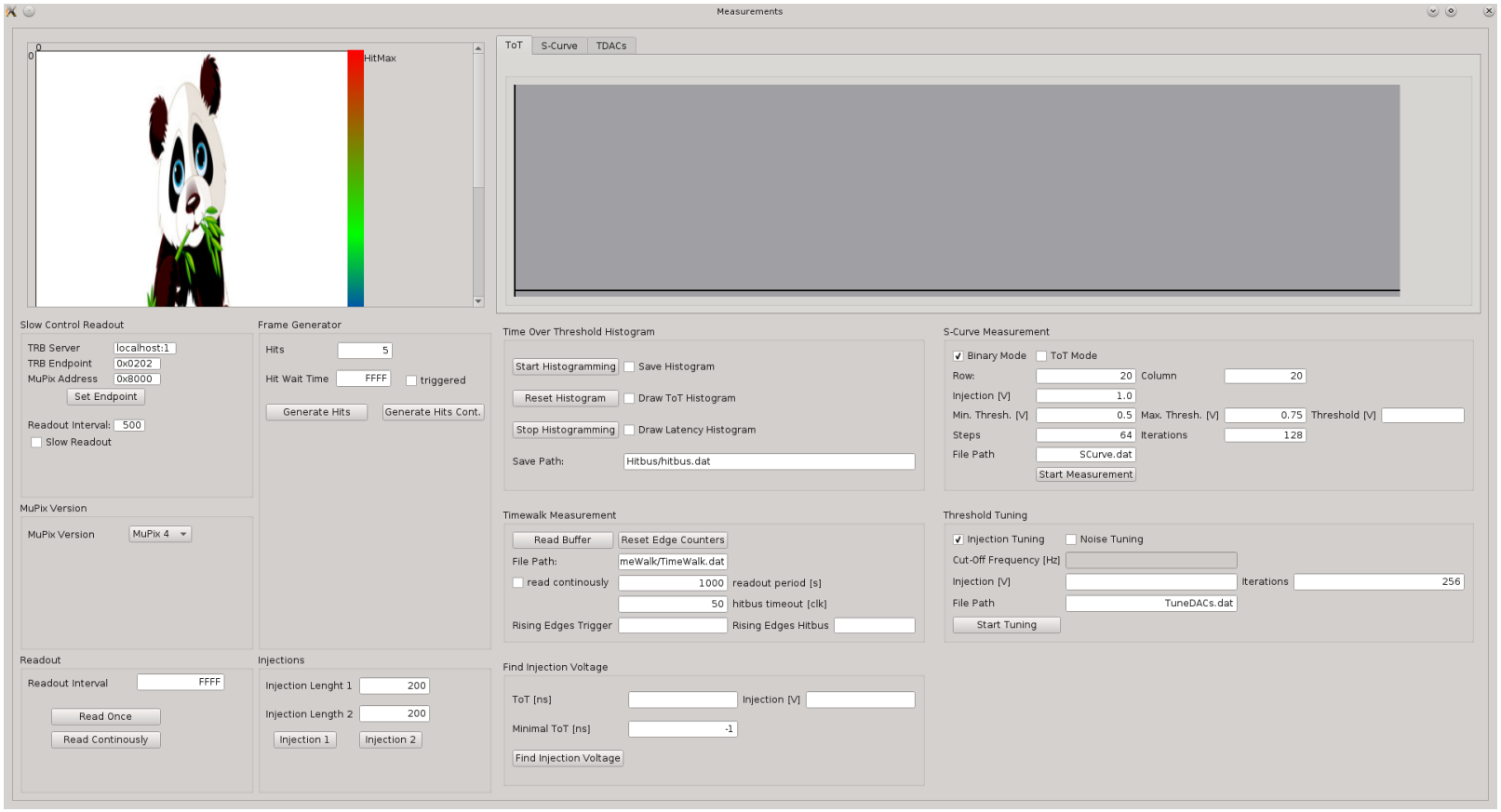
Luminosity Detector Frontend Board



Current Implementation

- slow control and readout of two Mupix prototypes on each peripheral FPGA
- histograms for Time-over-Threshold and latency

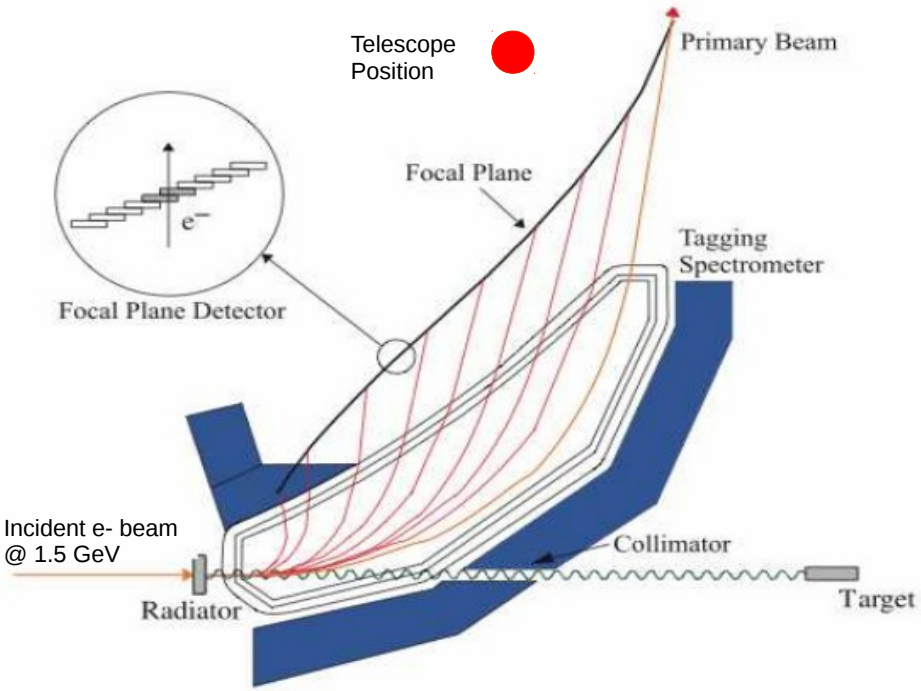
Measurement Software



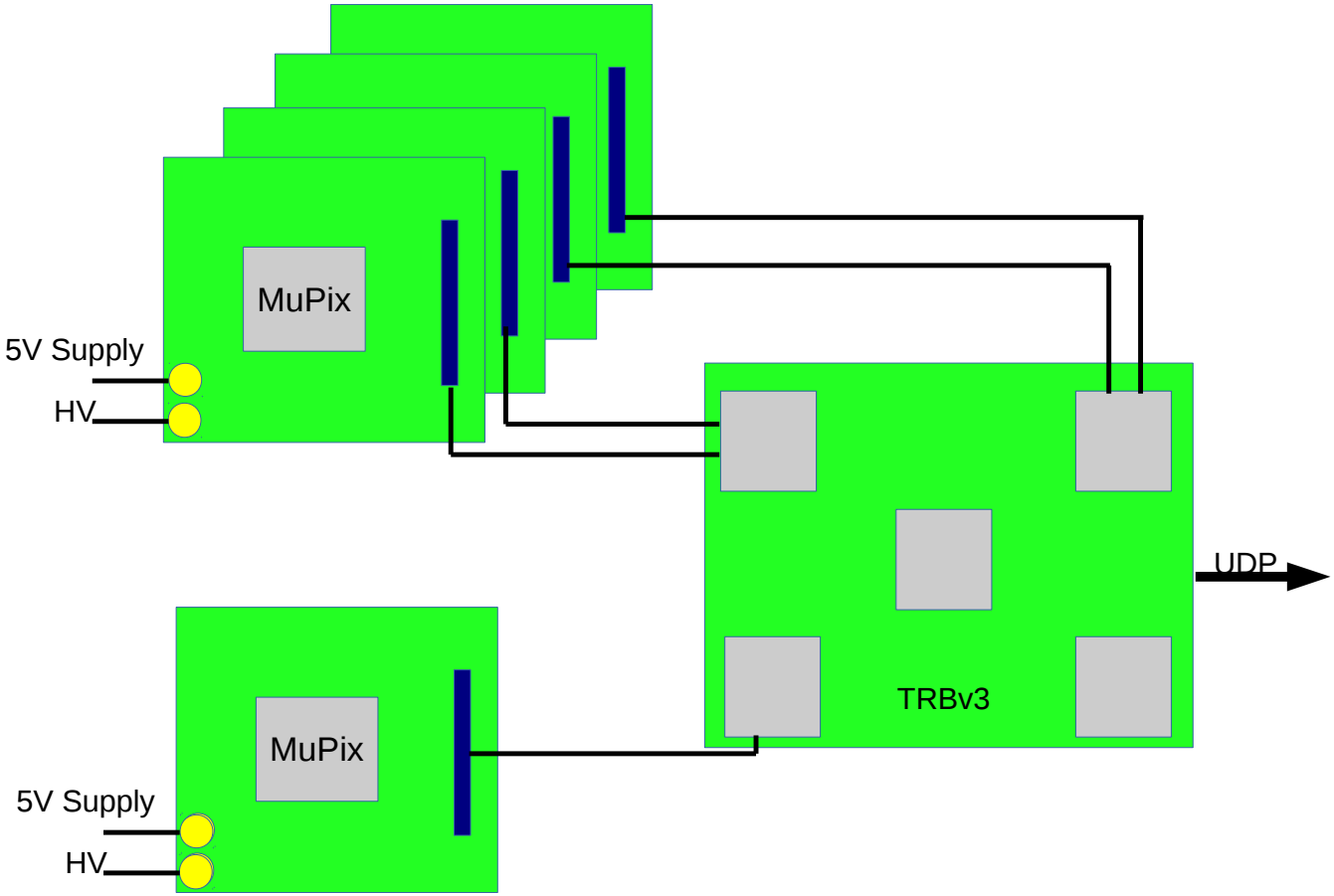
- Qt based software for laboratory measurement
  - ToT and latency distribution
  - threshold scans
  - adjustment of pixel tune DACs

MAMI Test Beam

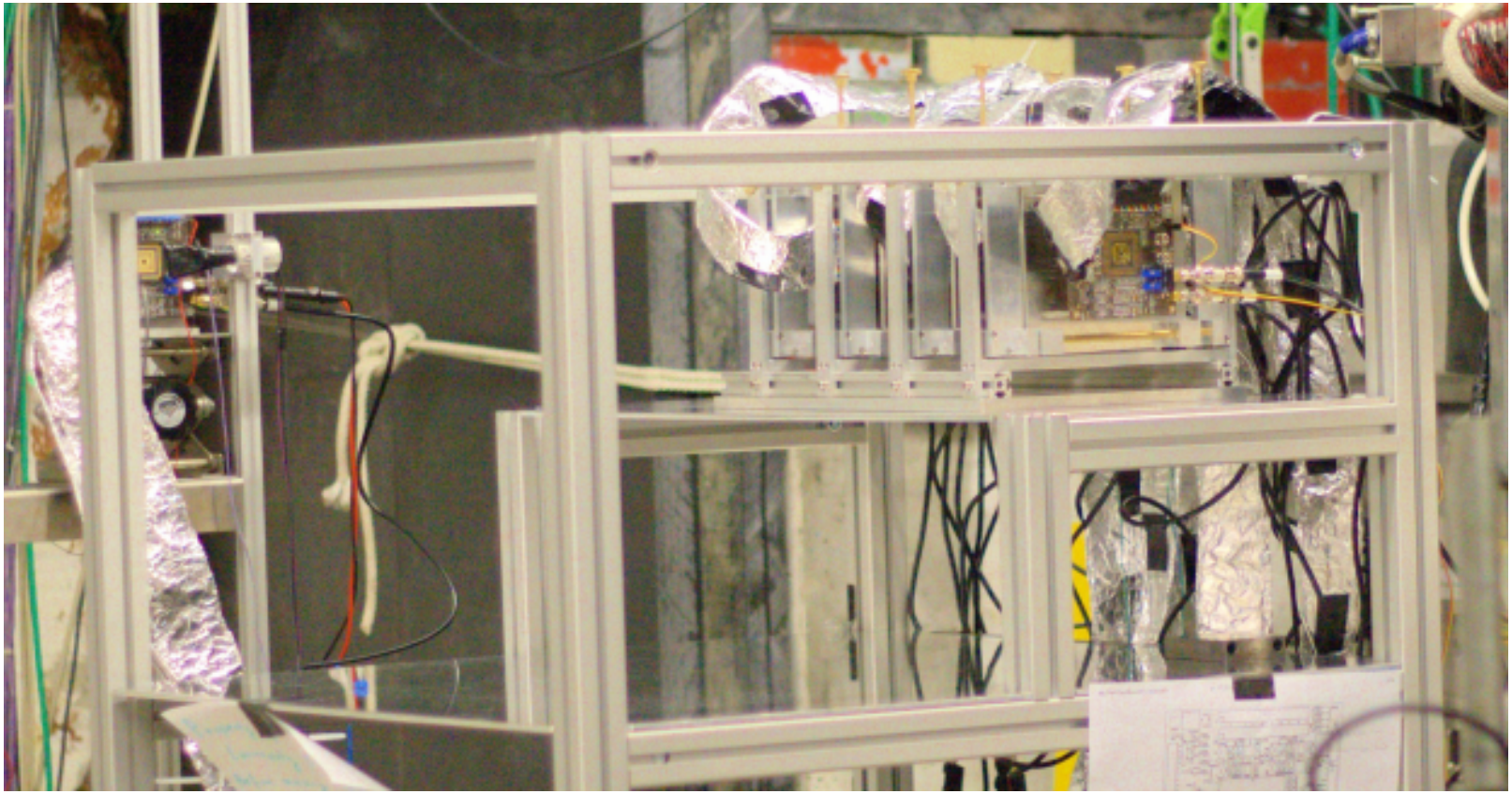
- test beam at A2@MAMI from 16.03. - 12.04.
- electron beam with energy of 1 GeV
- telescope setup with four layers of MuPix prototypes
- setup with single MuPix chip



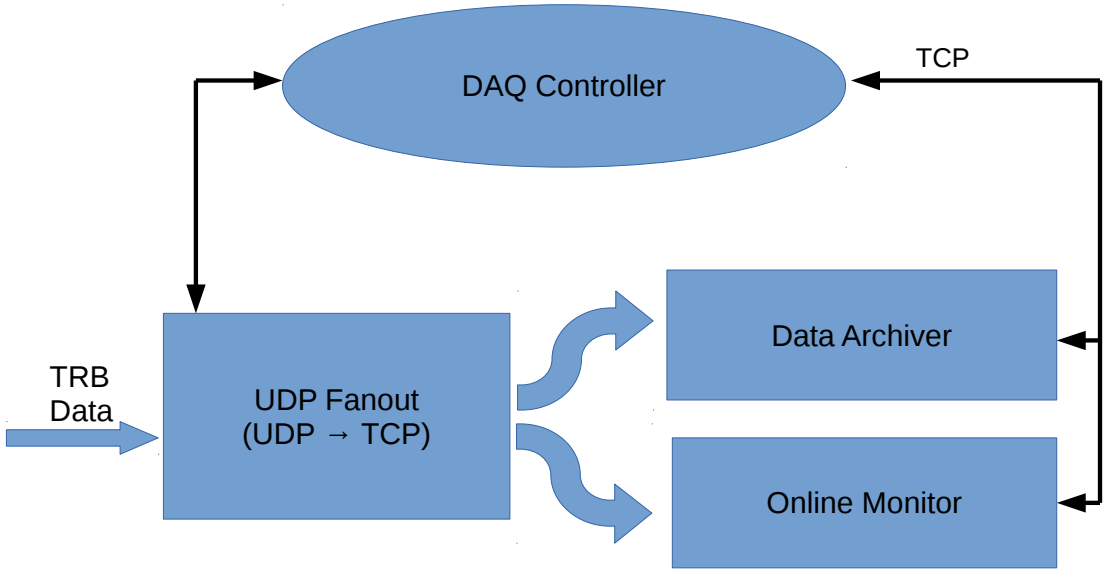
Setup



Setup II

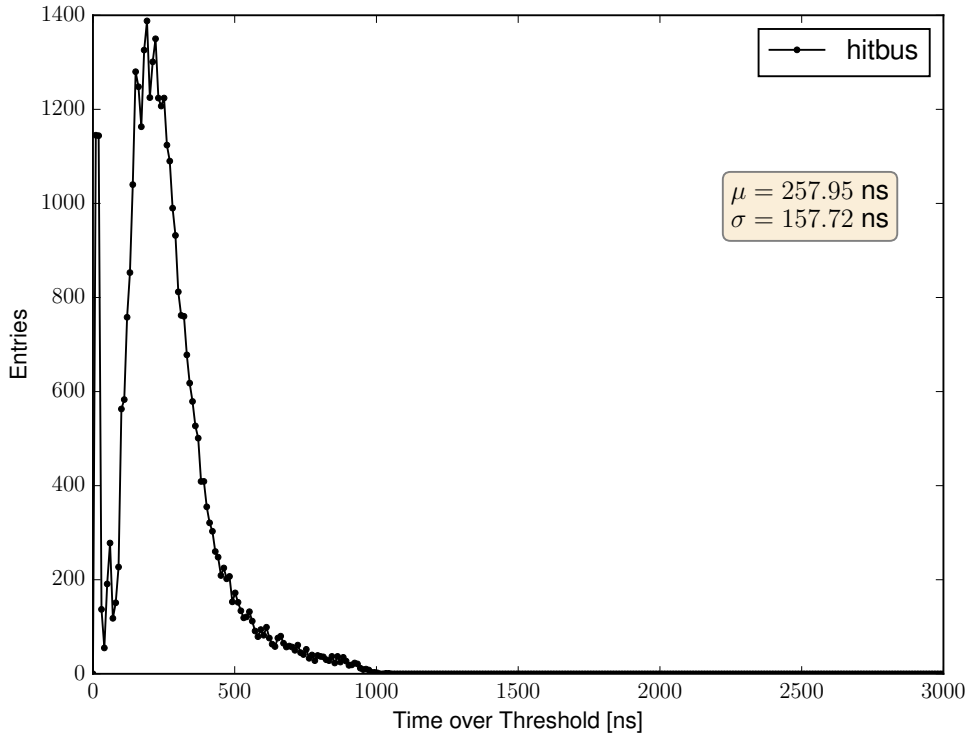


DAQ Software



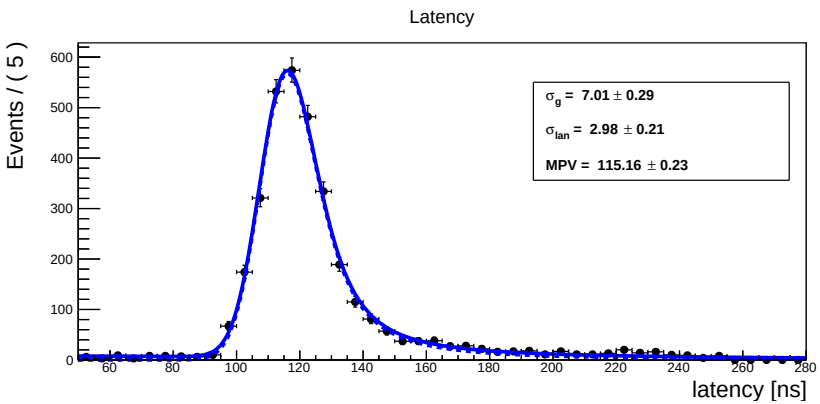
- DAQ Controller: start/stop and monitor DAQ
- Data Archiver: Write incoming data stream into binary files
- Online Monitor: online reconstruction of events and plotting of hit maps and correlations

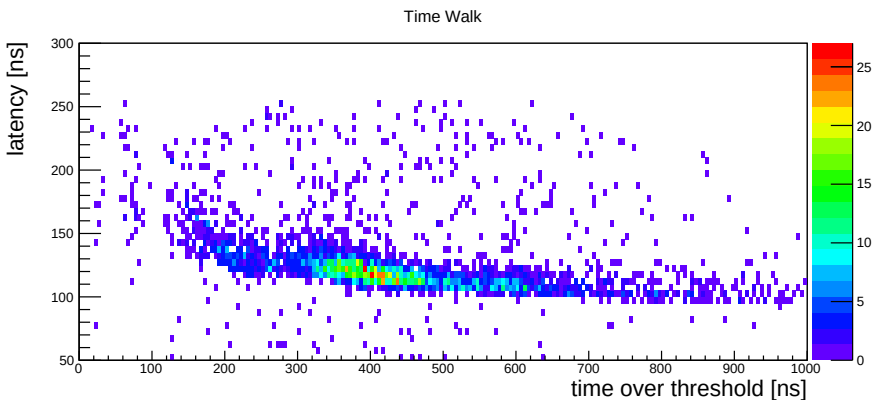
Time over Threshold Distribution



- landau shaped distribution
- ToT below 1 micro second

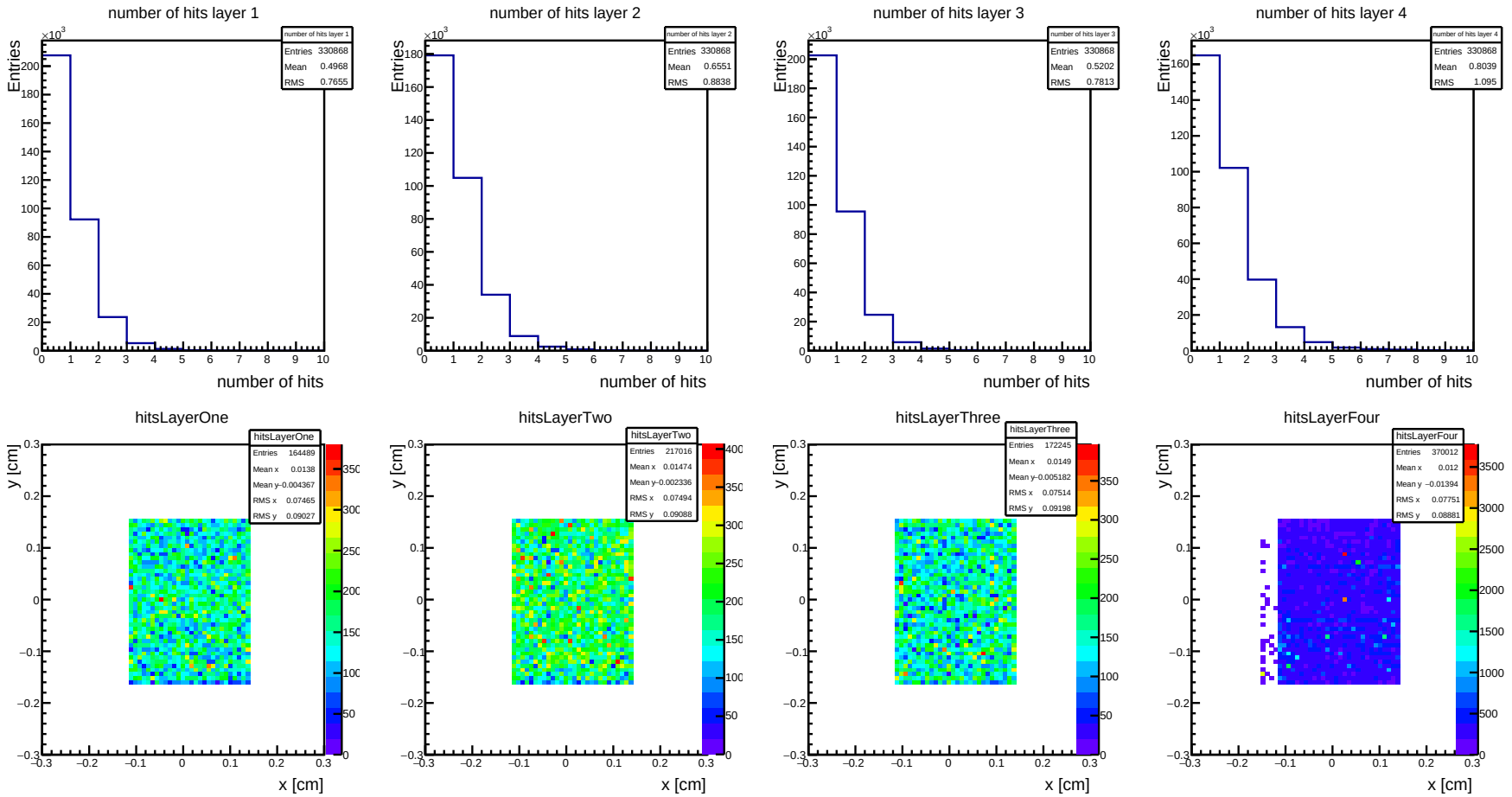
Latency and Time-Walk



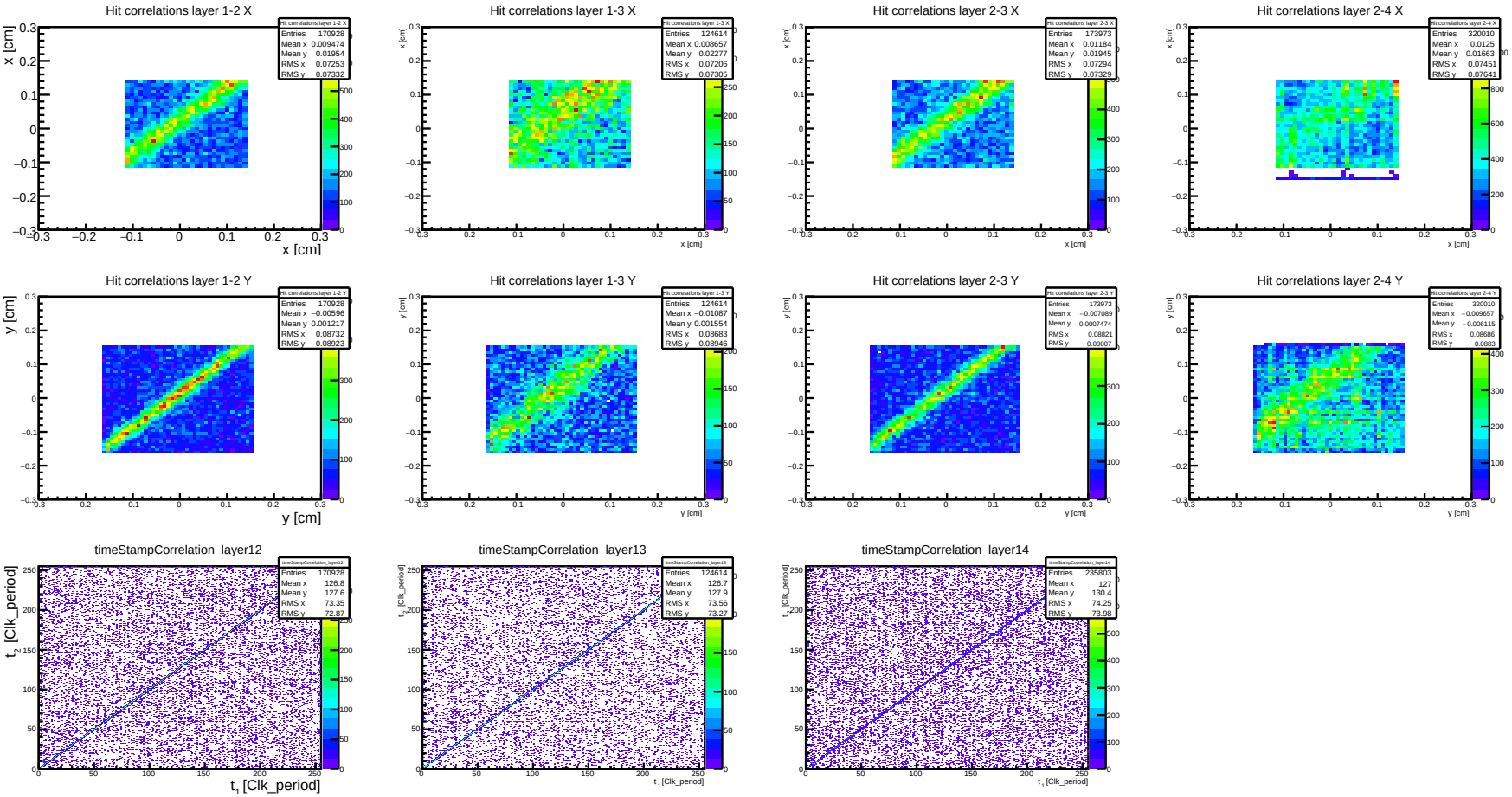


- measurement of delay between rising edge from szintillator and discriminator leading edge
- latency depends on deposited energy

Hit Distributions

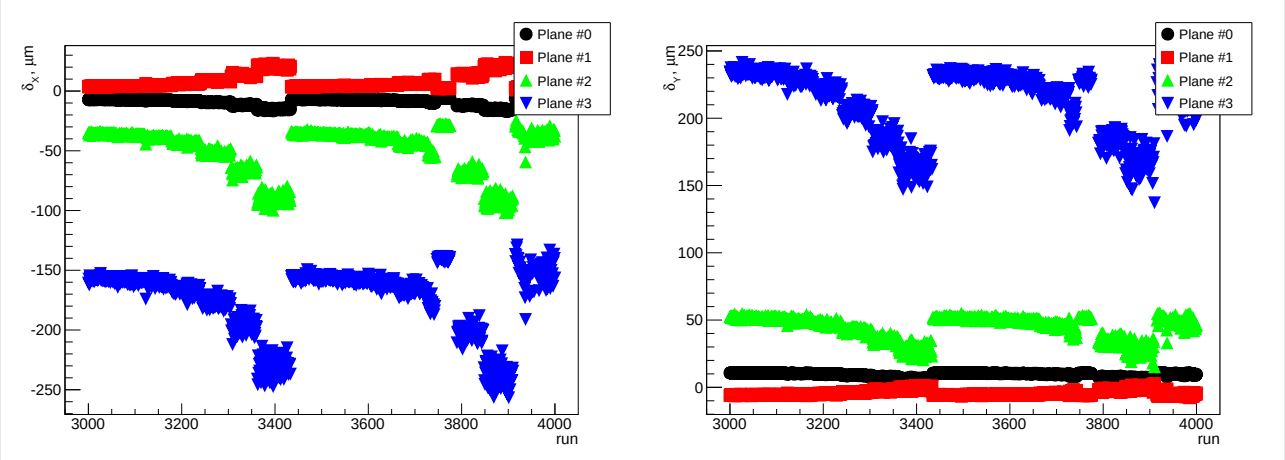


Hit Correlations

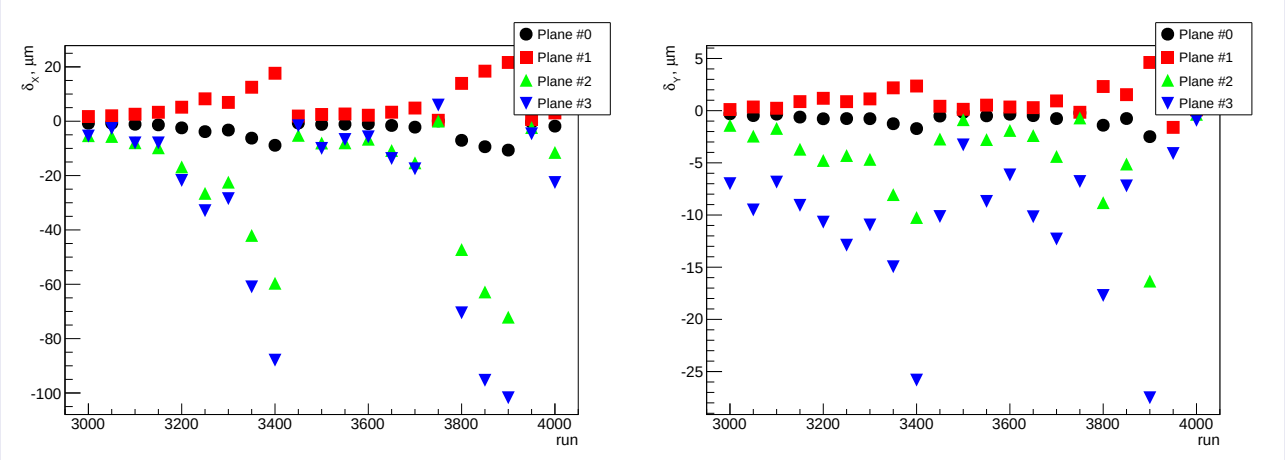


Hit-Track Residuals

no Alignment



after Software Alignment



Summary and Outlook

- readout of MuPix telescope with TRB working
- first results look promising

- sensor efficiencies from test beam data
- MuPix 7 on the door step
  first prototype with serial link
- online track reconstruction
- SODA integration