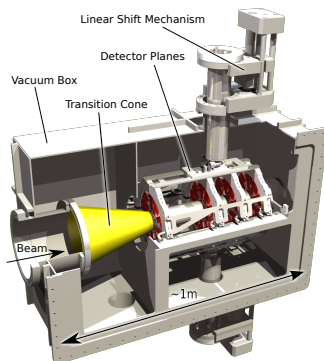


Front End Status of the Luminosity Detector

Tobias Weber

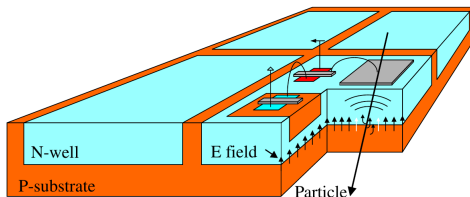
FEE-DAQ Workshop Spring 2018

The Luminosity Detector



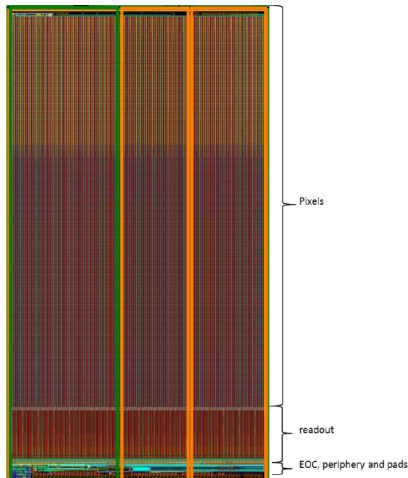
- reconstruction of antiprotons by 4 layers of HV-MAPS
- 320 sensors in total

High Voltage Monolithic Active Pixel Sensors



- design by Ivan Peric for Mu3e collaboration
- AMS aH18 technology
- application of bias voltage
 - formation of depletion layer
 - fast charge collection and radiation tolerance
- thickness less than 50 μm

MuPix 8 Prototype

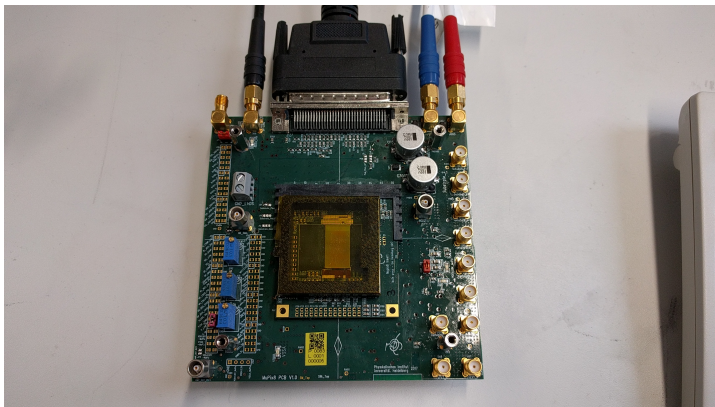


- size about 2 cm x 1 cm
- production on substrates with different resistivities
- separation of pixel matrix into two different parts
 - voltage signal transmission
 - current mode signal transmission
- **expected** radiation hardness $5 \times 10^{15} \text{ n}_{\text{eq}}/\text{cm}^2$

MuPix 8 Prototype

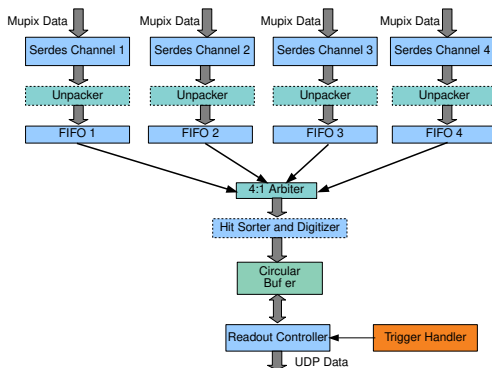
- time-over-threshold information part of data stream
- new slow control scheme using two clocks
- 4 serial readout links with 10b/8b encoding and 1.6 Gb/s
 - 3 independent links for each segment
 - transmission of multiplexed data on fourth link
- first prototypes arrived in Bochum at beginning of May

MuPix 8 - Sensorboard



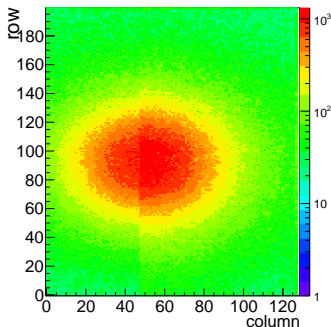
- chip on separate insert-PCB
- additional insert for simulation of chip with FPGA

MuPix 8 - Readout



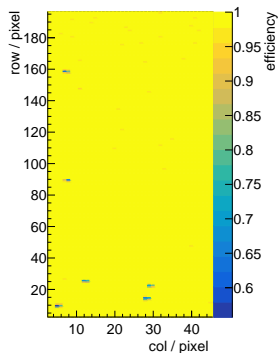
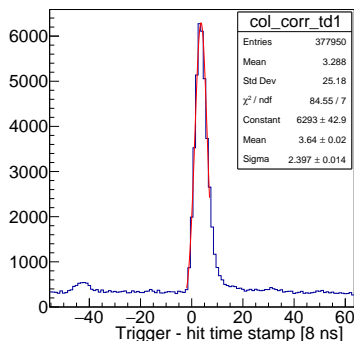
- using TRBv3 for readout
- rewriting readout firmware and software from scratch
- slow control software almost finished

Sr-90 Source



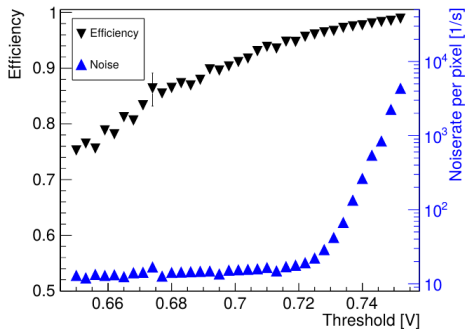
- measurement with collimated ^{90}Sr source
- clear beam spot
- difference between pixels with voltage and current transmission

Time Resolution and Efficiency



- time resolution 19 ns
- improvement after time walk correction
- efficiency close to 99%

Noise Rate



- noise rate and efficiency measurement with MuPix 7
- noise rate ≈ 50 Hz at 95% efficiency

Data Rate

Expected Data Rates

- hit size: 36 bit (ignoring headers or other overhead)
- track rate at 1.5 GeV: 11.8 MHz
- total noise rate: 1.05 GHz for 21 million pixels
- data rate
 - physics rate: 1693.44 Mb/s
 - noise rate: 37454.4 Mb/s

Data Rate Reduction

- increase of signal-to-noise ratio
 - increase of high voltage 60 V \rightarrow 120 V
 \Rightarrow increase of signal by 40%
 - tests with different substrate resistivities
- data rate reduction by online track reconstruction on GPU

Summary

- first full scale MuPix prototype arrived in Bochum
- finishing firmware and DAQ software
 - start debugging and measuring
- noise rate and efficiency studies with
 - higher bias voltages
 - different substrate resistivities

Future Prototypes

- work on MuPix 9 almost finished
 - small prototype to test daisy chaining of power supply and slow control signals
- full size prototype combining all features after successful tests of MuPix 8 and 9

Future Prototypes

- work on MuPix 9 almost finished
 - small prototype to test daisy chaining of power supply and slow control signals
- full size prototype combining all features after successful tests of MuPix 8 and 9

Thank you for your Attention!