# 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

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#### Qt based software for laboratory measurement

- ToT and latency distribution
- threshold scans
- adjustment of pixel tune DACs

#### Introduction

## 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 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

Test Beam Results

# Latency and Time-Walk



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

# **Hit Distributions**



Test Beam Results

# **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