Funded by
DFG Deutsche Forschungsgemeinschaft
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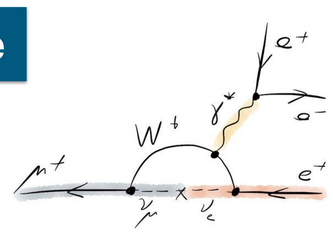
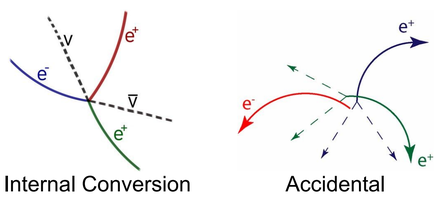
MuPix 11

The Mu3e Pixel Tracker Chip

Mu3e

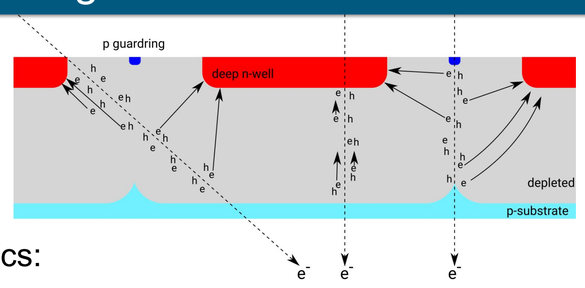


- Search for the cIFV decay
  - ➔ $\mu^+ \rightarrow e^+ e^- e^+$ (νSM: BR < 10^{-54})
- Current limit (SINDRUM 1980):
  - ➔ BR < 10^{-12} @ 90 % CL
- Sensitivity Goal (Phase I):
  - ➔ 1 in 10^{15} decays
- High intensity μ^+ - beam
  - ➔ Up to 10^8 decays / second
- Background suppression below sensitivity level



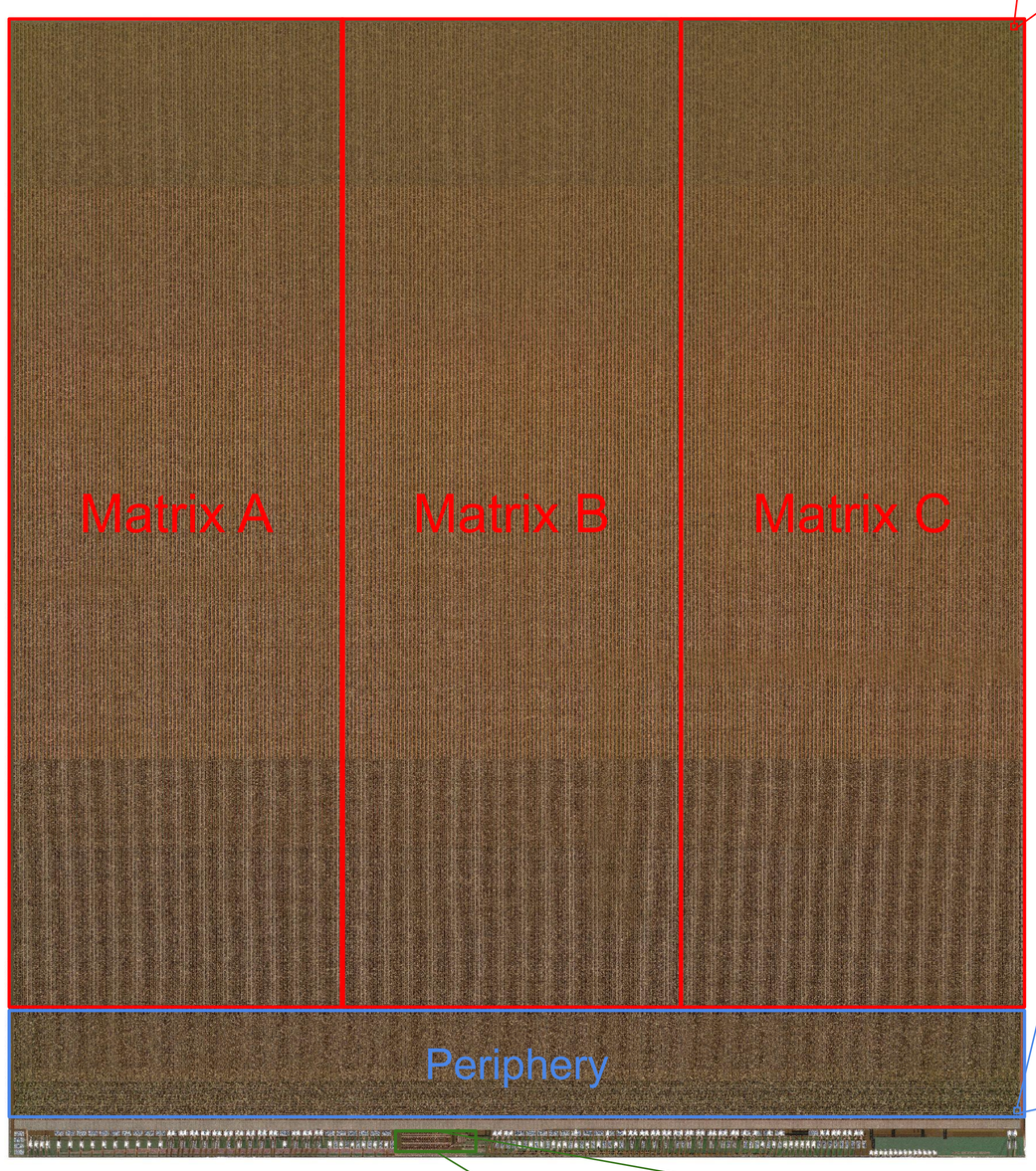
Pixel size [µm²]	80 x 80
Pixel matrix	256 x 250
Active area [mm²]	20.48 x 20.0
Sensor size [mm²]	20.66 x 23.18
Thickness [µm]	50, 70
Radiation length [x/X_0]	~ 0.5‰, ~ 0.7‰
Resistivity [Ωcm]	80, 370
ToA + ToT [bits]	11 + 5
TS binning [ns]	8 (option for 1.6)
Data links	3 + 1 (mux)
Link speed [Gbit/s]	1.25

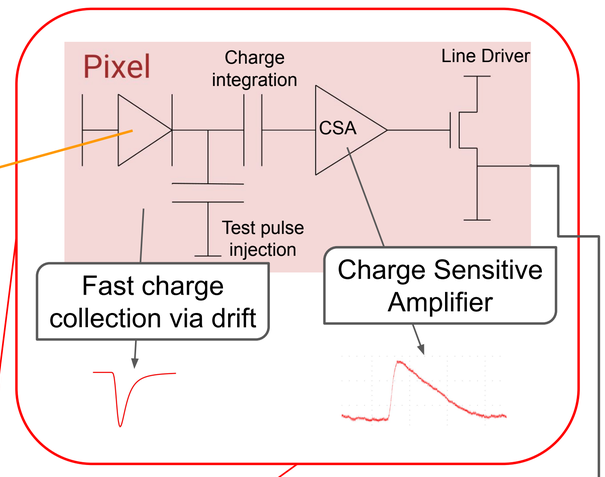
High-Voltage Monolithic Active Pixel Sensor



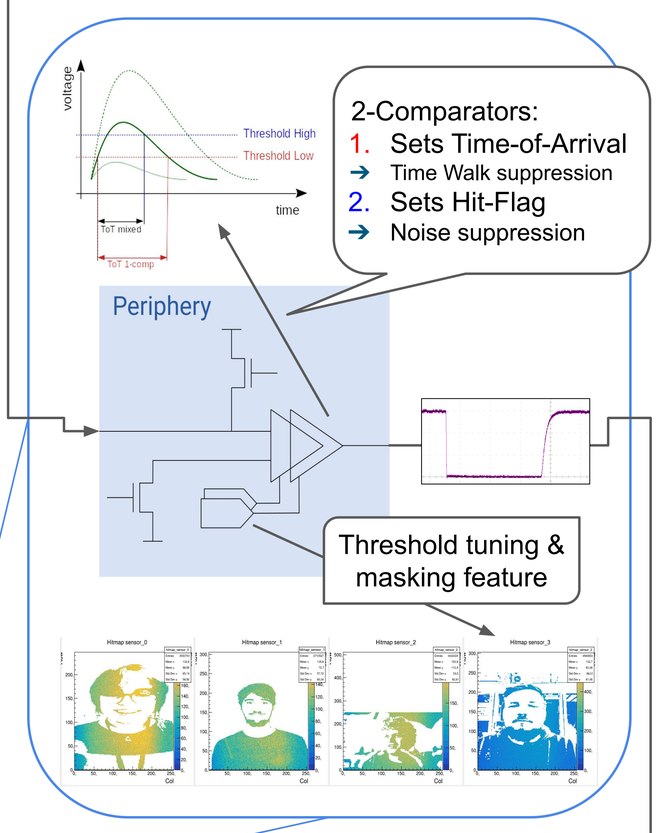
Characteristics:

- 180 nm HV-CMOS process (TSI Semiconductors) up to -120 V
- Low-ohmic substrate (10 - 400 Ωcm)
- Diode: deep n-well reversed biased (~10 - 30 µm depletion)
  - ➔ Chips can be thinned down to 50 µm



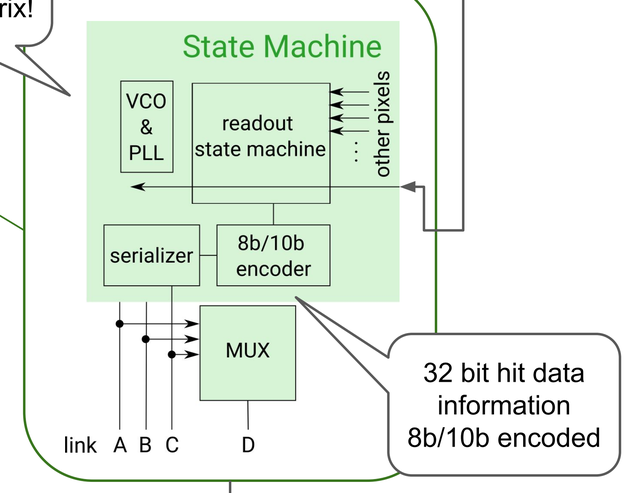


Up to ~2.2 cm line cross talk suppressing routing on 3 aluminium metal layers per pixel !



Column-drain readout managed by readout state machine!

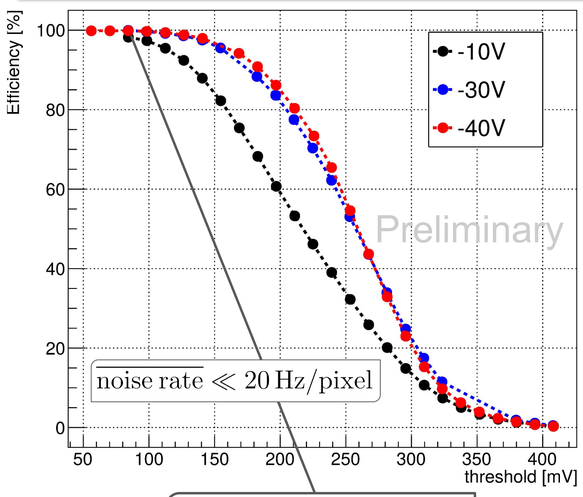
One readout state machine per sub-matrix!

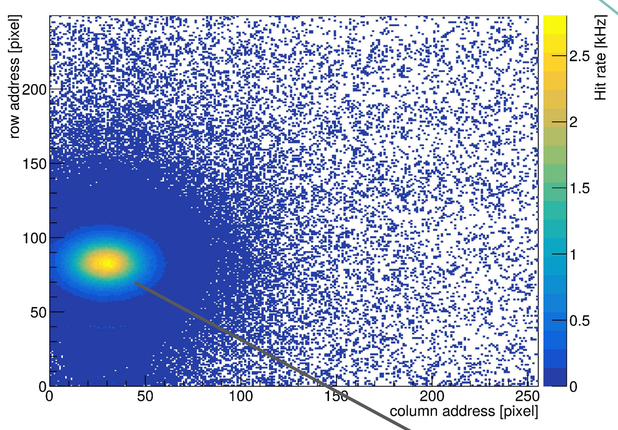


32 bit hit data information 8b/10b encoded

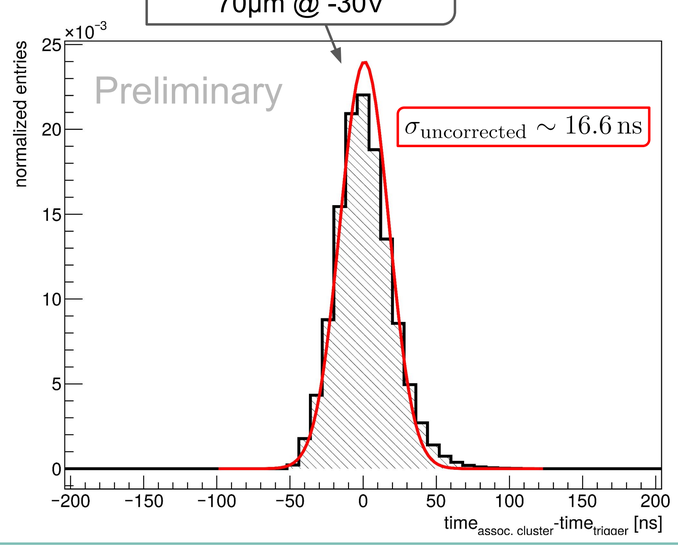
1.25 Gbit/s data links with zero suppression

MuPix 11 - 70 µm - Performance Study

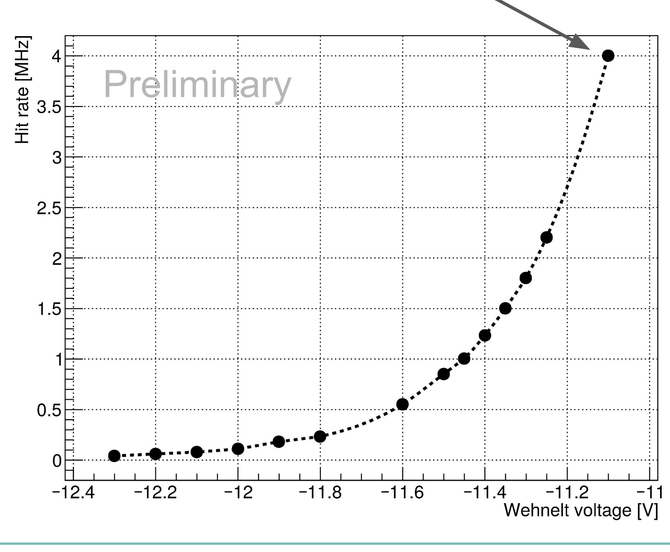




Raw time resolution for 70µm @ -30V



No readout problems for sub-matrix up to 4 MHz



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