High Voltage Monolithic Active Pixel Sensors for the PANDA Luminosity Detector

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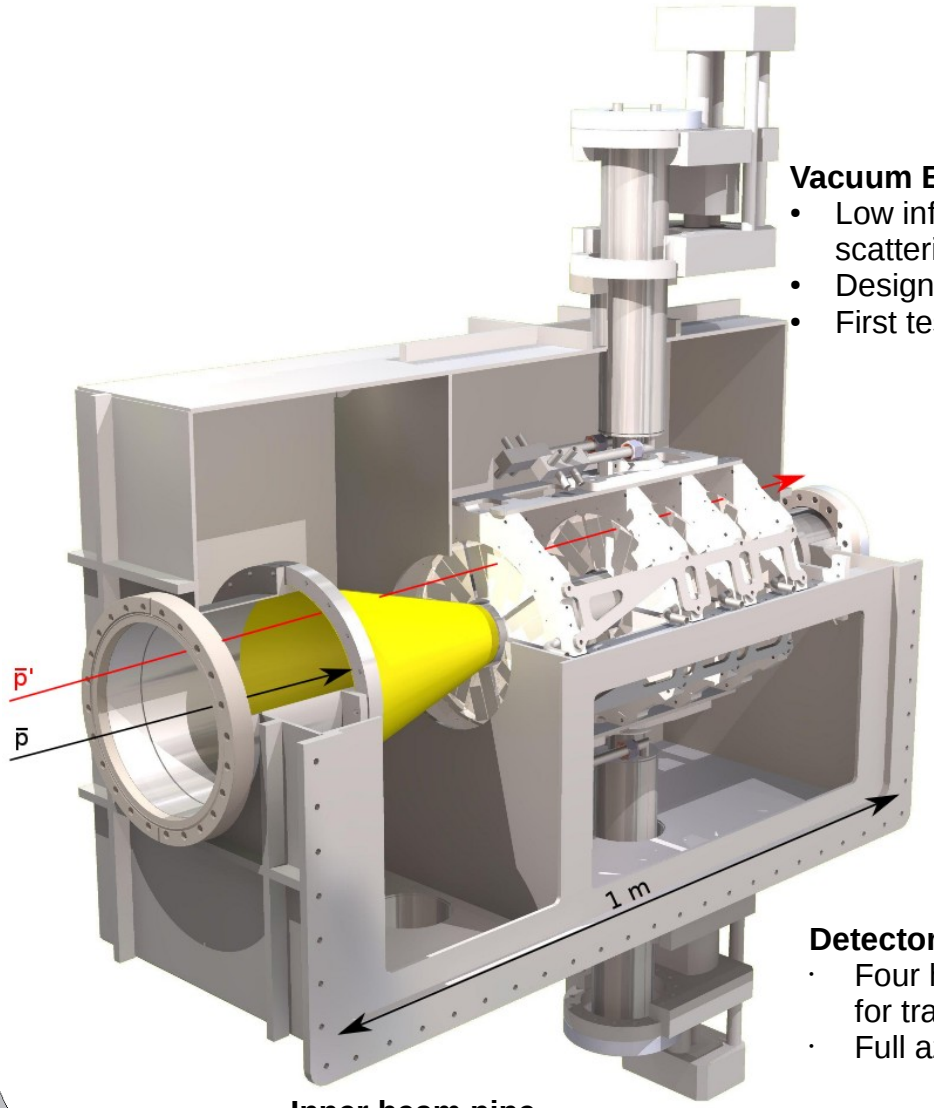
Luminosity determination at PANDA

- Measurement by normalization to the elastic antiproton proton cross section at very small scattering angles (Θ = 3 - 8 mrad)
- Reconstruction of tracks via 4 detector planes

Requirements:

- High angular resolution
- Low material budget
- Measurement at smallest angle
- Minimal distortion of the beam

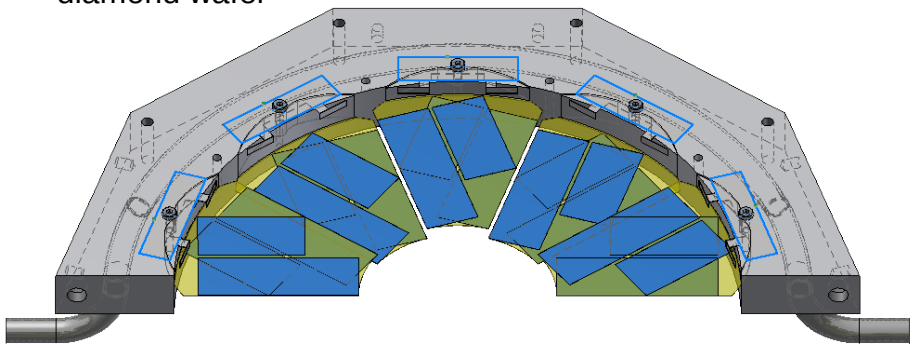


Vacuum Box

- Low influence of multiple scattering
- Design goal: 10^{-7} mbar
- First test: $5 \cdot 10^{-7}$ mbar

Half Plane with Cooling

- V2A pipe melted in aluminum structure
- 5 diamond wafers (200 µm) mounted per half plane
- 5 HV-MAPS glued on each side of the diamond wafer



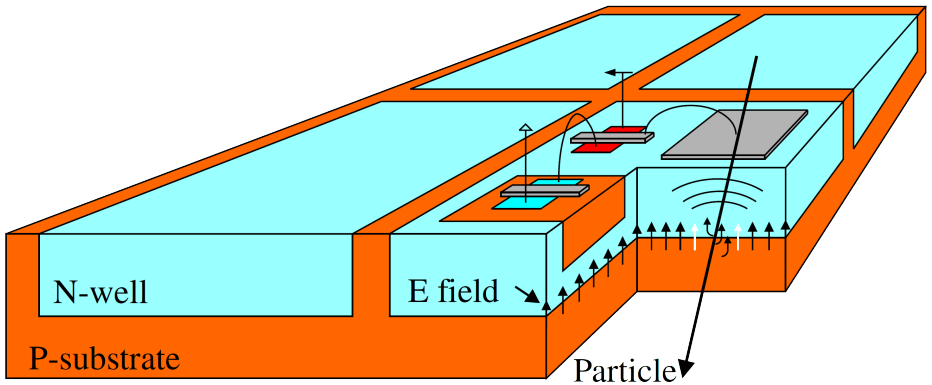
Detector Array

- Four half planes for track reconstruction
- Full azimuthal range

Inner beam pipe

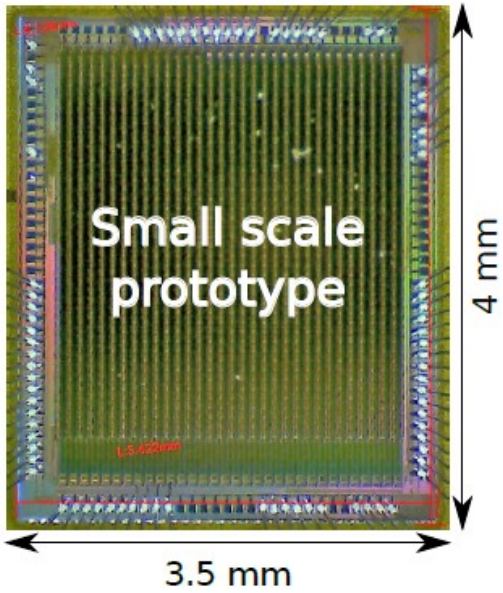
- 500 µm thick V2A pipe
- Vacuum seperation
- Design goal: 10^{-8} mbar
- First test: $6 \cdot 10^{-8}$ mbar

HV-MAPS



HV-MAPS

- Industrial HV-CMOS standard (180 nm)
- 2x2 cm², thinned to 50 µm
- Pixel size: 80 µm x 80 µm
- ~50 V bias voltage
- In pixel amplification
- Analog and digital readout integrated:

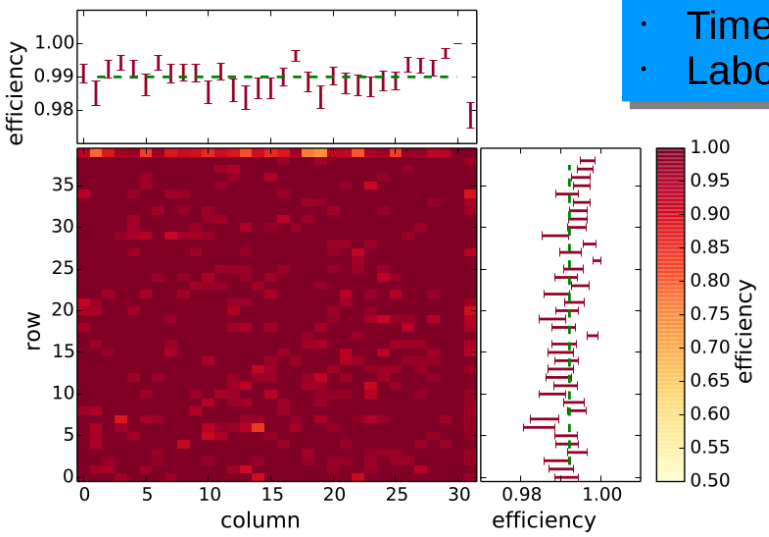


Performance

Prototype performance studies
at MAMI 1 GeV electron beam and
at DESY 5 GeV electron beam

- Electron detection efficiency >99%
- Hit resolution given by pixel cell size
- Time resolution: 7 ns
- Laboratory measurements give S/N >15

Efficiency



Spatial Resolution