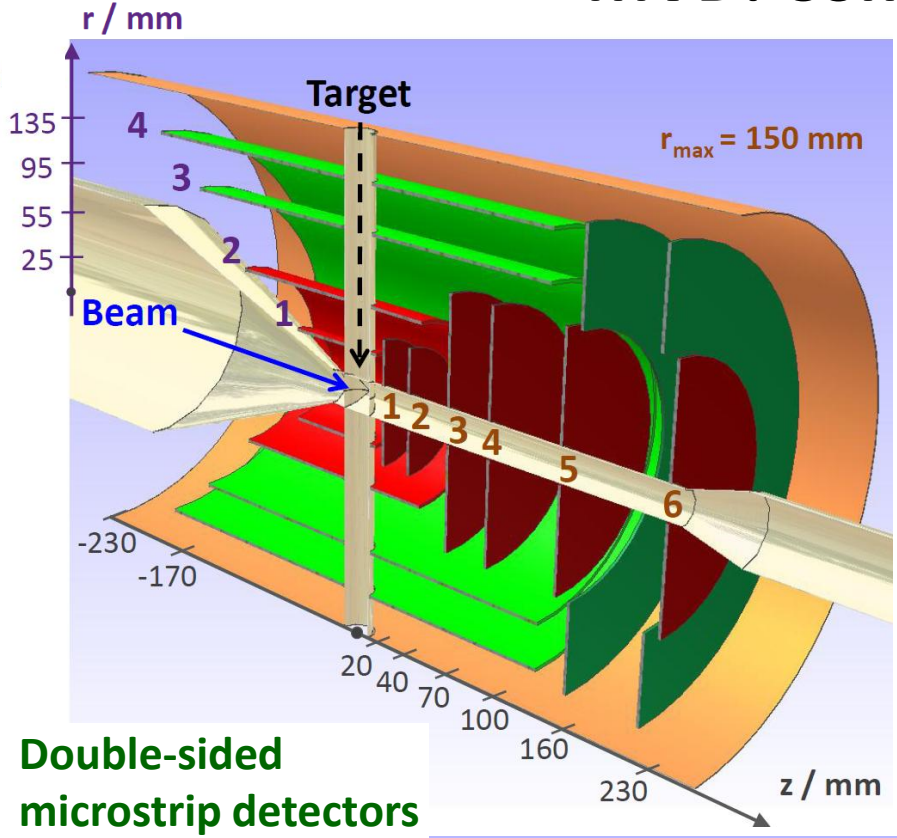
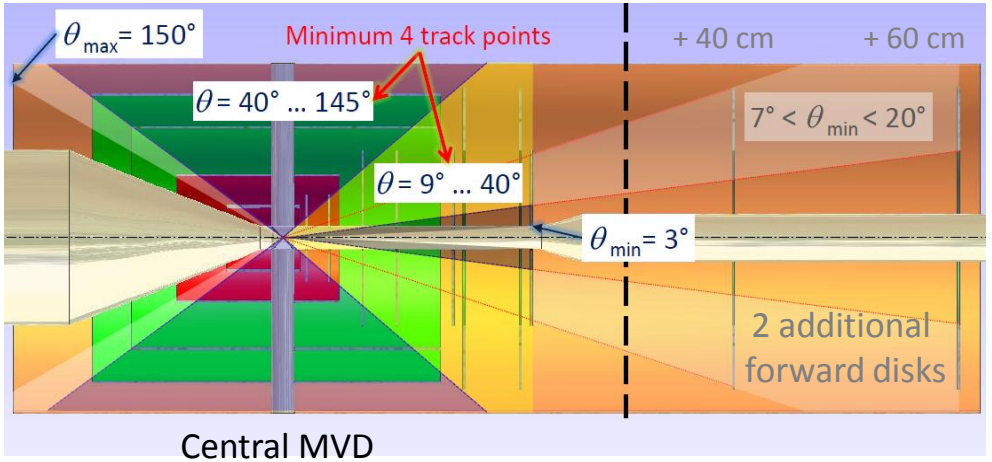
MVD: Conceptual design



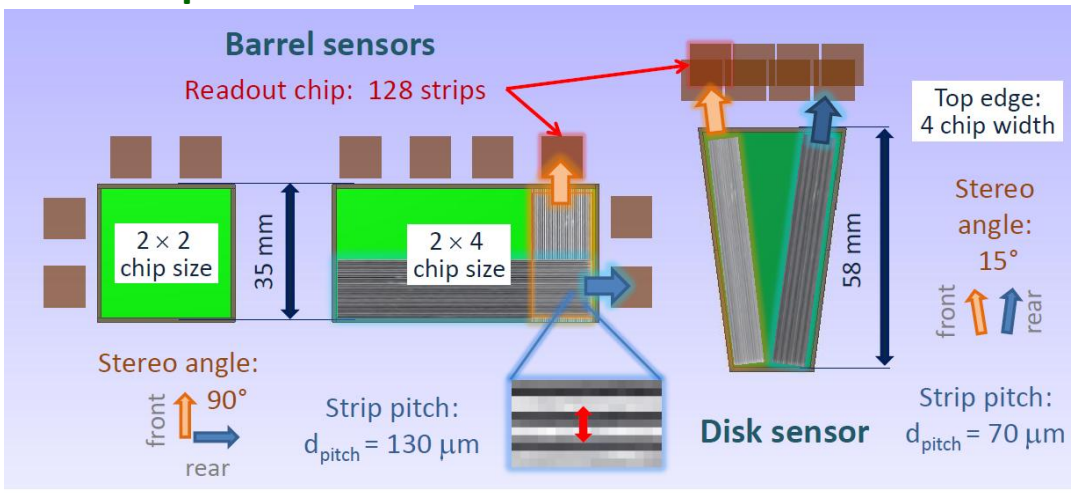


Central MVD

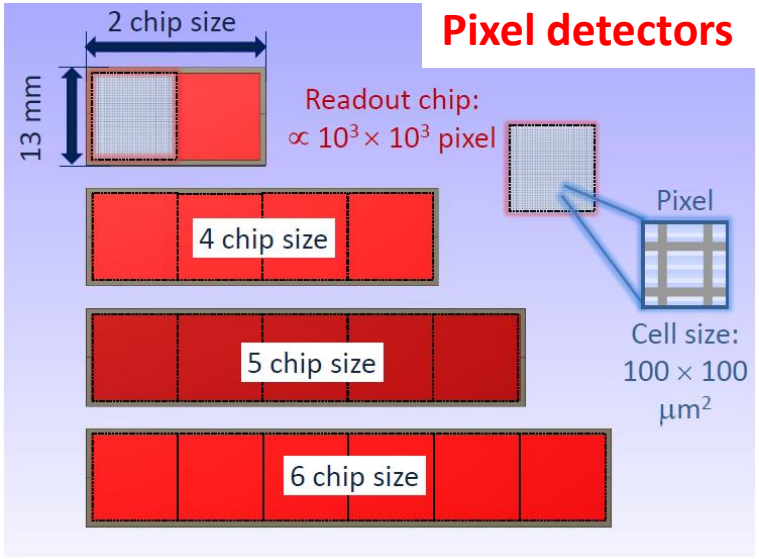
~11 million pixel readout channels

~ 200.000 strip readout channels

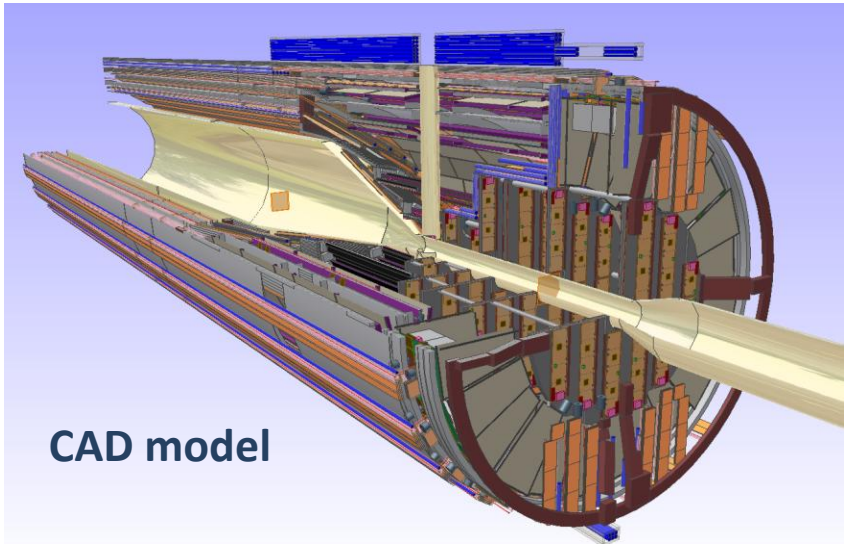
Double-sided microstrip detectors



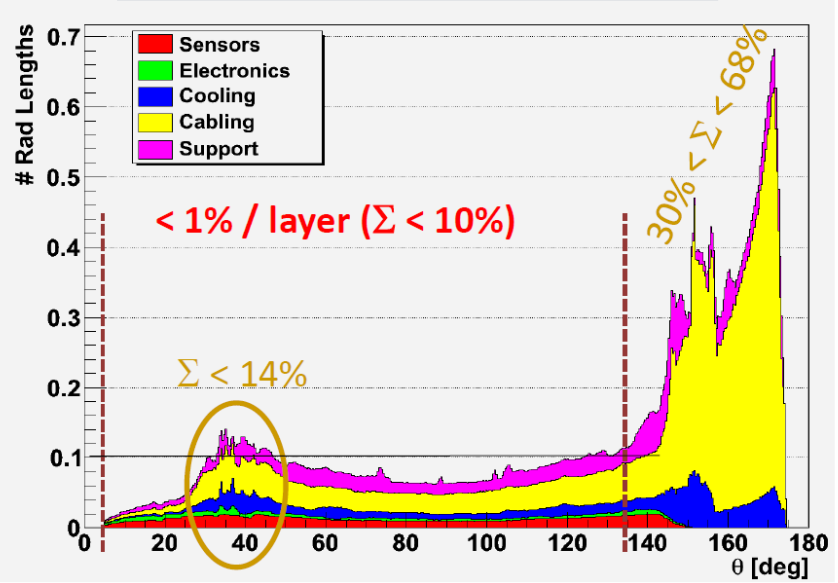
Pixel detectors

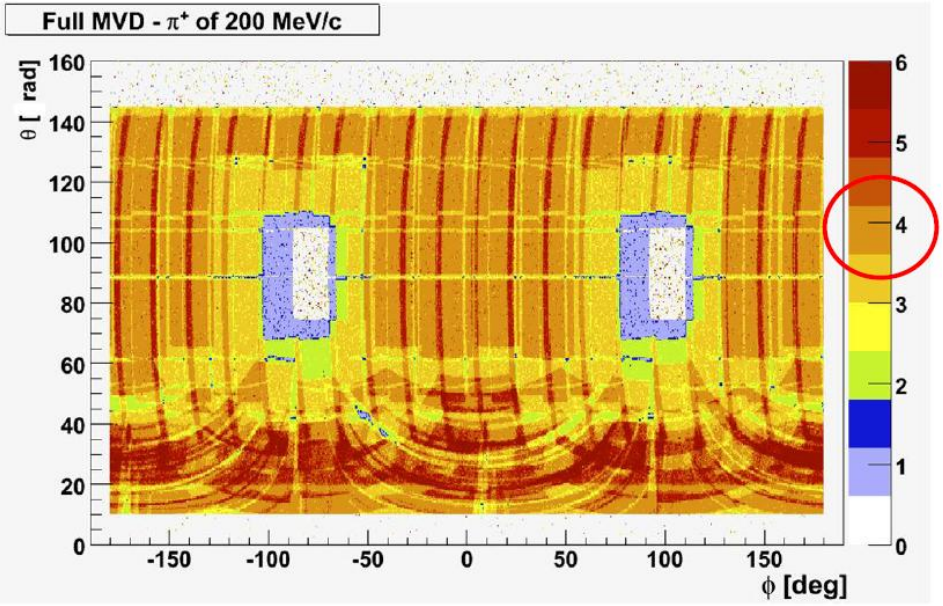


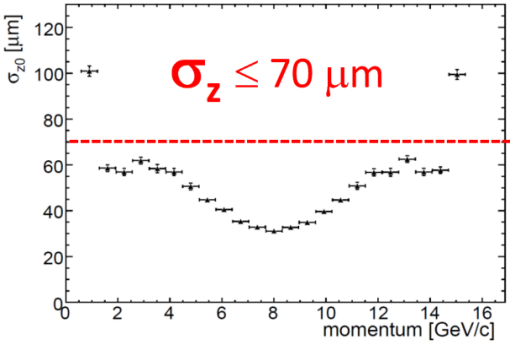
Simulations with detailed MVD model



Minimized material budget







Momentum resolution

σ(p) without MVD = 2.6 %
σ(p) with MVD = 1.4 %

$\sigma(p_t)$ without MVD = 2.9 %
$\sigma(p_t)$ with MVD = 1.4 %

→ Improvement by 50%

Vertex resolution

Primary and secondary vertex resolution:

$\sigma_{x,y} \leq 35\ \mu m$ / $\sigma_z \leq 100\ \mu m$

Design optimized for 4 MVD hit points / track

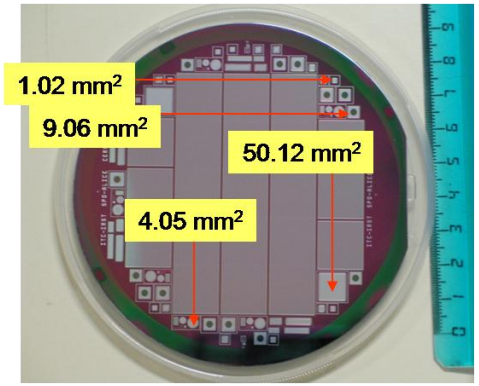
Hardware development

Pixel sensor

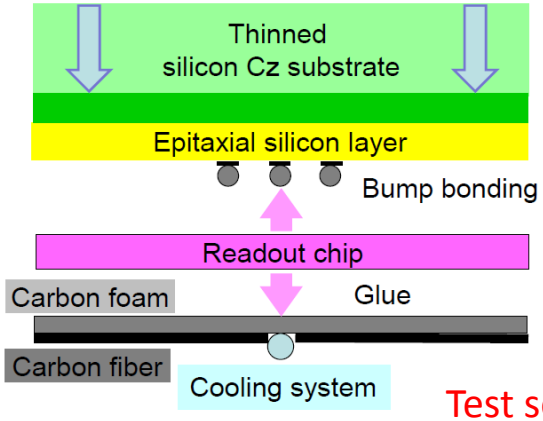
Epi-Silicon layer: (50 ... 100) µm

Thinned substrate: ≅ 50 µm

Chip sensor from epi-wafer



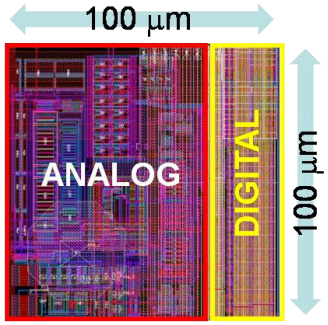
Standard hybrid technology

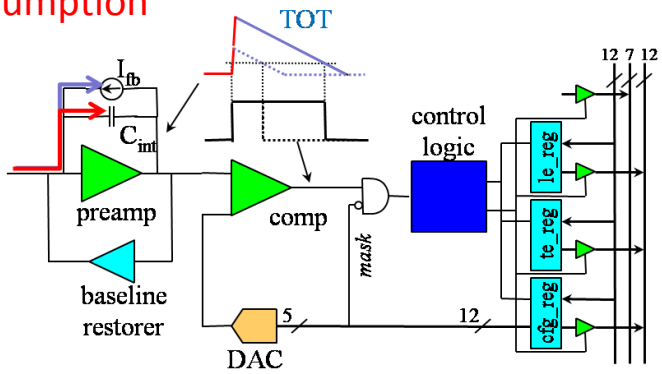


Pixel frontend

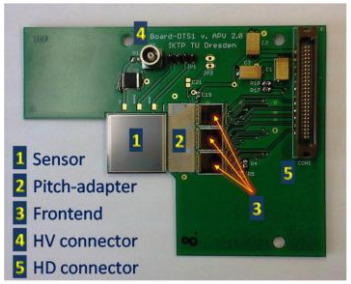
ToPix readout chip

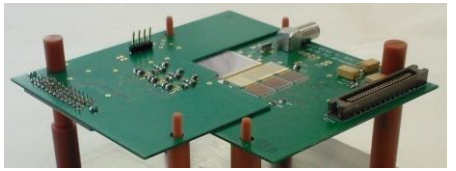
- ✓ CMOS 130 nm technology
- ✓ Time over threshold
- ✓ 100 × 100 µm² cell size
- ✓ Low power consumption





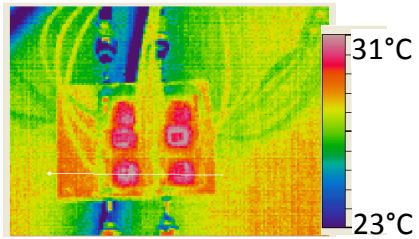
Tracking station



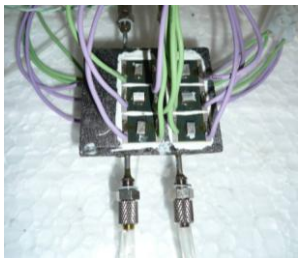


Setup with double-sided strip detectors:
Sensor test and tracking algorithms

Test setup

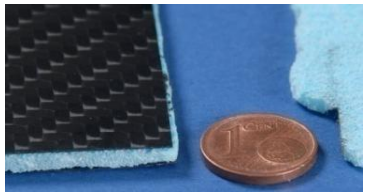


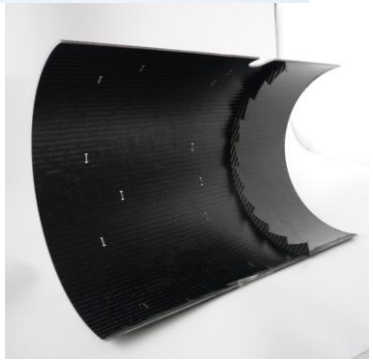
Mechanics



Micro fittings:
Thermoplastic resin

Light carbon support structures



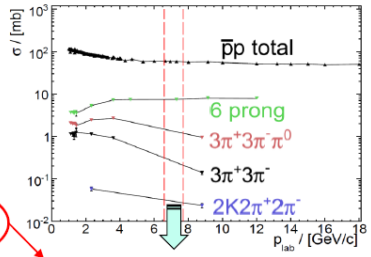


Physics performance

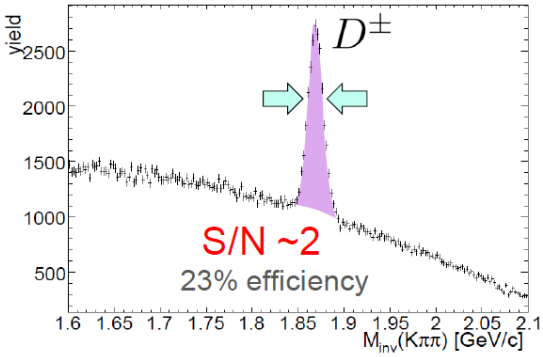
- Physics analysis $\bar{p}p \to D^+D^-$
  - Reconstruction: $D^\pm \to K^\mp\pi^\pm\pi^\pm$

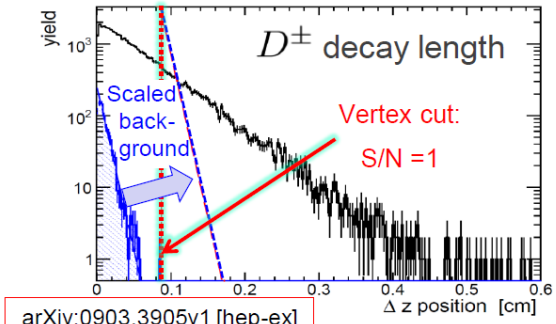
$$R = \frac{\sigma(\bar{p}p \to D^+D^-)}{\sigma(\bar{p}p \to X)} = \frac{2.83nb \cdot (0.092)^2}{60mb} = 4.0 \cdot 10^{-10}$$

Conservative estimate



6 orders of magnitude lower





arXiv:0903.3905v1 [hep-ex]

- Physics analysis $\bar{p}p \to D_s^\pm D_{s0}^*(2317)^\mp$
  - Reconstruction: $D_s^\pm \to \phi\pi^\pm, \quad \phi \to K^+K^-$
    $\to D_{s0}^*(2317)^\mp$ identification via missing mass
  - Energy scan around threshold
  - → D_{s0}*(2317) world average (PDG)
    - Mass: 2317.8 ± 0.6 MeV/c²
    - Width: < 3.8 MeV/c²

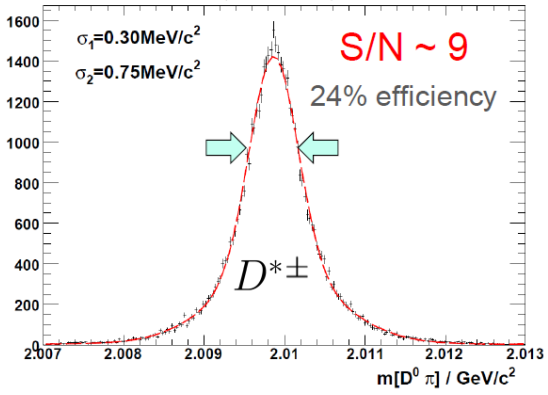
    Achievable PANDA performance
    - Mass resolution: ~100keV/c²
    - Width resolution: ~ 0.1 MeV/c²

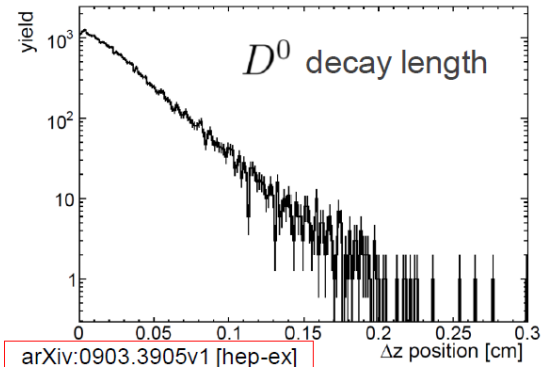
- Physics analysis $\bar{p}p \to D^{*+}D^{*-}$
  - Reconstruction: $D^{*+} \to D^0\pi^+, D^0 \to K^-\pi^+$

$$R = \frac{\sigma(\bar{p}p \to D^{*+}D^{*-})}{\sigma(\bar{p}p \to X)} = \frac{0.90nb \cdot (0.677)^2 \cdot (0.038)^2}{60mb} = 1.0 \cdot 10^{-11}$$

7 orders of magnitude below main background channels

Conservative approach





arXiv:0903.3905v1 [hep-ex]

- Physics analysis $X(3872) \to \pi^+\pi^-J/\psi$