News from the Micro Vertex Detector of CBM

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CBM

FAIR

Compressed Baryonic Matter experiment at FAIR

The Micro Vertex Detector (MVD) of CBM

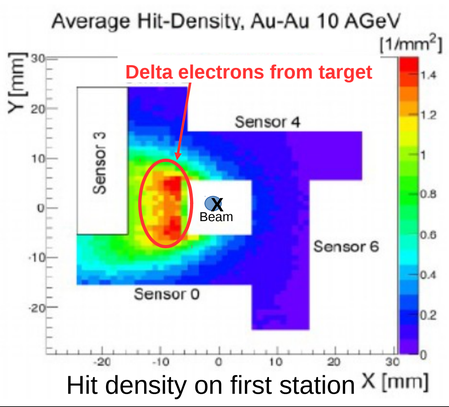
The task of the MVD) of CBM

1) Open Charm reconstruction → Provide ~50 µm sec. vertex reconstruction.
2) Support e^+/e^- spectroscopy → Provide excellent low momentum tracking.
3) Charged reconstruction in HIC (first time)

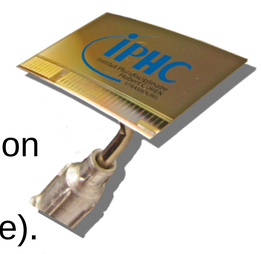
Operate at 100 kHz Au+Au (10 AGeV) and 10 MHz p+Au (30 GeV)

The technological challenge

- Needs ultra thin (0.3% X_0) stations.
- Operation in target vacuum needed.
- High track density (700 kHz/mm² peak)
- High radiation load:
  - $3 \times 10^{13}\ n_{eq}/cm^2$
  - 3 Mrad



The sensor technology

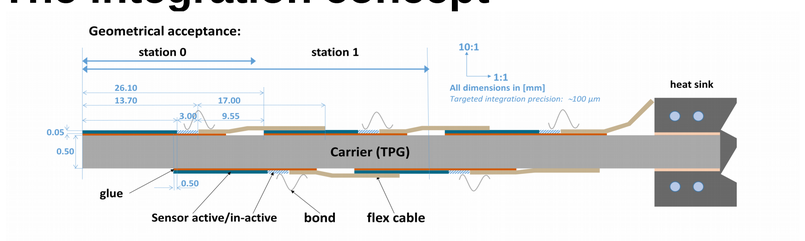


CMOS Monolytic Active Pixel Sensor

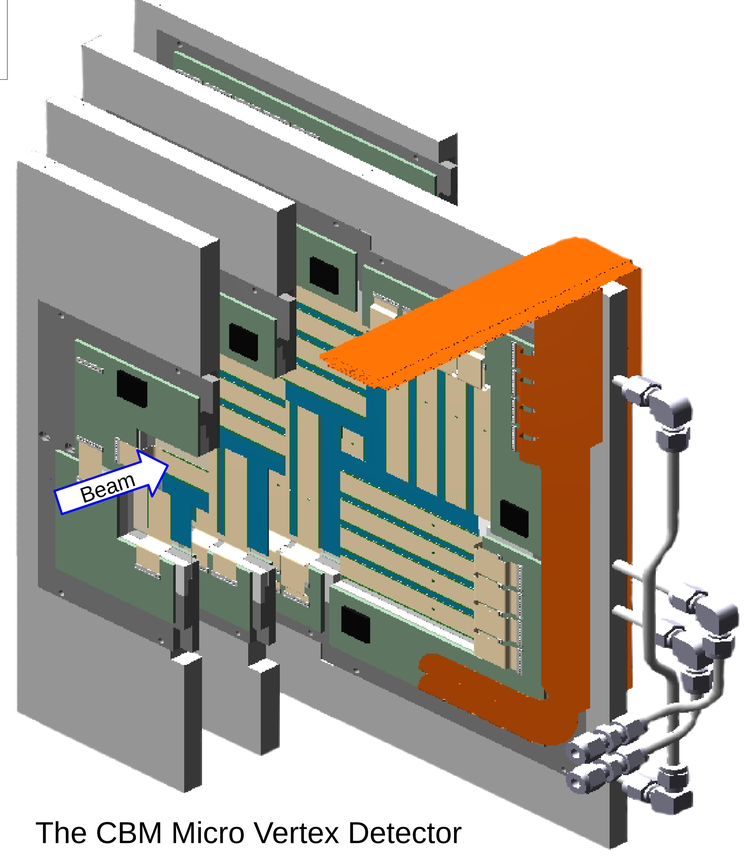
- Excellent compromise between high precision tracking and high rate capability.
- Used in STAR/HFT and ALICE/ITS (upgrade).
- Dedicated sensor required for CBM (MimoSIS):

	ALICE ALPIDE (demonstrated)	MimoSIS (design goal)	Improvement factor
Pixel count	512 x 1024	504 x 1024	ok
Pixel pitch	29.2 µm x 26.9 µm	30.2 µm x 26.8 µm	ok
Spacial resolution	< 5 µm	< 5 µm	ok
Time resolution	5 - 10 µs	~5 µs	ok
Radiation load TID	500 krad	3 Mrad	x 6
Radiation load NIEL	1.7 x $10^{13} n_{eq}/cm^2$	3 x $10^{13} n_{eq}/cm^2$	x 2
Peak hit rate	> 12 kHz/mm²	700 kHz/mm²	x 56

The integration concept

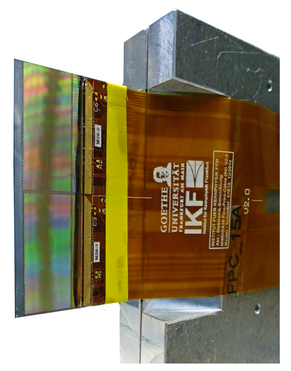


- Place sensors on carbon based cooling support
- Evacuate dissipated power to liquid cooled heat sink outside of acceptance

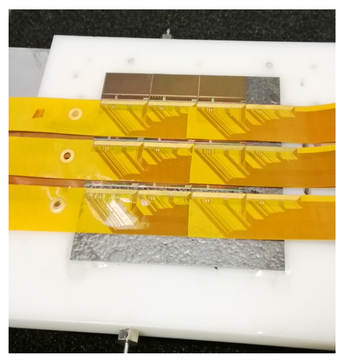


The CBM Micro Vertex Detector

Results of prototyping



MVD - Prototyp



PRESTO
(2nd gen. Prototype)

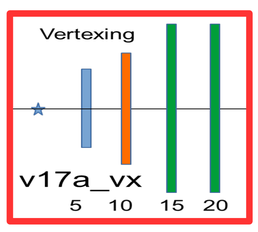
M.Koziel et.al., NIM A 732 (2013) P. 515

M.Koziel et.al., NIM A 845 (2017) P. 110

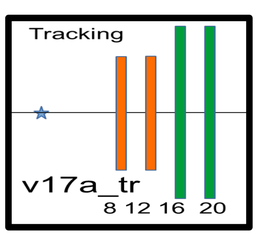
- Integration feasible.
- Excellent tracking performance > 99% det.eff. (with Mimosa26 @ CERN SPS)
- Long term vacuum operation under study

Tracking performance simulations

Aim - Test MVD geometry options

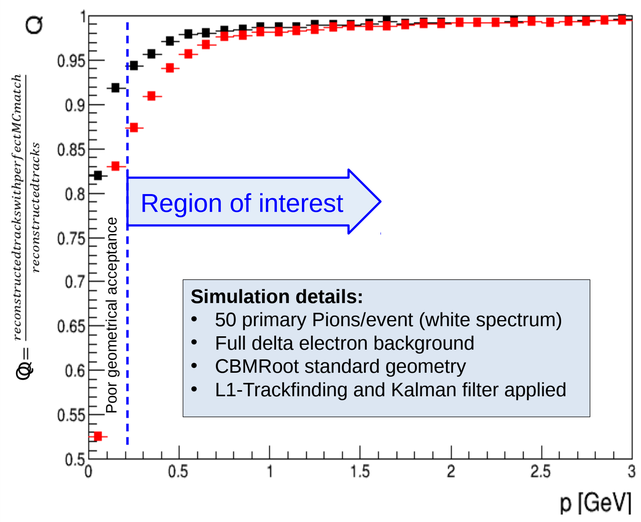


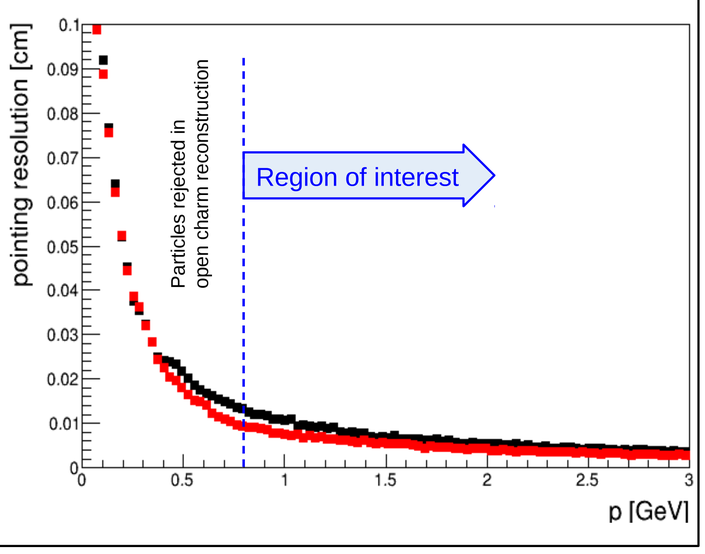
station @ 5 cm
⇒ expect improved IP resolution,
⇒ tracking complicated by high track density.



first station @ 8 cm
⇒ reduced track density expect robust tracking
⇒ expect reduced pointing resolution

Results





Conclusion: Both geometries provide robust performances.
Next step: Full physics case simulation

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