

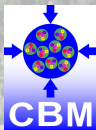
# A new concept for the geometry of the Silicon Tracking System in the CBM Experiment

by

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*for the CBM Collaboration*

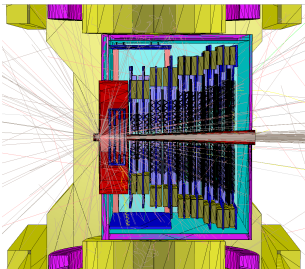
*DPG Spring Meetings 2023*



*March 15, 2023*

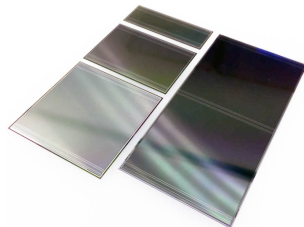
- Silicon Tracking System detector
- Updated Silicon Tracking System (STS-3 + STS-5)
- Basic Simulation Studies
  - Efficiency, Momentum Resolution
  - Pt-Rapidity distribution
- Rate Studies

# Introduction: Silicon Tracking System



- 8 STS stations.
- Inside 1 Tm dipole magnet.
- Double-sided Silicon micro-strips sensors of four different sensor sizes: ( $6 \times 2 \text{ cm}^2$ ,  $6 \times 4 \text{ cm}^2$ ,  $6 \times 6 \text{ cm}^2$ ,  $6 \times 12 \text{ cm}^2$ )
- Sensor thickness  $320 \pm 15 \text{ }\mu\text{m}$ , strip pitch width:  $58 \text{ }\mu\text{m}$ .
- Free streaming data read-outs.

- STS ladder: Carbon fiber support structure.
- Ultra thin signal read-out micro-cables.



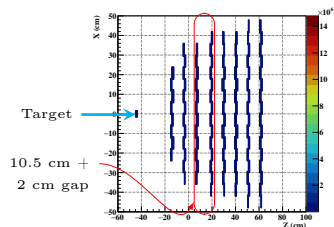
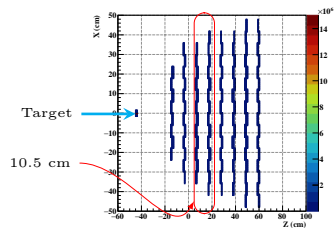
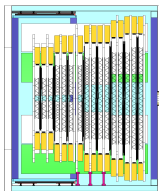
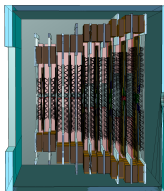
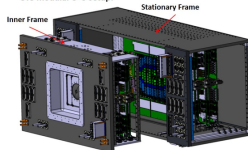
# Silicon Tracking System (STS-3 + STS-5)

- Introduced 2 cm gap between STS-3 and STS-5 block.
- The internal distance between stations (105 mm) remains the same

STS monolithic setup:

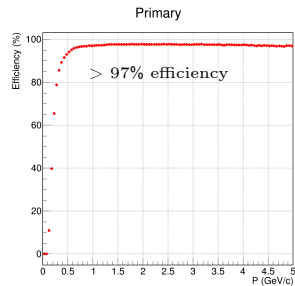
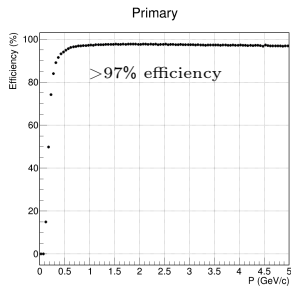
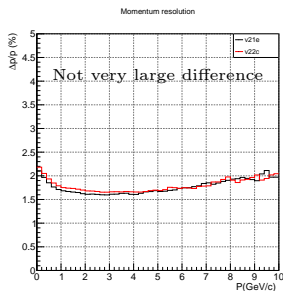


STS modular 3+5 setup:

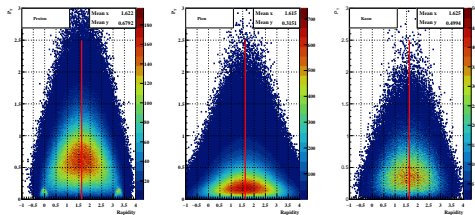


XZ distribution of MC points in STS geometry

# Results: Momentum resolution, Efficiency @ 12 AGeV/c

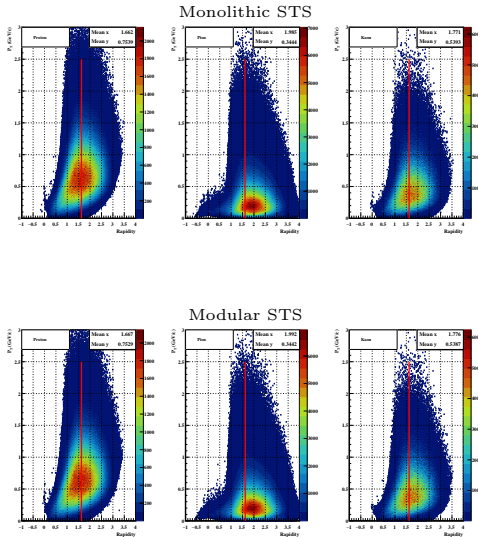


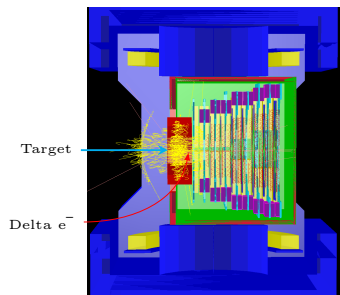
# Results: Pt-y acceptance @ 12 AGeV/c



Urqmd, 4 $\pi$  distribution

$$Y_{\text{mid}} = 1.62$$

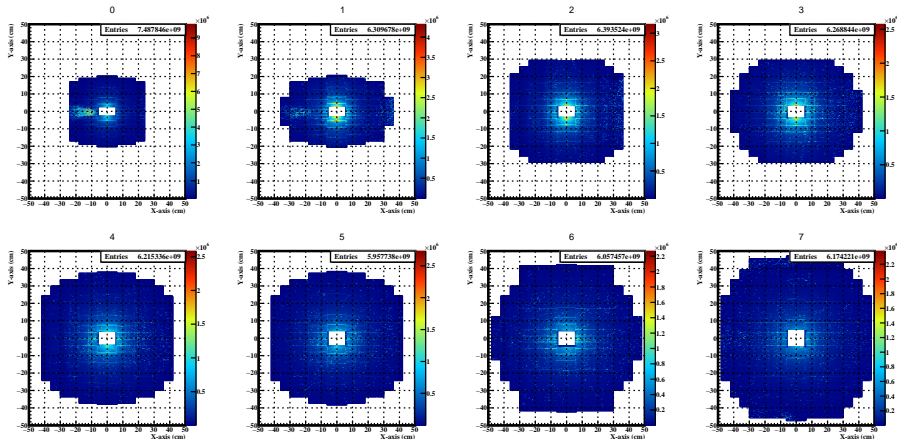




- Delta electrons: Secondary electrons, knocked out from atoms by charged particle
- Source of origin
  - Beam-target interaction
  - Beampipe interaction
  - Photon conversion
  - Anywhere from detector passive material interaction

- Insulation box around the STS stations considered during the study
- Geant3 used to transport Au ions through the target
- Standard delta electron energy cut value 1 MeV was used
  - Delta electron selection criteria
  - PID PDG = 11
  - Mother ID = 0
  - $|X| < 1.5$  cm
  - $|Y| < 1.5$  cm
  - $Z < -43.9$  cm

# Rate Studies: Urqmd + Delta rays

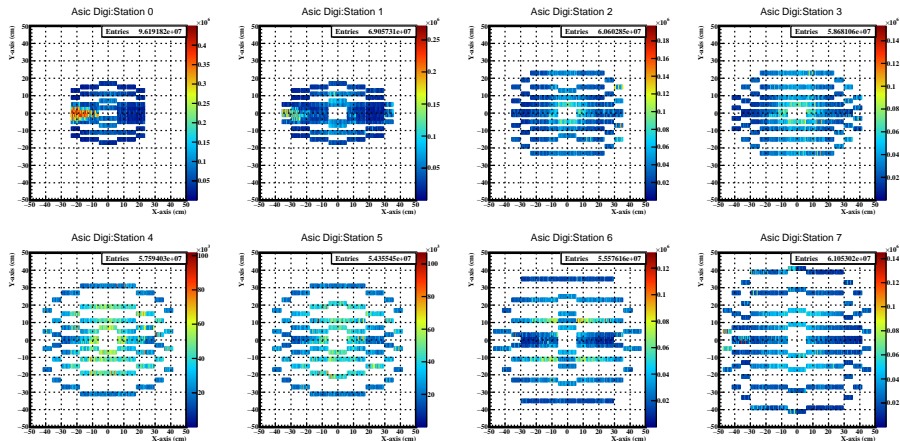


- 12 AGeV/c momentum
- 1 Tm Magnetic field

- Urqmd  $10^5$  events at  $10^7$  rates
- Beam  $10^7$  events at  $10^9$  rates

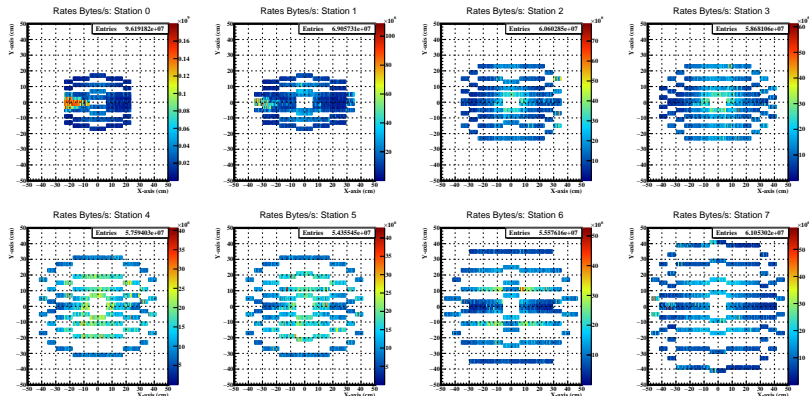


# Rate Studies: Digis per Asic (Chips)



- Threshold  $4\sigma$
- ENC  $1000\ e^-$

# Rate Studies: Rates per Asic (Chips)



| Station no. | Rates $\frac{MB}{s}$ |
|-------------|----------------------|
| 0           | 171                  |
| 1           | 103                  |
| 2           | 75                   |
| 3           | 58                   |
| 4           | 38                   |
| 5           | 40                   |
| 6           | 50                   |
| 7           | 55                   |

- Substantial amount of delta rays were seen in a very concentrated part of the detector.
- Further investigation is underway.

- We are upgrading the simulation geometry as realistic as possible to the CAD model.
- So far we have not seen any big difference in momentum resolution and efficiency performance.
- No difference was seen in the Pt-y Distribution of the primary particle such as proton, pions and kaons.
- Data rates studies and the effect of delta electrons produced due to beam-target interaction is under investigation.



*Thank you*