Silicon Tracking System of CBM Experiment

S. Mehta[1,2] for the CBM collaboration

[1] Eberhard Karls Universität Tübingen (DE)

[2] GSI Helmholtzzentrum für Schwerionenforschung GmbH (DE)

Zimanyi Winter School 2023

EBERHARD KARLS
UNIVERSITÄT
TÜBINGEN

MATHEMATISCH-
NATURWISSENSCHAFTLICHE FAKULTÄT
Physikalisches Institut

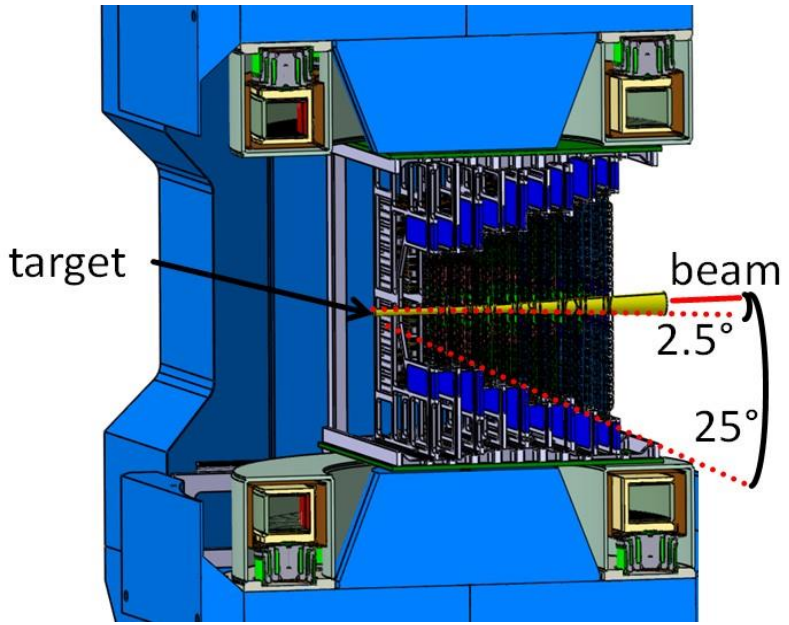
GSI

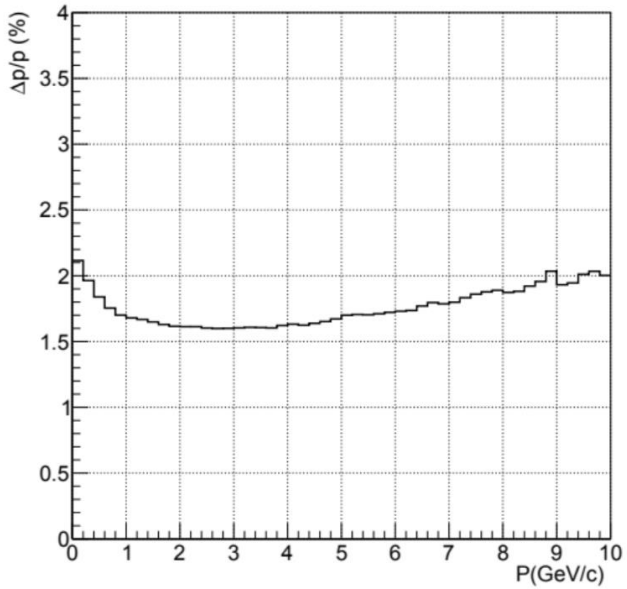
CBM

FAIR

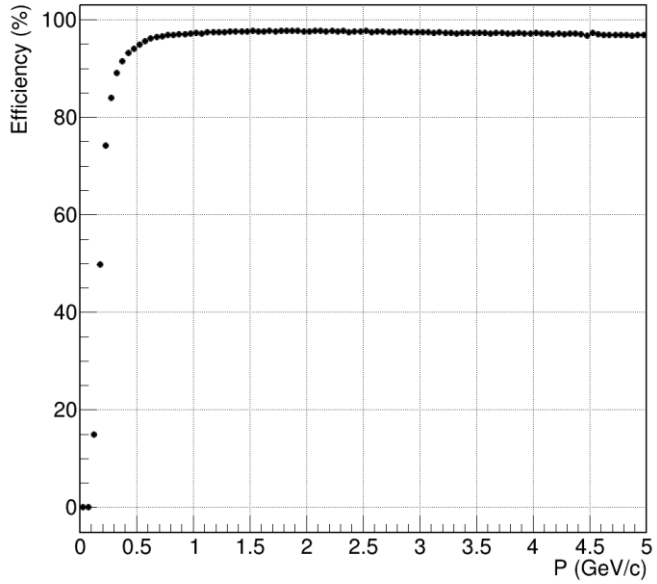
Silicon Tracking System of CBM experiment

Silicon Tracking System is designed to provide good momentum resolution (< 1.5 %) with tracking efficiency (< 97 %) -> Low material budget (exp challenge)





Momentum resolution



Tracking efficiency

Au target with 12 GeV/c Au beam

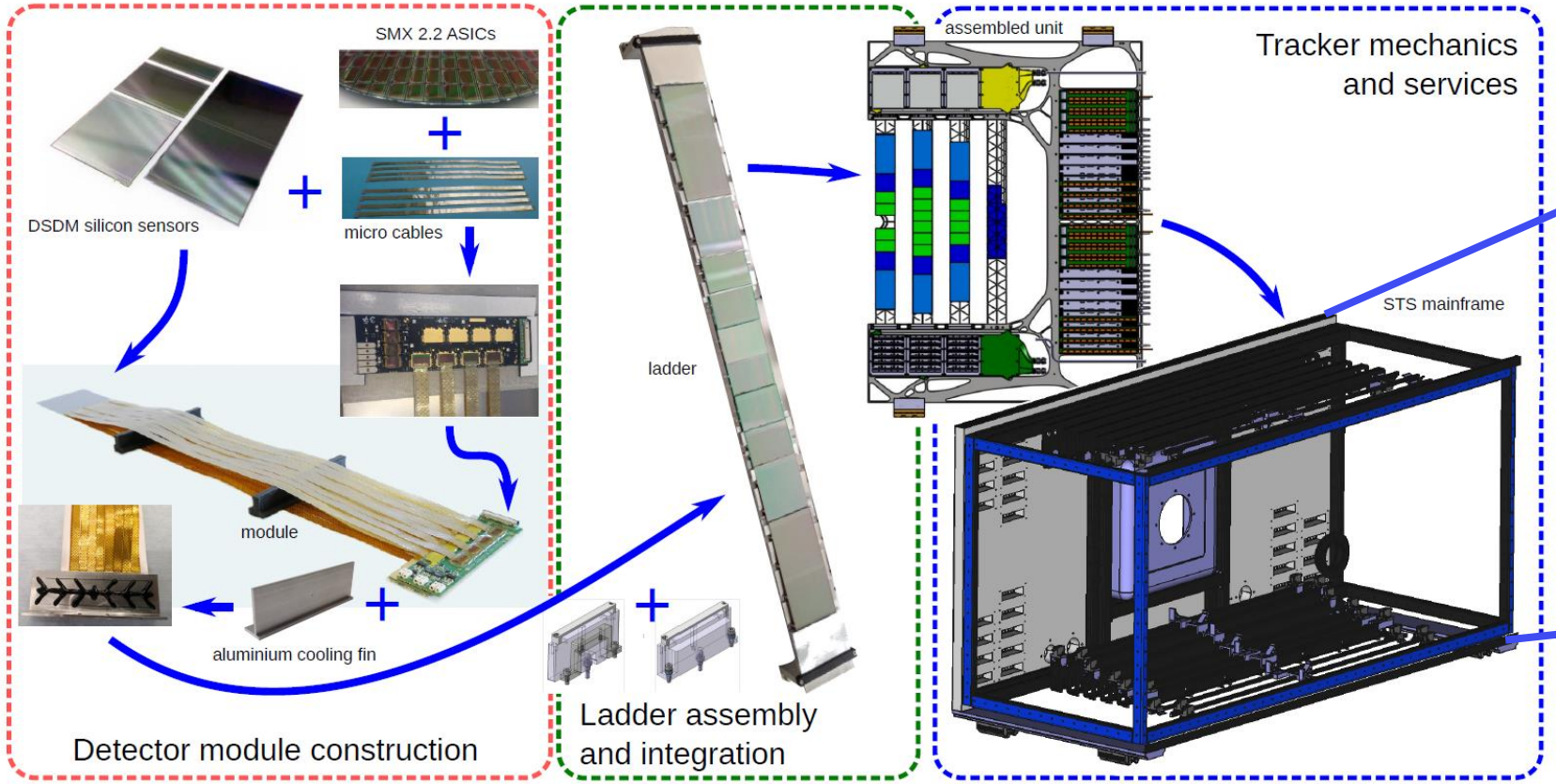
- **S**ilicon **T**racking **S**ystem is the key **tracking detector** of CBM experiment
- 8 Tracking Stations inside 1 T.m superconducting dipole magnet
- Material budget per station: 0.3 % - 2 % X_0
- Power dissipation ~ 40 kW in ~ 3 m^3

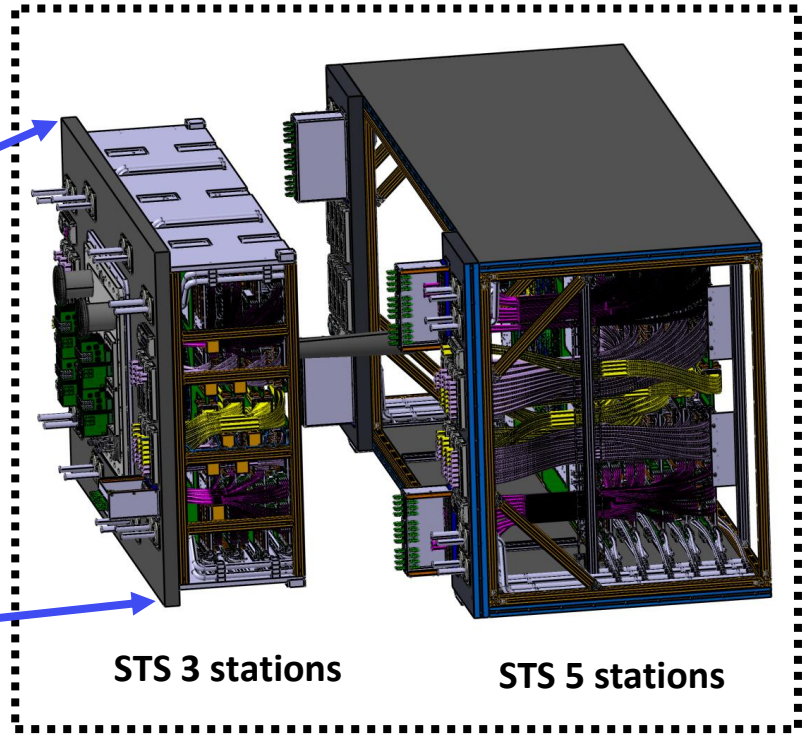
- Radiation tolerance: ≤ 10^{14} n_{eq} cm^{-2}
  - Sensor temperature 10 °C at EOL
- Self-triggering Front End Electronics outside the physics aperture
  - cooled at -20 °C using 3M NOVEC 649

STS expands reconstruction horizons from 3D to 5D with spatial, timing and amplitude in free streaming mode essential for CBM goals

Integration of Silicon Tracking System

Experimental challenge for STS: Optimize material of the components under acceptance region



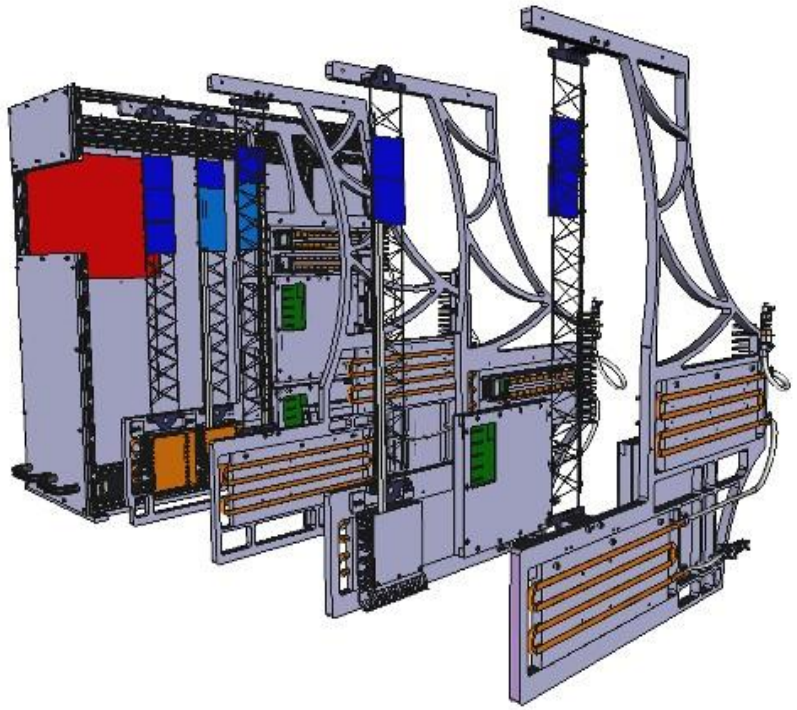


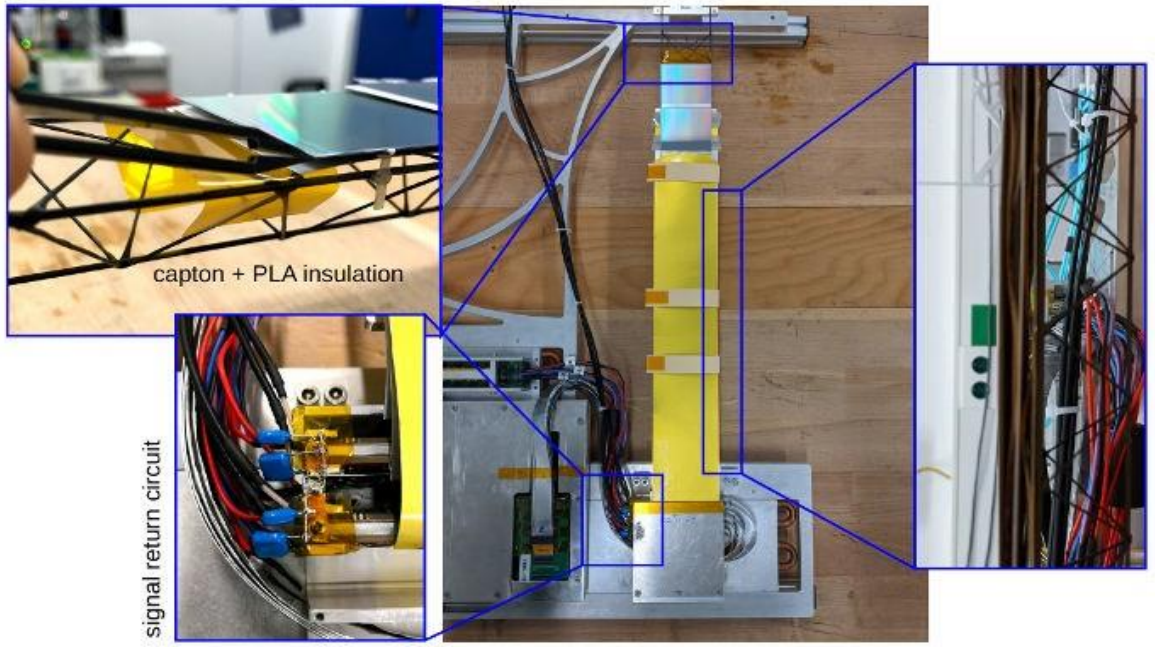
- **Module assembly** procedure has been developed and tested in the lab as well as with beam
- **Ladder Assembly** has been optimized with achievable mounting precision of ± 100 µm
- **Detector integration** aspects has been understood using mechanical and thermal demonstrators

Modular STS design has been prepared for enhanced flexibility: allowing first 3 stations to be detachable during the maintenance

Assembly and testing procedure is well established and module series production has started

mSTS: functional prototype at SIS 18





- mini-CBM is the small precursor of full scale CBM detector
- mini-STS operation involves using STS modules in real data taking scenario
- 2 tracking stations (sensor layers) 12 × 12 cm^2 and 18 × 18 cm^2 arranged on 2 stations without magnetic field
  - 11 modules (<1 % of STS modules) mounted on 4 ladders
- Testing of hit reconstruction performance, timing resolution, vertex reconstruction

Pre-liminary results: Hit reconstruction efficiency of 97 % is reached using tracks from station (6 modules) and an external detector (TOF) as reference