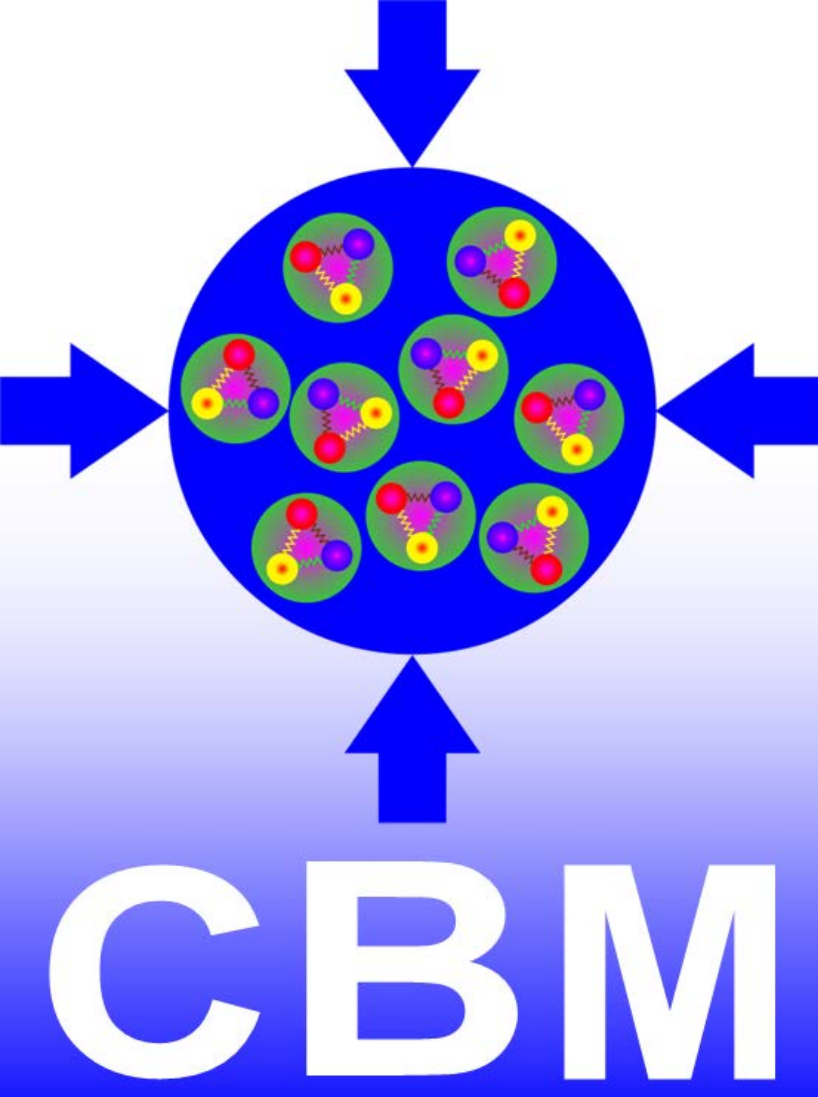




The Silicon Tracking System of the CBM experiment at FAIR

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Compressed Baryonic Matter experiment at FAIR

Silicon Tracking System

Silicon Tracking System in Dipole Magnet

- track point measurement in high-rate collision environment:
 $10^5 - 10^7/\text{s}$ (A+A), up to $10^9/\text{s}$ (p+A)
- physics aperture :
 $2.5^\circ \leq \theta \leq 25^\circ$, $0.3 \text{ m} \leq z \leq 1.0 \text{ m}$
- 8 tracking stations
- double-sided silicon microstrip sensors
- hit spatial resolution $\approx 25 \mu\text{m}$
- self-triggering front-end electronics
- time-stamp resolution $\approx 5 \text{ ns}$
- material : $\approx 0.3\% - 1.5\% X_0$ per station
- $\Delta p/p \approx 1.8\%$ ($p > 1 \text{ GeV}/c$, 1 Tm field)

System Integration

system in thermal enclosure
sensors at -5°C
cooling of electronics with bi-phase CO_2

896 modules
sensor
ultra-thin r/o cables
front-end electronics board in cooling box

8 tracking stations
18 mechanical half-units
106 ladders

material budget [$\% X_0$]

Silicon Microstrip Sensors

- 285/320 $\pm 15 \mu\text{m}$ thick
- n-type silicon
- double-sided segmentation
- 1024 strips of 58 μm pitch
- strip length 2/4/6/12 cm
- angle front/back: $7.5^\circ/0^\circ$
- read-out from top edge
- double-metal routing on p-side
- radiation tolerance
 $1 \times 10^{14} n_{\text{eq}} (1 \text{ MeV}) / \text{cm}^2$, 1 Mrad

prototypes developed and produced:
CiS/ Germany, Hamamatsu/Japan

- 6.2 x 2.2 cm^2
- 6.2 x 4.2 cm^2
- 6.2 x 6.2 cm^2
- 6.2 x 12.4 cm^2

Read-out Electronics

read-out chain for *miniSTS*

STS modules
Common GBTx Readout Board
μTCA crate with AFCK boards
FLES input node with FLIB boards

copper link (~1 m)
optical link (~50 m)
optical link (~300 m)

on detector
in DAQ room
in "Green Cube" computing center

Modules and Ladders

module assembly

tab-bonding of Al-polyimide cables between ASICs and sensor

ladder assembly

mounting of modules onto low-mass carbon-fiber supports

assembly procedure defined and tested on mechanical dummy modules

sensor position precision $\pm 40 \mu\text{m}$

Demonstrators

prototype modules

test at COSY, Feb. 2018

- proton beam, 1.7 GeV/c
- sensor 285 μm thick
- 128 channels /side read out
- microcable 25 cm long

performance:

- noise: 1090 ± 150 e (n), 1350 ± 200 e (p)
- r/o threshold: 7000 e
- signal mean: 16720 e (n), 20300 e (p)
- signal-to-noise: 15 $\pm$ 3
- hit detection eff.: > 95%

miniSTS

in demonstrator experiment *miniCBM* at GSI/SIS18

- operation 2018 - 2021
- 2 tracking stations
 - 13 modules
 - 5 half-ladders
- GBT read-out
- FLESin DAQ node

verification of :

- ASIC under load
- system aspects
- data transport
- tracking

miniSTS design

STS Project Timeline

- Production Readiness : Nov. 2018
- Detector construction 2019 – 2022
- Detector ready for installation: 2023

Assembly Centers: GSI-FAIR, JINR-VBLHEP