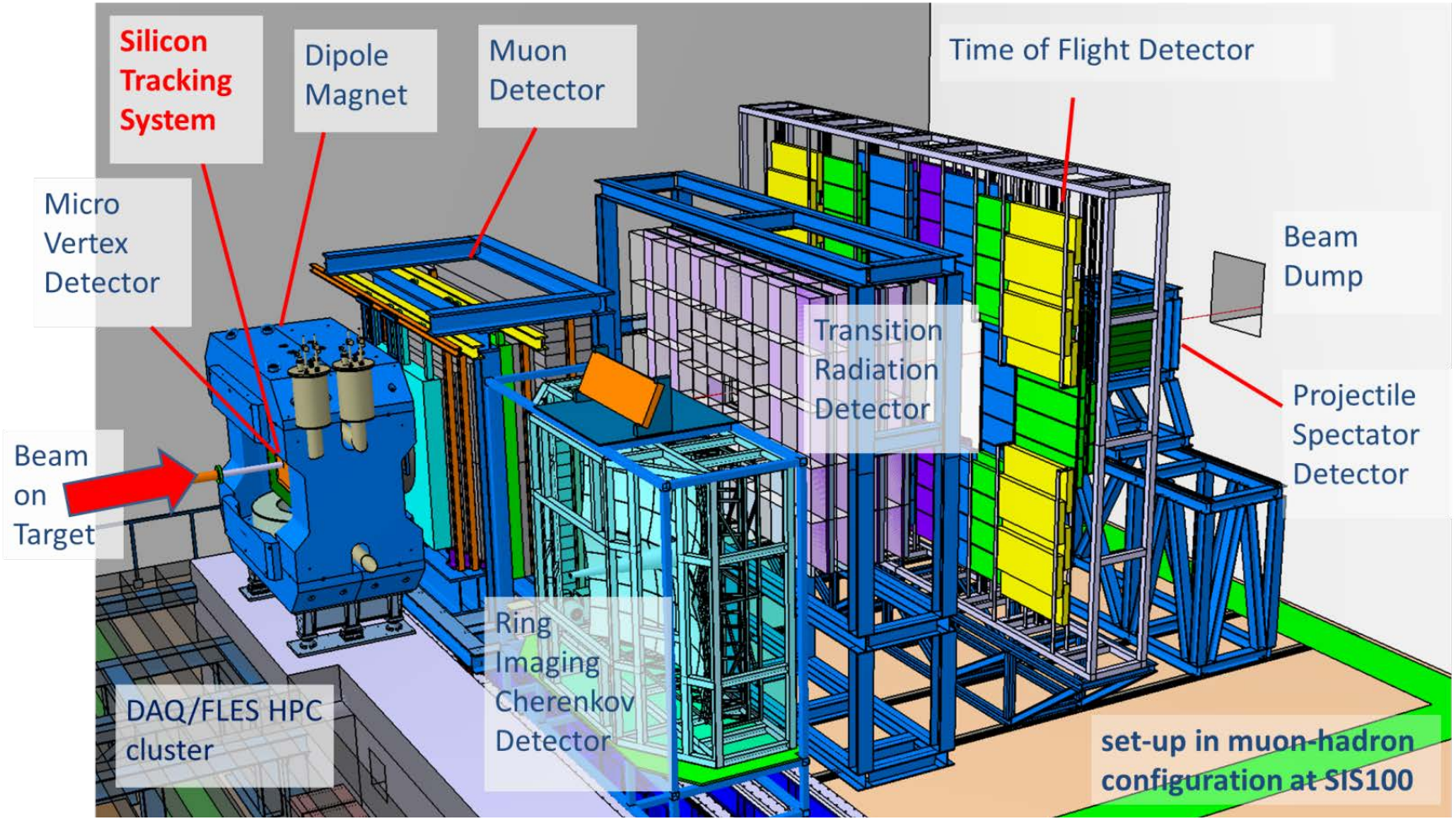
CBM silicon tracker: status and potential items for collaboration

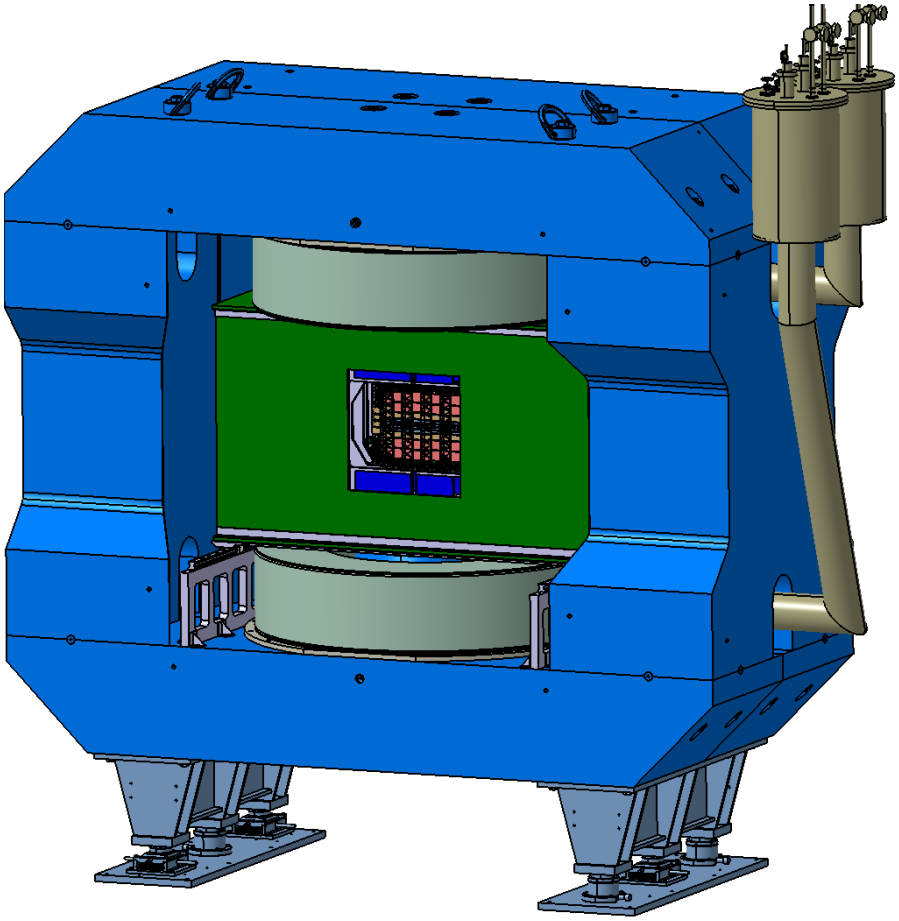
- *Silicon Tracking System – brief overview and status*
- *Items for cooperation – already started, potentially new*

Johann M. Heuser, GSI,
CBM-STAR Joint Meeting, Wuhan, 23 September 2017

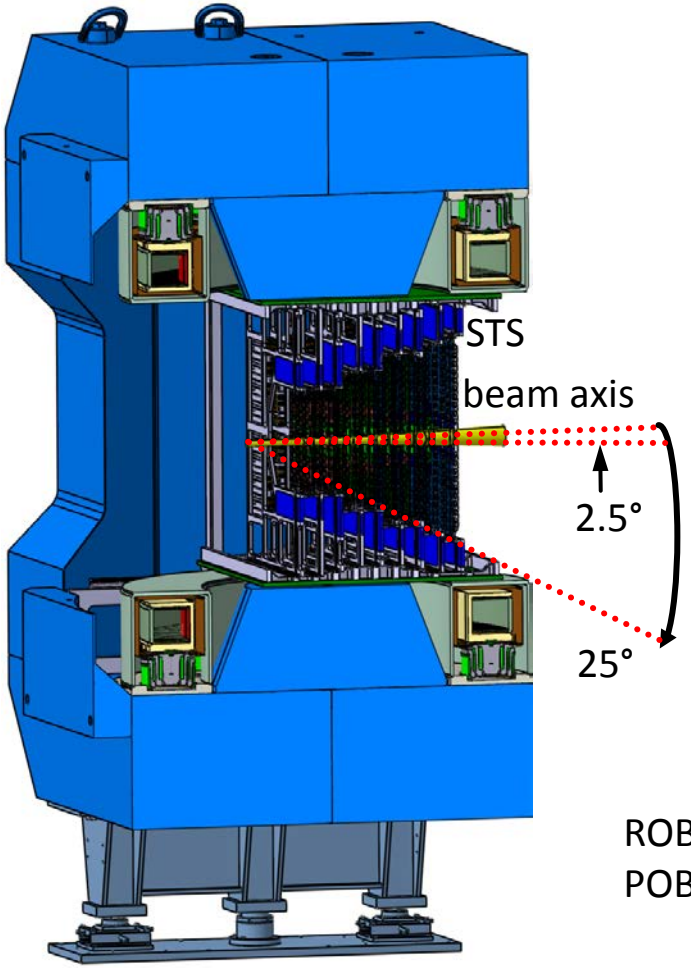
STS in CBM experiment

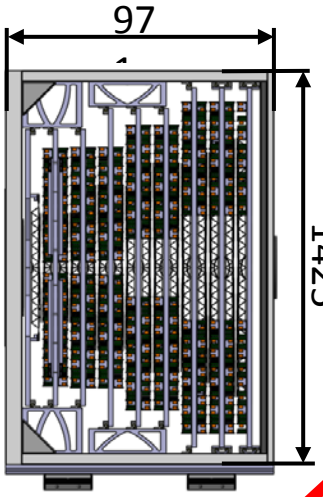


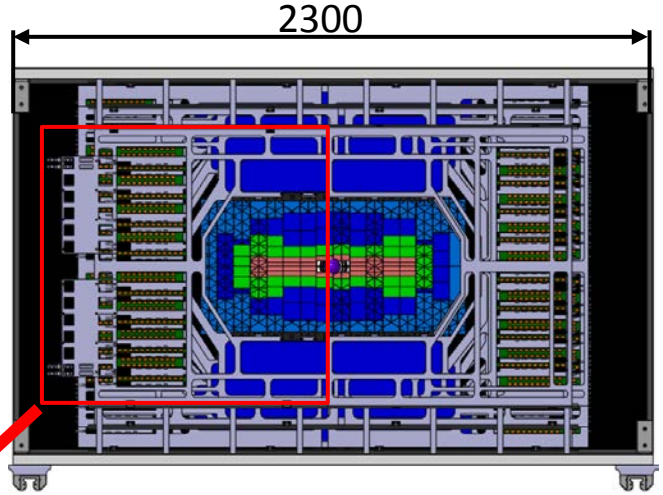
Silicon Tracking System

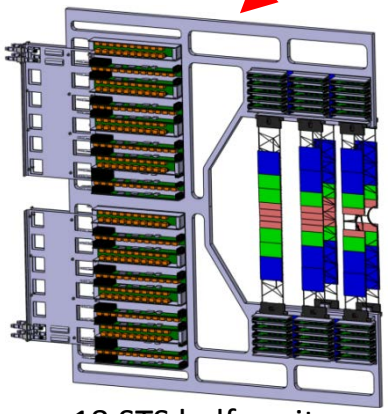


Silicon Tracking System









18 STS half- units

106 ladders

896 modules
(1.8 M channels)

+ LV + HV supplies
+ cooling system
+ controls system
+ software

Status

[source:
detailed STS project plan]

Towards Production Readiness:

- Silicon Sensors:
  - readiness: 12/2017, tendering Early 2018
- front-end electronics:
  - ASIC: prototype v2.0 under evaluation, readiness by Fall 2018
  - Front-end board: prototype: Fall 2017, ready for production: 7/2018
  - Read-out board: GBTx chip set ordered via CERN; ready 7/2018
  - Power boards: under development, FEAST *dc-dc* converter from CERN; ready 7/2017
- modules:
  - prototypes for in-beam test: 12/2017; pre-production for mCBM: mid 2018
  - assembly procedure ready: 7/2018
- ladders:
  - pre-production for mCBM: 5/2018 and 9/2018
- system integration:
  - progressing towards units for mCBM: Mid 2018, for CBM: 10/2018

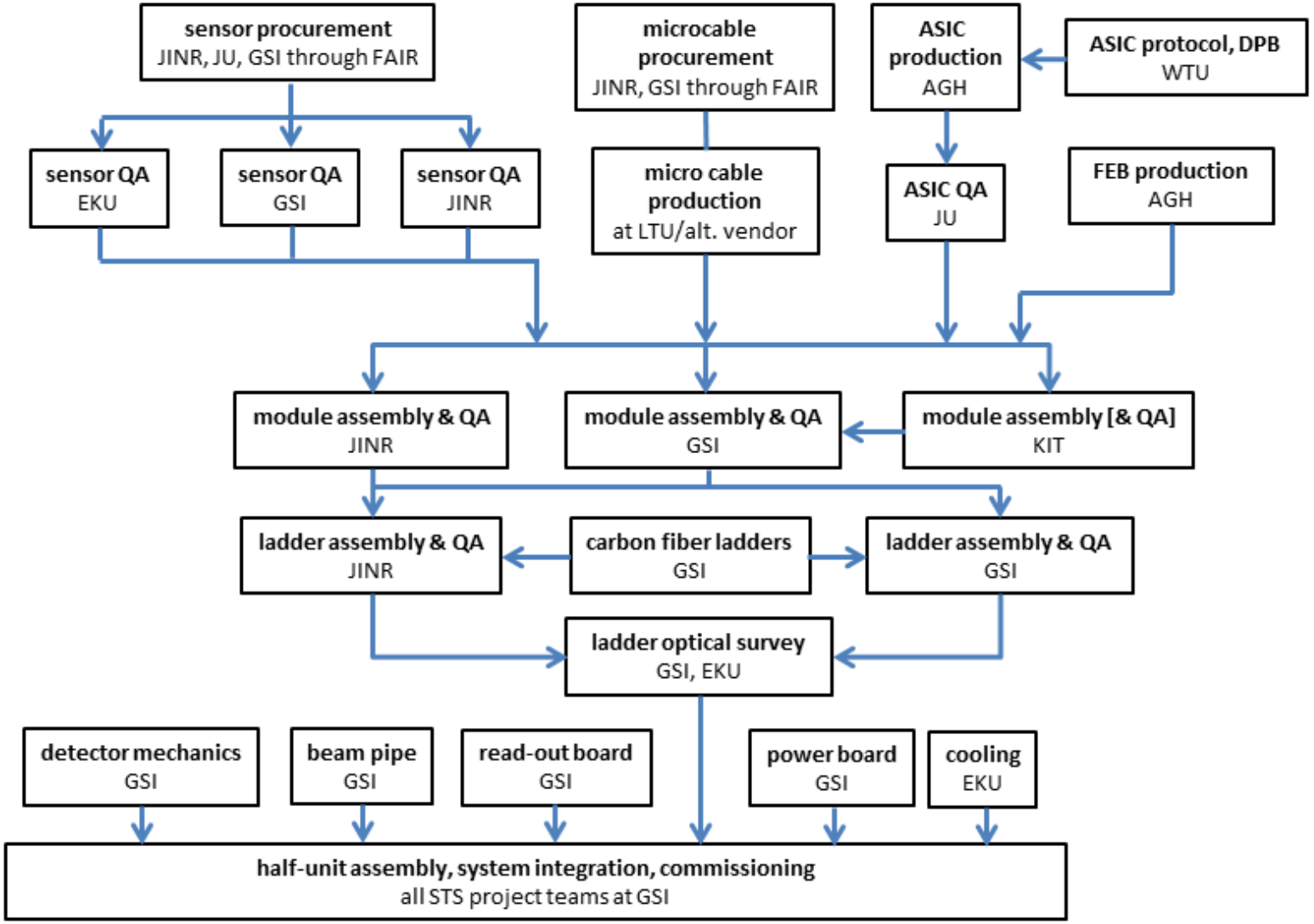
Core Readiness: 1/2019 Production: 2019 – 2022

Teams involved

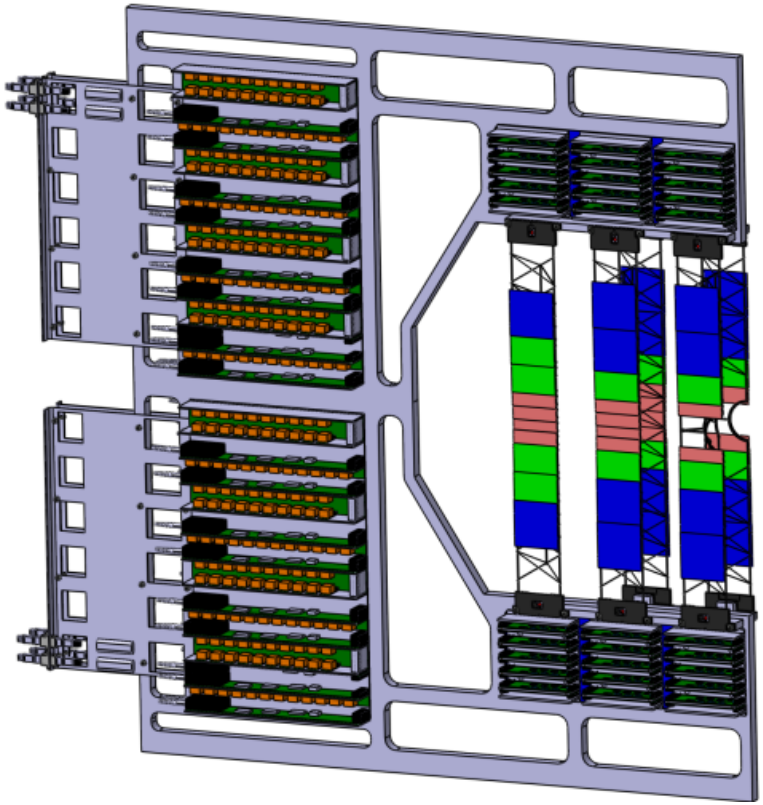
Task	Team
Si microstrip sensors	GSI, Darmstadt, Germany EKU Tübingen, Germany JINR-VBLHEP, Dubna, Russia
Front-end ASIC and board	AGH, Cracow, Poland WUT, Warsaw, Poland GSI, Darmstadt, Germany JU, Cracow, Poland
Read-out and power boards	GSI, Darmstadt, Germany
Module assembly	GSI, Darmstadt, Germany JINR-VBLHEP, Dubna, Russia KIT, Karlsruhe, Germany
Ladder assembly	GSI, Darmstadt, Germany JINR-VBLHEP, Dubna, Russia
System Integration	GSI, Darmstadt, Germany
Cooling	EKU Tübingen, Germany

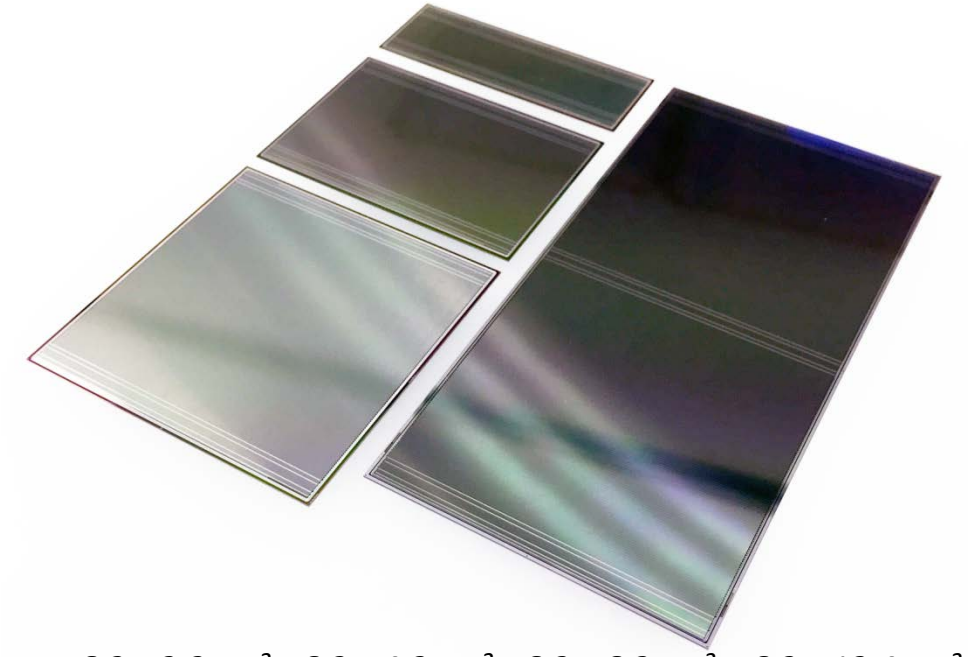
Assembly Centers: *GSI-FAIR, JINR-VBLHEP*

STS construction flow



Silicon microstrip sensors



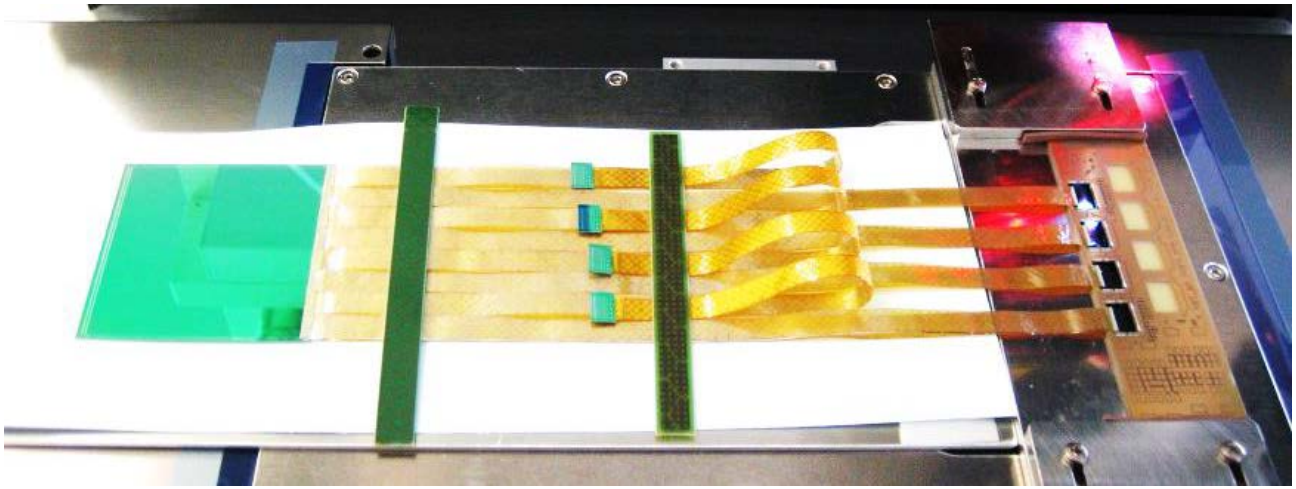


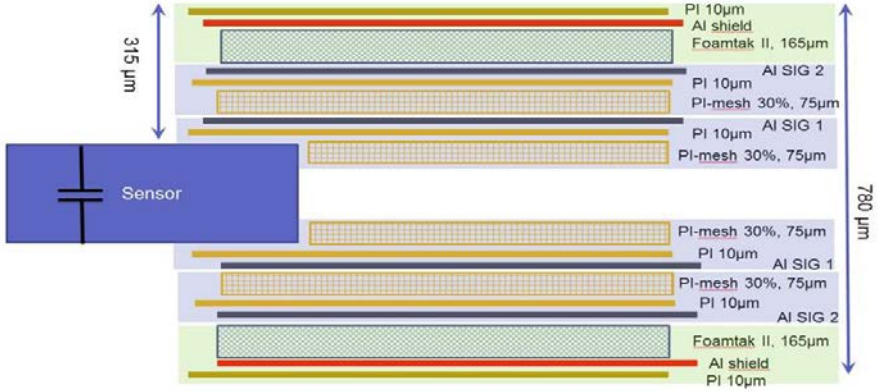
6.2 x 2.2 cm² *6.2 x 4.2 cm²* *6.2 x 6.2 cm²* *6.2 x 12.4 cm²*

→ cooperation started:

- sensor specimen + technical information sent to UIC (Zhenyu Ye) after 1st CBM-STAR meeting for independent evaluation
- input welcome for Production Readiness in 2018

Micro cables/Module assembly

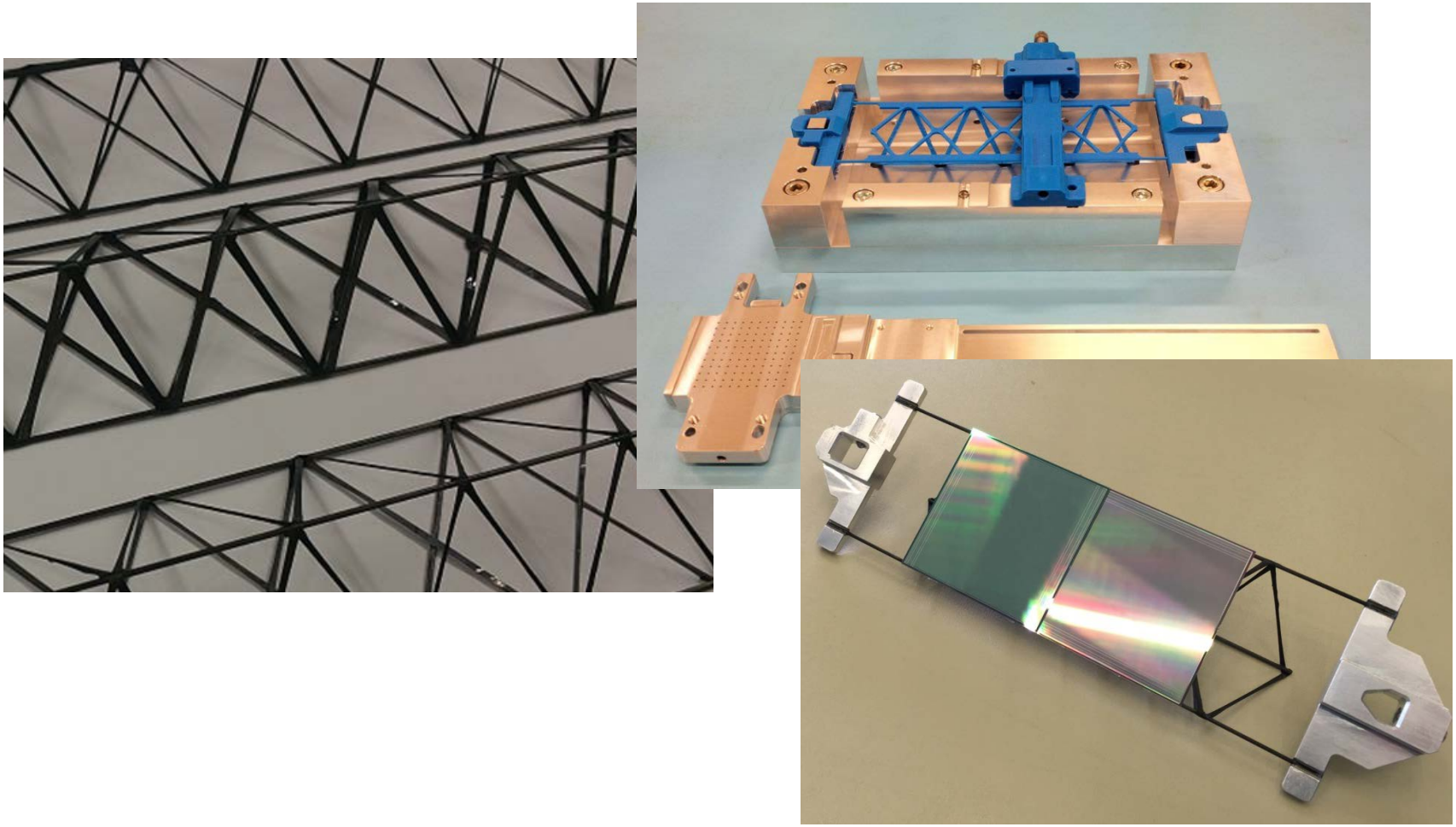




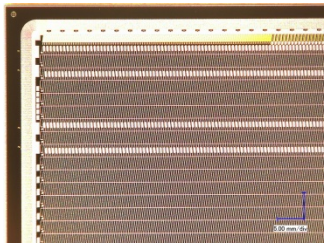
→ cooperation started:

- technical information on micro cables sent to UIC (Zhenyu Ye) after 1st CBM-STAR meeting
- Q: is there a US based vendor for this technology (Al or Cu based) ?
- A: negative
- UIC addressing to CERN TS-DEM

Ladder assembly



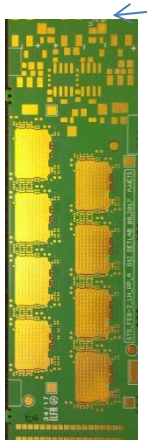
Read-out chain



microstrip sensor with
1024 channels/side

STS-XYTER ASIC 8 ×

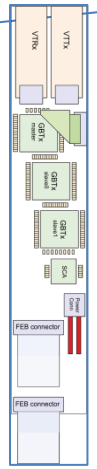
Front-end Board



STS-XYTER chips
à 1/2/5 LVDS E-links out
time-stamped data

copper link

Read-Out Board



GBTx chip-set (CERN):
3 GBTx, 1 VTRx, 1 VTTx, 1 SCA

42 E-links à 320 Mb/s
3 GBT optical uplinks à 4.48 Gb/s

Power Boards

optical link

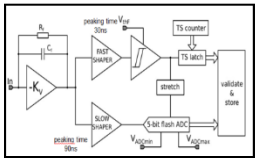
data combining

Data Processing Board
time-slicing

FLES
online
event
computing
center

free-streaming DAQ system

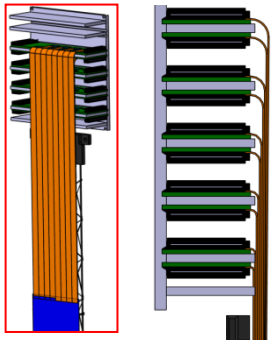
self-triggering

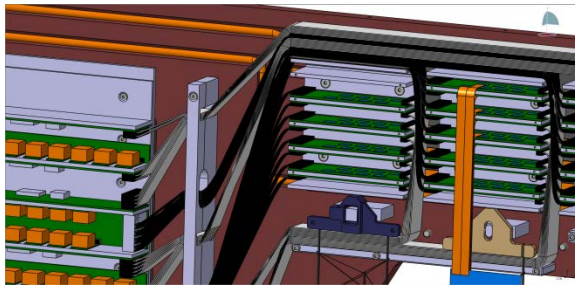


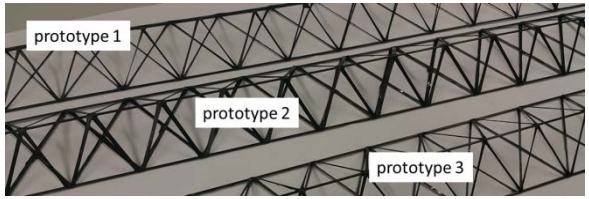
STS-XYTER ASIC	*v2.0 (produced 2016)* **2016 JINST 11 C02024**
CMOS process	*UMC 180 nm*
channels	128, polarity +/-
noise	< 1ke⁻ at 20-50 pF load
ADC range	linear up to12 fC, 5 bit
clock	250 MHz
power	< 10 mW/channel
timestamp	~5 ns resolution
out interface	5 × 500 Mbit/s LVDS

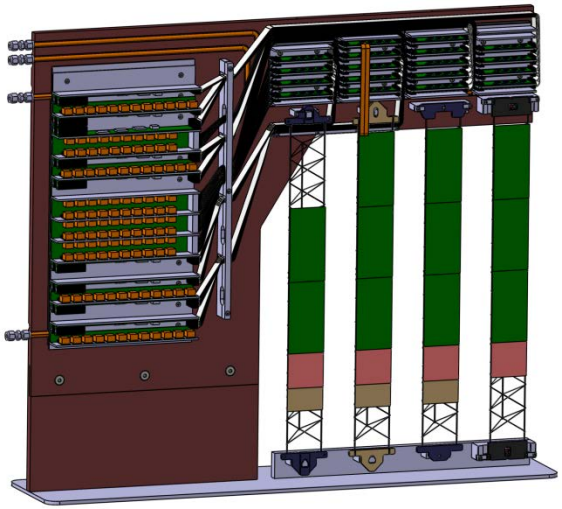
System Integration

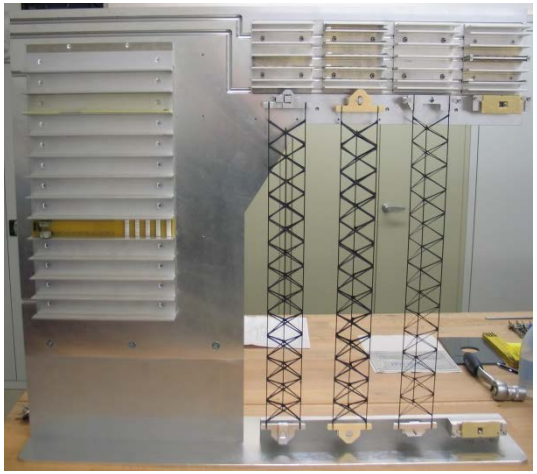
Assembly of demonstrator ¼ Unit 07

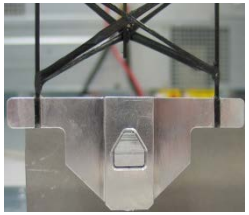


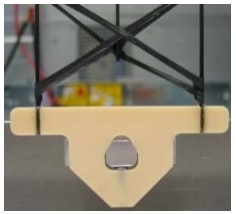












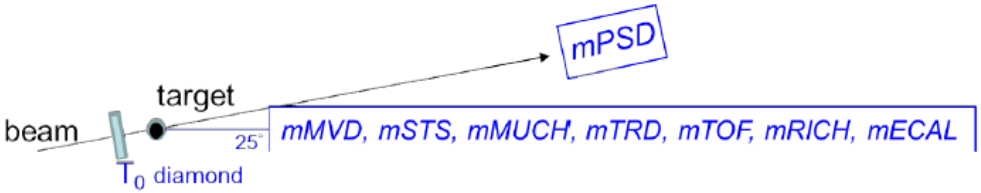
Test experiments

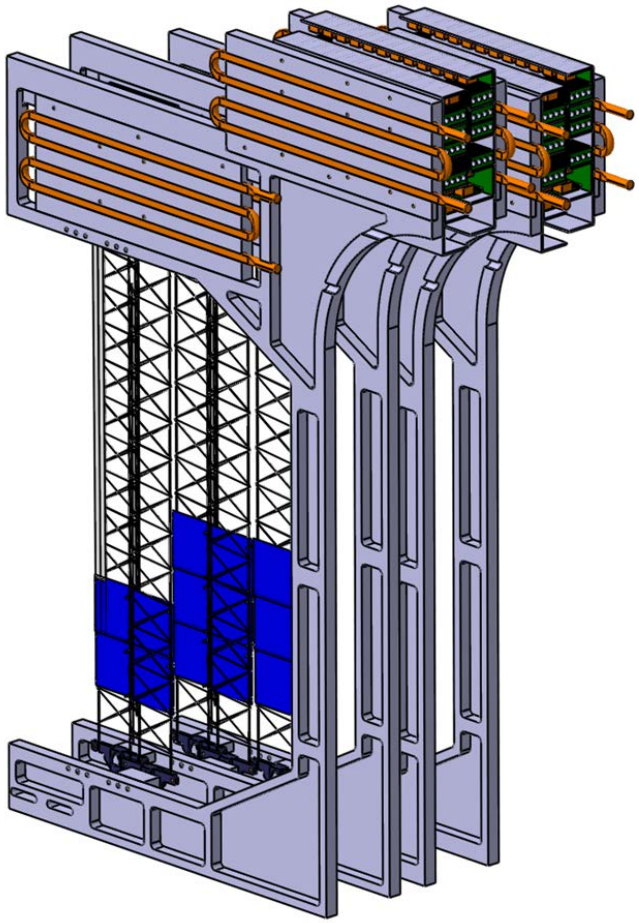
mSTS in mCBM

propsed: Fall 2018 – 2019, potentially until 2021

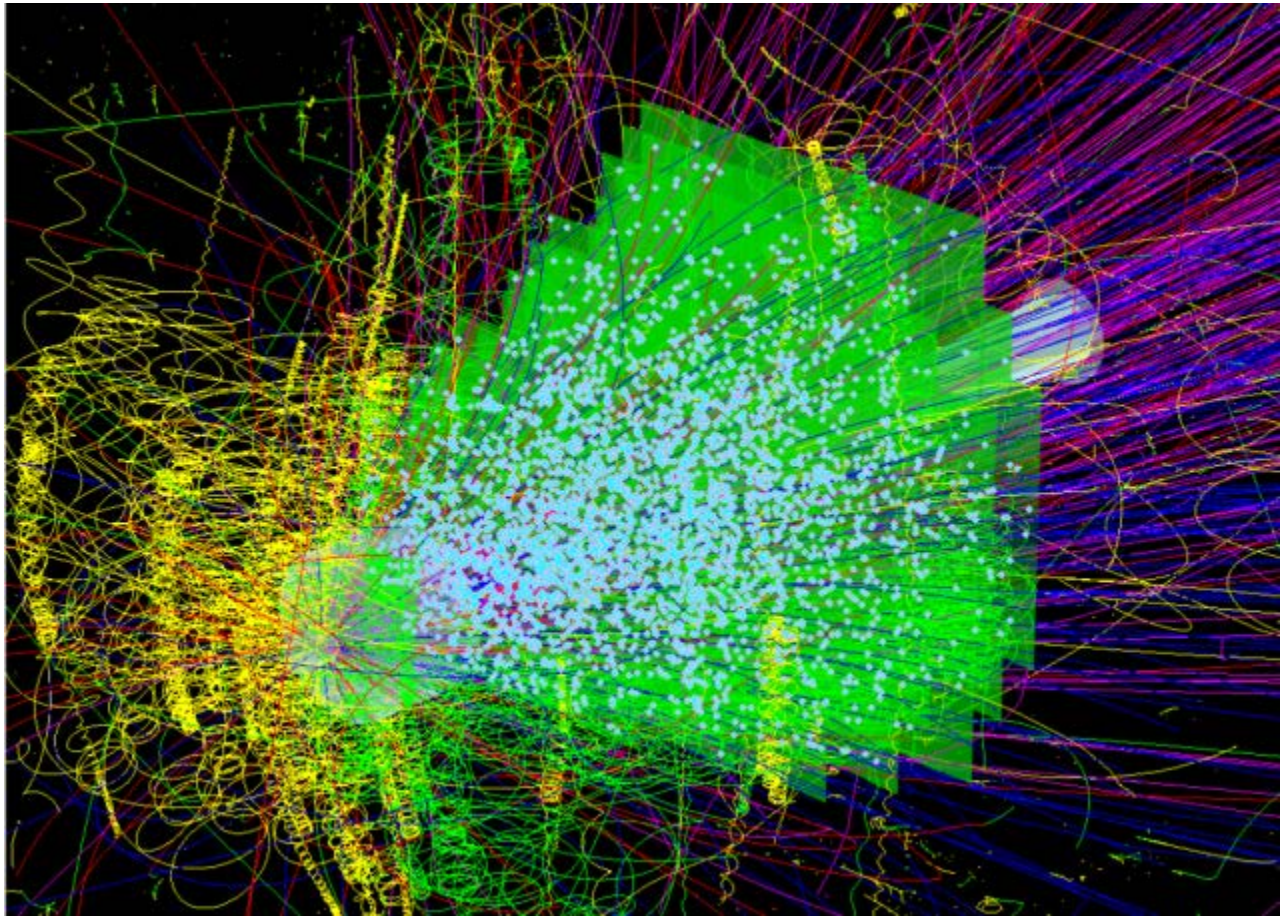
mSTS:
two tracking stations
aim: verify module/ladder/tracking performance

- *station 0:*
  made from 2 ladders of 2 modules with sensor 6x6 cm²
- *station 1:*
  made from 3 ladders of 3 modules with sensor 6x6 cm²





Detailed understanding of STS detector



Detailed understanding of STS detector

- Validation of detector simulation against experimental data:
  - detailed coding of detector and physical processes/parameters (charge diffusion, cross talk, noise, attenuation, ...) available. But is it realistic, calibrated, validated?
  - alignment
  - fast 4d track reconstruction
- Detector commissioning:
  - using prototype modules
- mSTS/mCBM → STS/CBM

→ further grounds of cooperation ?

Thank you