Cremlin Connecting Russian and European Measures for Large-scale Research Infrastructures

EU project for science cooperation between the Russian megascience facilities and European RIs

Joint developments for FAIR and NICA supported within the “CREMLIN” EU project for science cooperation between the Russian megascience facilities and European RIs

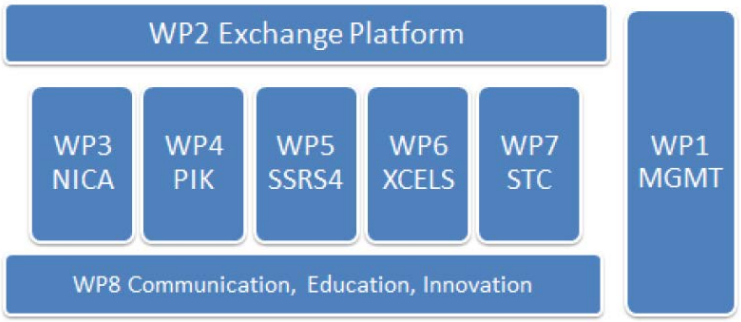
EU project
in framework programme H2020

Cremlin Connecting Russian and European Measures for Large-scale Research Infrastructures

Objectives

CREMLIN shall improve and strengthen the relations and networks between European and Russian research infrastructures both at a scientific level and at a research policy level:

1. CREMLIN will enhance science cooperation between the six Russian megascience facilities and the European RI counterparts, including e-infrastructure and big data handling.
2. CREMLIN will develop research policies involving all relevant stakeholders from science and policy with respect to the European Union and the Russian Federation: Within CREMLIN, specific recommendations, foresight studies, strategies and prospects for an enhanced EU-Russia cooperation will be worked out.
3. CREMLIN will establish an effective exchange platform of findings and results within each respective Russian megascience project and will stimulate and ensure a process of mutual learning across the various science disciplines and European and Russian communities.



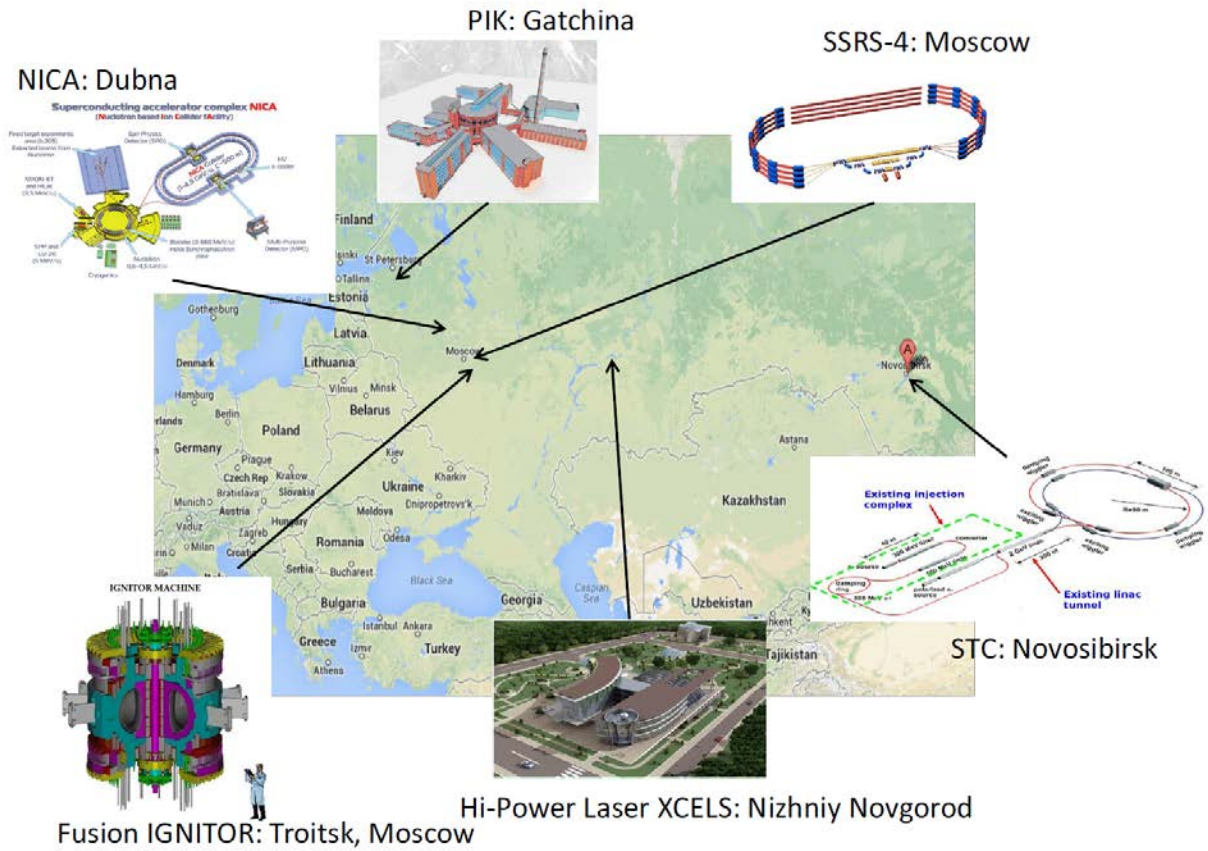
Project Duration: 36 months
1.9.2015 - 31.08.2018

Budget: ~1,7 M€

13 European beneficiaris	6 Russian beneficiaris
DESY	NRC KI
Jülich	PNPI
FAIR	JINR
HZG	IAP RAS
TUM	BINP
European XFEL	IC RAS
ILL	
ESS	
ESRF	
ELI-DC	
CEA LIDyL	
CERN	
MAX IV Lab	

Coordinator:
Dr. Martin Sandhop
DESY

Russian Megascience Projects



megasience project NICA
at JINR, Dubna
funded by Russian government

CREMLIN targets at **all 6 Russian megascience projects**:

- Powerful Research Reactor **PIK,** PNPI Gatchina
- Ion Collider Facility **NICA,** JINR Dubna
- Fourth Generation SR Source **SSRS-4,** NRC KI Moscow
- High power laser **XCELS**, IAP Nizhniy Novgorod
- Lepton collider **STC**, BINP Novosibirsk
- (Fusion project **IGNITOR**, NRC KI Moscow)

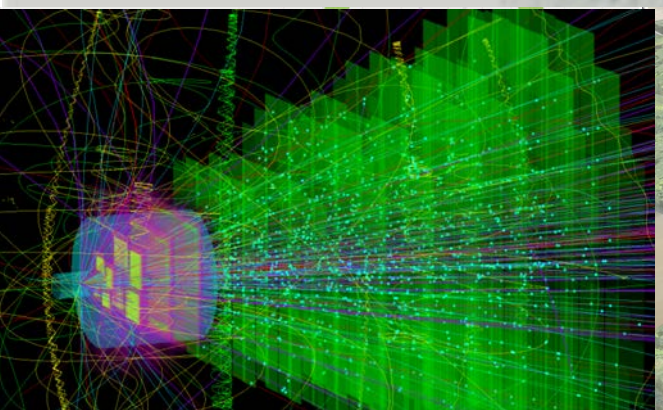
Cremlin Connecting
Russian and European Measures
for Large-scale Research Infrastructures

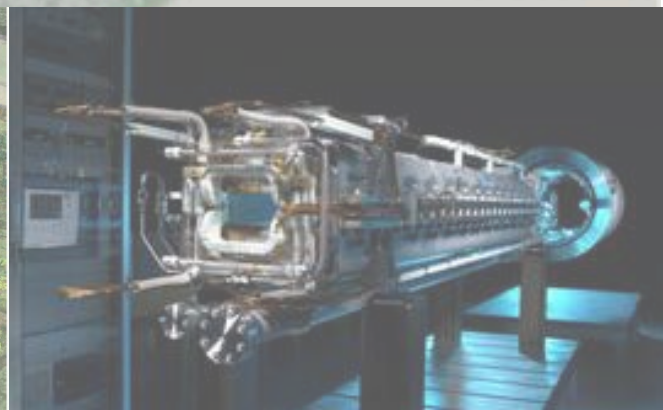
WP3 - Science cooperation with the NICA collider facility in the field of ion beams and heavy ion physics

Jürgen Eschke
(Work Package Leader)
FAIR GmbH

FAIR

NICA





Overview WP3 - Science cooperation with the NICA collider facility in the field of ion beams and heavy ion physics

J. Eschke (WP Leader and CBM Resource Coordinator)

- Research Infrastructure Projects:
  - NICA at Joint Institute of Nuclear Research (JINR) in Dubna, Russia
  - Facility for Antiproton and Ion research (FAIR) in Darmstadt, Germany

- Cooperation of FAIR and JINR
  - in the field of accelerator components
  - for the Compressed Baryonic Matter experiment (CBM) at FAIR and for the BM@N and MPD experiments at JINR

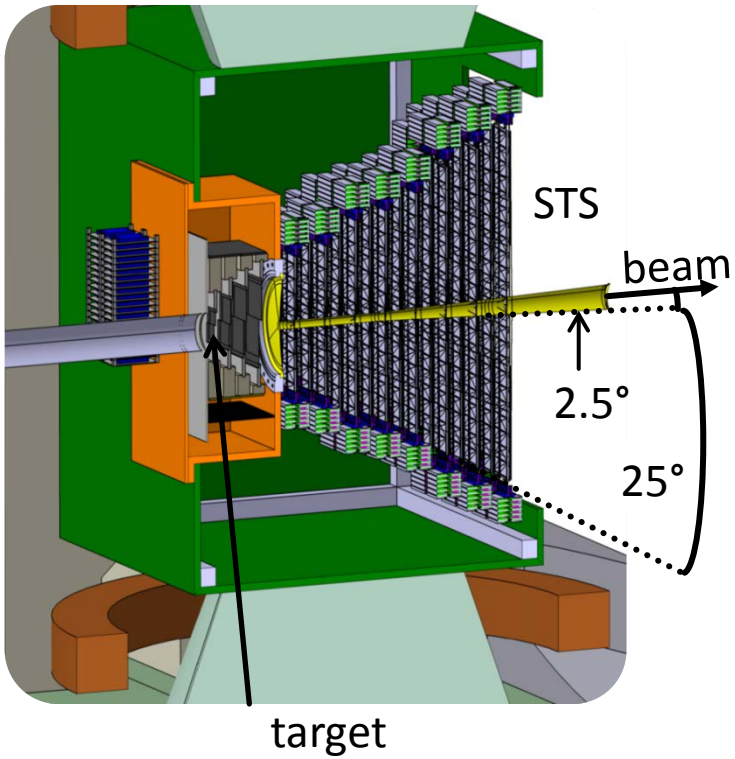
- Overview WP3
  - scope (main objective of this WP in CREMLIN is the joint development of silicon tracking detectors
  - tasks
  - deliverables

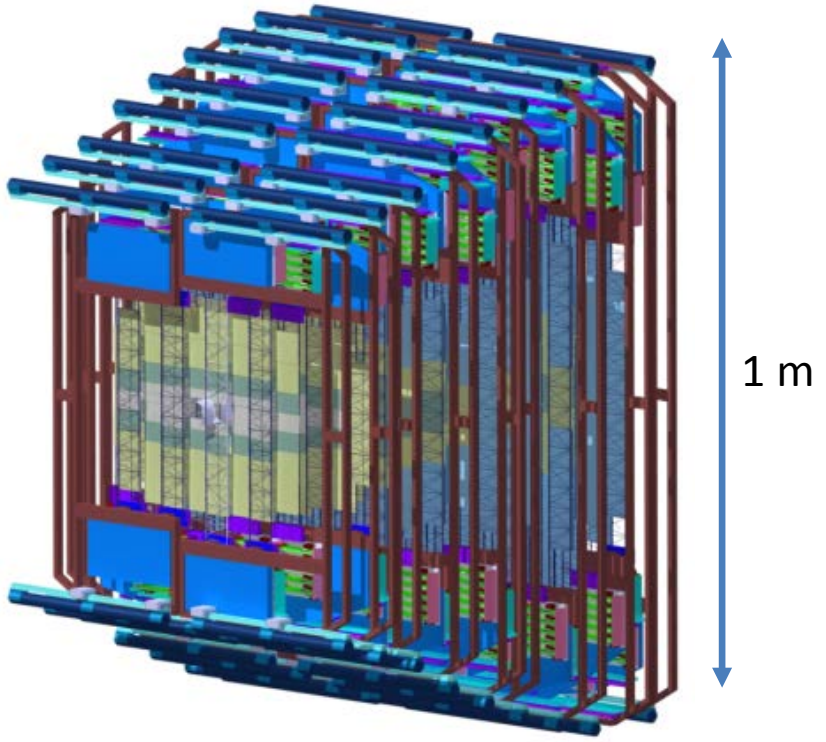
→ Task: joint developments of main components of the Silicon Tracking System
- development of STS modules/ladders

CBM Silicon Tracking System

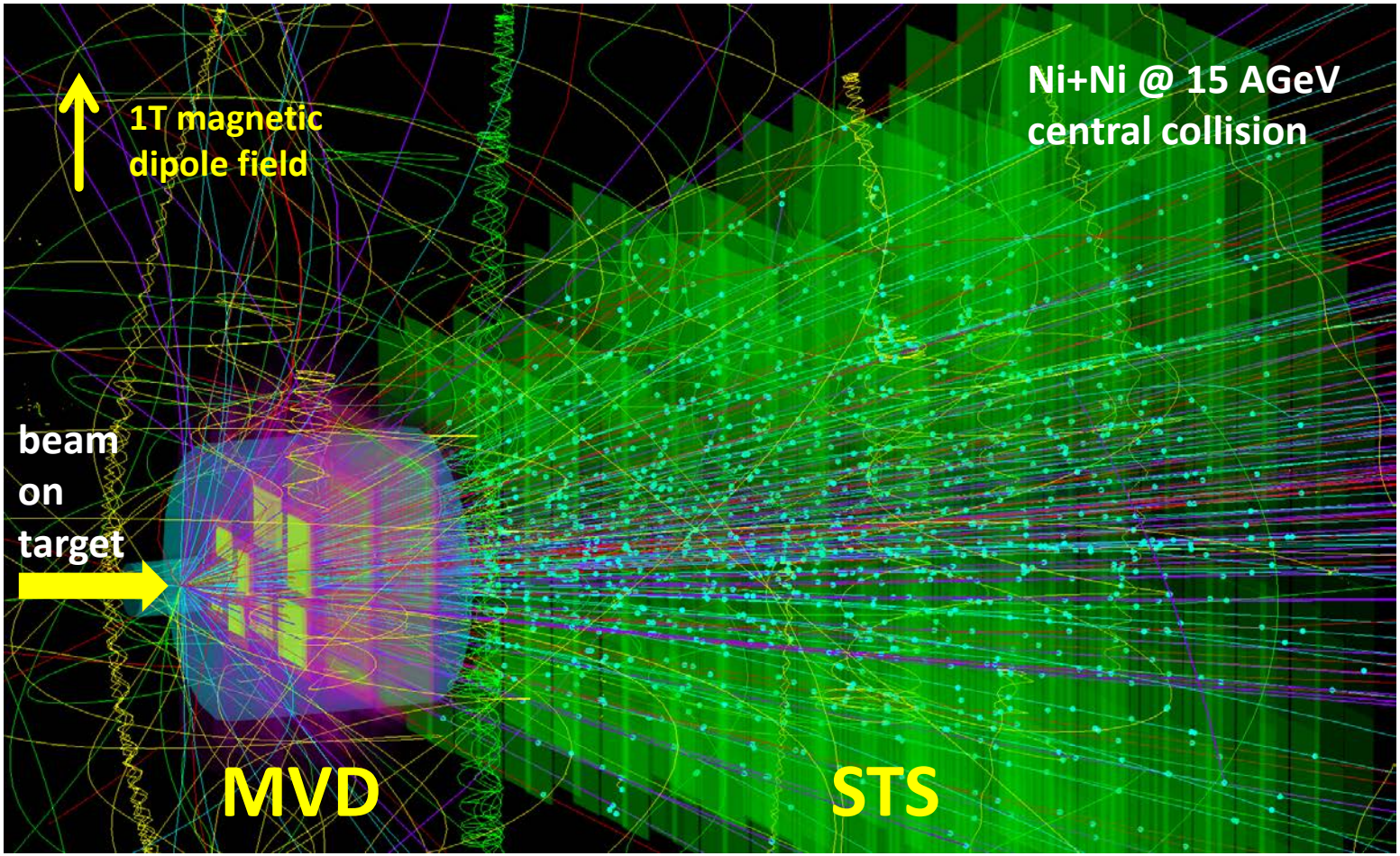
central detector of the CBM experiment:

- *measures tracks of charged particles, determines their momenta, in pA and AA collisions*
- *detects particle decay topologies*
- *challenge: large aperture, fine segmentation, low-mass, radiation hard , 0.1- 10 MHz r/o*

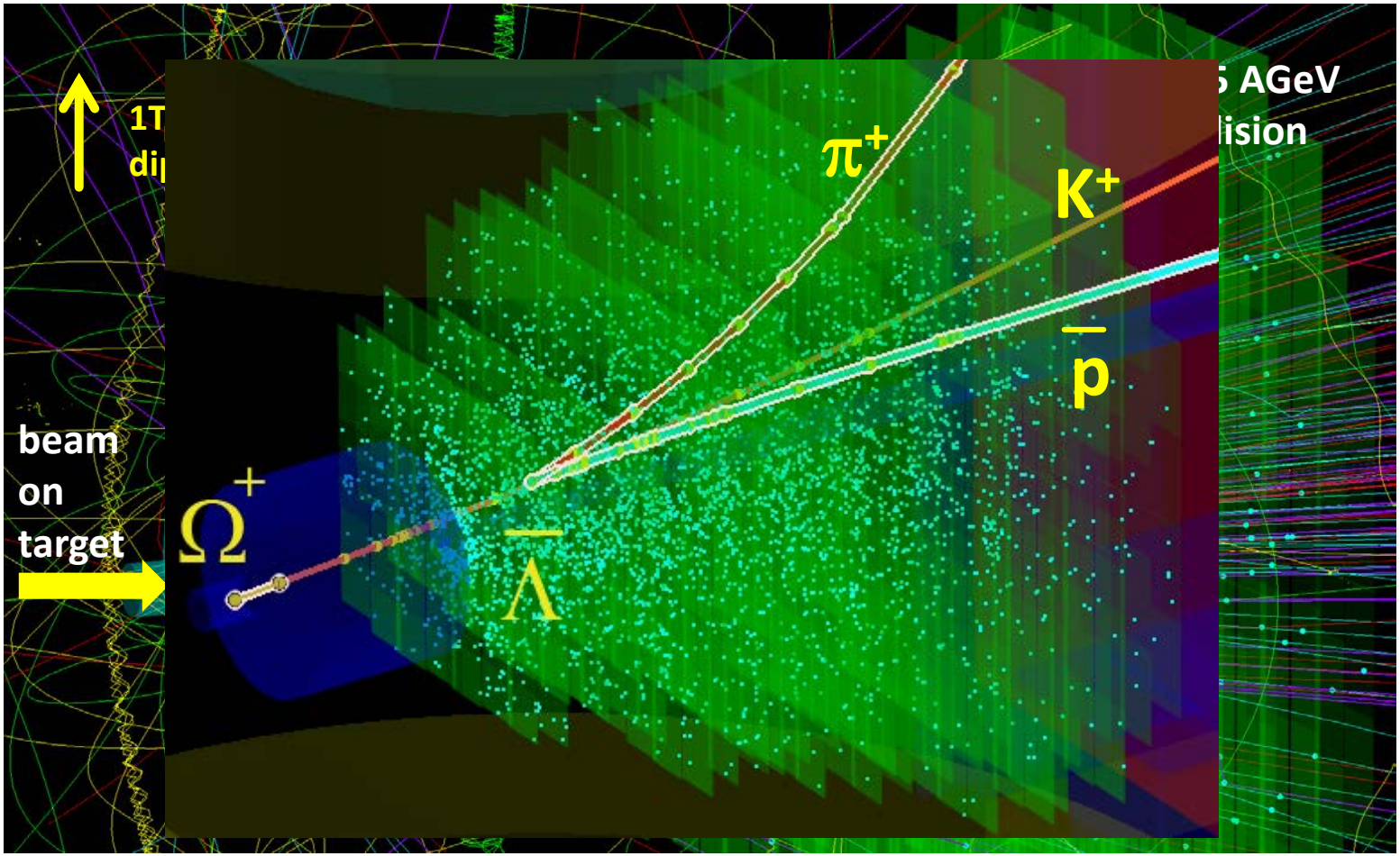




Charged-particle tracking

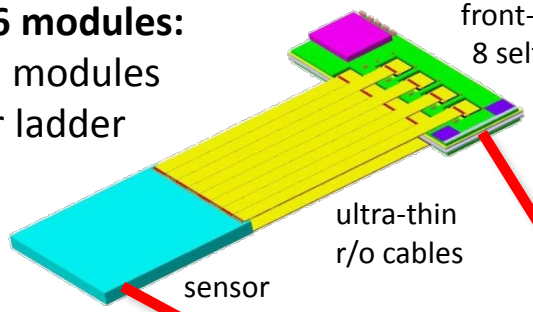


Detection of particle decays



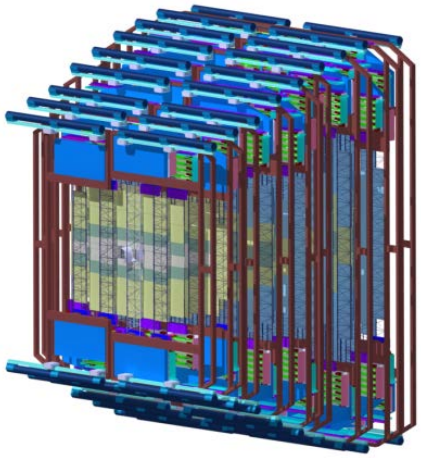
STS integration

896 modules:
4-5 modules
per ladder

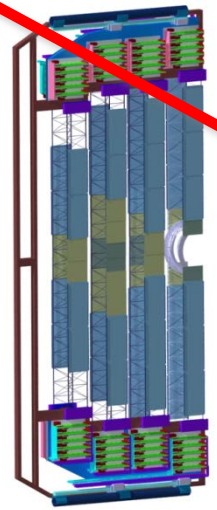


- 8 stations, volume 2 m^3, area 4 m^2
- 896 detector modules
  - 1220 double-sided microstrip sensors
  - ~ 1.8 million read-out channels
  - ~ 14 400 r/o STS-XYTER ASICs
  - ~ 14 400 ultra-thin r/o cable stacks
- 106 detector ladders with 4-5 modules
- power dissipation: 42 kW (CO_2 cooling)

C-frame

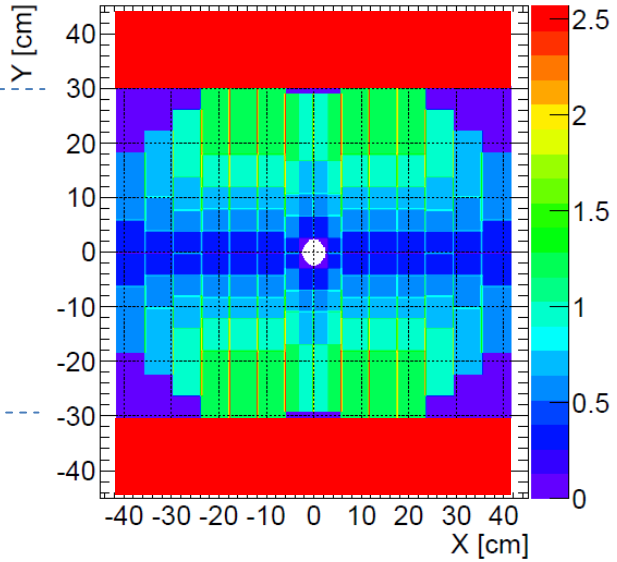


8 tracking stations



18 half-units

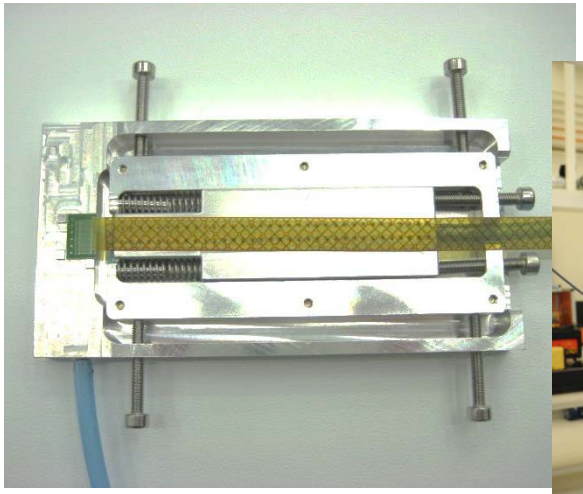
106 ladders

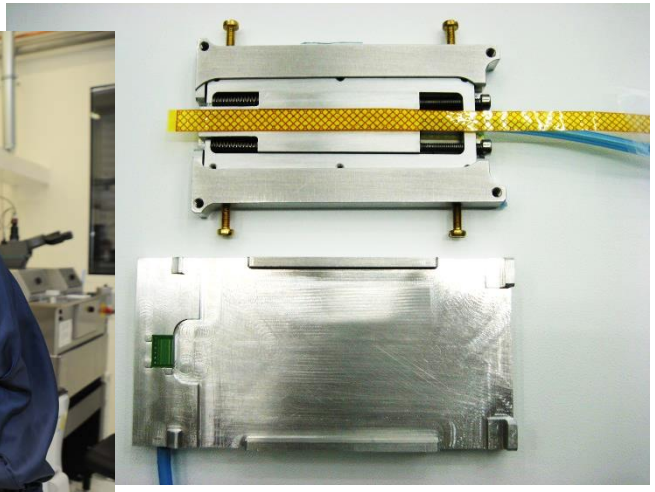


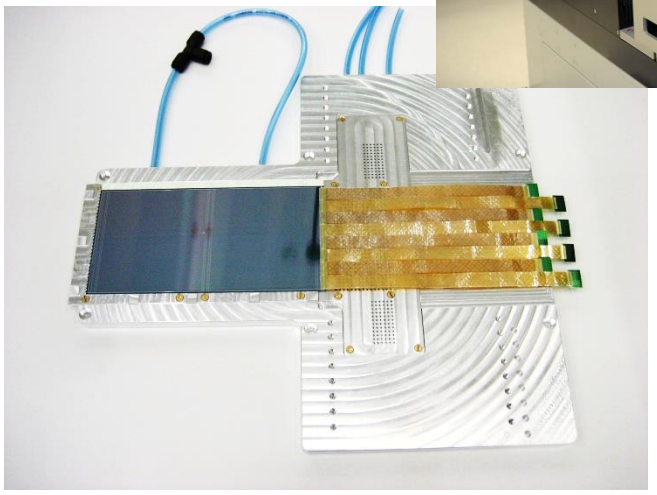
material budget of one tracking station [%X_0]

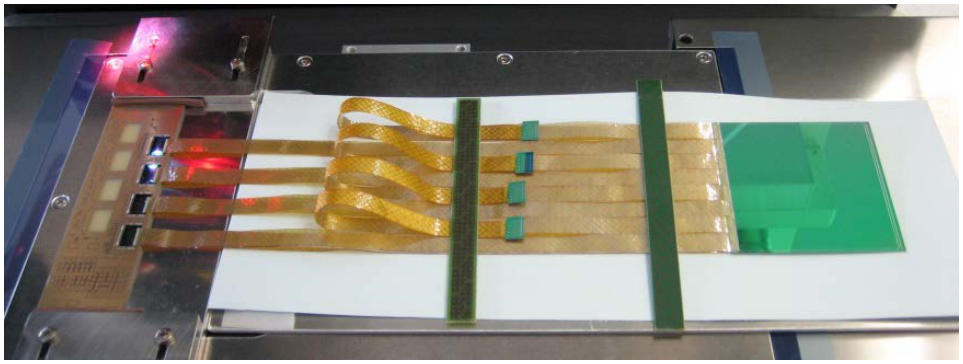
Module assembly

GSI-Detector Lab

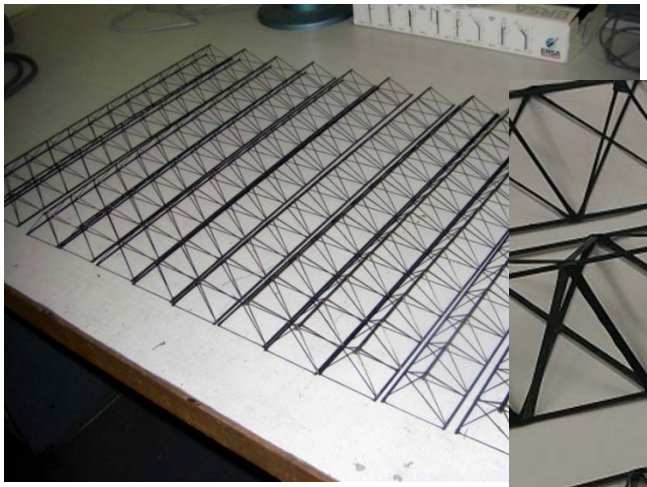






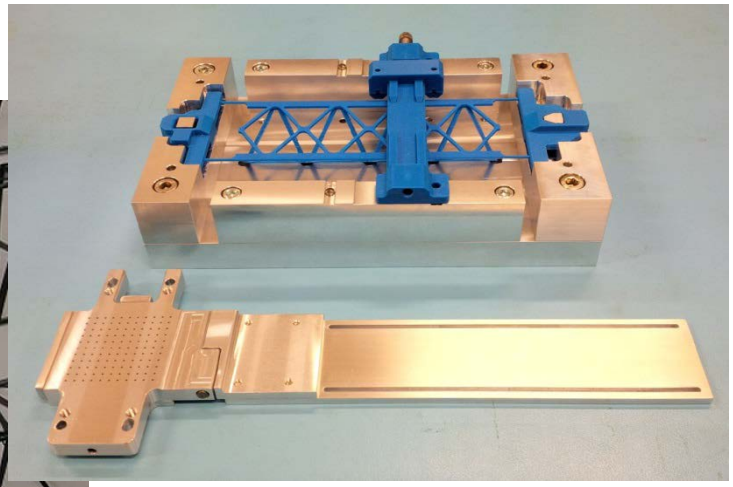


Ladder assembly



prototype carbon-fiber ladders , JINR team/CERN

pre-series carbon-fiber ladders made in industry, GSI



ladder assembly tooling, under development at GSI

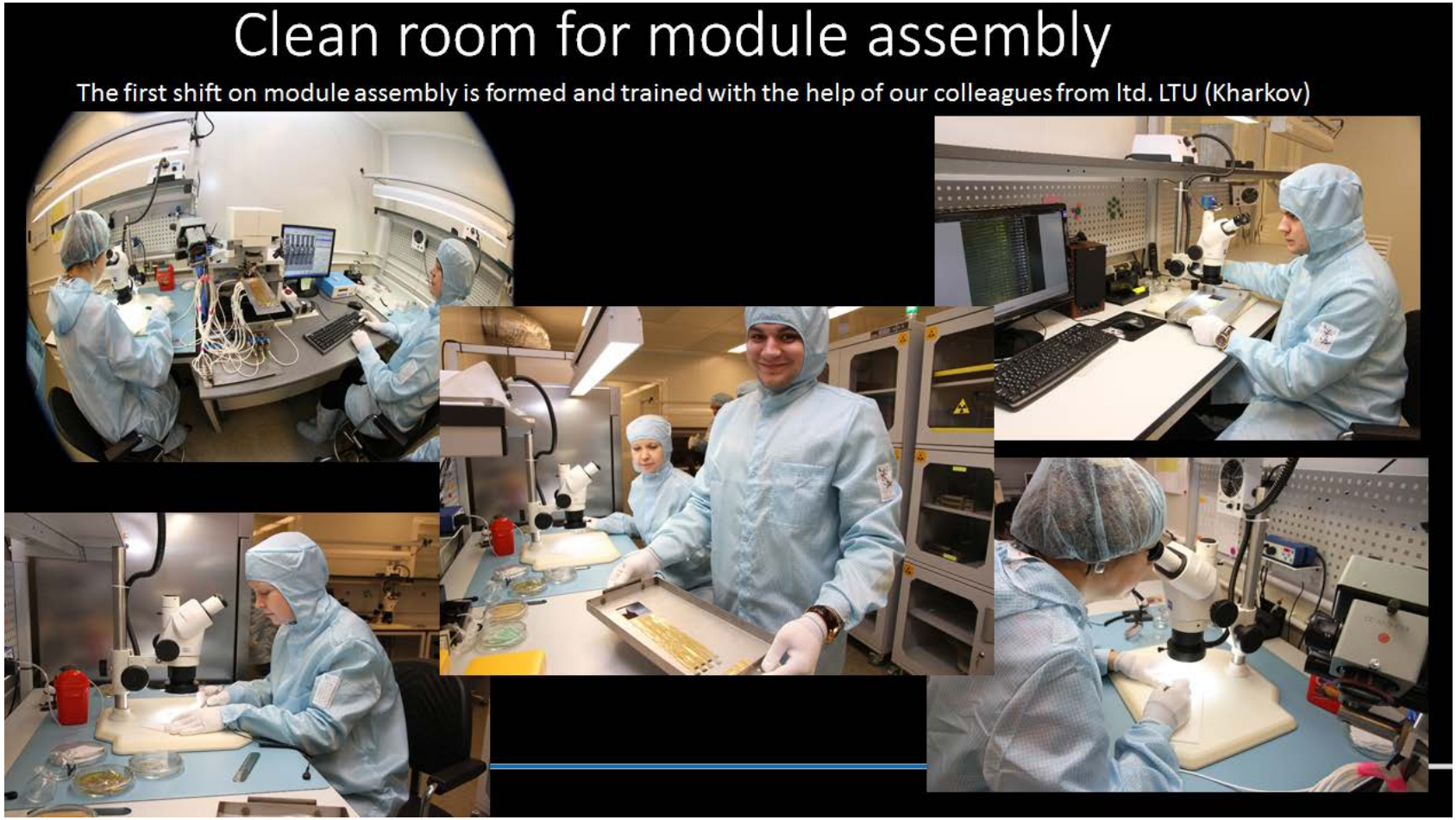
mock-up ladder, JINR-LTU

Assembly center at GSI

STS modules, ladders,
STS system integration

Assembly center at JINR VB-LHEP

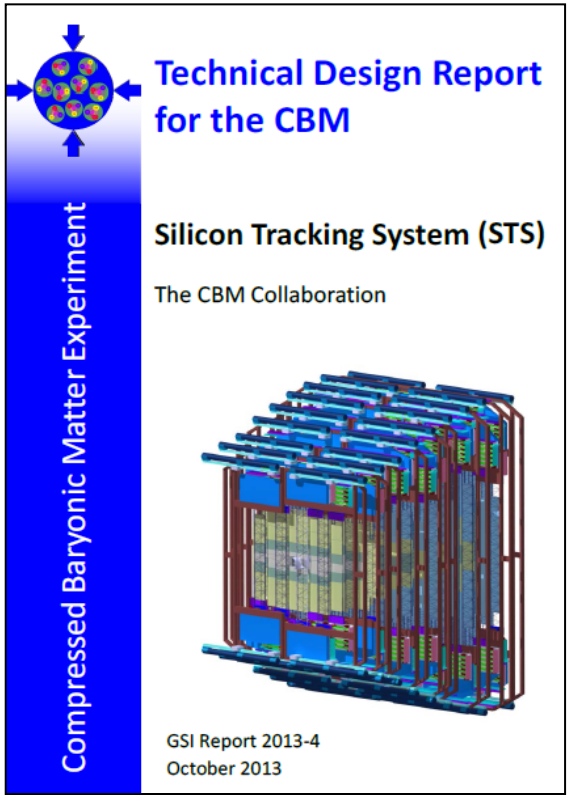
STS modules, ladders



realized in GSI + JINR cooperation with BMBF-JINR funding (2015)

CBM-STS Project Timeline

- Technical Design Report approved in 2013
- Production Readiness of components in 2017
- Production of components 2017 - 2020
- STS system assembly in 2019 – 2020
- STS commissioning in lab in 2021
- Installation in CBM cave in 2022/2023



http://repository.gsi.de/record/54798

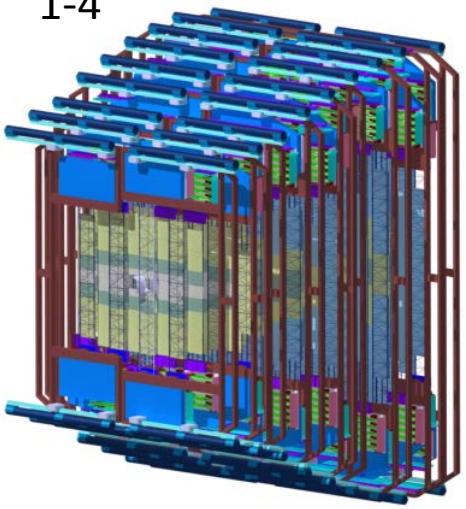
CBM-STS Workshops

Contributions to STS construction

GSI, Darmstadt:
- sensor procurement
- read-out chain
- LV and HV powering
- detector controls
- procurement of micro-cables
- production of carbon-fiber ladder supports
- **assembly (center)** of 500 modules and 50 ladders for STS stations 5-8
- mechanical integration
- system assembly

KIT (GSI contract):
- module assembly

JINR VB-LHEP, Dubna:
- sensor procurement
- **assembly (center)** of 400 modules and 46 ladders for STS stations 1-4



all STS teams :
- commissioning

AGH, Crakow :
- production of STS-XYTER ASICs
- production of front-end electronics boards

JU, Crakow :
- STS-XYTER ASIC QA

Tech. Univ. Warsaw:
- ASIC data protocol

Univ. Tübingen:
- sensor QA
- module QA
- cooling systems

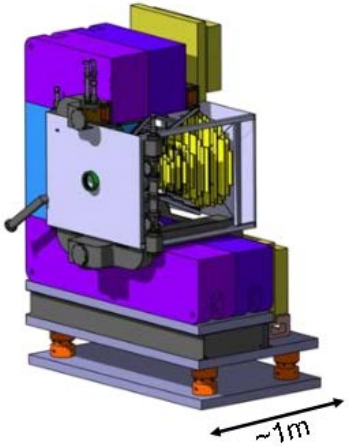
Cooperation on STS for CBM and NICA experiments

common aspects in technologies, expertise, physics

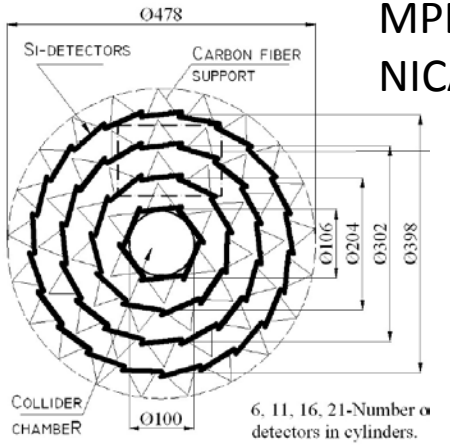
- CBM-STS Workgroup: started in 2007
- CBM-MPD STS Consortium: 2007 – 2011

  1st Meeting, Dubna, Russia, November 2007
  2nd Meeting, Protvino, Russia, June 2008
  3rd Meeting, Sortavala, Russia, June 2009
  4th Meeting, Hirschhorn, Germany, October 2010
  5th Meeting, Alushta, Ukraine, May 2011

- CBM-STS Project teams:
  Workgroup, Electronics, Integration: 2011 – today
- Detector development – Silicon Tracker:
  BMBF-JINR project No. 5.2, 2009 until present
- Development of Silicon Microstrip Detector Systems for experiments at NICA and FAIR: BMBF-JINR, 2013 -2015
- CBM-like STS for BM@N: MoU signed in 2016



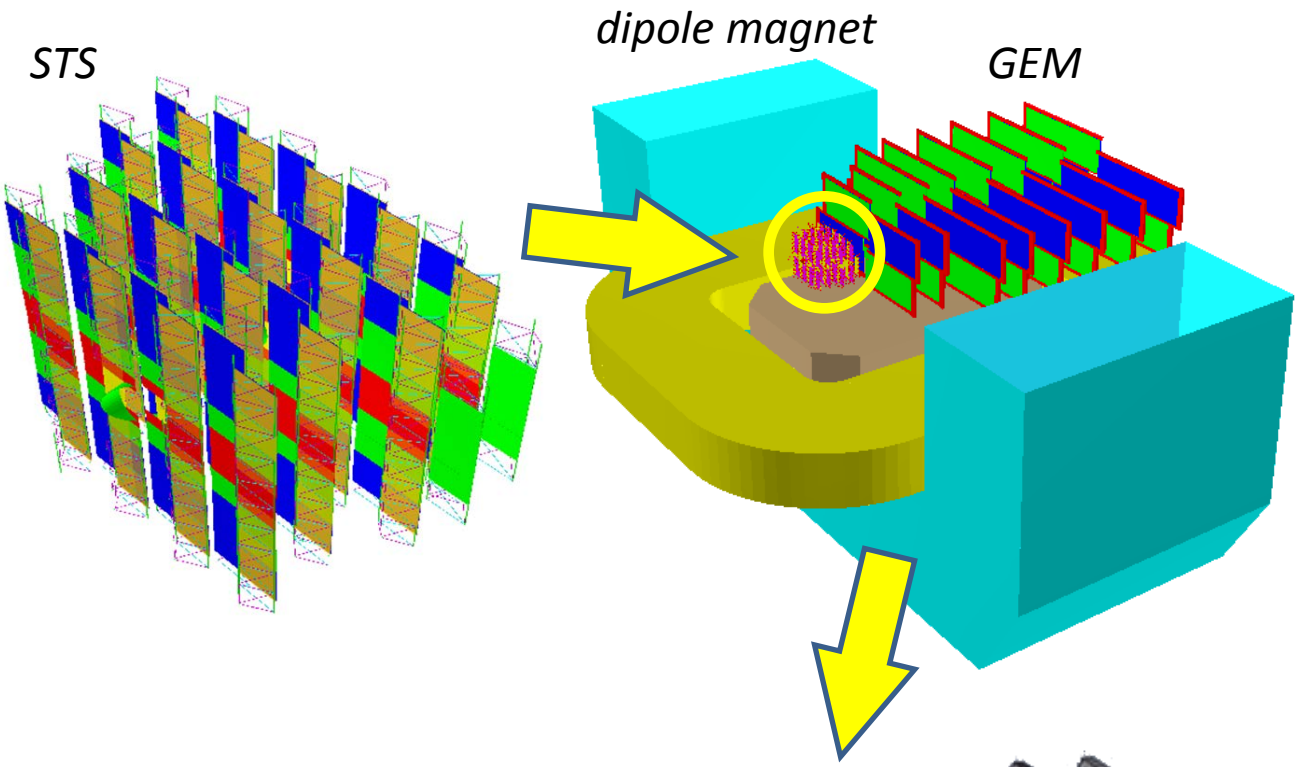
CBM at FAIR

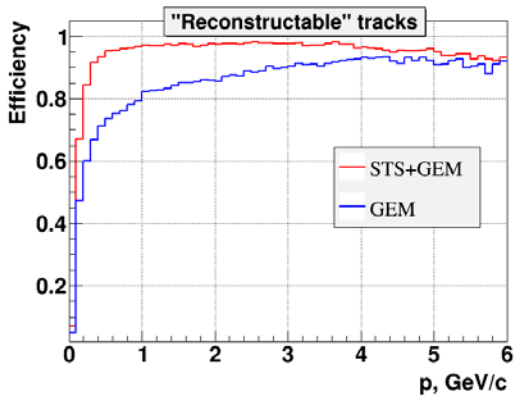


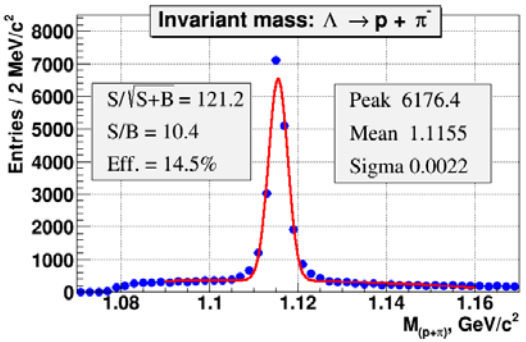
MPD at NICA

STS for BM@N experiment at Nuclotron

Mutual interest by CBM groups from Germany and Russia to install, commission and use 4 CBM-like Silicon Tracking Stations in BM@N in 2018 – 2019.





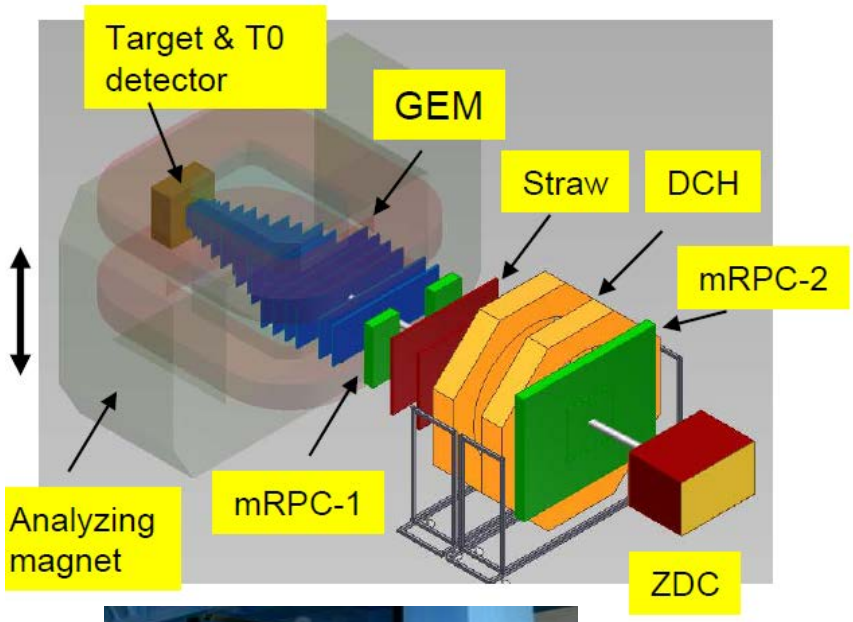


Funding for 4 STS stations at BM@N

- The cost sharing between CBM-STS and BM@N for the installation of the 4 STS stations within BM@N has been agreed upon in the corresponding MoU.
- Investment costs for additional silicon sensors and readout electronics are carried by the Russian partners.
- CBM (groups in Germany) contributes in term of know-how, personal and extended use of the detector assembly facilities (GSI, KIT, Tübingen).

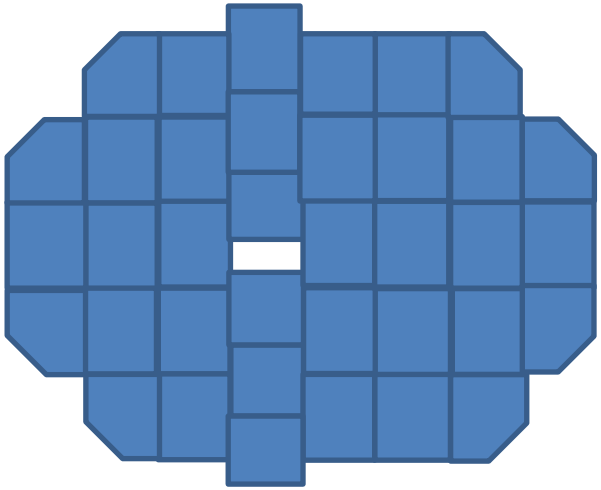
→ only possible if manpower at GSI and other resources will be funded

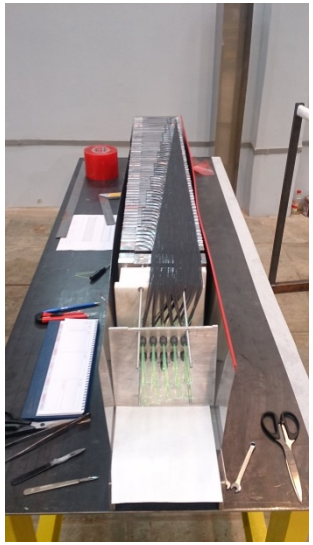
CBM Projectile Spectator Detector for BM&N



Projectile Spectator Detector (PSD) provides:

- Centrality of the collision
- Orientation of the reaction plane





BM&N already has ZDC, but old technology of light collection and detection is used ⇨ problems with calibration, long term stability etc .

New ZDC with the hole in the center assembled from 36 PSD modules with use of modern technologies has been proposed.

FAIR Phase 0: CBM – BM@N

Install, commission and use 4 STS layers and the PSD at the BM@N experiment at the Nuclotron in JINR/Dubna (Au-beams up to 4.5 A GeV in 2018/19)