Results of 12-years GSI-JINR cooperation in development of large-area fast Si tracking systems for experiments at FAIR and NICA facilities

Dmitrii Dementev

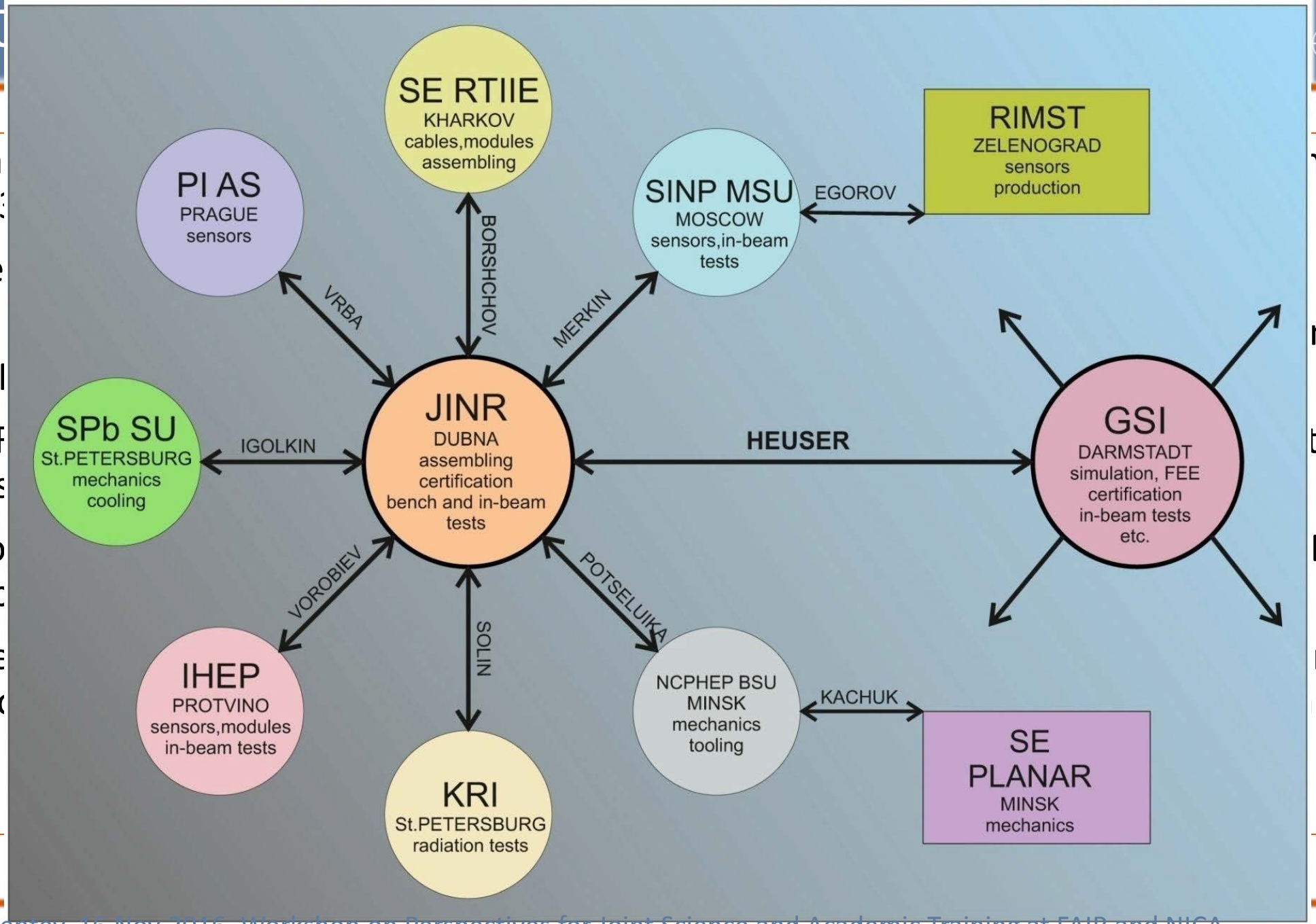
JINR LHEP

Workshop on Perspectives for Joint Science and Academic Training at FAIR and NICA

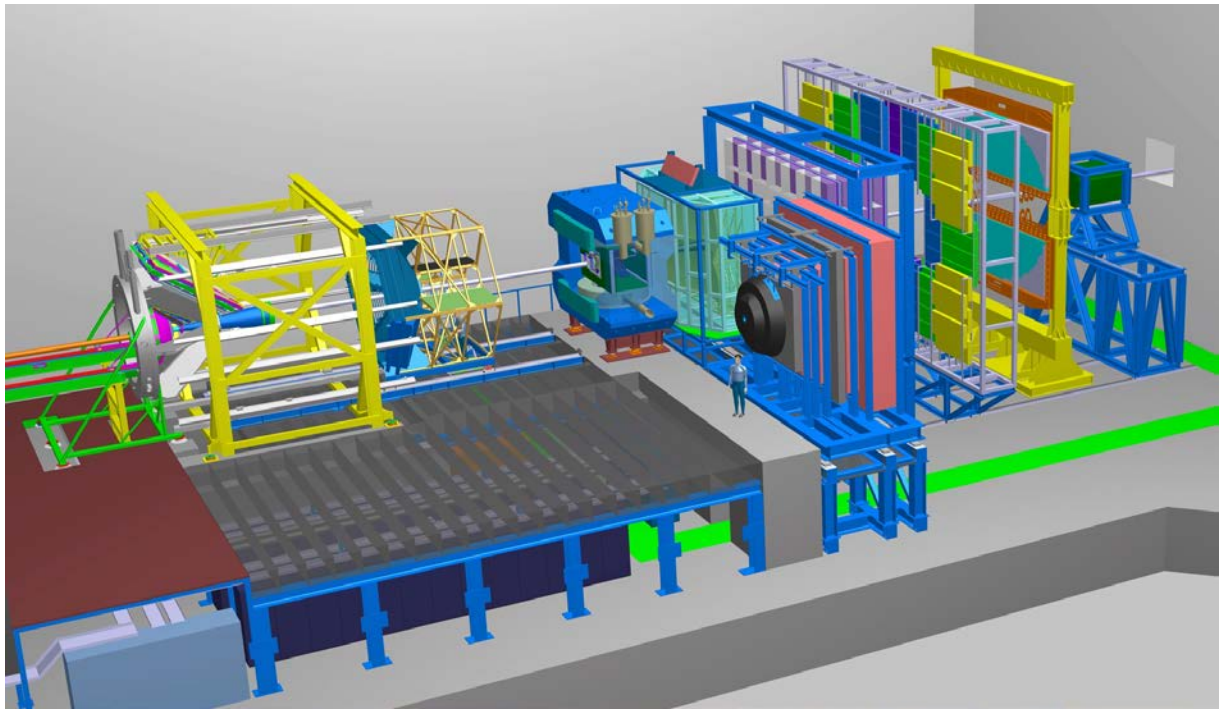
2016

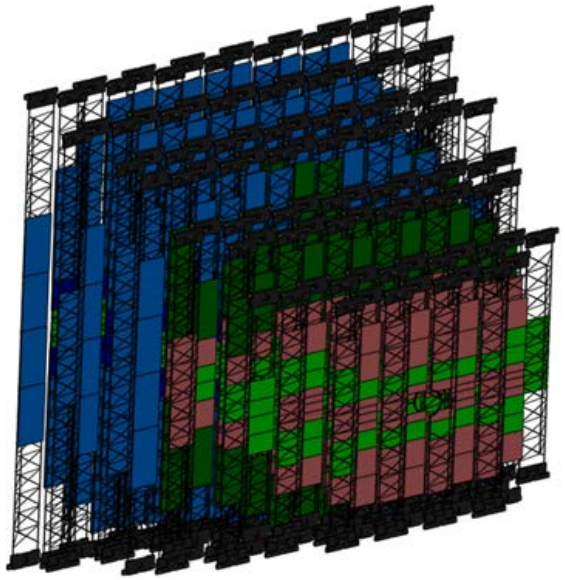
Hist

- 2004 Sta … nt (ISTC project #…
- 2008 The …
- 2013 BM … mbly at JINR-LHEI…
- 2014 FAIR … the first 4 stations…
- 2015 Mo … BM-like stations b…
- 2016 The … nd RPC sensors fo… ny
- Contacts …



CBM Silicon Tracking System



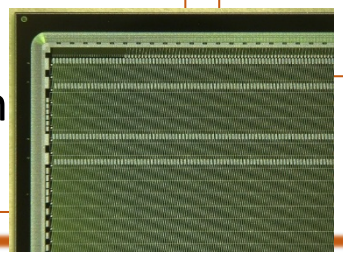


8 Stations
106 Carbon ladders
896 Sensor modules

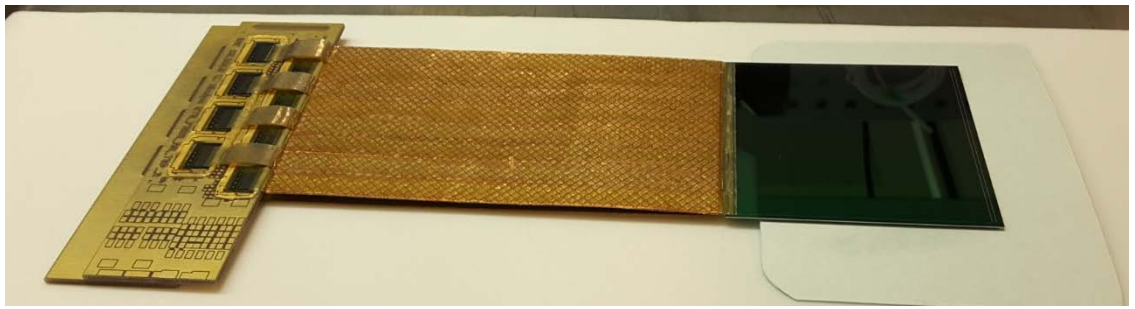
Ladder mockup

4 sizes of the Si sensors:
6.2 cm × 2.2 cm
6.2 cm × 4.2 cm
6.2 cm × 6.2 cm
6.2 cm × 12.4 cm

Thickness: 300 µm
Pitch: 58 µm
Stereo angle: 7.5°



CiS (Germany),
Hamamatsu (Japan)

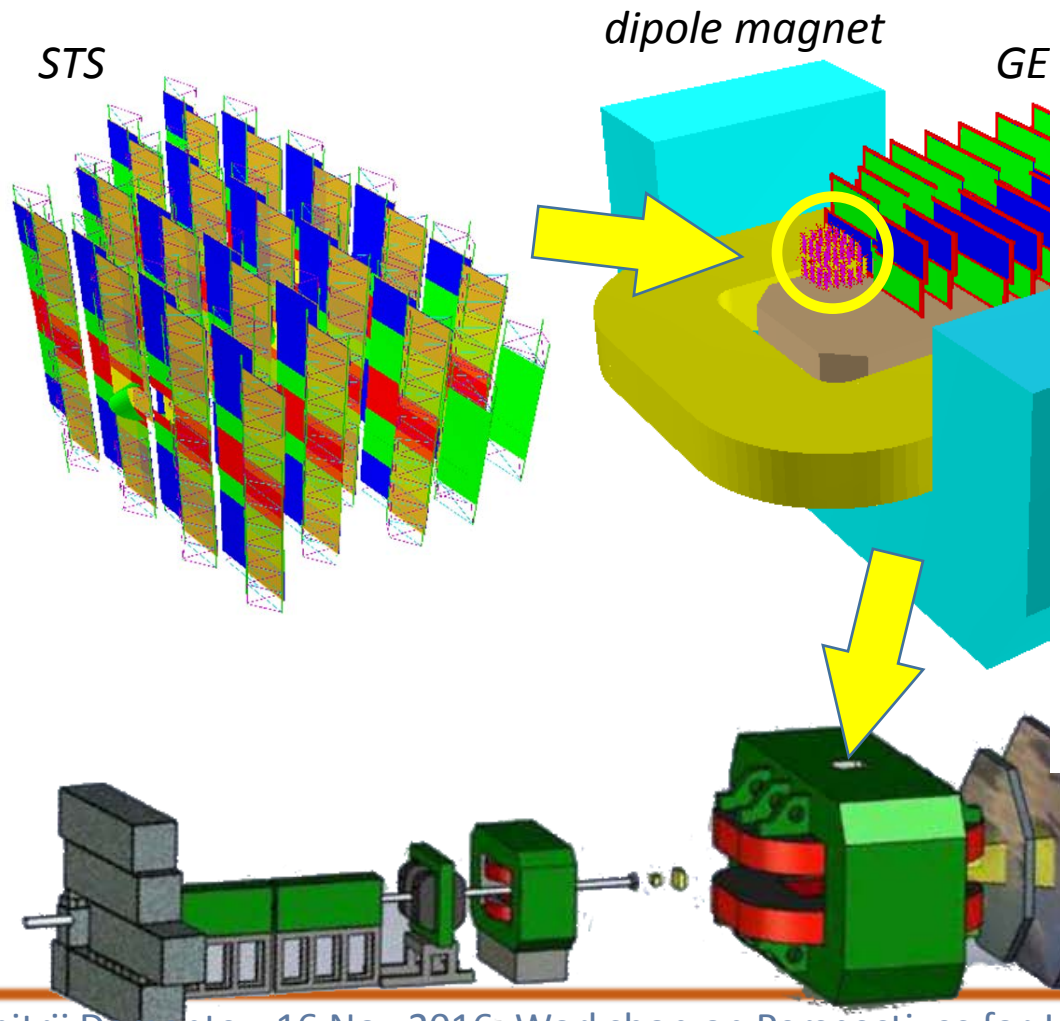


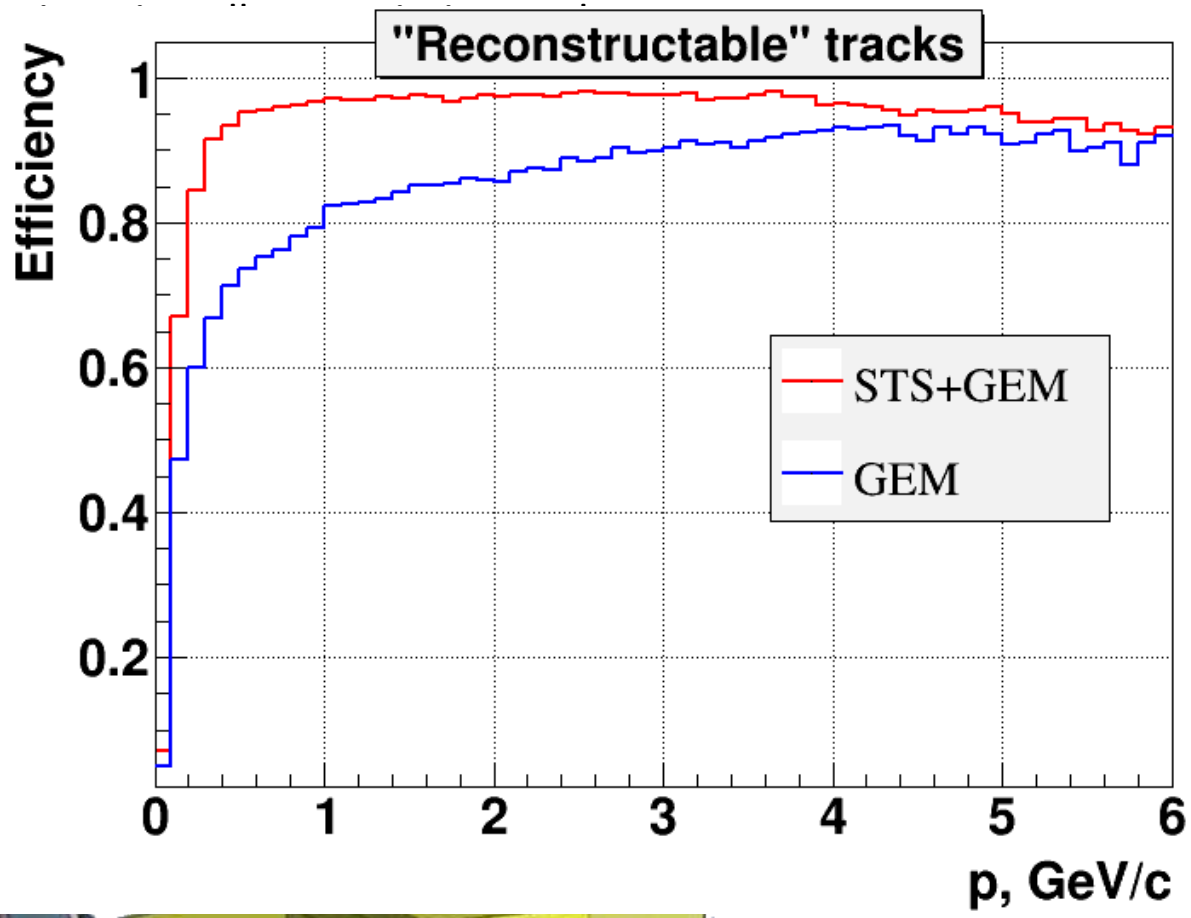
STS module mockup

Core teams: Darmstadt, Dubna, Karlsruhe, Krakow, Kiev, Kharkov, Tübingen, Warsaw

BM@N

Mutual interest by CBM groups from Germany and Ru
4 CBM-like Silicon Tracking Stations in BM@N in 2018





Slide by J. Heuser

JINR-LHEP STS Department

- **The head of the department is Yu. Murin**
- **Quality assurance of sensors: N. Zamyatin (LHEP)+ M. Merkin (SINP)**
- **Silicon Tracking Systems (STS+ITS)**
  - **Assembly of modules and super-modules: A. Sheremetev +4**
  - **Mechanics of Composite Materials: A. Voronin, Igolkin as a consultant (CERN)**
  - **Bench and in-beam testing group: D. Dementev + 2 students**
- **Administration, civil construction and procurements support: V. Penkin + S. Udovenko**
- **Industry partners: lrd. LTU (Kharkov), Planar enterprise (Minsk)**

Results of the module assembly team

3 pillars of assembling process:

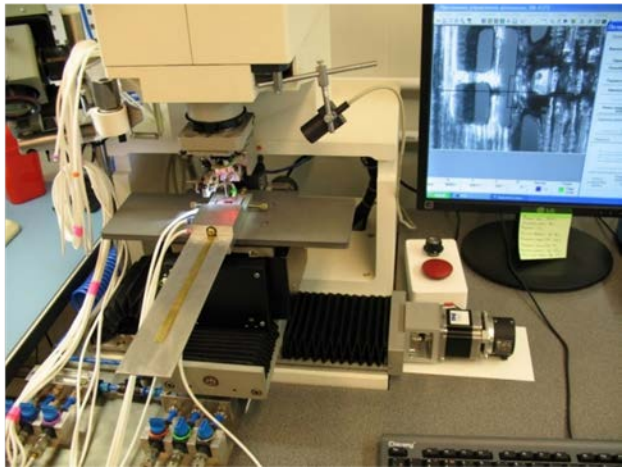
- *Infrastructure*
- *Trained stuff*
- *Custom designed fixtures*

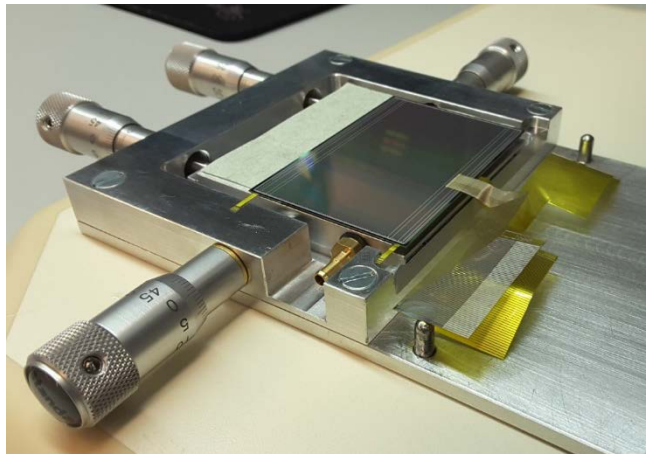

iBond5000

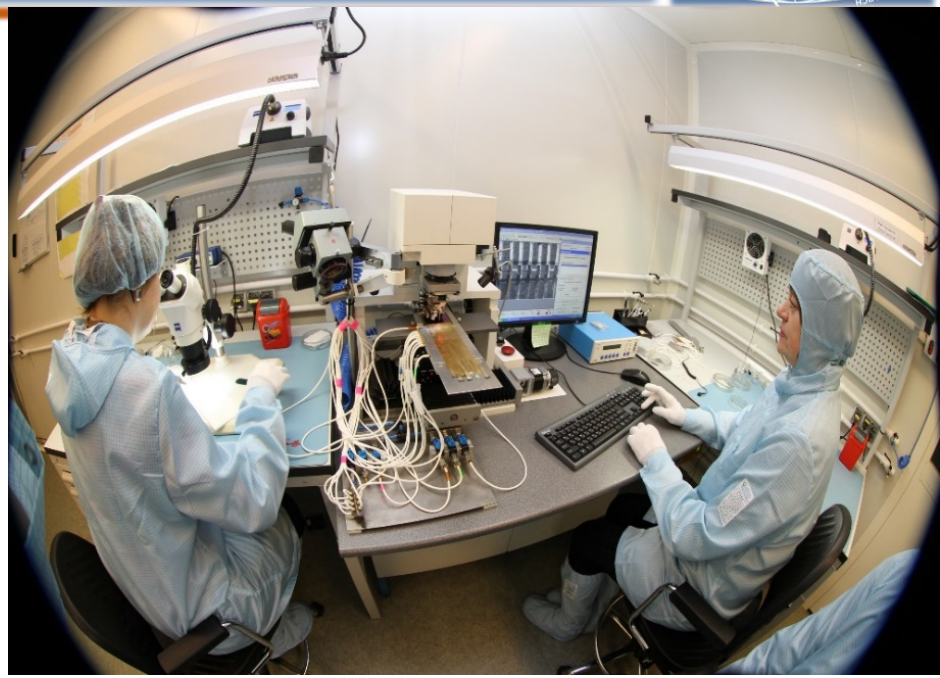

Planar EM-4370

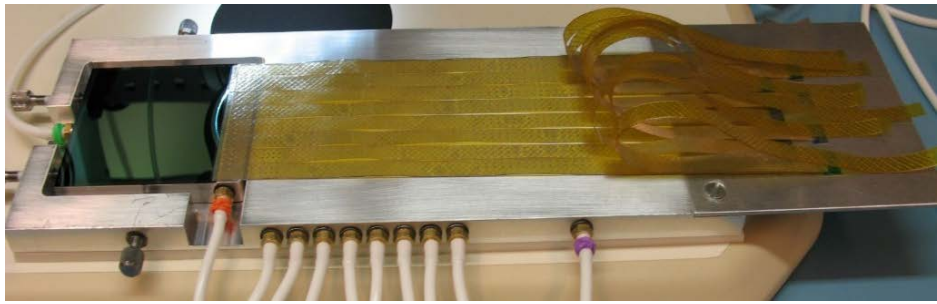

SuperDry SD-702-02


Memmert UFP-800



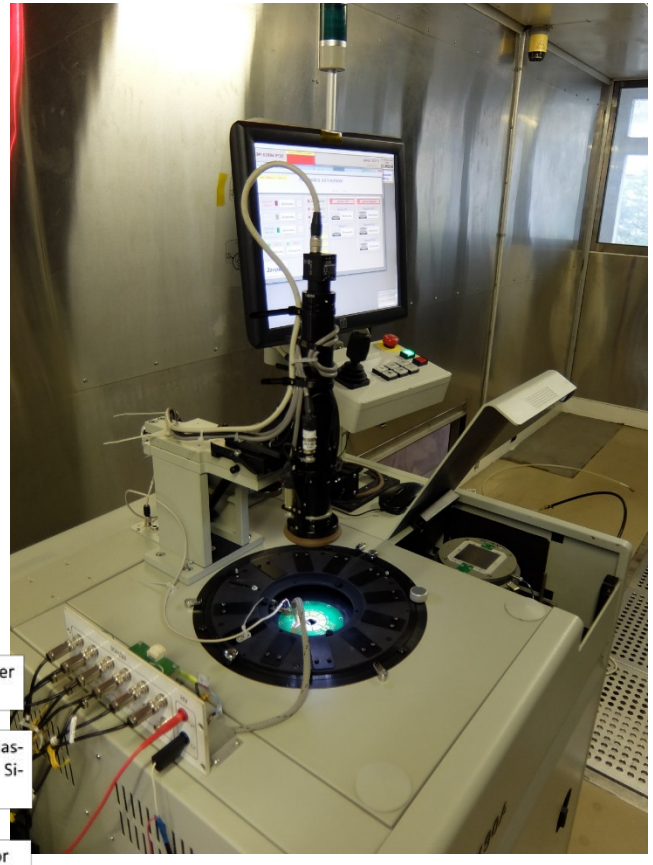


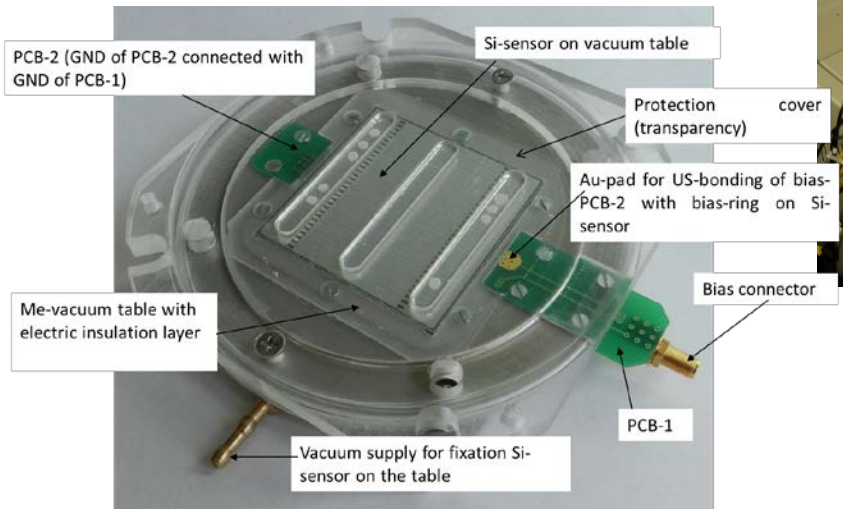




Results of sensors QA group

- **EM-6190A standard probe station was adapted for QA –scan of CBM STS sensors and delivered to JINR LHEP.**
- **Local Production Database of the sensors and module components was developed**
- **Procedure of QA tests should be approved**

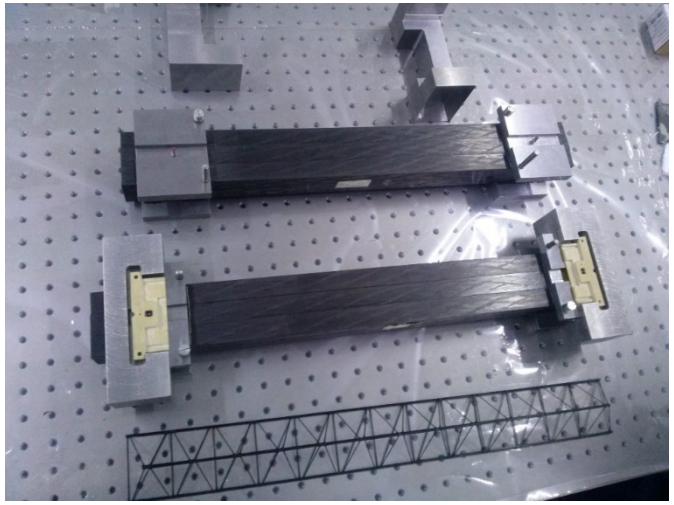




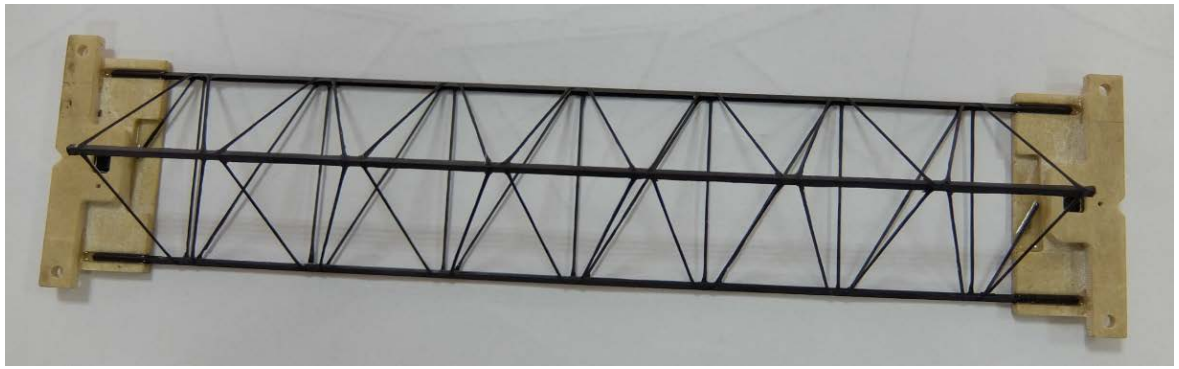
Results of CF space-frames production team

ALICE ITS Upgrade team (L. Musa)

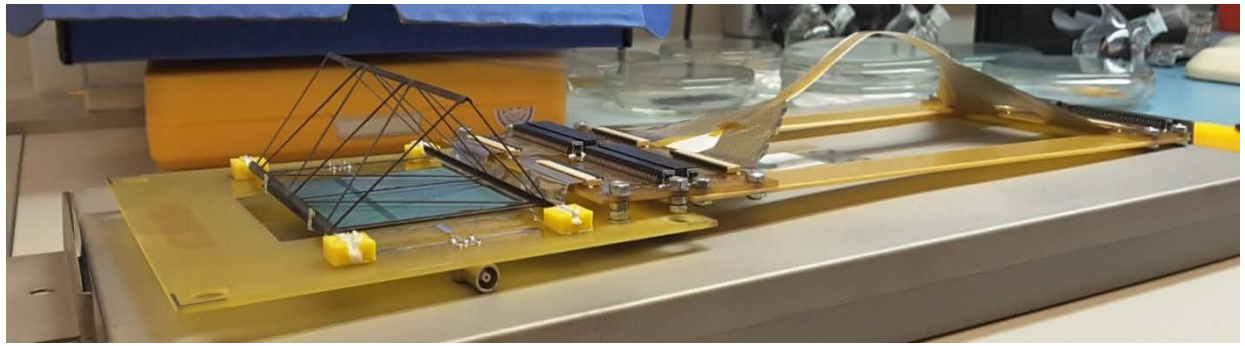
- **A new site was organized at LHEP for lamination of CF frames. It was equipped with hydroabrasive machine Gidroabraziv KS-100**
- **2 people are involved into launching of CF frames production line**
- **40 CF frames were already produced by our group at CERN and transported to JINR.**

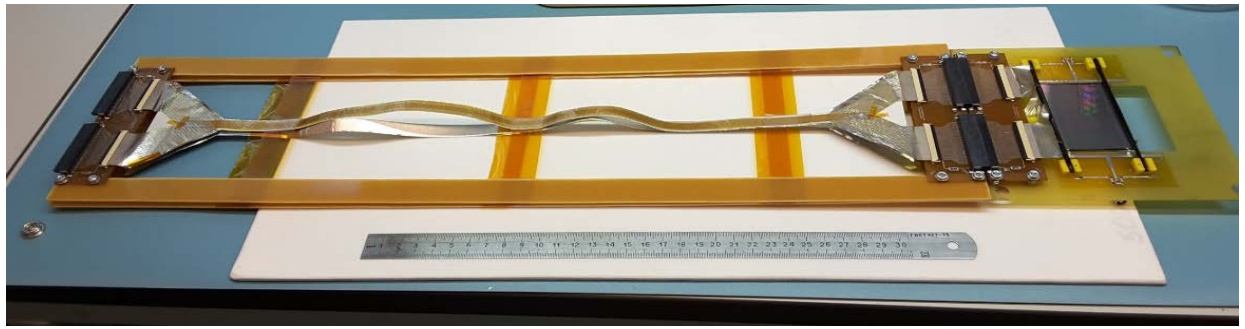


ALICE ITS-like ultralight CF space-frames

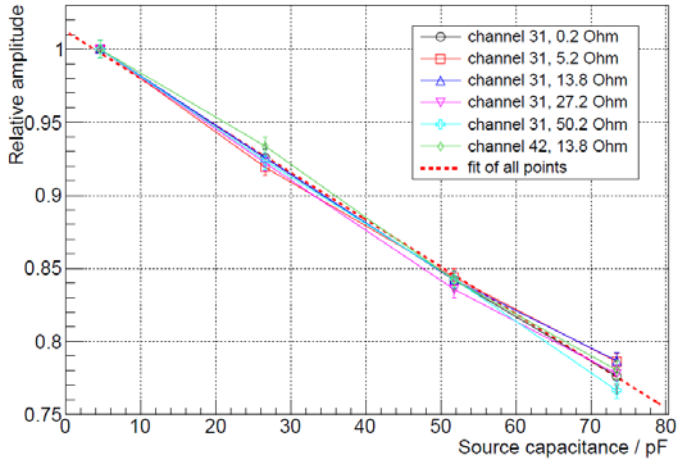


Laboratory tests



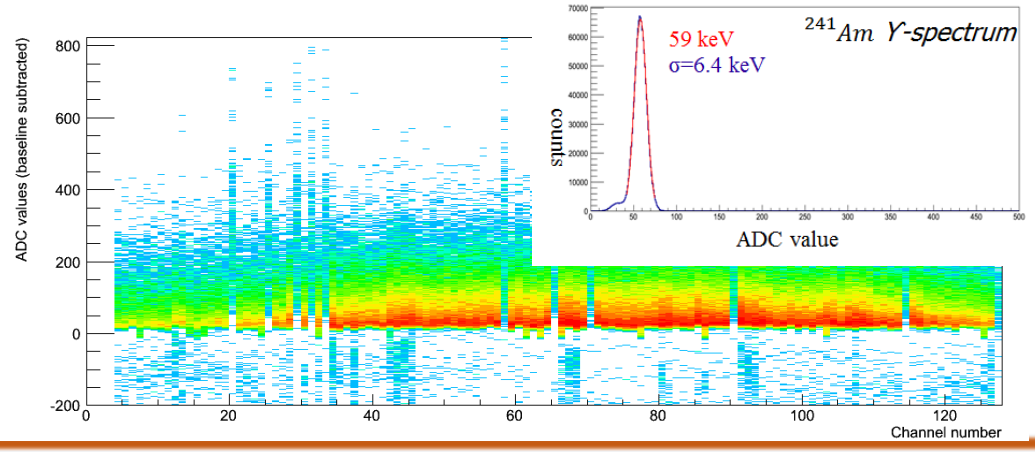


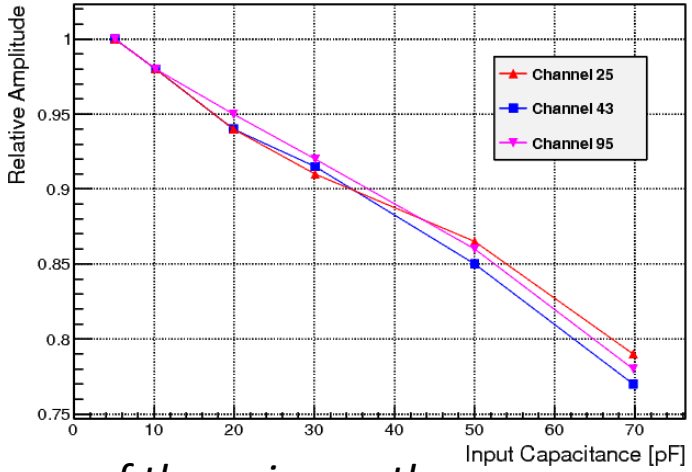
Different types of demonstrators with Si sensors were assembled for laboratory tests



Dependence of the signal ampl. on the source capacitance

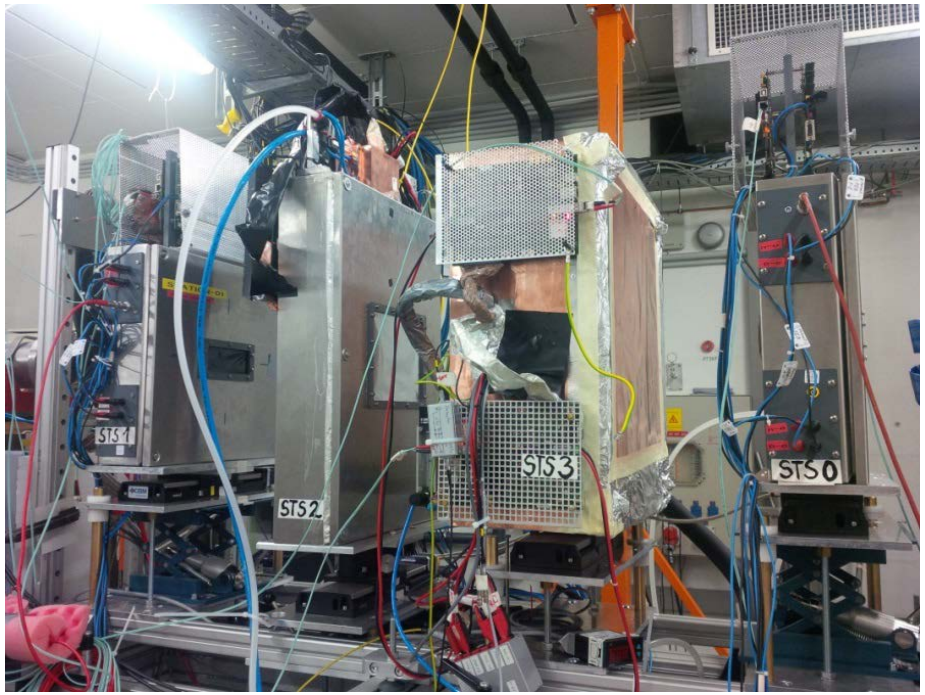
- n-XYTER based readout electronics is used for laboratory tests





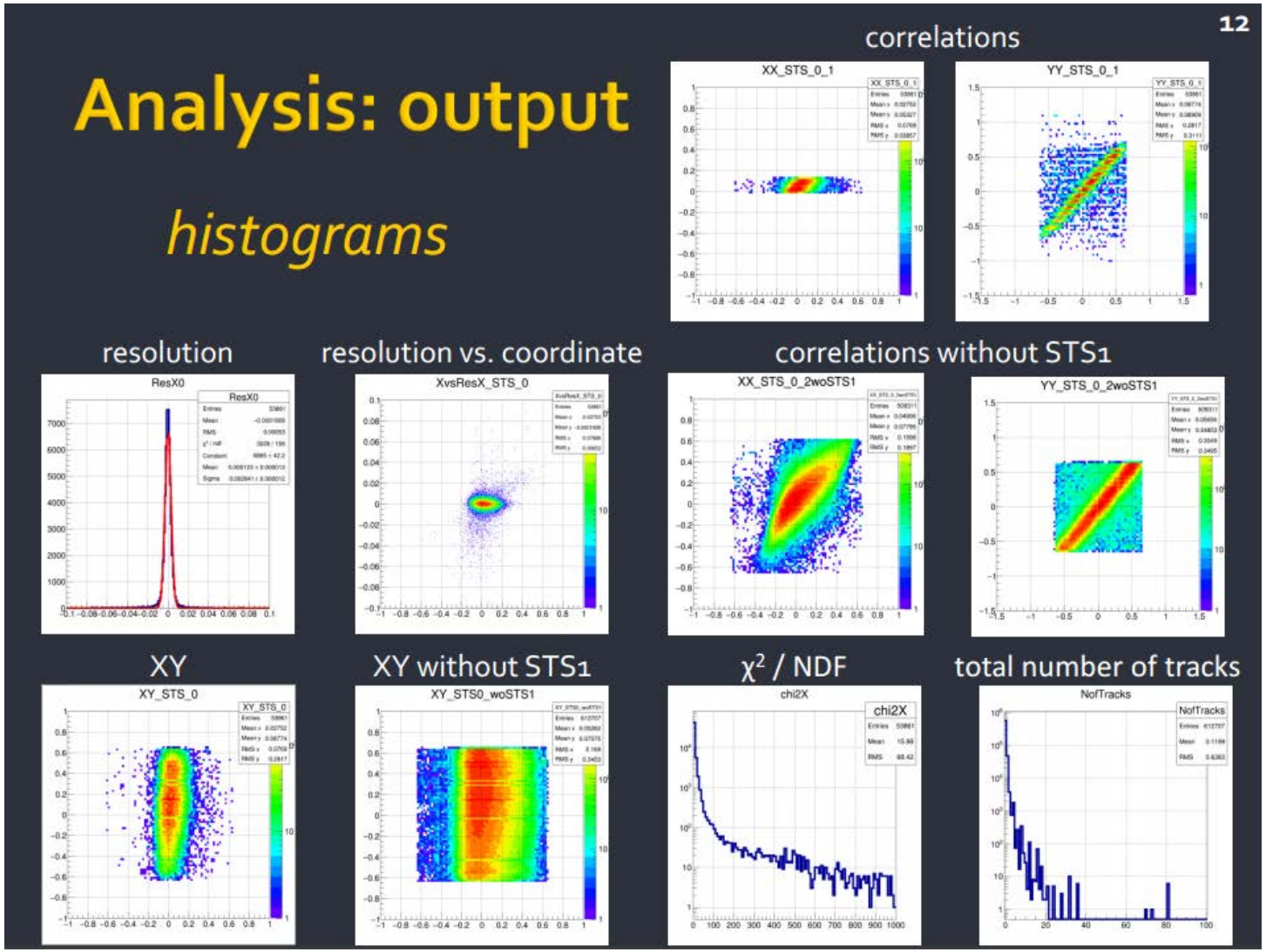
Dependence of the noise on the source capacitance

In-beam tests at COSY



COSY Dec 2014

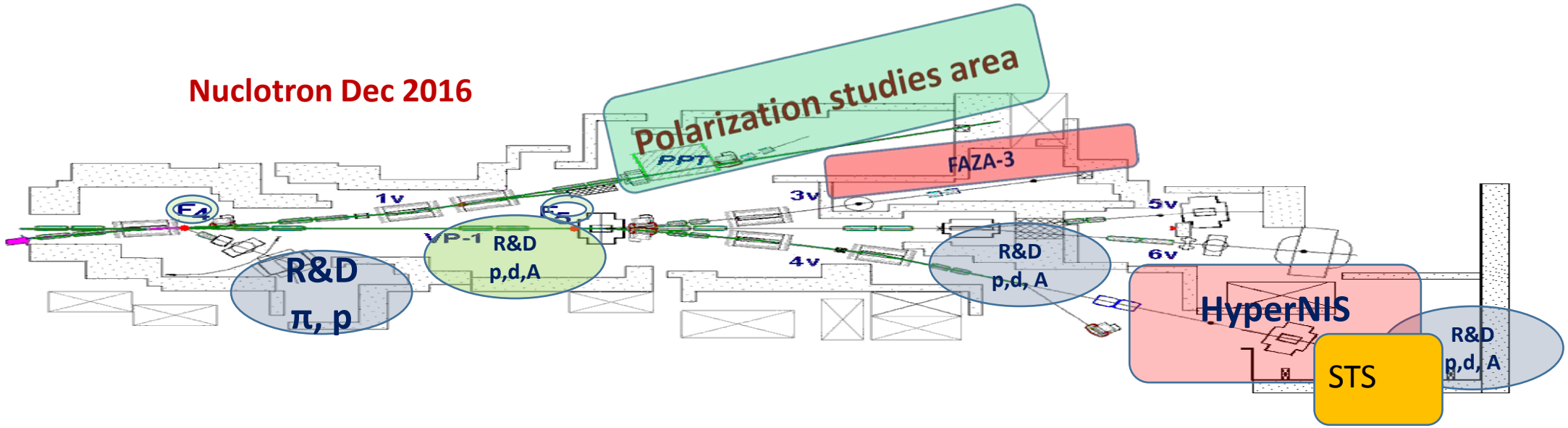
Test bench setup:
2 hodoscopes + 4 STS stations
+ GEM set-up + electronics tests



Anna Senger, 26th CBM Collaboration Meeting

In-beam tests at Nuclotron

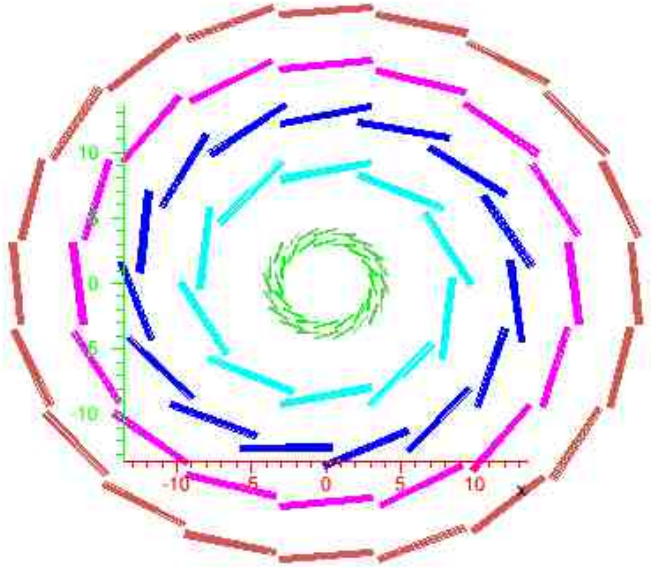
Test bench setup:
2 scincilators + 1 STS station



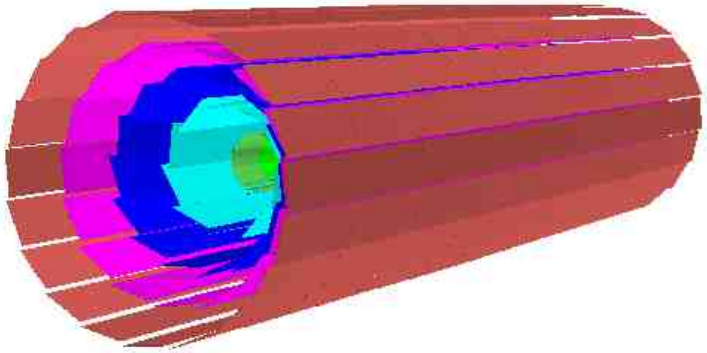
Application for the in-kind contribution of Germany to NICA

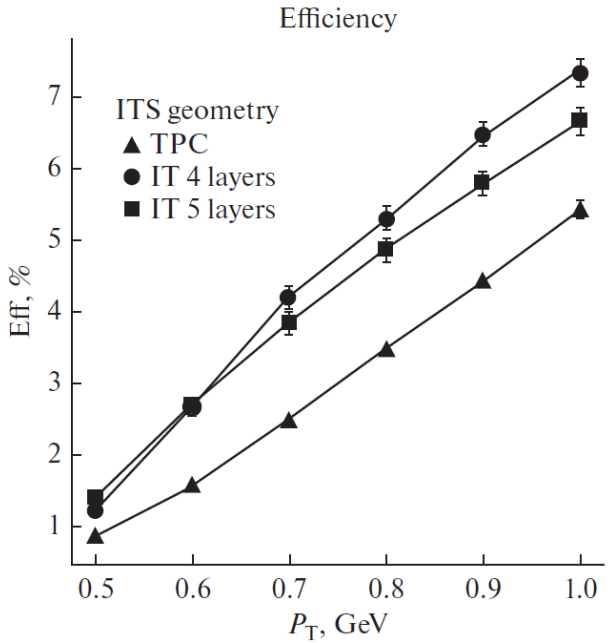
№ п/п	Name of the object	Funding volume (k€)	terms
1	Development of a dedicated test facility for testing of superconducting magnets	9360	Dec. 2013
2	Stochastic cooling system for collider	3000	2018
3	Helium refrigerator for MPD magnet	690	2017
4	Two helium refrigerators for collider	4800	2017
5	Energy storage system	1500	2017
6	Power convertor for booster synchrotron	1000	2017
7	Power convertors for collider	2200	2018
8	30K time of flight (TOF) detector channels, 300K GEM-based gaseous detector pad readout channels,3M double-sided silicon strip detector channels	7 450	Start-up configuration: middle 2019 Delivery of full sets: end of 2020
9	Double-sided sensors jointly designed and pre-produced by German vendor (CiS, Erfurt) – 2 500 pcs	5 000	Due to production capacity limitations delivery starts in 2017 up to 2020

MPD ITS geometrical model: first vision

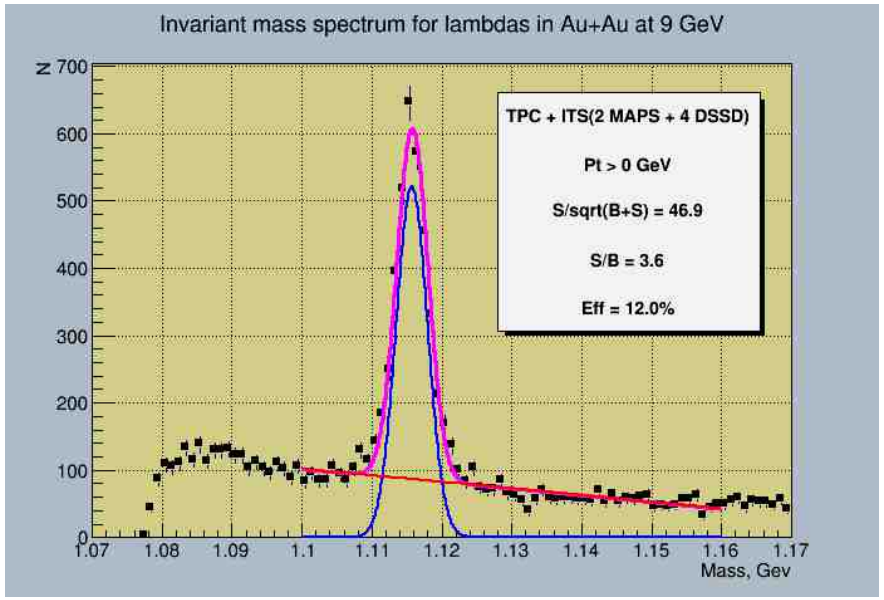


Six layers of CBM STS-like modules





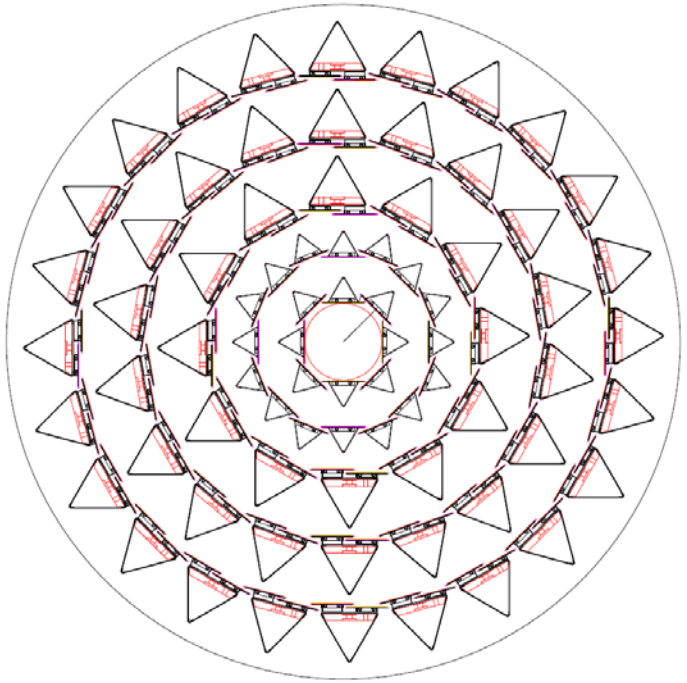
Λ^0 -hyperon reconstruction efficiencies for different IT geometries



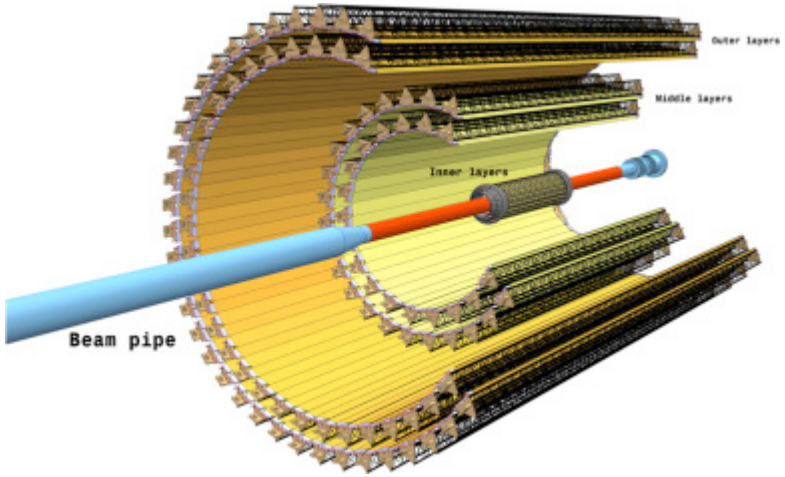
Reconstructed Λ-hyperon invariant mass spectrum (p_t<0.6 Gev)

A. Zinchenko et al.

MPD ITS geometrical model: based on ALPIDE sensors

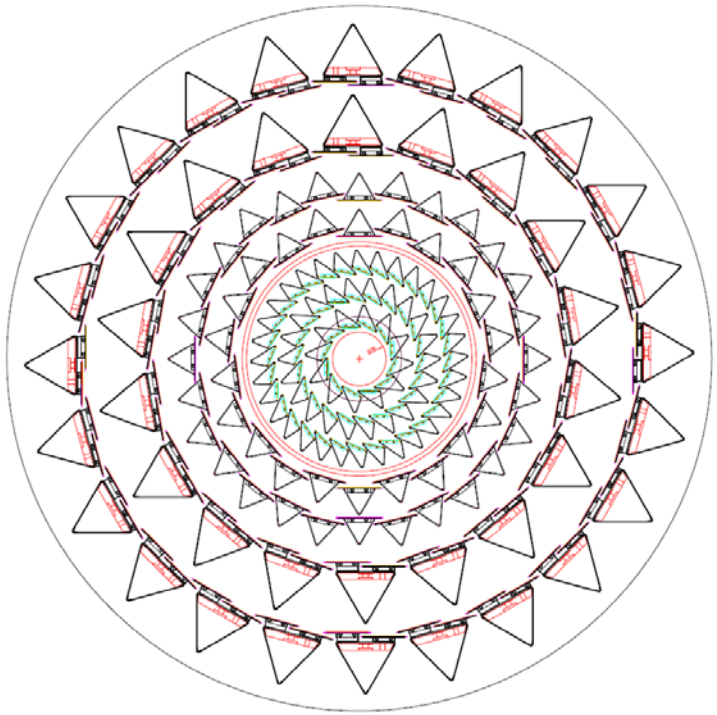


5 layers of ALPIDE sensors
With beam-pipe diameter 58 mm



Schematic layout of the upgraded ALICE ITS

MoU is preparing



7 layers of ALPIDE sensors
With beam-pipe diameter 38 mm

Identification of charm particles: D_0, Λ_c

Challenge: The length of the ladders should be twice more than in ALICE ITS with the same weight

Summary

- Our experience of GSI-JINR cooperation in developing of Si tracking systems for CBM and BM@N experiments is positive for both parties
- FAIR-JINR-CBM contract was the first CBM signed contract
- STS for BM@N project as a CBM STS “phase 0” experiment has benefits for both experiments
- We hope to continue and intensify our cooperation

Thank you for your attention!