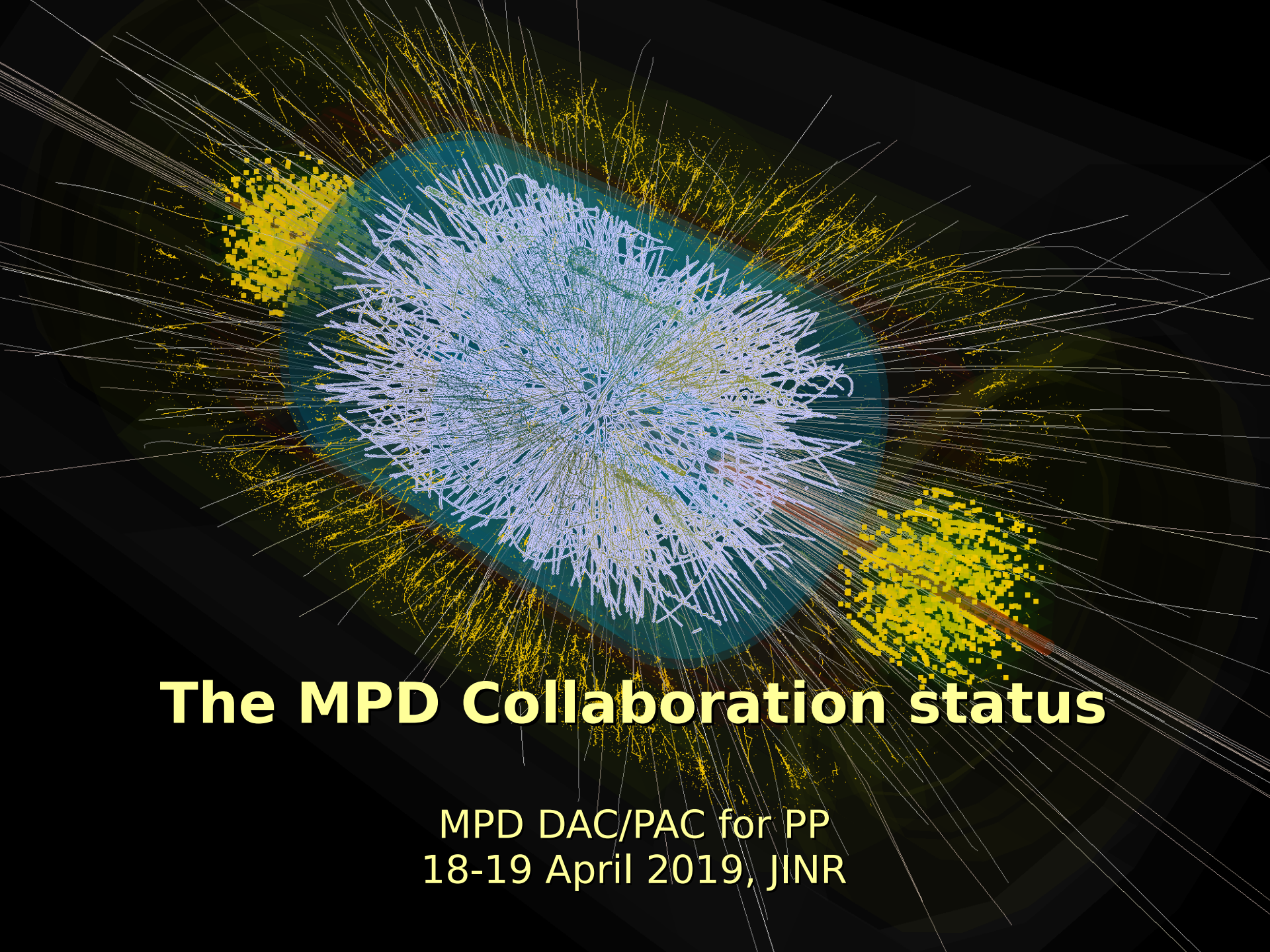


The MPD Collaboration status

MPD DAC/PAC for PP
18-19 April 2019, JINR

3rd meeting of the MPD Collaboration

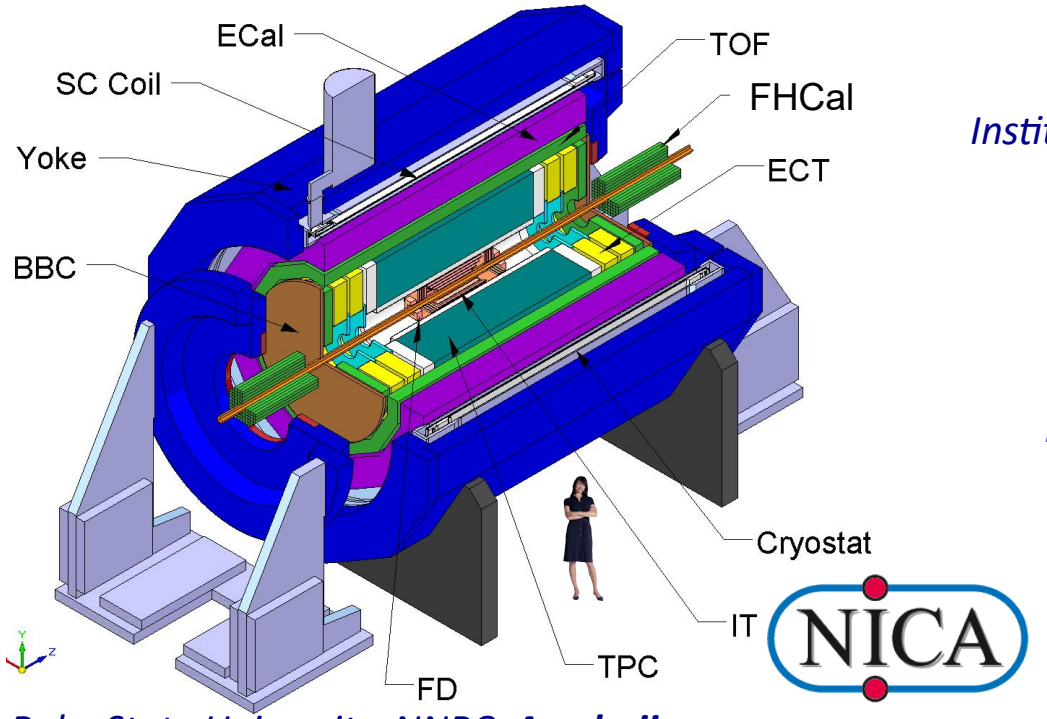
carried out in Dubna on 16-17 April, 2019

https://indico.jinr.ru/event/805/overview

Next MPD Collaboration Meeting and NICA Days 2019: 21-25 Oct 2019, Warsaw

MultiPurpose Detector (MPD) Collaboration:

33 institutions from 10 countries + JINR, 475 Collaboration members



*Baku State University, NNRC, **Azerbaijan**;*
*University of Plovdiv, **Bulgaria;***
*University Tecnica Federico Santa Maria, Valparaiso, **Chile**;*
*Tsinghua University, Beijing, **China**;*
*USTC, Hefei, **China**;*
*Huizhou University, Huizhou, **China**;*
*Institute of Nuclear and Applied Physics, CAS, Shanghai, **China**;*
*Central China Normal University, **China**;*
*Shandong University, Shandong, **China**;*
*IHEP, Beijing, **China**;*

*University of South China, **China**;*
*Three Gorges University, **China**;*
*Institute of Modern Physics of CAS, Lanzhou, **China**;*
*Palacky University, Olomouc, **Czech Republic**;*
*NPI CAS, Rez, **Czech Republic**;*
*Tbilisi State University, Tbilisi, **Georgia**;*
***Joint Institute for Nuclear Research**;*
*UNAM, Mexico City, **Mexico**;*
*Institute of Applied Physics, Chisinev, **Moldova**;*
*WUT, Warsaw, **Poland**;*
*NCNR, Otwock – Świerk, **Poland**;*
*University of Wrocław, **Poland**;*
*University of Warsaw, **Poland**;*
*Jan Kochanowski University, Kielce, **Poland**;*
*Belgorod National Research University, **Russia**;*
*INR RAS, Moscow, **Russia**;*
*MEPhI, Moscow, **Russia**;*
*Moscow Institute of Science and Technology, **Russia**;*
*North Osetian State University, **Russia**;*
*NRC Kurchatov Institute, ITEP, **Russia**;*
*Kurchatov Institute, Moscow, **Russia**;*
*SPSU - Dept. of NP, **Russia;***
*SINP, Moscow, **Russia**;*
*PNPI, Gatchina, **Russia**;*

Collaboration formation

- Approval of the ByLaws at the 1st meeting, defining the structure of the Collaboration
  - Memorandum of Understanding approval by member institutions ongoing (Common Fund Task Force proposed)
  - Deputy Spokesperson approved by the IB:
    - Victor Riabov, Zebo Tang
  - Formation of Executive Council, Detector Council done
  - Other Collaboration structures being formed (Talks Committee, Editorial Board)

Physics Working Groups

PWG1
Global observables

- Total event multiplicity
- Total event energy
- Centrality determination
- Total cross-section measurement
- Vertex determination
- Event plane measurement at all rapidities
- Spectator measurement

PWG2
Spectra of light flavor and hypernuclei

- Light flavor spectra
- Hyperons and hypernuclei
- Total particle yields and yield ratios
- Kinematic and chemical properties of the event
- Mapping QCD Phase diagram

PWG3
Correlations and Fluctuations

- Collective flow for hadrons
- Vorticity, Λ polarization
- E-by-E fluctuation of multiplicity, momentum and conserved quantities
- Femtoscopy
- Forward-Backward corr.
- Jet-like correlations

PWG4
Electromagnetic probes

- Electromagnetic calorimeter measurements
- Photons in ECAL and central barrel
- Low mass dilepton spectra and search for in-medium modification of resonances and intermediate mass region

PWG5
Heavy flavor

- Study of open charm production
- Charmonium with ECAL and central barrel
- Charmed meson through secondary vertices in ITS and HF electrons
- Explore production at charm threshold

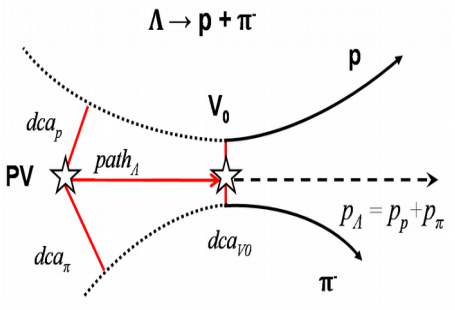
PWG Convenors

- PWG Convenors appointed by the Spokesperson, approved by the EC:
  - „Global observables”: **Grigory Feofilov** from SPSU, St. Petersburg, and **Alexander Ivashkin** from INR RAS, Moscow
  - "Spectra of light flavor and hypernuclei": **Vadim Kolesnikov** from JINR, and **Xainglei Zhu** from Tsinghua University, Beijing
  - "Correlations and Fluctuations": **Konstantin Mikhaylov** from NRC "Kurchatov Institute" - ITEP, Moscow/JINR and **Arkadiy Taranenko** from MEPhI, Moscow
  - "Electromagnetic Probes": **Victor Riabov** from PNPI, Gatchina and **Chi Yang** from Shandong University, Qingdao
  - "Heavy Flavor": **Wangmei Zha** from USTC, Hefei and **Alexander Zinchenko** from JINR

Study of hyperons at NICA/MPD

V.Vasendina, A.Zinchenko, V.Kolesnikov

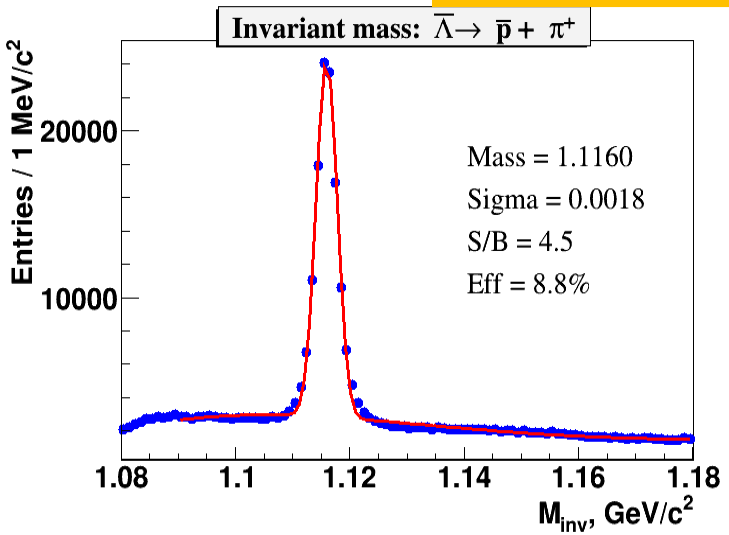
Centrality dependence for hyperon spectra & yields

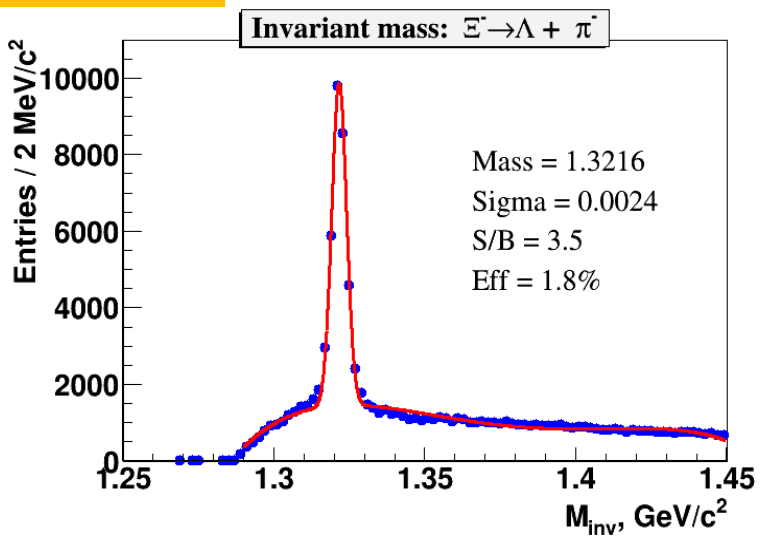


- 8M minbias Au+Au @ 11 GeV (PHSD model)
- TPC & TOF, $|\eta| < 1.3$
- Realistic track reconstruction and PID (dE/dx+TOF)
- Secondary vertex finding technique for hyperon reconstruction

- **PV** – primary vertex
- **V_0** – vertex of hyperon decay
- **dca** – distance of the closest approach
- **path** – decay length

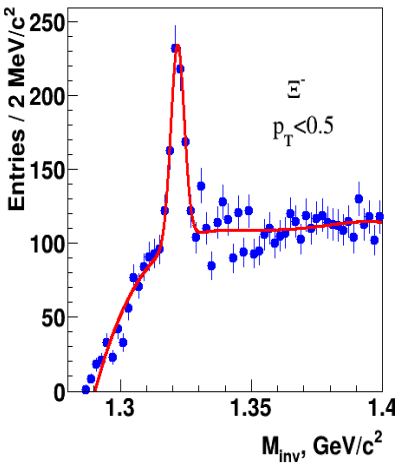
← All p_T →

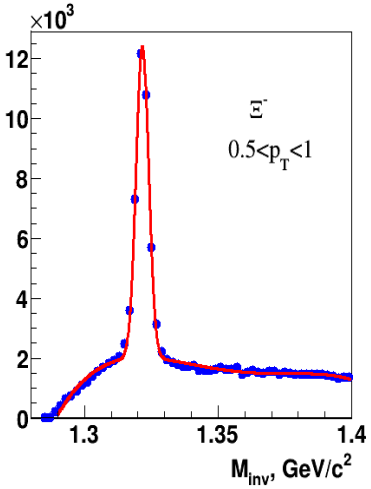


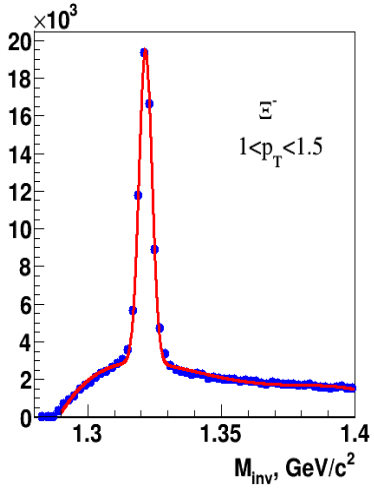


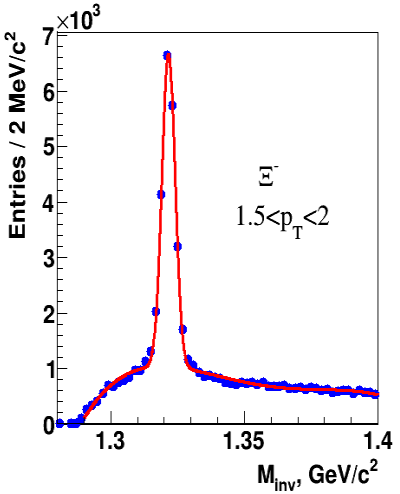
Ξ^- reconstruction, phase space, invariant spectra

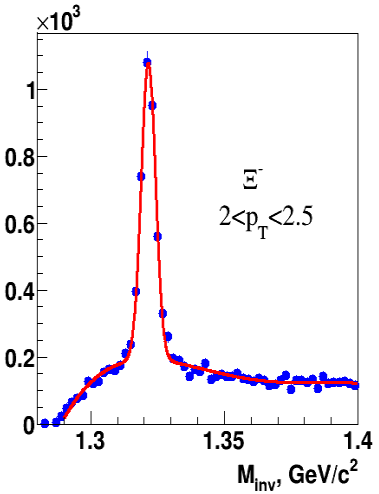
- Reconstruction of hyperons in p_T intervals
- Analysis of invariant p_T-spectra in centrality bins

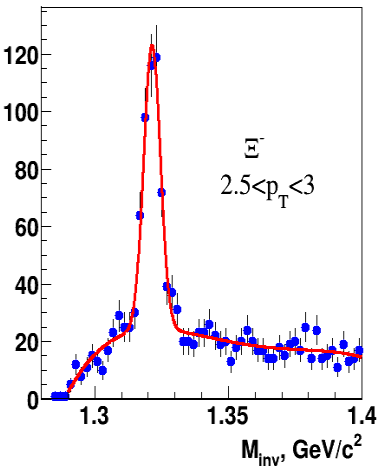


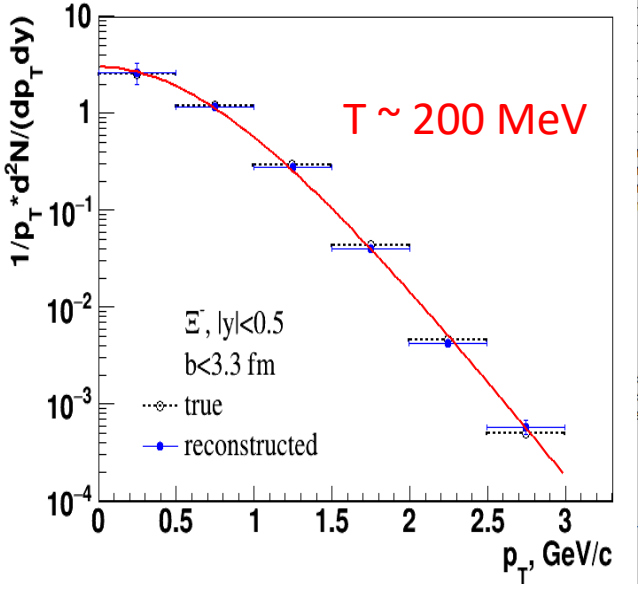






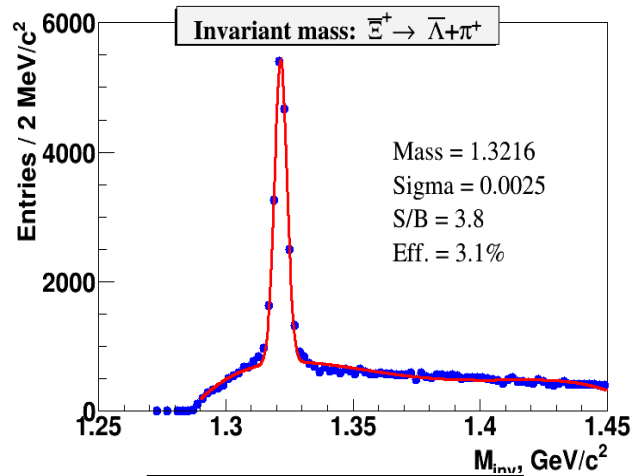


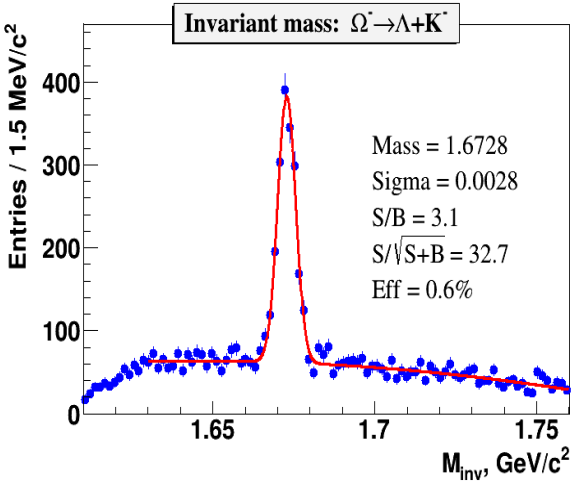


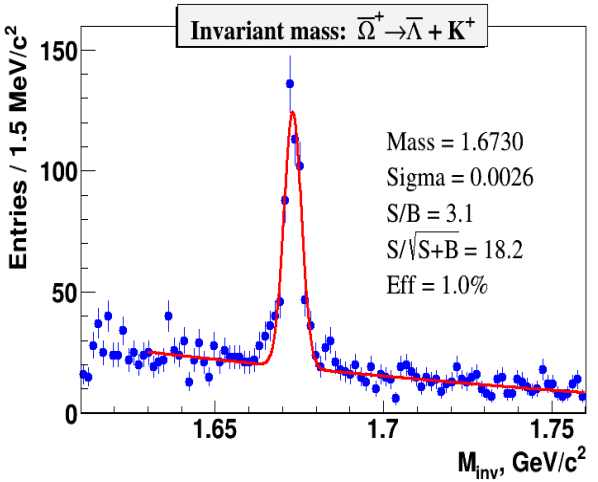


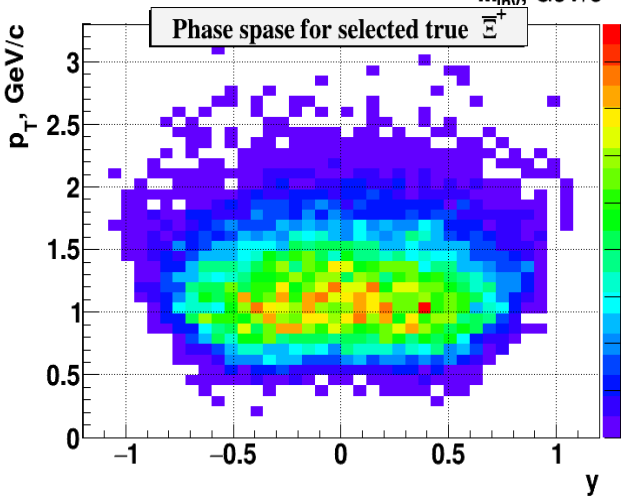
$\Xi^+, \Omega^-, \Omega^+$ reconstruction and phase space

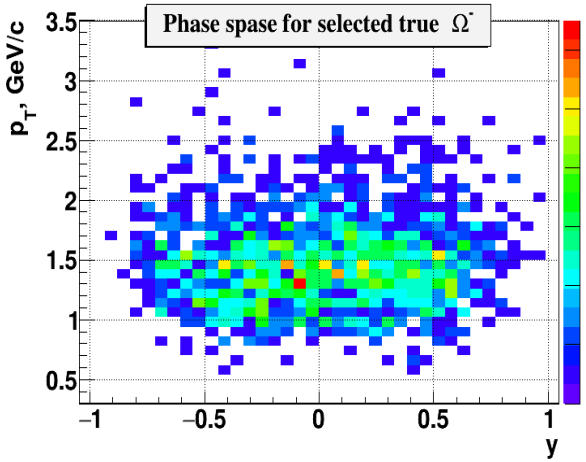
- Reconstruction of anti-hyperons in p_T intervals
- Analysis possible even with lower statistics

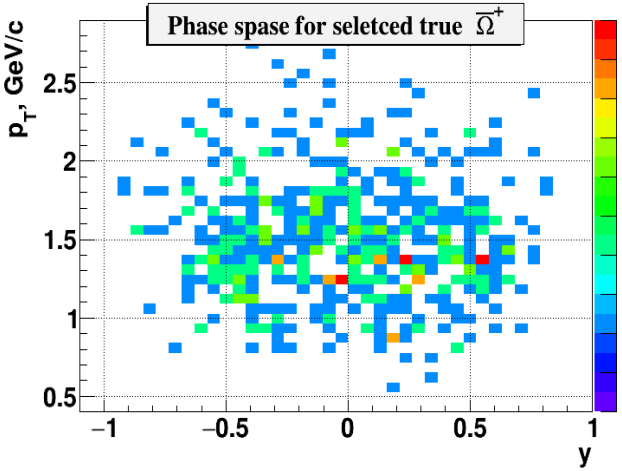












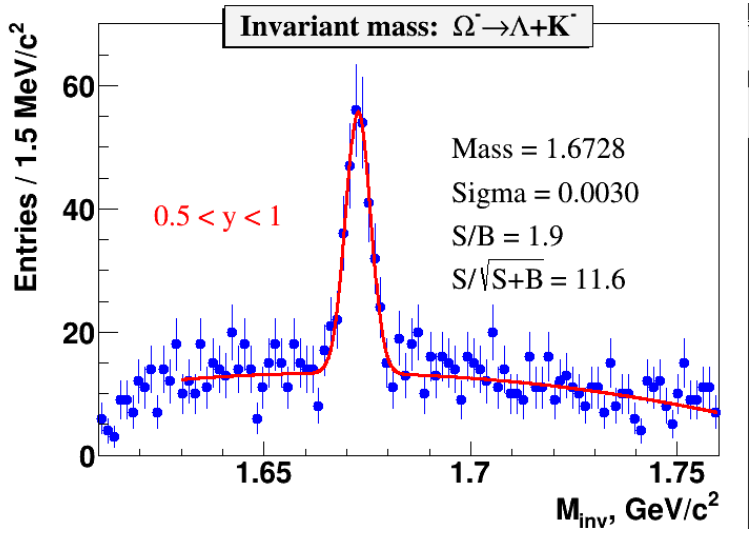
Statistics **15089**

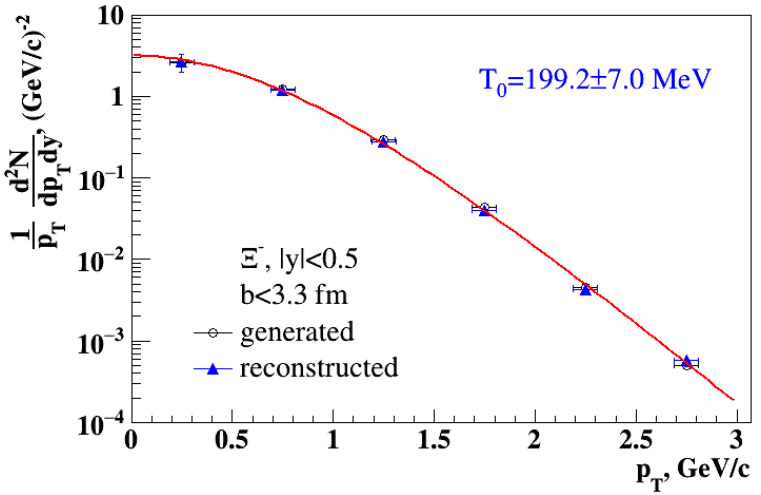
Statistics **1531**

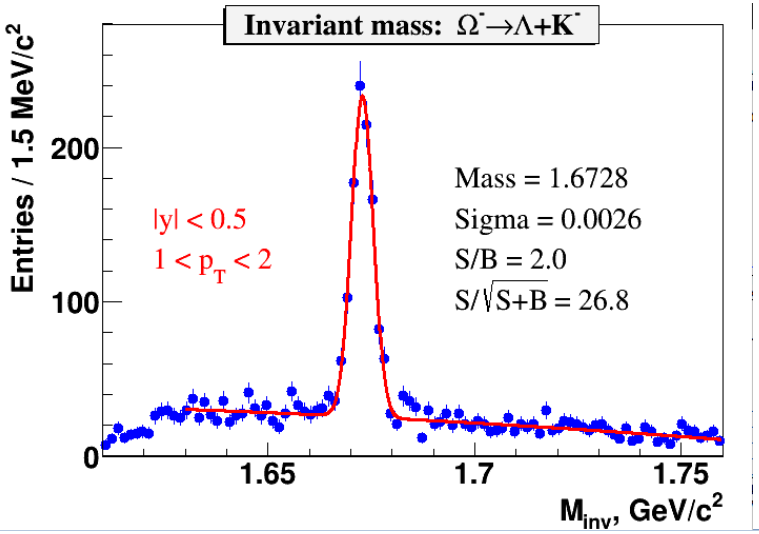
Statistics **502**

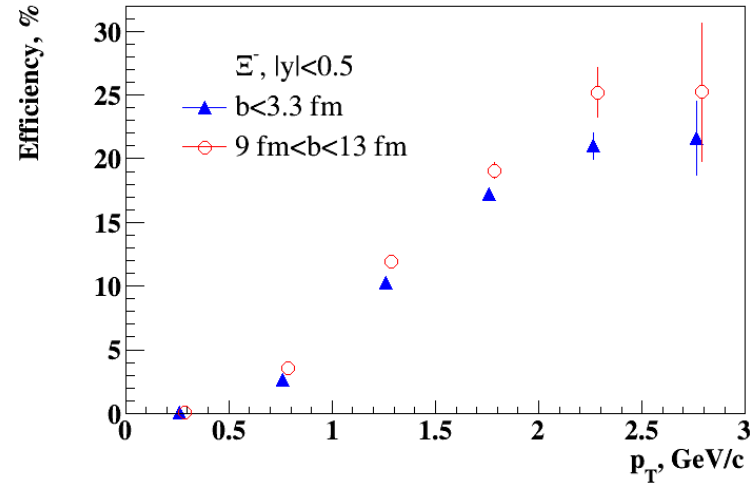
hyperon p_T spectra and efficiency

- Analysis in p_T and y intervals for Λ and Ξ
- Efficiency determined for central and peripheral events









Femtoscopy correlations at NICA/MPD

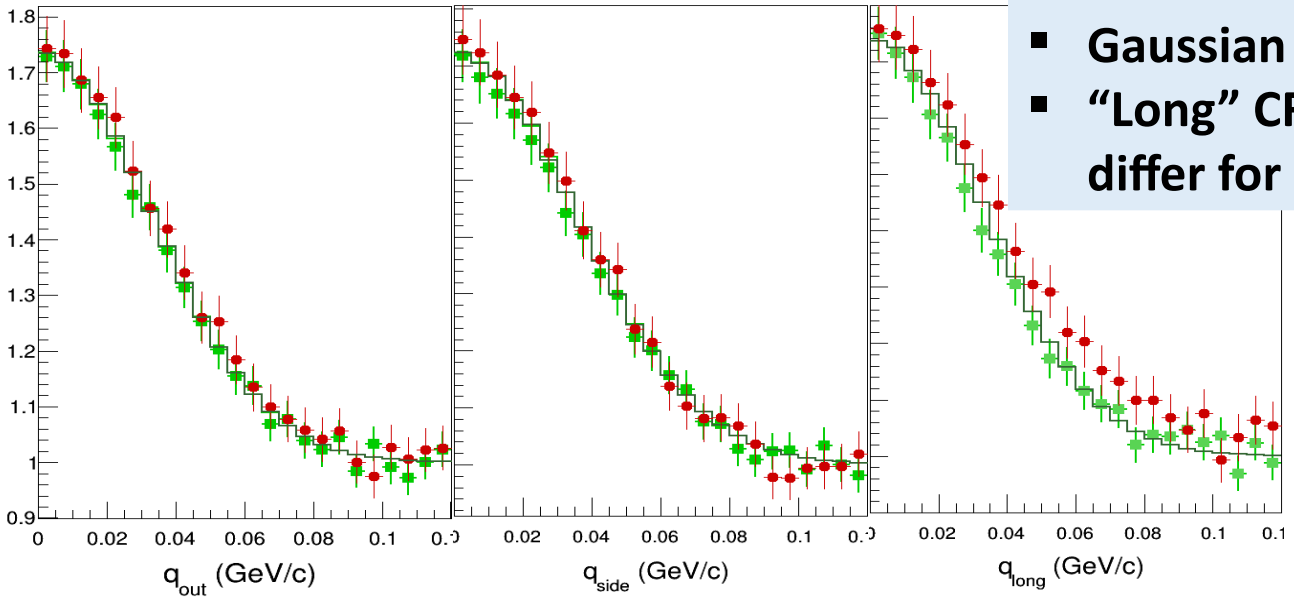
P.Batyuk, L.Malinina, K.Mikhaylov, G.Nigmatkulov

Study of collective effects, space-time characteristics of the emitting source at kinetic freeze-out, collision dynamics and quark-hadron phase transitions via femtoscopic correlations of hadrons at NICA energies

- MC input: vHLLE+UrQMD model implements hydro stage with different EoS, tuned to reproduce experimental data
- Data set : Au+Au collisions at 11 GeV, MPD full reconstruction chain
- Kaon particle ID and Correlation Function (CF) reconstruction

Projections of 3D kaon CF on the Out-Side-Long directions

Green – first order phase transition (1PT), **Red** – crossover (XPT)



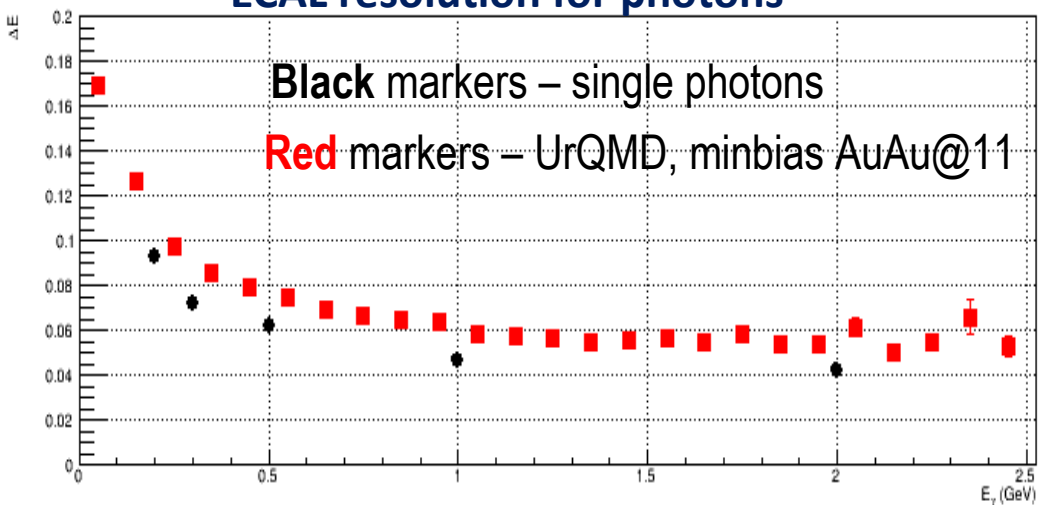
- **Gaussian shapes for kaon 3D CF**
- **"Long" CF projections for kaons differ for 1PT and XPT**

ECAL simulation

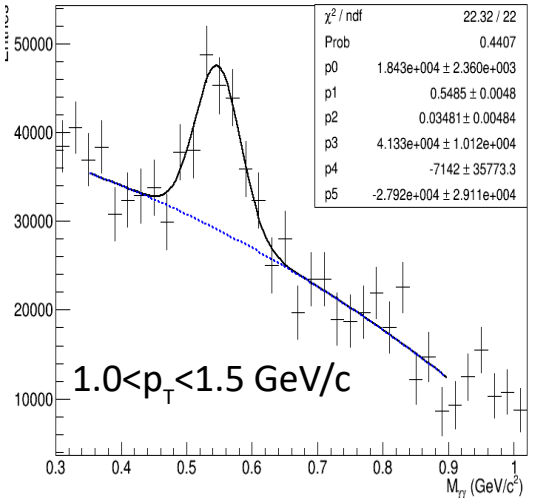
V.Riabov, A.Zinchenko, M. Martemyanov, V. Kulikov

- Realistic ECAL reconstruction & analysis – large acceptance ECAL with good energy resolution is an ideal tool for measurement of neutral mesons in a wide momentum range

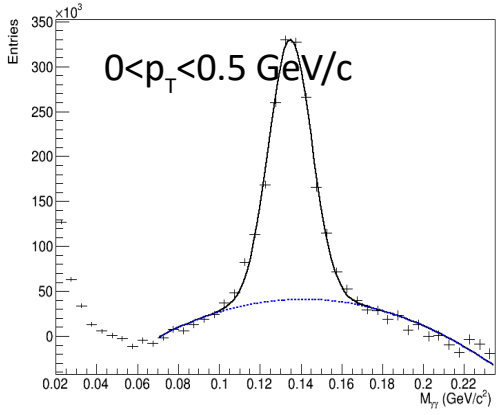
ECAL resolution for photons

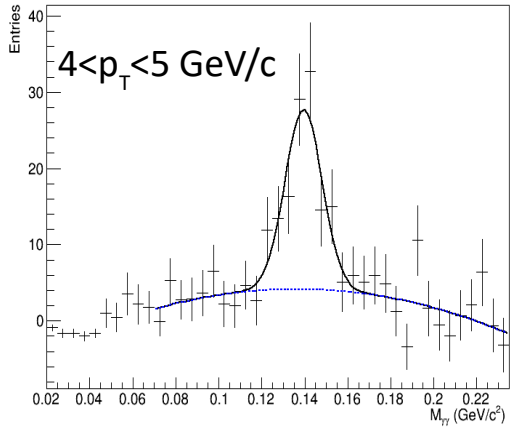


η-meson in minbias Au+Au



π^0-meson in central Au+Au





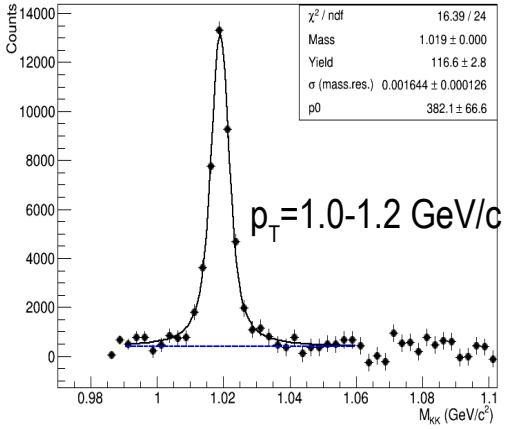
- **π^0 (η) reconstruction in MPD ECAL – feasible!**

Study of resonances with the MPD detector

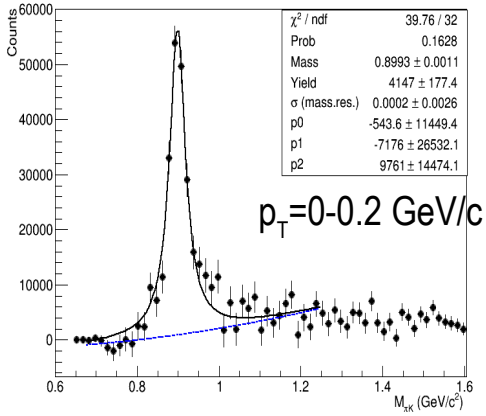
D.Ivanishchev, D. Kotov,, M. Malaev, V. Riabov, Yu. Ryabov

- Minbias Au+Au@11 (UrQMD model)
- Full event reconstruction and realistic PID
- Topology cuts and secondary vertex finding for hyperons
- Event mixing for background estimation

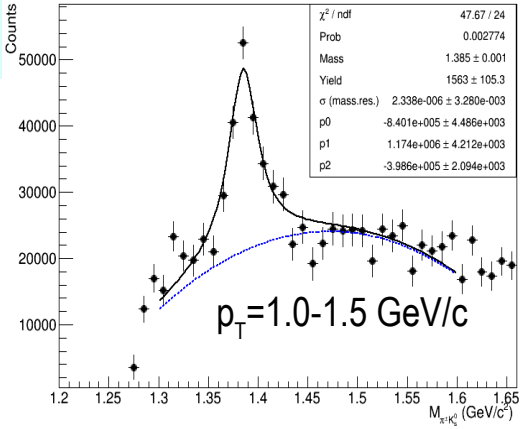
$\phi(1020) \rightarrow K^+K^-$,



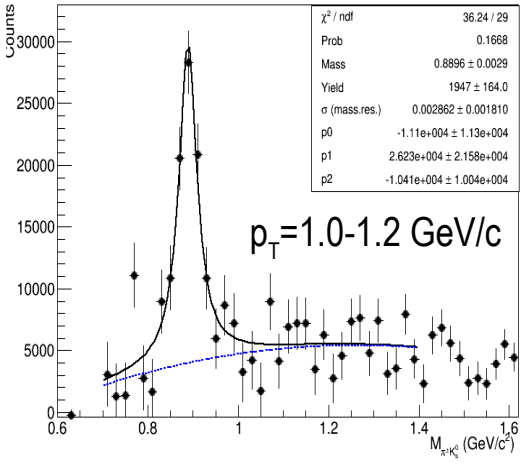
$K^*(892)^0 \rightarrow K^{\pm}\pi^{\pm}$



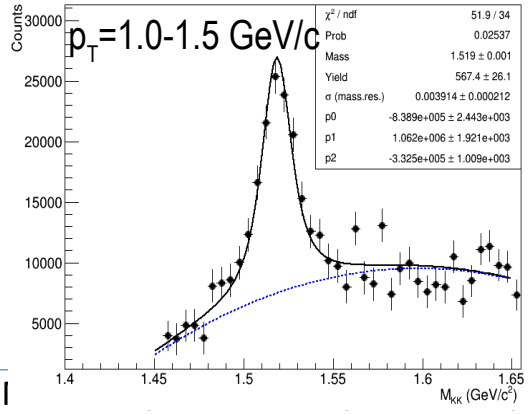
$\Sigma(1385)^{\pm} \rightarrow \pi^{\pm}\Lambda$ ($\Lambda \rightarrow p\pi$)



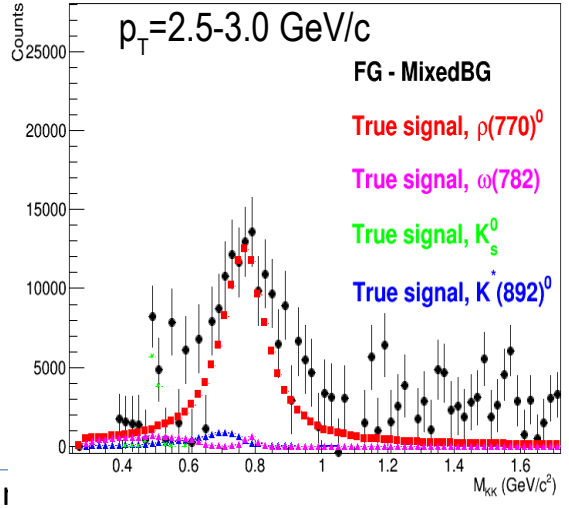
$K^*(892)^{\pm} \rightarrow \pi^{\pm}K_s$ ($K_s \rightarrow \pi^+\pi^+$)



$\Lambda(1520) \rightarrow pK^-$



$\rho(770)^0 \rightarrow \pi^{\pm}\pi^{\pm}$,

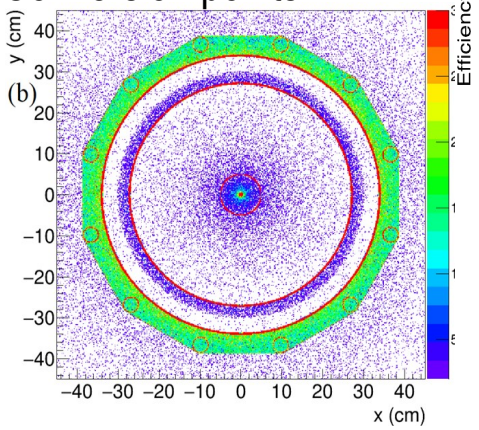


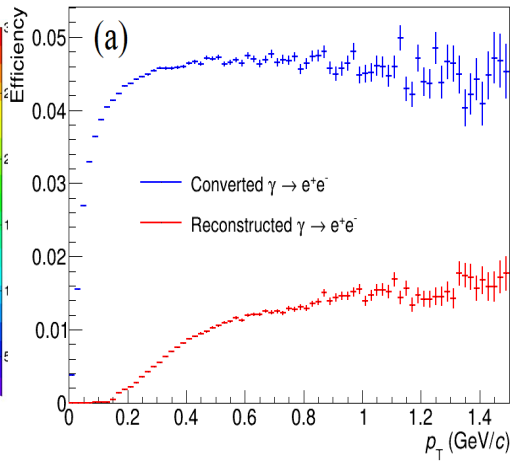
π^0 and η reconstruction via conversion in MPD

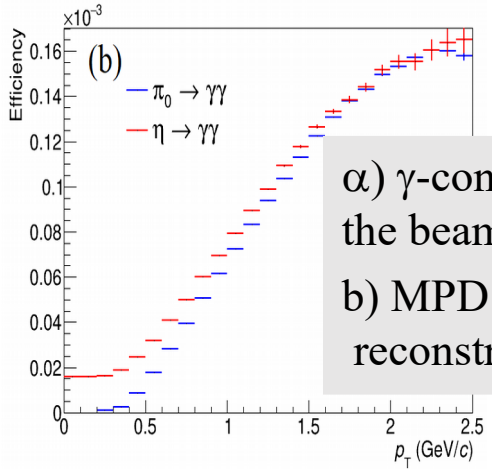
D. Ivanishchev, D. Kotov, E. Kryshen, M. Malaev, V. Riabov, Yu. Ryabov

- Photon reconstruction, complimentary to ECAL
- Direct photons, neutral mesons, geometry scan etc …
- Minbias AuAu@11, UrQMD - conversion on the beam pipe and inner layers of the TPC

Conversion points in MPD



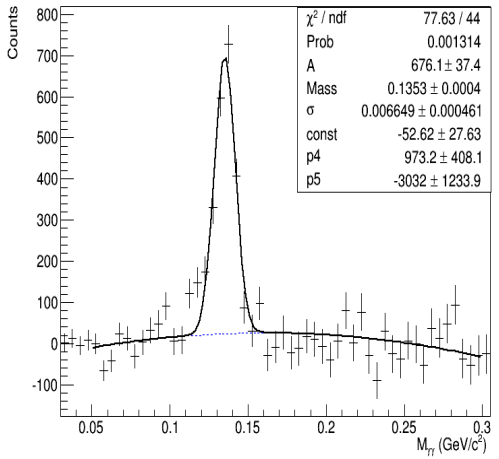




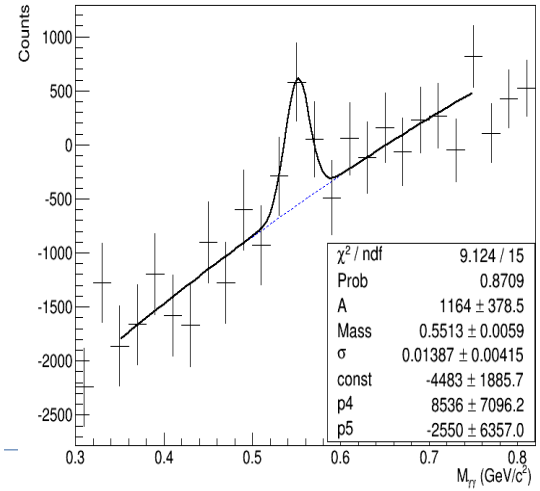
α) γ-conversion efficiency in the beam pipe & TPC vs p_T

b) MPD efficiency for π^0 and η reconstruction vs meson's p_T

$\pi^0 \to \gamma\gamma \to (e^+e^-)(e^+e^-)$



$\eta \to \gamma\gamma \to (e^+e^-)(e^+e^-)$



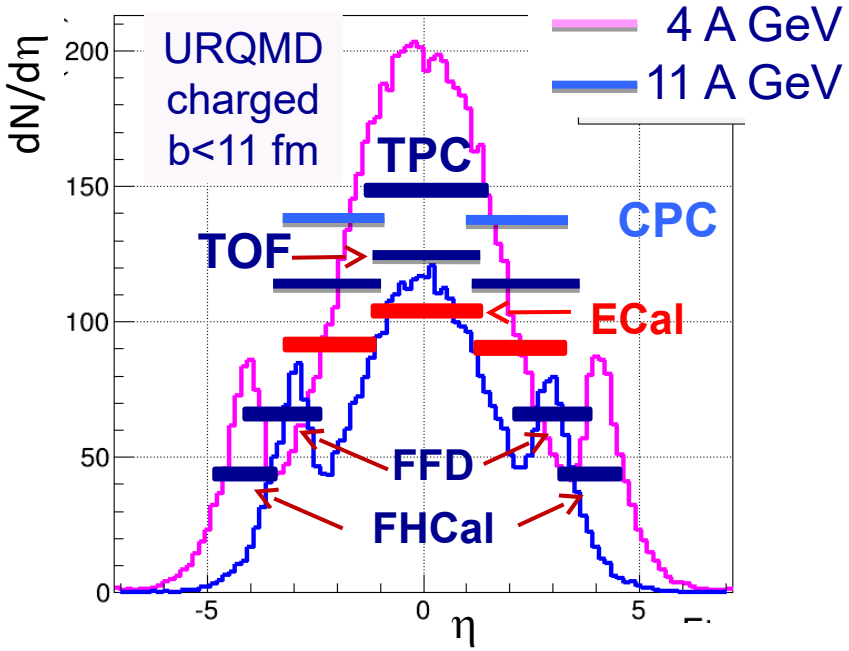
- Standard MPD configuration allows to reconstruct π^0 and η via conversion pairs

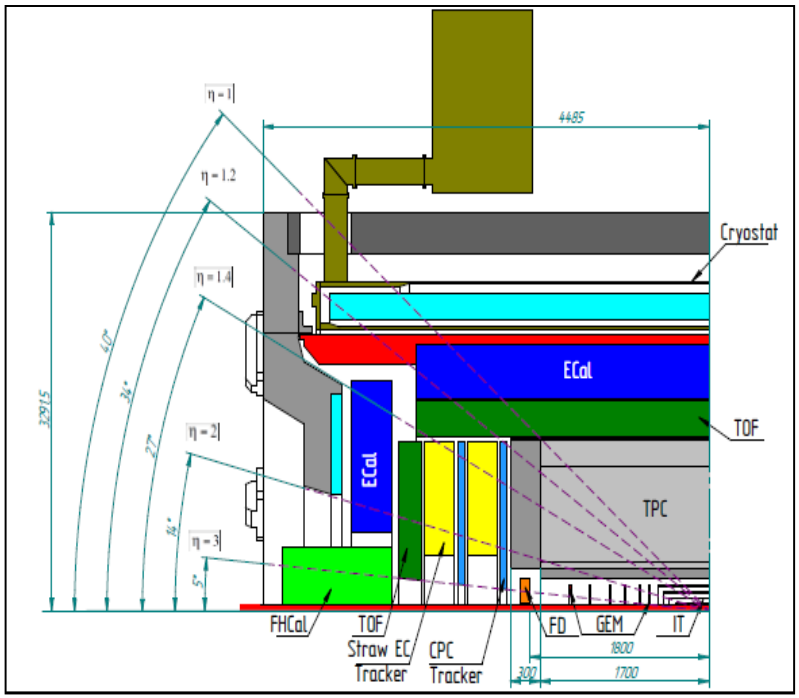
MPD (stage 1) detector status

- **Magnet** – *assembly & magnetic field measurement - **2019***
- **FHCal** – *production in progress*
- **TOF, FFD** – *production in progress*
- **TPC** – *production in progress*
- **ECAL** – *TDR completed, Chinese contribution secured*
- **Integration** – *TDR in preparation*

Stage II

MPD acceptance



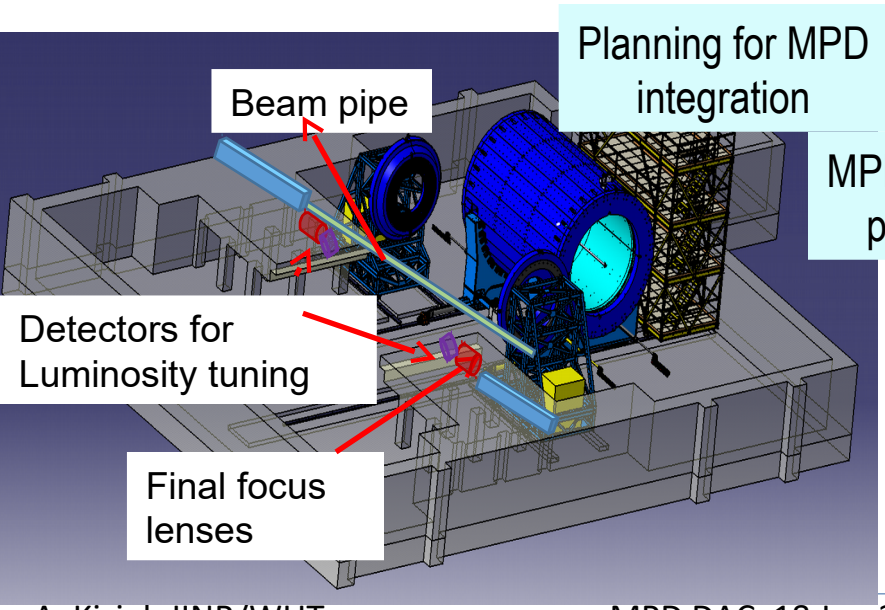


NICA/MPD infrastructure:

- **MPD Hall construction is progressing - soon ready for equipment installation!**
- **Preparatory works: designing space, tooling and service systems for MPD assembling and maintenance**

Working place inside/outside of the MPD Hall

- Place & tooling for MPD assembling
- Service & supply systems (cryo, cooling, power, etc.)
- Cabling inside the magnet yoke
- Connection to the electronics platform
- Carbon fiber support structure in design



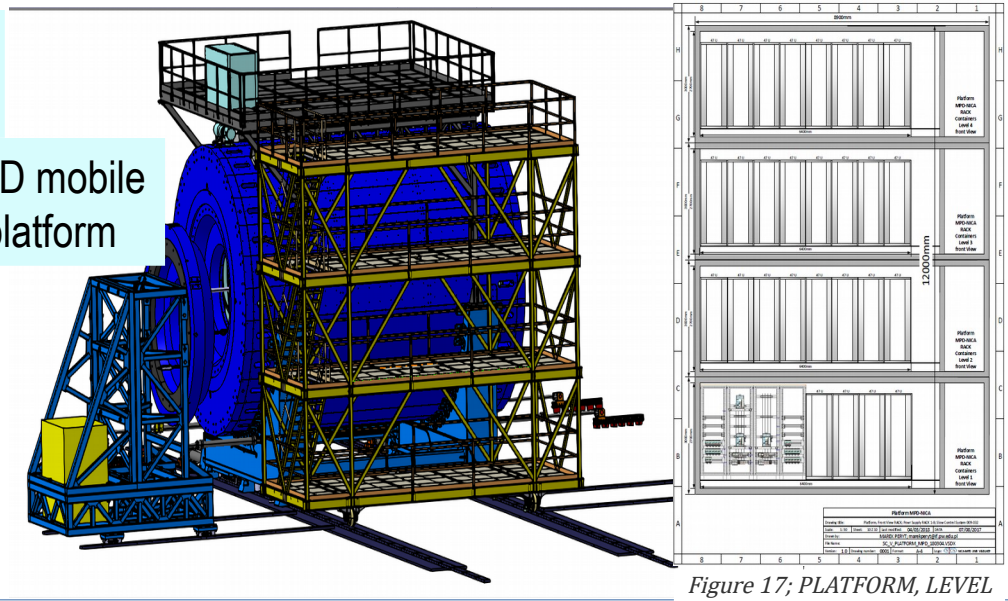
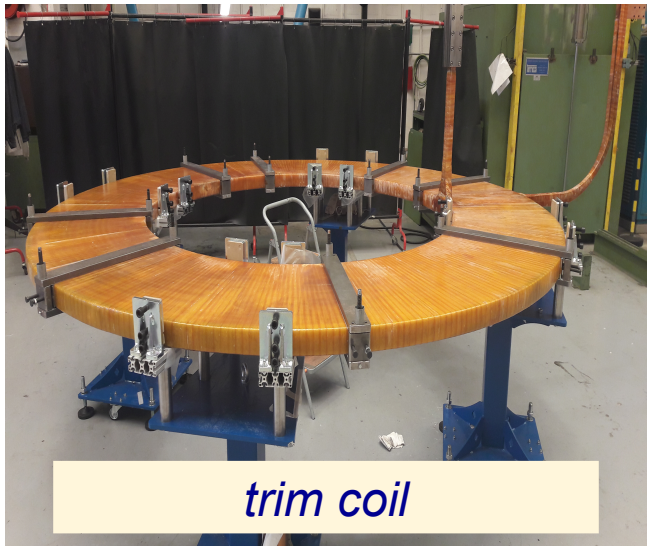


Figure 17; PLATFORM, LEVEL 1-4

Magnet fabrication: ASG (Genova) & Vitkovice HM


trim coil

End of 2018 – SC coils are ready
March 2019 – Solenoid is ready
July-October 2019 – Transportation to Dubna
Oct 2019 – Mar 2020 – Assembling of Magnet Yoke and Solenoid at JINR, alignment
Apr-May 2020 – Magnetic field measurements

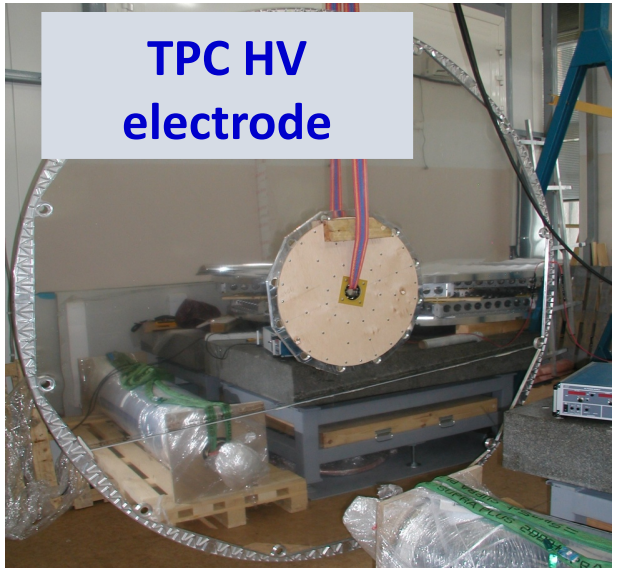

yoke control assembly at HM Vitkovice

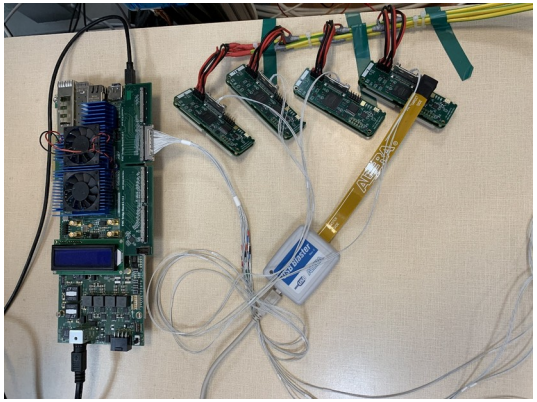

winding machine


cryostat

MPD TPC status

Delivered to JINR





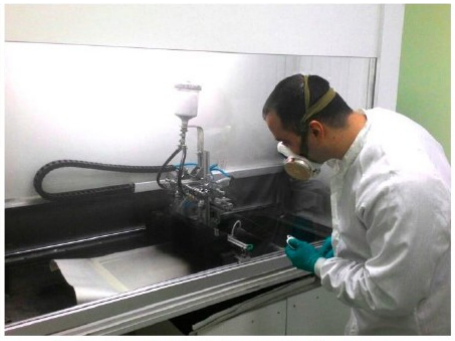
Gas system

MPD TPC FEE: FEC64SAM based on SAMPA

item	Date
Testing FEC v1.0 finished	Feb. 2019
Receive SAMPA V4 chips at Dubna 4500 (all)	June 2019
32 preproduction vervion 2.1 FE Card assembled (1/2ROC)	Jul. 2019
Testing of half ROC equipped with FECards	Aug. - Oct 2019
Production FE Cards for 1 ROC and Tests	Dec. 2019-Apr. 2020
Production FE Cards for 3 ROCs (Total 4) May	May 2020
Production FE Cards for the first 10 ROCs (Total 14)	July 2020
Production FE Cards for the second 10 ROCs (Total 24)	August 2020

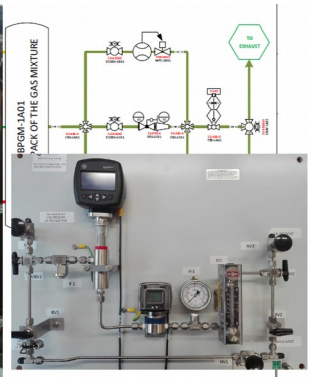
MPD TOF status

Ultrasonic wave glass cleaning

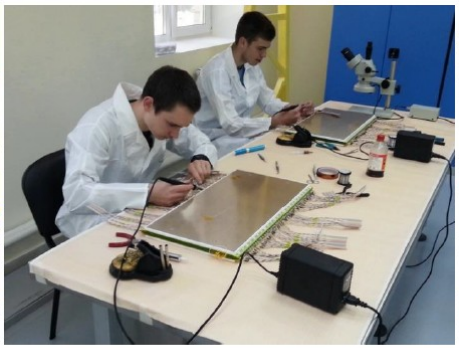


Painting of the HV conductive layer

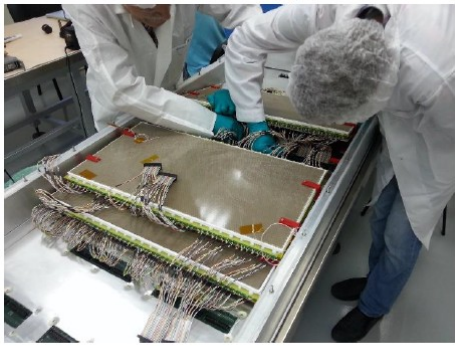
MRPC assembling



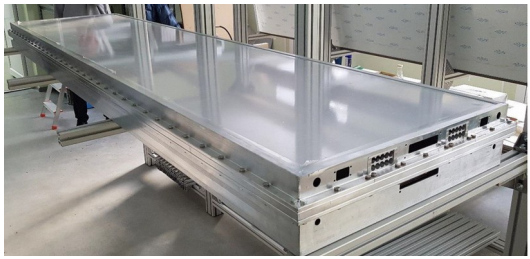
Optical quality control



Cables and connectors soldering



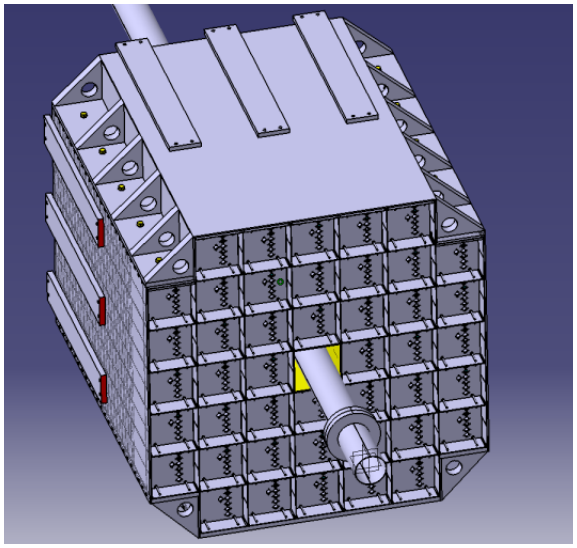
Detectors installation to the TOF box



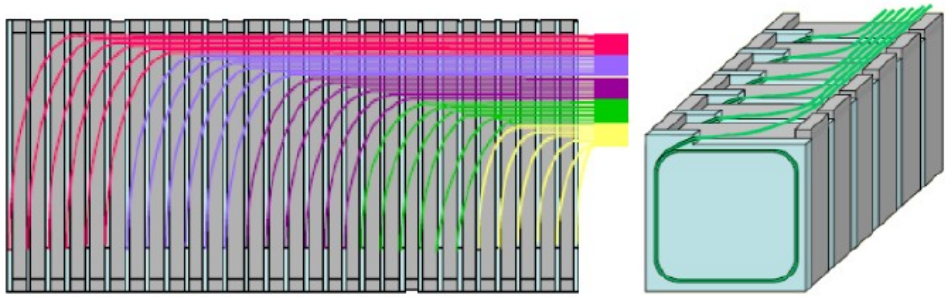
	Number of detectors	Number of readout strips	Sensitive area, m²	Number of FEE cards	Number of FEE channels
MRPC	1	24	0.192	2	48
Module	10	240	1.848	20	480
Barrel	280	6720	51.8	560	13440 (1680 chips)

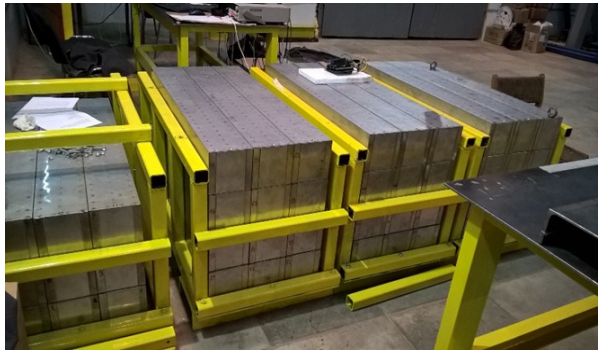
So far 10% of all mRPCs are assembled
At the end of March 2020 all mRPCs will be assembled

MPD FHCal status and readiness for beam tuning



- **Two-arms at ~3.2 m from the interaction point.**
- **Each arm consists of 45 individual modules.**
- **Module size 150x150x1100cm^3 (55 layers)**
- **Pb(16mm)+Scint.(4mm) sandwich**
- **7 longitudinal sections**
- **6 WLS-fiber/MAPD per section**
- **7 MAPDs/module**





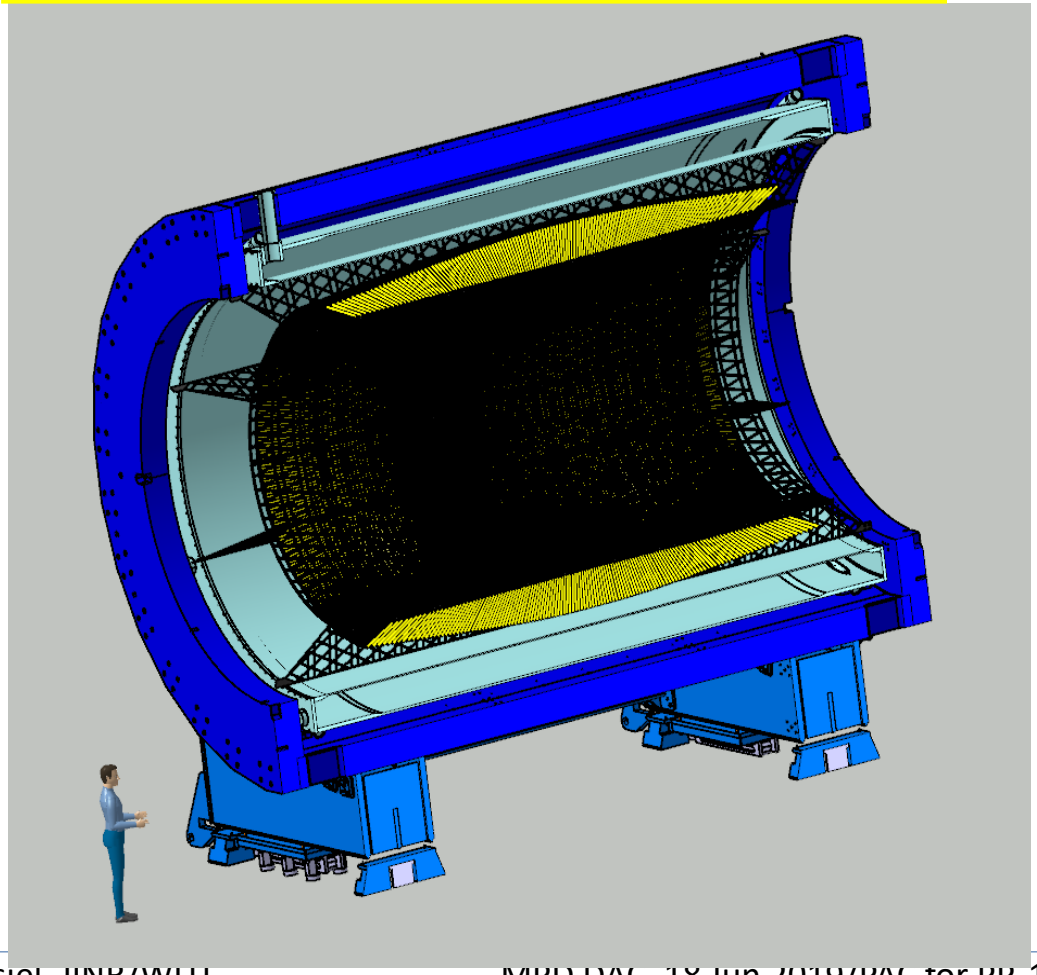
1. We have 80 modules ready (need 88)
   Plan to have 100 modules in September 2019
   Produced modules are under test on Cosmic
2. FE Electronics is under production – will be ready at the end of 2019
3. Design of the Support platform for FHCal is under way

ECAL status

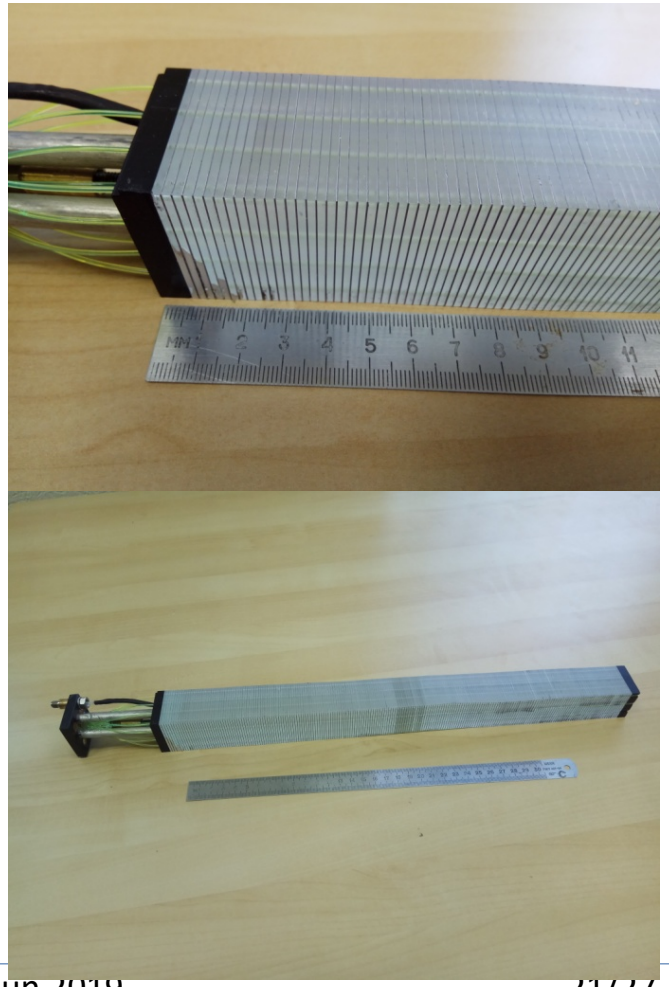
ECal – THU – Tsinghua University., Yi Wang , SDU –Shandong University, HU- Huzhou University Fuqing Wang

There is expectation that ECal modules assembling (75%) in China will be financed soon (middle of this year). Production of 25% modules in Russia is going on according to the Plan

Barrel ECAL ~ 43000 ECAL modules



Prototype of one module



MPD assembly milestones

The main goal is to have MPD ready for cosmic tests at the end of 2020.

1. July 2019 MPD Hall and pit are ready to store and unpack Yoke parts
2. July– August 2019 – Transportation of MPD Yoke parts to Dubna
3. August 2019 – Solenoid is ready for transportation
4. August - September 2019 – Transportation Solenoid to Dubna
5. September – November 2019 – Assembling of Magnet Yoke and Solenoid at JINR
6. December 2019 - Assembling of Endcaps, Alignment
7. January-March 2020 Preparation for switching on the Solenoid (Cryogenics, Power Supply et cet.)
8. April - May 2020 - Magnetic Field measurement
9. June - July 2020 Installation of Ecal Support Frame
10. August – November – Installation of subsystems, Electronics Platform, Cabling
11. December 2020 Commissioning
12. End of December 2020 – Readiness for Cosmic Ray tests

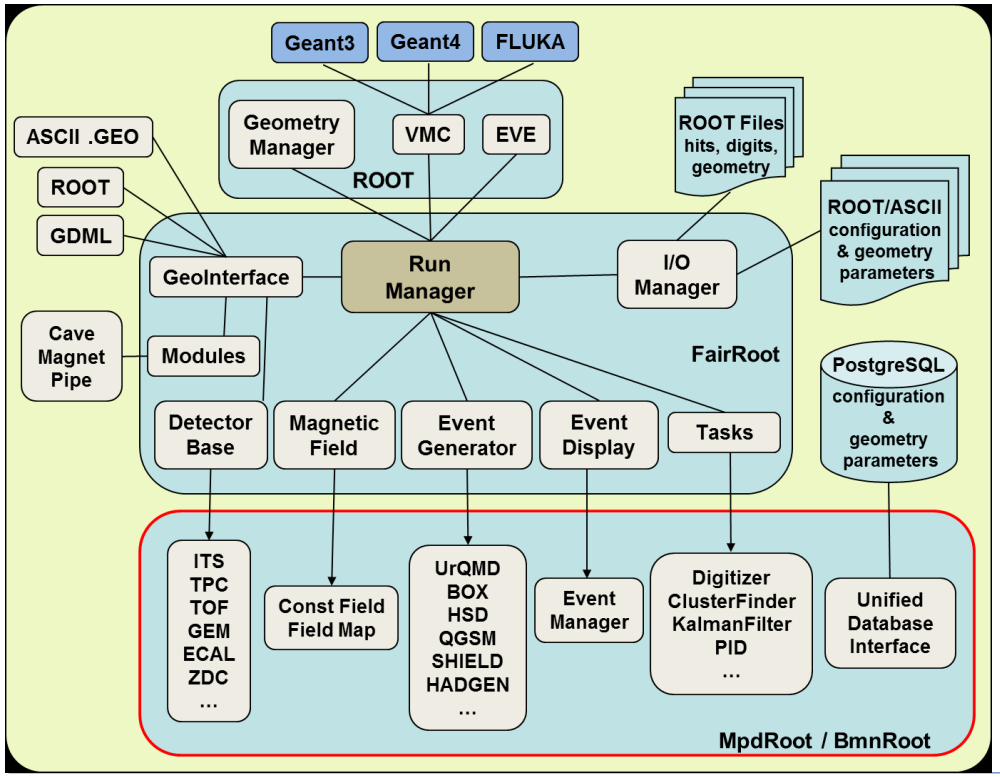
Software status

NICA > mpdroot > **Details**

mpdroot
Project ID: 24

Add license · 366 Commits · 6 Branches · 3 Tags · 24.1 MB Files

Simulation and Analysis Framework for NICA/MPD Detectors

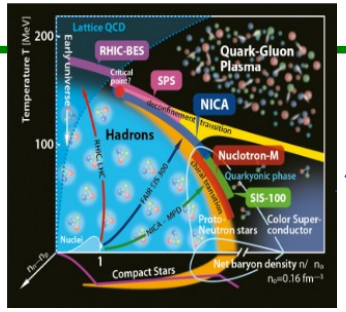


Plans and future tasks:

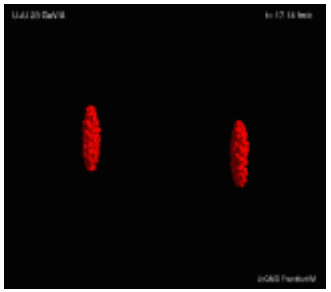
- Manpower
- Boost clustering
- Boost tracking
- Detector alignment and calibration
- Cloud computing for the MPD
- Virtual organization for MPD in GRID
- Physics Analyses

Detector	MC Geometry	Hits/digits
TPC	Ver. 8 (2018)	hitproducer
TOF	Ver. 7 (2016)	hitproducer
ECAL	Ver. 8 (2018)	hitproducer
FHCal	Ver. 2 (2018)	hitproducer
ITS	Ver. 3 (2015)	hitproducer
FFD	Ver. 0 (2016)	hitproducer
BBC	Ver. 2 (2019)	MC points

Computing for the NICA Megaproject

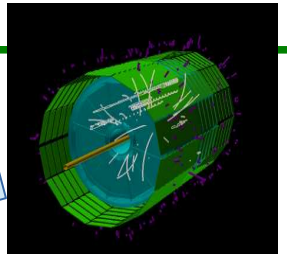


QCD phase diagram

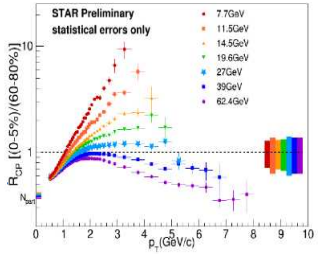


Simulations

GOVORUN



Events reconstruction



Physics analysis

Computing for the NICA megaproject:

- data acquisition from detectors
- data transmission for processing and analysis.

Requirements for the network infrastructure, computing architectures, storage systems as well as appropriate software for data processing and analysis. Developed computing models should take into account the trends in the development of network solutions, computing architectures and IT-solutions, which allow combining supercomputer (heterogeneous), grid and cloud technologies and creating distributed, software-configured HPC platforms on its basis. The use of such solutions for data processing and analysis requires the creation of software environments, which provide a necessary code abstraction enabling to implement the required functionality for a wide range of computing tools.

The GOVORUN supercomputer can become a tool for computing modeling, as it contains the latest computing and data storage resources including the ultrafast data storage system, which ensures a high speed of data acquisition up to hundreds of gigabytes per second with the possibility of a linear extension of performance and capacity of the system up to 1000 times.

Significant new computing at LHEP

- Upgrade of the exisiting dedicated NICA Cluster ongoing (expected completion of all works: end of 2019)
- New computing capabilities provided to the end users on March 6th 2019:
  - 3000 job slots (final expected number: 5000 cores x 2 threads/core)
  - Up to 7 PB of additional disk space (3.5 PB+3.5 PB replica, EOS filesystem) – final value: 10 PB
  - Negiotiations ongoing on the division of resources between MPD, BM@N, and SPD
- Will be tested for massive production of Monte-Carlo events for new physics performance studies

Electronic tools for communication

- Major concern expressed by Collaboration members is the urgent need for efficient communication tools
- Several resource exist, but need to be strongly developed and kept up to date:
  - General NICA webpage with MPD section: http://mpd.jinr.ru
  - „New" MPD-dedicated webpage: http://mpd.jinr.ru/experiment
  - General purpose mailing list: MPD_Coll_List(at)maillist.jinr.ru
- More specific tools have been proposed by the JINR IT and are being tested within the Collaboration:
  - The MPD Wiki (based on the DocuWiki platform)
  - The MPD Forum (based on the Discourse web forum platform)

Summary

- MPD project progress according to schedule
- All major detectors now under construction
- Integration effort underway, actual work in the experimental hall will begin shortly
- Large effort in the formation of the international collaboration
  - All main collaboration bodies formed
  - Formation of Physics Working Groups
  - Preparation for massive Monte-Carlo productions