NICA

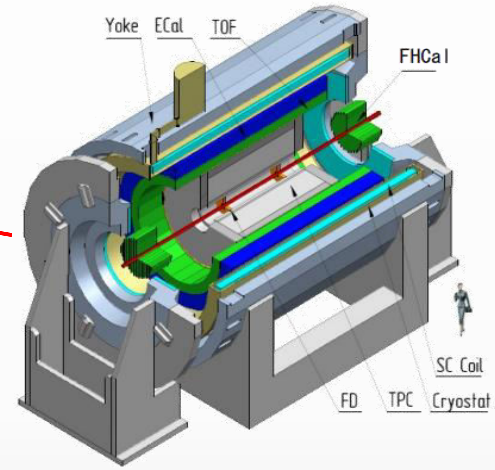
Nuclotron based **I**on **C**olider f**A**cility

MPD Collaboration Status

V. Riabov for the MPD Collaboration

MPD at NICA

❖ One of two experiments at NICA collider to study heavy-ion collisions at $\sqrt{s_{NN}}$= 4−11 GeV

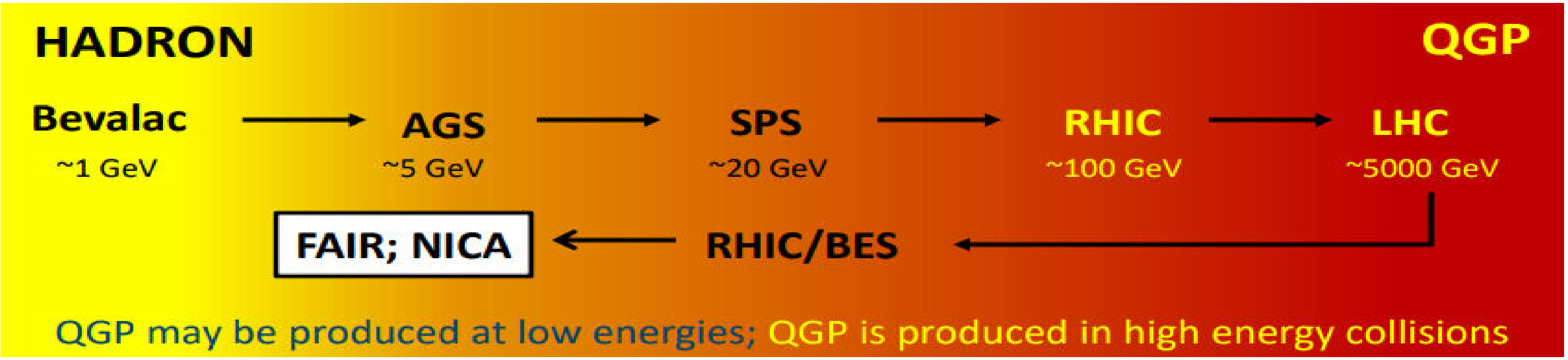


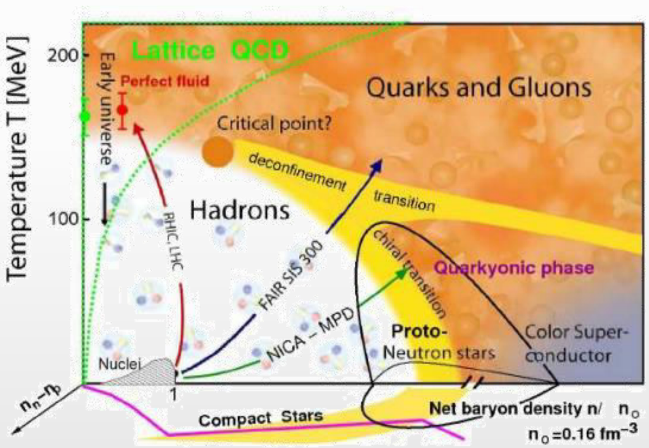
Stage- I

TPC: |Δφ| < 2π, |η| ≤ 1.6
TOF, EMC: |Δφ| < 2π, |η| ≤ 1.4
FFD: |Δφ| < 2π, 2.9 < |η| < 3.3
FHCAL: |Δφ| < 2π, 2 < |η| < 5

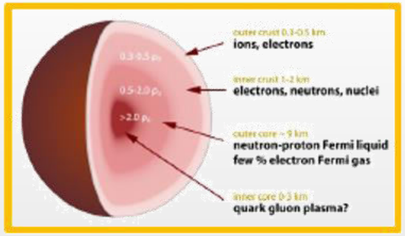
❖ Expected beam configuration in first year(s) of operation:
- ✓ not-optimal beam optics with wide z-vertex distribution, σ_z ~ 50 cm
- ✓ reduced luminosity (~10^{25} is the goal for 2023) → collision rate ~ 50 Hz
- ✓ collision system available with the current sources: C (A=12), N (A=14), Ar (A=40), Fe (A=56), Kr (A=78-86), Xe (A=124-134), Bi (A=209)
- ✓ First beams: Bi+Bi @ 9.2 GeV in 2024

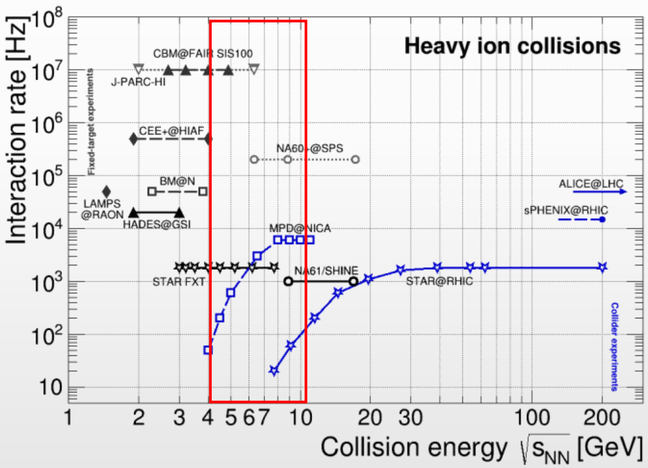
Relativistic heavy-ion collisions





high baryon densities
→ inner structure of
compact stars





- ❖ At μ_B ~ 0, smooth crossover (lattice QCD calculations + data)
- ❖ At large μ_B, 1st order phase transition is expected → QCD critical point
- ❖ BM@N and MPD will study QCD medium at extreme net baryon densities
- ❖ Many ongoing (NA61/Shine, STAR-BES) and future experiments (CBM) in ~ same energy range

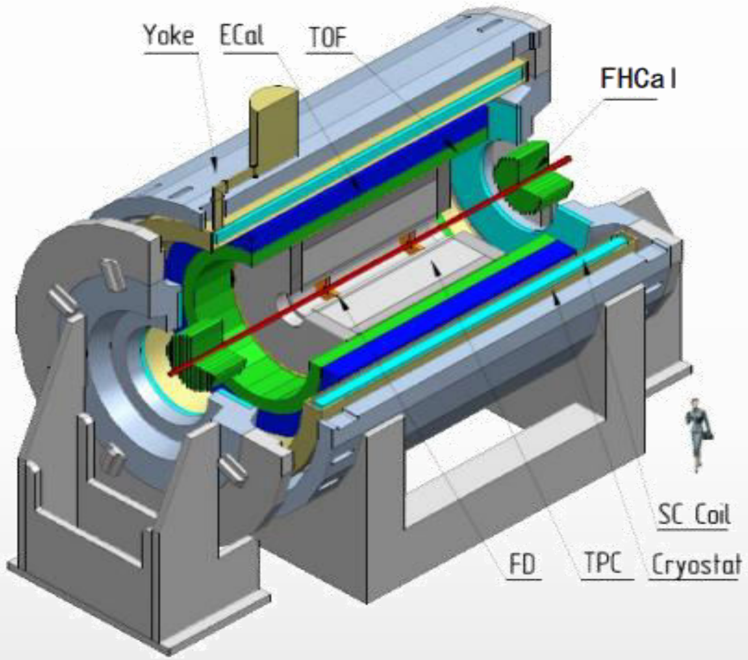
Multi-Purpose Detector (MPD) Collaboration

MPD** International Collaboration was established in **2018
to construct, commission and operate the detector

10** Countries, **>450** participants, **33** Institutes and **JINR

Organization

Acting Spokesperson:	***Victor Riabov***
Deputy Spokesperson:	***Zebo Tang***
Institutional Board Chair:	***Alejandro Ayala***
Project Manager:	***Slava Golovatyuk***



***Joint Institute for Nuclear Research**;*
*AANL, Yerevan, **Armenia;***
*University of Plovdiv, **Bulgaria;***
*Tsinghua University, Beijing, **China**;*
*USTC, Hefei, **China**;*
*Huzhou University, Huizhou, **China**;*
*Institute of Nuclear and Applied Physics, CAS, Shanghai, **China**;*
*Central China Normal University, **China**;*
*Shandong University, Shandong, **China**;*
*University of Chinese Academy of Sciences, Beijing, **China***
*University of South China, **China**;*
*Three Gorges University, **China**;*
*Institute of Modern Physics of CAS, Lanzhou, **China**;*
*Tbilisi State University, Tbilisi, **Georgia**;*
*Benemérita Universidad Autónoma de Puebla, **Mexico**;*
*Centro de Investigación y de Estudios Avanzados, **Mexico**;*
*Instituto de Ciencias Nucleares, UNAM, **Mexico**;*
*Universidad Autónoma de Sinaloa, **Mexico**;*
*Universidad de Colima, **Mexico**;*
*Universidad de Sonora, **Mexico**;*
*Institute of Applied Physics, Chisinev, **Moldova**;*
*Institute of Physics and Technology, **Mongolia**;*

*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, **Russia**;*
*Plekhanov Russian University of Economics, Moscow, **Russia**;*
*St. Petersburg State University, **Russia;***
*SINP, Moscow, **Russia**;*
*PNPI, Gatchina**, Russia**;*
*Vinča Institute of Nuclear Sciences**, Serbia**;*
*Pavol Jozef Šafárik University, Košice, **Slovakia***

MPD schedule

❖ Latest estimates provided by V. Golovatyuk

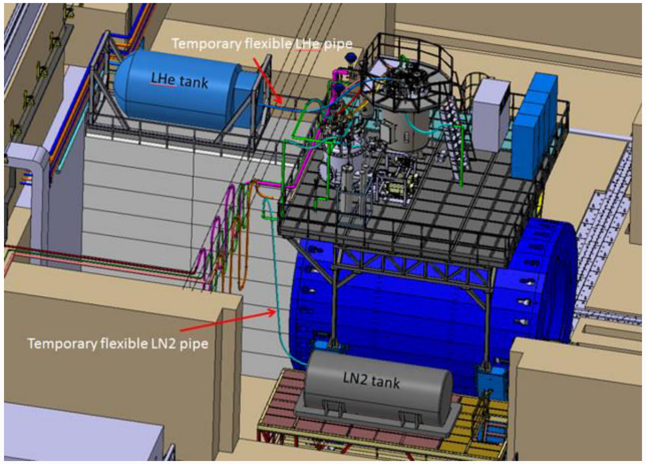
	Year 2023	
12	Jan 15 - April 15th	Preparation for Vacuum test of Solenoid with Cryostat
13	April 20 May 15th	Vacuum tests
14	May 15 - June 15th	Solenoid cooling down to Liquid Nitrogen temperature (-80K)
15	June 15 – September 15	Activities in the MPD Hall stopped
16	October – December	Cooling down to the He temperature
	Year 2024	
17	January. - February 15	Supplying the current to the solenoid and Correction coils
15	March - May 15	Magnetic Field measurements
15	June 1 - June 10	Support Frame installation
16	June 20 – August 30th	Installation ECal sectors, Moving Platforms mounting
17	Sept 1 – September 30th	Installation TOF modules, FHCal into poles
18	Oct 1st - Nov 30	TPC installation
19	Sept 18 - Nov 30	Cabling
20	Dec 4 - Dec 25	Installation of beam pipe
	Year 2025	
21	Jan 10 - Feb	Move the MPD on Collider beam line, Commissioning

Schedule of the MPD-NICA is significantly affected by the current geopolitical situation (suspension of collaboration with CERN and Polish & Czech Republic member institutions, economic sanctions and problems with supplies of many components from companies).

Activities in the MPD Hall

Top platform (cryogenics, power supplies, control system)

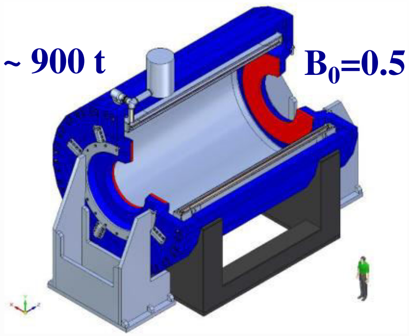
Temporary scheme of Solenoid cooling



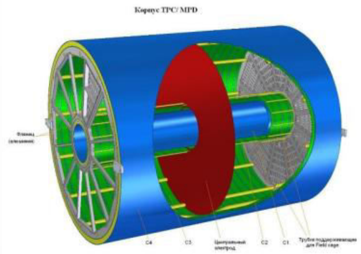
- Yoke, TRIM coils, top platform assembled
- Started assembling of the refrigerators and control Dewar
- Chimney area partly assembled, missing elements for SC cable connections ordered in Russia
- Pipes, LN2 tanks, LHe pipe, heaters and other equipment was re-ordered in Russia
- Power supplies and control system are being tested, works with cables are ongoing

MPD subsystems in production

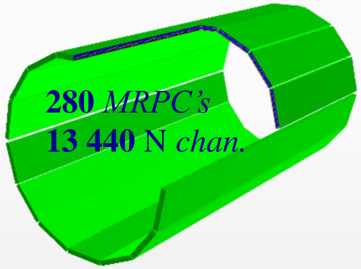
SC Solenoid + Iron Yoke

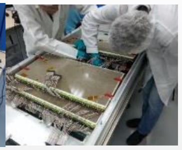


TPC – central tracking detector



TOF

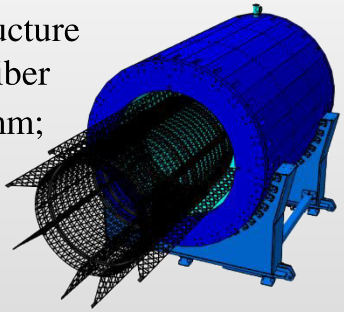




Support structure

support structure of carbon fiber

sagite ~ **5** mm;
0,13 X_0



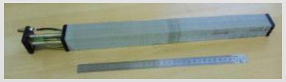
ECAL ~ 100 t

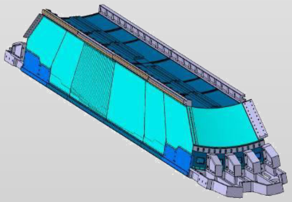
ECAL

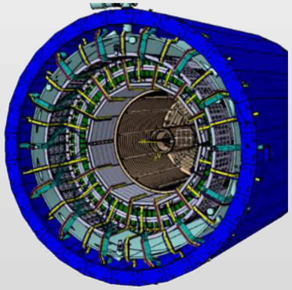
Pb+Sc "shashlyk"

38 400 towers

70% sectors in production for Stage I



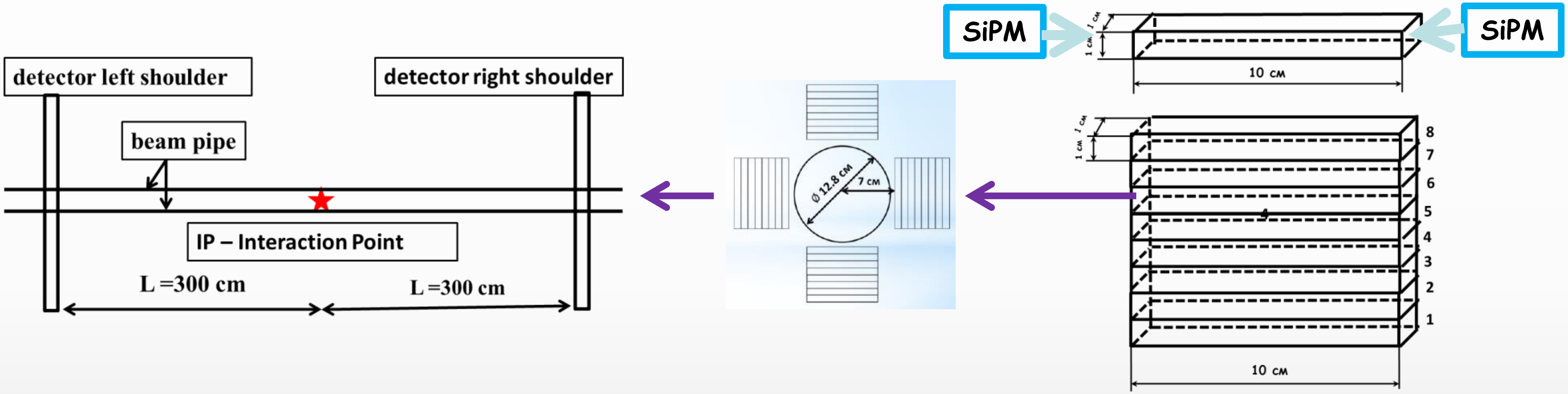




*** Excursion to the MPD Hall on Wednesday morning**
**** See subsystem reports for details**

Beam and luminosity monitoring

- To be used with MPD in service/working position:
  - ✓ assistance in controlling the transverse sizes of the bunches
  - ✓ assistance in setting up transvers and longitudinal convergence of bunches
  - ✓ control of the distribution of vertices in the longitudinal direction.



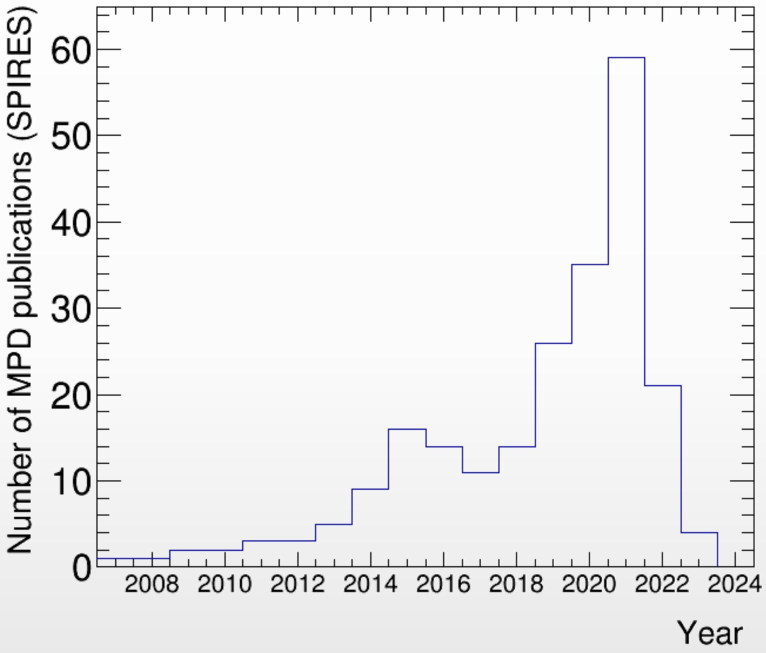
The detector consists of 100x10x10 mm^3 plastic scintillator strips (organic polystyrene scintillator with the addition of 1.5% p-terphenyl and 0.05% POPOP) viewed from both sides with SiPMs (HAMAMATSU S13360 6025 CS)

- Trigger: condition: $|T_L^{min} - T_R^{min}| < 10$ ns; efficiency – 77% in AuAu@11 GeV (DCM-SMM)
- Observables & methods:
  - ✓ counting rate and z-vertex distribution ($\sigma_{z\text{-vertex}}$ ~ 5 cm with $\delta\tau$ ~ 300 ps)
  - ✓ Van der Meer and ΔZ scans for optimization of beam optics

Collaboration activity

- Many ongoing construction works, theoretical and physics feasibility studies, see reports on hardware/software/physics topics at the collaboration meeting

- MPD publications: over 200 in total for hardware, software and physics studies:



- Support of Russian institutions in the NICA project:
  - ✓ 2019-2021: RFBR grant program, 2019-2021
  - ✓ 2022: internal JINR grants for students/PhD, 2022
  - ✓ 2023: internal JINR grants for leaders/students/PhD, 2023
  - ✓ 2023 and beyond: expect support by Russian Ministry of Science

Conferences

- MPD presentations at conferences since last CM:
  - ✓ DAE-BRNS CETHENP-2022, November 15 – 17
  - ✓ XVIII Mexican Workshop on Particles and Fields (XVIII MWPF), November 21 – 25
  - ✓ International Conference on Particle Physics and Astrophysics (ICPPA-2022), Nov. 29 – Dec. 2
  - ✓ Infinite and Finite Nuclear Matter (INFINUM-2023), February 27 – March 3

- MEPhI-JINR organized International Workshop NICA-2022 (http://indico.oris.mephi.ru/event/298):
  - ✓ 25 lectures in three days on experimental and theoretical topics
  - ✓ a step towards enhancing communications between theoretical and experimental communities
  - ✓ joint platform for discussion of NICA physics at BM@N and MPD

MPD physics program

G. Feofilov, A. Aparin

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

V. Kolesnikov, Xianglei Zhu

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 Diag.

K. Mikhailov, A. Taranenko

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

V. Riabov, Chi Yang

Electromagnetic probes
- Electromagnetic calorimeter meas.
- Photons in ECAL and central barrel
- Low mass dilepton spectra in-medium modification of resonances and intermediate mass region

Wangmei Zha, A. Zinchenko

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

❖ Cross-PWG format of meetings for discussion of results and analysis techniques

✓ increase the attendance

✓ improve communication and sharing of ideas between different analysis groups

MPD mass productions

- Physics feasibility studies using centralized large-scale MC productions → consistent picture of the MPD physical capabilities with the first data sets, preparation for real data analyses

- https://mpdforum.jinr.ru/c/mcprod/26:

  Request 25: General-purpose, 50M UrQMD BiBi@9.2 → **DONE**

  Request 26: General-purpose (trigger), 1M DCM-QGSM-SMM BiBi@9.2 → **DONE**

  Request 27: General-purpose (trigger), 1M PHQMD BiBi@9.2 → **DONE**

  Request 28: General-purpose with reduced magnetic field, 10M UrQMD BiBi@9.2 → **DONE**

  Request 29: General-purpose (hypernuclei), 20M PHQMD BiBi@9.2 → **DONE**

  Request 30: General-purpose (hyperon polarization), 15M PHSD BiBi@9.2 → **DONE**

  Request 31: General-purpose (femtoscopy), 50 M UrQMD BiBi@9.2 with freeze-out → **QA**

  Request 32: General purpose (flow), 15M vHLLE+UrQMD with XPT → **in preparation**

  Request 33: General purpose (flow), 15M vHLLE+UrQMD with 1PT → **in preparation**

- Production and analysis of data sets, which are comparable in size to the first expected real data samples test the existing computing and software infrastructure

- Learn how to handle the big data sets, develop analysis methods and techniques, set priorities for different analyses, find group leaders, etc.

- Thanks to Andrey Moshkin and the whole computing/software team !!!

Handling the big data sets

- ❖ Move to a centralized Analysis Framework for access and analysis of data: (used at RHIC/LHC)
  - ✓ analogous approaches are used at RHIC/LHC, proved to be very useful
  - ✓ consistent approaches and results across collaboration, easier storage and sharing of codes and methods
  - ✓ analyses are grouped in trains and run simultaneously with a single access to data per train → reduced number of input/output operations for disks and databases, easier data storage on tapes

- ❖ Analysis manager reads event into memory and calls wagons one-by-one to modify and/or analyze data:

Analysis manager	wagon #1	wagon #2	wagon #3	wagon #4	wagon #5	wagon #6

- ❖ Example:
  - ✓ Wagon #1 – event selector – selects events to be analyzed
  - ✓ Wagon #2 – centrality analyzer – returns values of centrality for all other wagons in the train
  - ✓ Wagon #3 – recalibrator – redefines some DST variables that need recalibration after production
  - ✓ ………………………..
  - ✓ Wagon #4, 5, … – physics analysis 1, 2, …

Analysis Train

❖ The Analysis manager and the first Wagons have been created

- Analysis manager in MpdRoot @ mpdroot/physics, originally committed by D. Peresunko:

MpdAnalysisEvent.cxx	MpdAnalysisManager.cxx	MpdAnalysisTask.cxx
MpdAnalysisEvent.h	MpdAnalysisManager.h	MpdAnalysisTask.h

- Analysis Wagons:
  - ✓ mpdroot/physics/evCentrality – provides **event centrality** for all mass productions using TPC multiplicity
  - ✓ mpdroot/physics/evPlane – provides **event plane** for all mass productions using FHCAL and TPC
  - ✓ mpdroot/physics/photons – example of the code for $\pi^0 \to \gamma\gamma$, $\pi^0 \to \gamma e^+e^-$, $\pi^0 \to e^+e^-e^+e^-$ analyses
  - ✓ mpdroot/physics/pairKK – example of the code for $\phi(1020) \to K^+K^-$ analysis ← uses **event centrality** and **event plane**

- Eventually all analysis codes should be committed to MpdRoot as Wagons
- The Train will run on a group of DST files, ~ 100k events → 500 jobs for 50M production
- Will need a Train Conductor (Production manager ???) to run the jobs without quota issues
- Results for all analyses/wagons run on a big production (~ 50 M events) in a day !!!

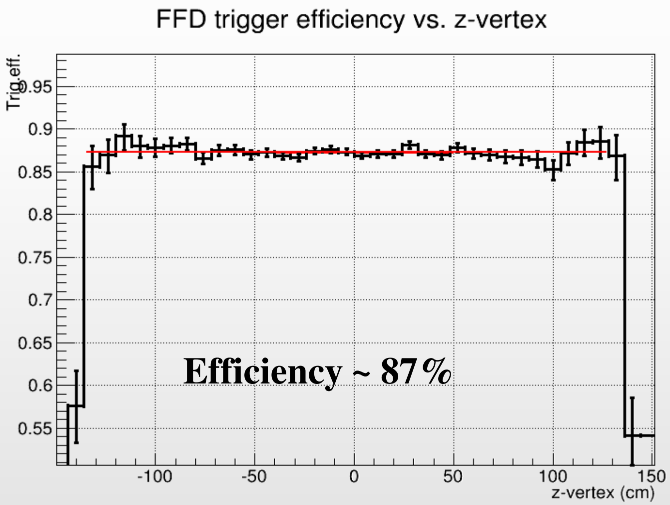
Advancements in analyses

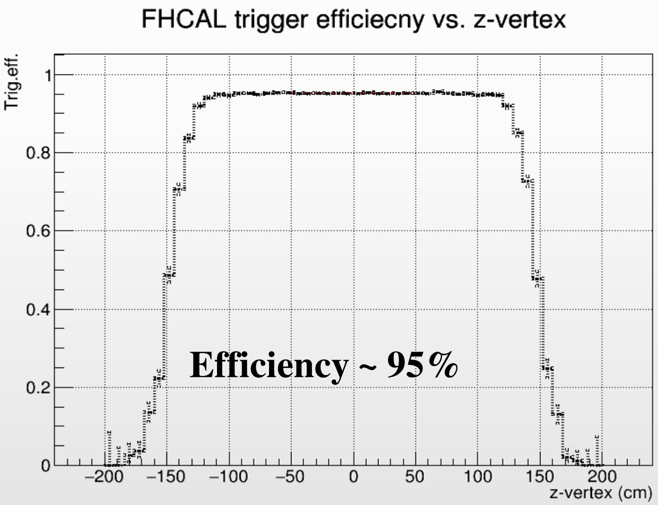
Trigger simulation, BiBi@9.2 GeV

- Trigger subsystems: FFD, FHCAL, …
- Simulation of forward detectors requires specialized event generators: DCM-QGSM-SMM, PHQMD

- FFD trigger definition:
  - ✓ at least one fired channel per side
  - ✓ meaningful times, $0 < \text{time}_{E,W} < 50$ ns
  - ✓ reconstructed z-vertex, |z-vertex| < 140 cm

- FHCAL trigger definition:
  - ✓ at least one fired channel per side
  - ✓ meaningful times, $0 < \text{time}_{E,W} < 50$ ns
  - ✓ reconstructed z-vertex, |z-vertex| < 150 cm

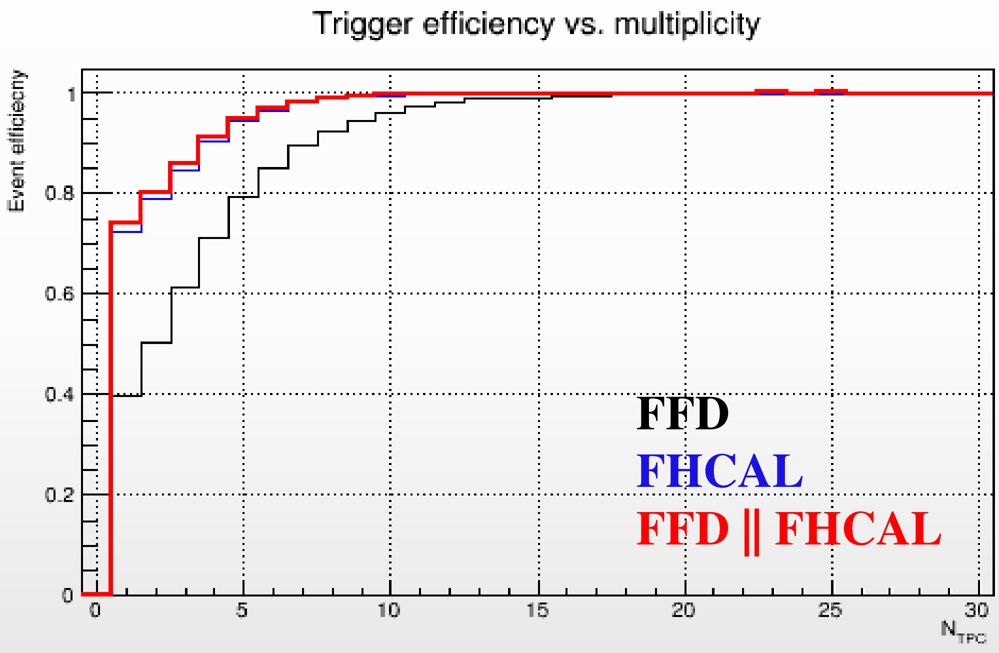




- For the mass productions, we use FFD||FHCAL trigger with trigger efficiency of 95%

Trigger emulation

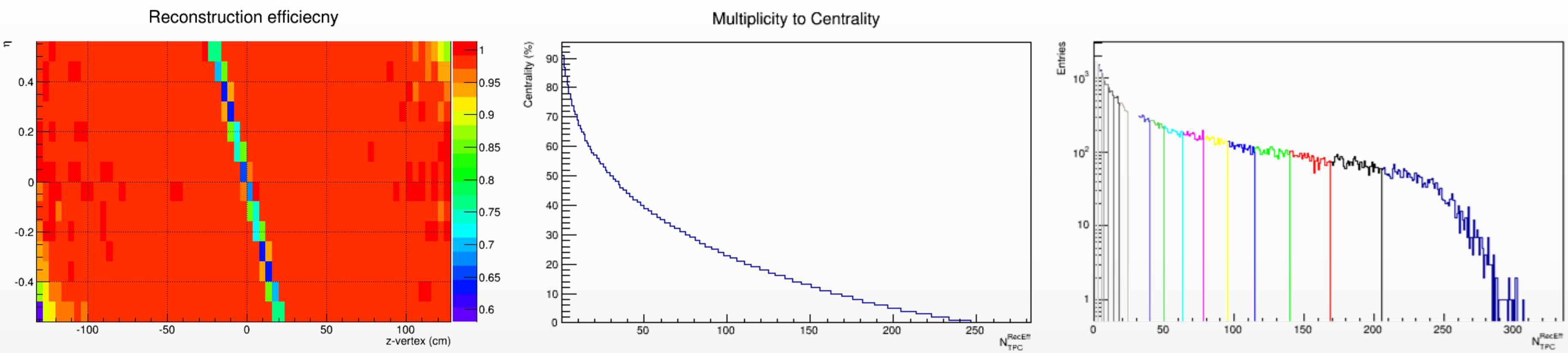
- UrQMD, PHSD → simulation of trigger is meaningless
- Use TPC multiplicity as a proxy for trigger efficiency for all mass productions
- Drop a fraction of event with trigger efficiency < 1, Rndm() > TrigEff[N_{TPC}]



- At N_{TPC} > 0-10 the trigger efficiency saturates for FFD||FHCAL option
- Evaluated trigger efficiency is applicable only for default track/event selection cuts:
  - ✓ nhits > 10; p_T > 0.1 GeV/c; DCA < 2.0 cm; |η| < 0.5

Event centrality by TPC multiplicity

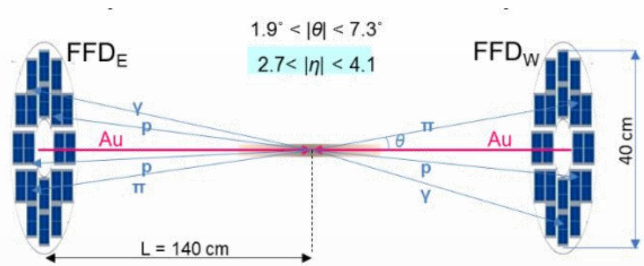
- Additional requirement, $N_{TPC} > 0$ → together with FFD||FHCAL sample 91% of the total cross section
- Event multiplicity is calculated using weight for each track ~ 1/RecEff(z-vertex, η)
- Centrality is defined as percentile of the total multiplicity with maximum of 91%



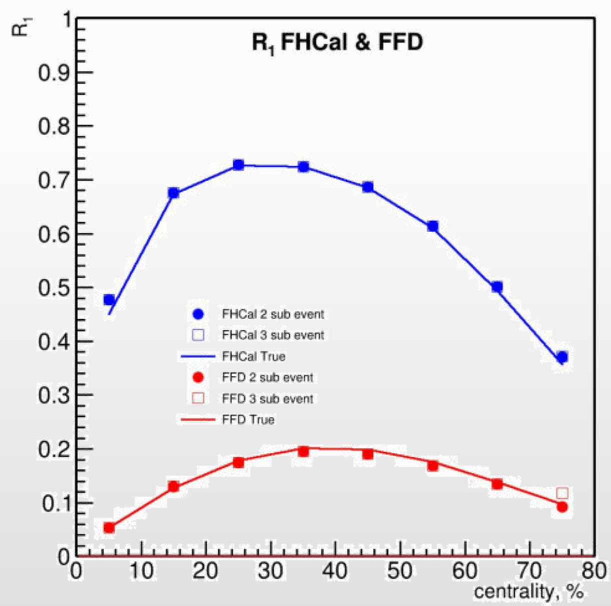
- Centrality Wagon calculates centrality for all available mass productions, including Request 28 production with the reduced magnetic field

FFD as a reaction plane detector

- Forward FFD detector – 2 arrays (40 channels each) of Cherenkov detectors



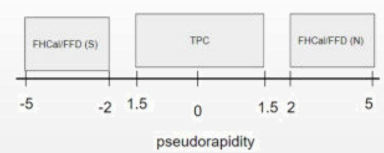
- Event plane resolution with FFD and FHCAL:



2 sub event

$$R_{1,i} = \sqrt{\langle Q^N_{1,i} Q^S_{1,i} \rangle}, i = x, y$$

$$R^{True}_{1,i} = \langle Q_{1,i} \Psi_{RP} \rangle$$



3 sub event

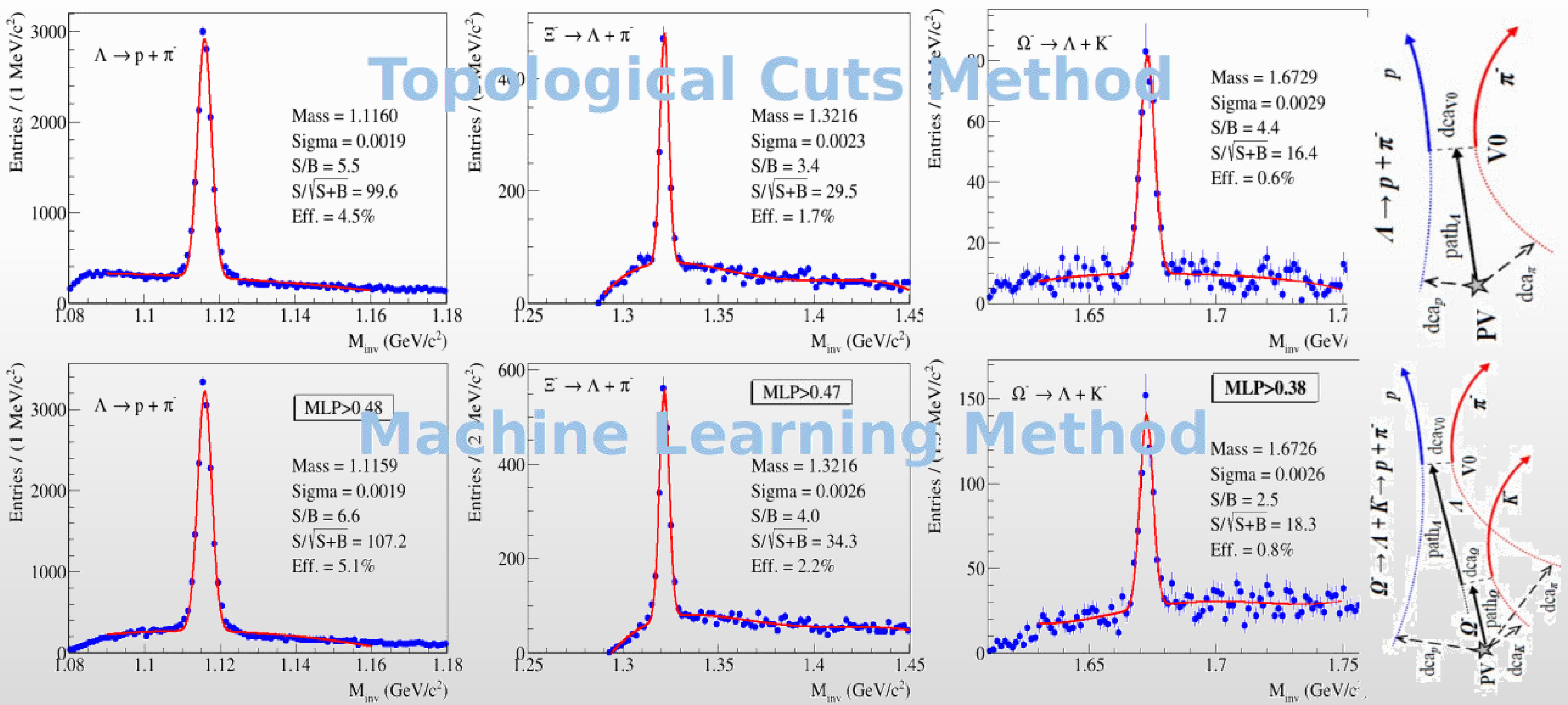
$$R^N_{1,i} = \sqrt{\frac{2\langle Q^N_{1,i} Q^S_{1,i} \rangle \langle Q^S_{1,i} Q^{TPC}_{1,i} \rangle}{\langle Q^N_{1,i} Q^{TPC}_{1,i} \rangle}}$$

Good agreement for 2 and 3 sub event methods

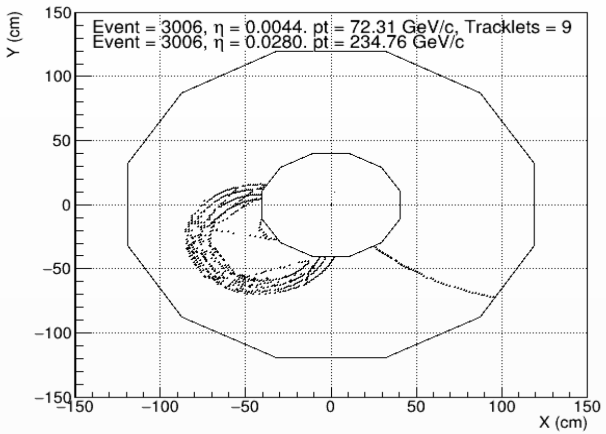
- FFD resolution is much worse than that of FHCAL
- Flow measurements with FFD are possible (backup solution) but require much larger statistics

Machine learning techniques at MPD

- TPC fast digitizer
- PID for TOF matched TPC tracks
- Open charm reconstruction with ITS
- Hyperon reconstruction



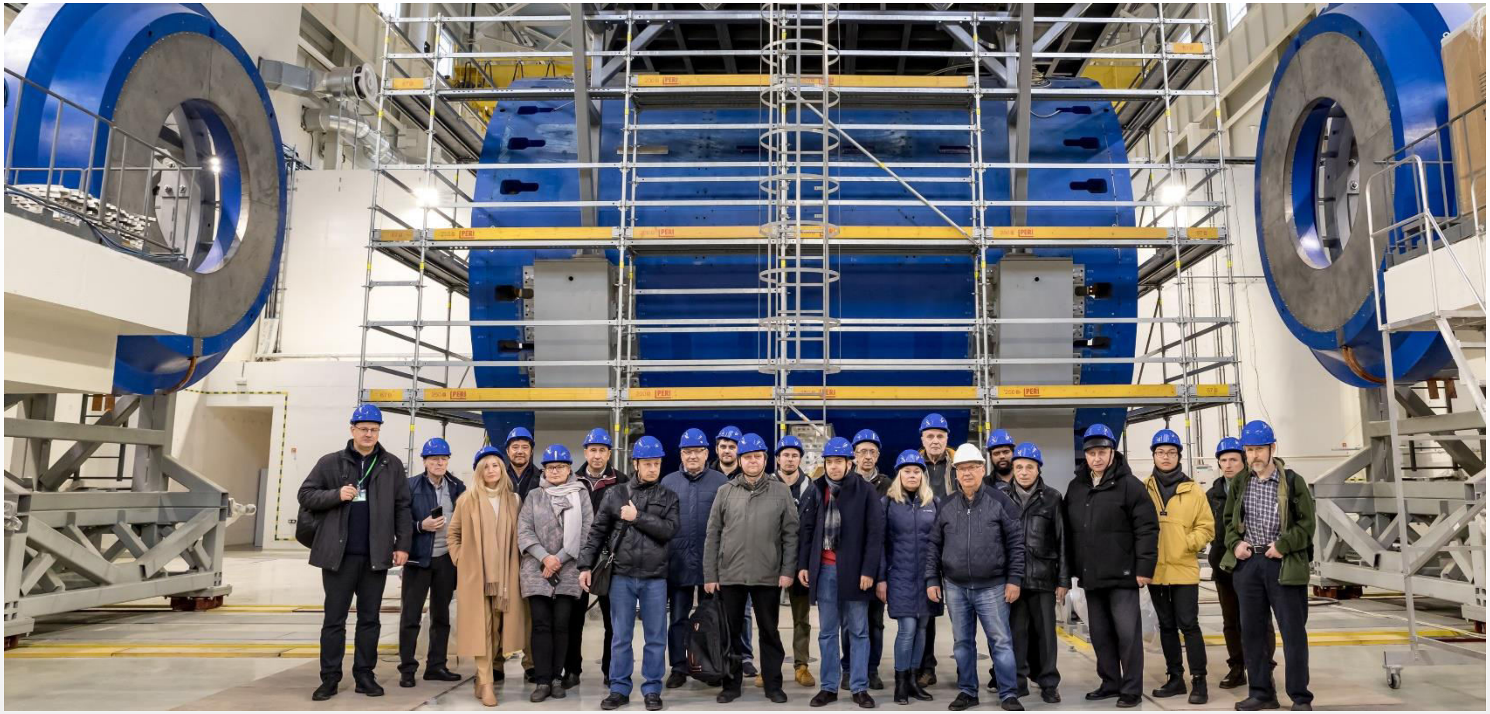
Dielectrons



- ❖ With current track reconstruction algorithm, low p_T tracks are not reconstructed properly even though full hit information is available in the detector for tracks with $p_T \gtrsim 30$ MeV → major source of CB.
- ❖ Tracks with p_T <~ 100 MeV do not cross the TPC (hence don't reach TOF → Not defined as fully reconstructed).

- ❖ Possible solutions → higher tagging efficiency of Dalitz and conversion electrons:
  - ✓ fully reconstructed conversion and Dalitz pairs
  - ✓ Dalitz pairs reconstructed as e-γ pairs using TPC/TOF and ECAL
  - ✓ Selection of good e-track candidates in a narrower η-range, looser e-ID/selection cuts to increase probability to find a Dalitz/conversion partner in the detector
- ❖ Running with the most realistic simulations (recent mass productions)
- ❖ p_T-integrated S/B ~ 0.05 in 0.2-1.5 GeV/c^2 → expects further improvements

Summary



- ❖ Preparation of the MPD detector and experimental program is ongoing, all activities are continued
- ❖ Commissioning and start of data taking → 2025
- ❖ Further program will be driven by the physics demands and NICA capabilities

BACKUP

RHIC BES program

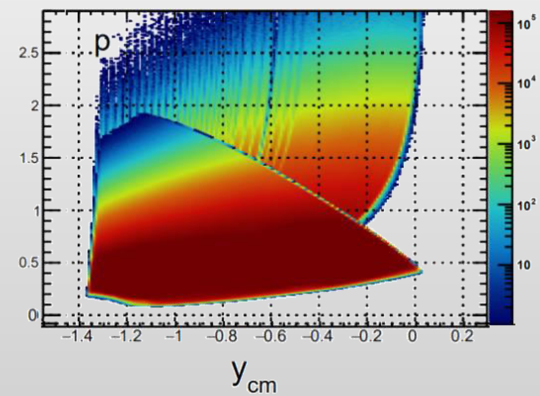
- Data taking by STAR at RHIC: 3 < $\sqrt{s_{NN}}$ < 200 GeV (750 < μ_B < 25 MeV)

Au+Au Collisions at RHIC

Collider Runs						Fixed-Target Runs					
	$\sqrt{s_{NN}}$ (GeV)	#Events	μ_B	y_{beam}	run		$\sqrt{s_{NN}}$ (GeV)	#Events	μ_B	y_{beam}	run
1	200	380 M	25 MeV	5.3	Run-10, 19	1	13.7 (100)	50 M	280 MeV	-2.69	Run-21
2	62.4	46 M	75 MeV		Run-10	2	11.5 (70)	50 M	320 MeV	-2.51	Run-21
3	54.4	1200 M	85 MeV		Run-17	3	9.2 (44.5)	50 M	370 MeV	-2.28	Run-21
4	39	86 M	112 MeV		Run-10	4	7.7 (31.2)	260 M	420 MeV	-2.1	Run-18, 19, 20
5	27	585 M	156 MeV	3.36	Run-11, 18	5	7.2 (26.5)	470 M	440 MeV	-2.02	Run-18, 20
6	19.6	595 M	206 MeV	3.1	Run-11, 19	6	6.2 (19.5)	120 M	490 MeV	1.87	Run-20
7	17.3	256 M	230 MeV		Run-21	7	5.2 (13.5)	100 M	540 MeV	-1.68	Run-20
8	14.6	340 M	262 MeV		Run-14, 19	8	4.5 (9.8)	110 M	590 MeV	-1.52	Run-20
9	11.5	157 M	316 MeV		Run-10, 20	9	3.9 (7.3)	120 M	633 MeV	-1.37	Run-20
10	9.2	160 M	372 MeV		Run-10, 20	10	3.5 (5.75)	120 M	670 MeV	-1.2	Run-20
11	7.7	104 M	420 MeV		Run-21	11	3.2 (4.59)	200 M	699 MeV	-1.13	Run-19
						12	3.0 (3.85)	2000 M	750 MeV	-1.05	Run-18, 21

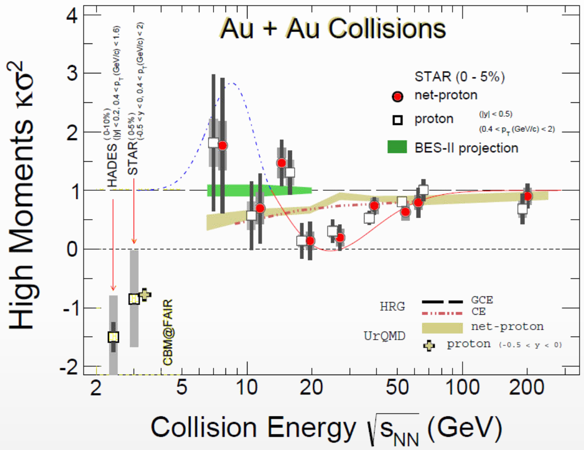
- A very impressive and successful program with many collected datasets, already available and expected results
- Limitations:
  - ✓ Au+Au collisions only
  - ✓ Among the fixed-target runs, only the 3 GeV data have full mid-rapidity coverage for protons (|y| < 0.5), which is crucial for physics observables

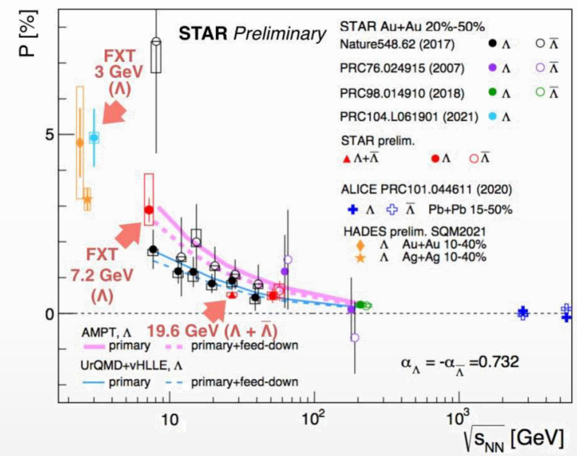
Au+Au @ 3.9 GeV

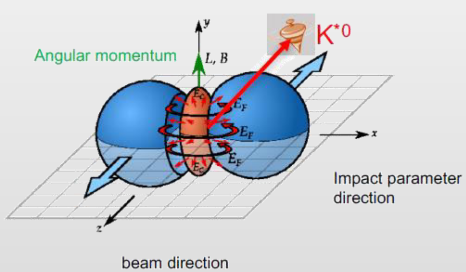


Hot topics to fill the gaps

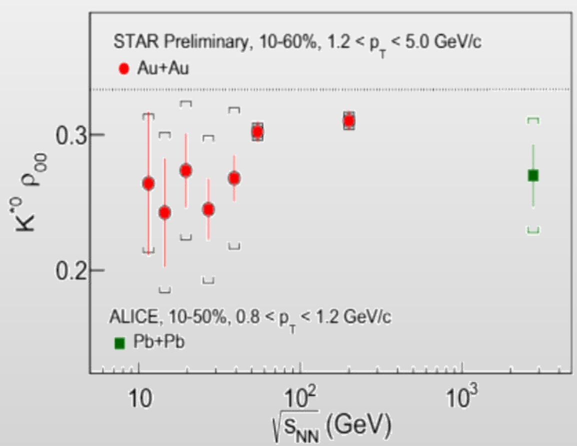
- Critical fluctuations for (net)proton/kaon multiplicity distributions
- Global hyperon polarization in mid-central A+A collisions (Λ, Ξ, Ω)
- Spin alignment of vector mesons ($K^*(892)$, $\phi(1020)$)
- Dielectron continuum and LVMs
- ….

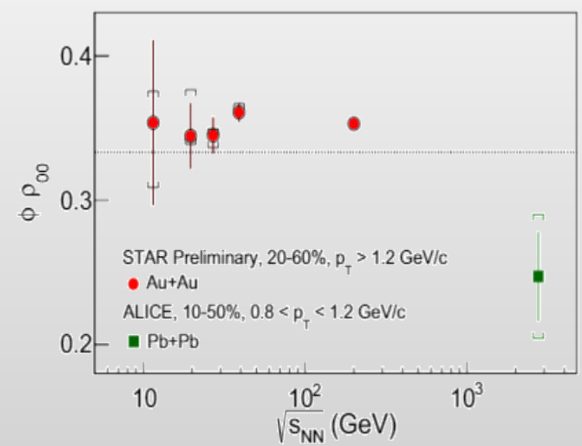






$$\frac{dN}{dcos\theta} = N_0\left[1 - \rho_{0,0} + cos^2\theta\left(3\rho_{0,0} - 1\right)\right]$$

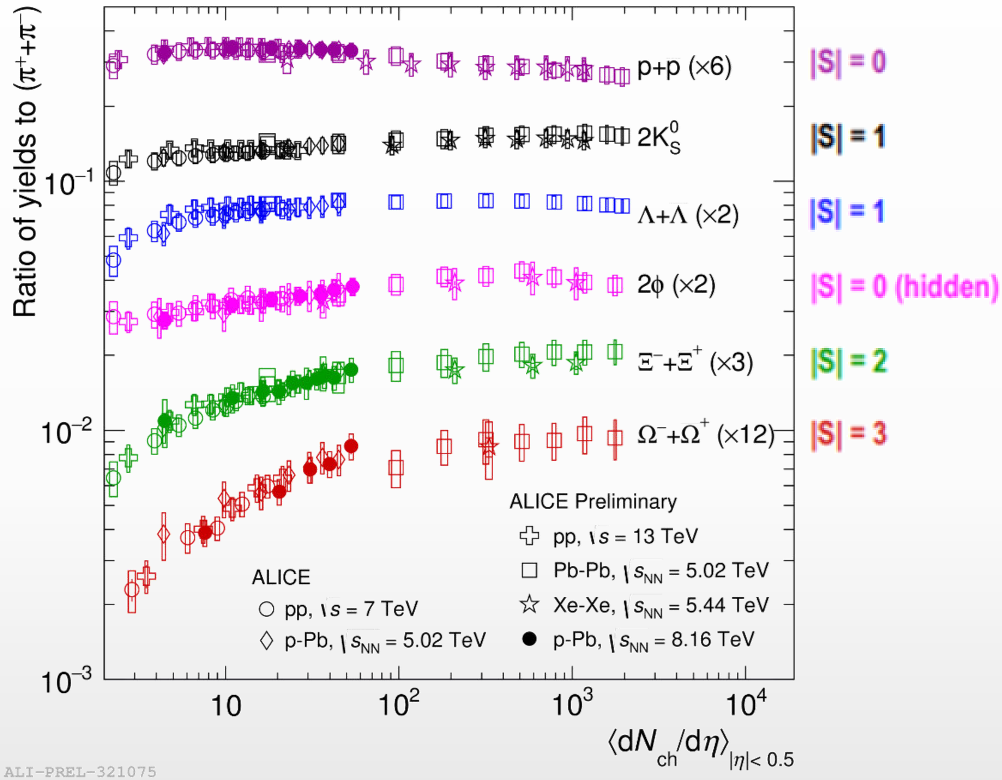


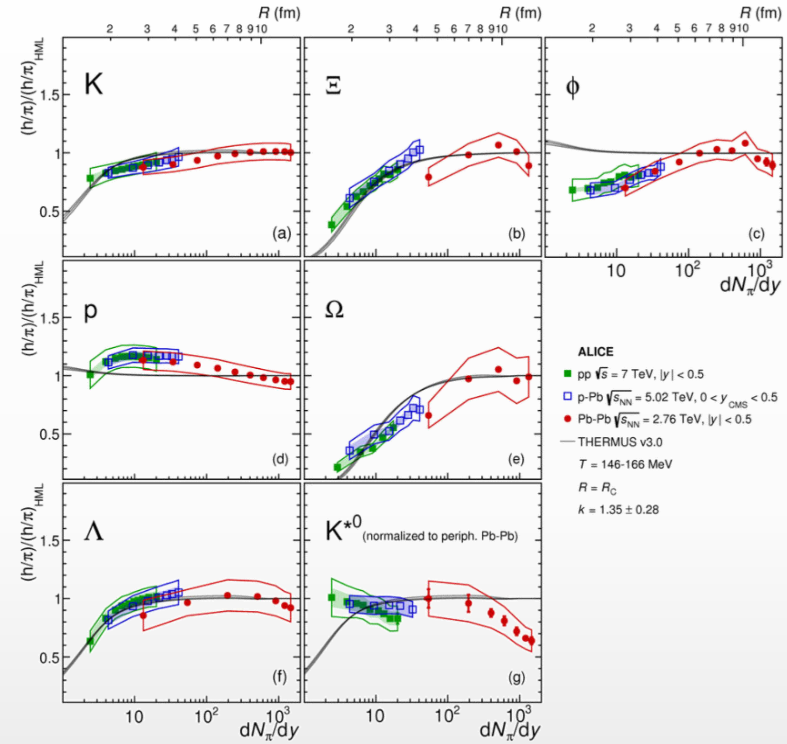


Strangeness enhancement: pp, p-A, A-A

❖ Predicted and experimentally observed in heavy-ion collisions at AGS, SPS, RHIC and LHC energies

Nature Phys. 13 (2017) 535





❖ Discovery of ALICE - smooth evolution of enhancement vs. multiplicity in pp, p-A and A-A

❖ Origin of the strangeness enhancement in small/large systems is still under debate:

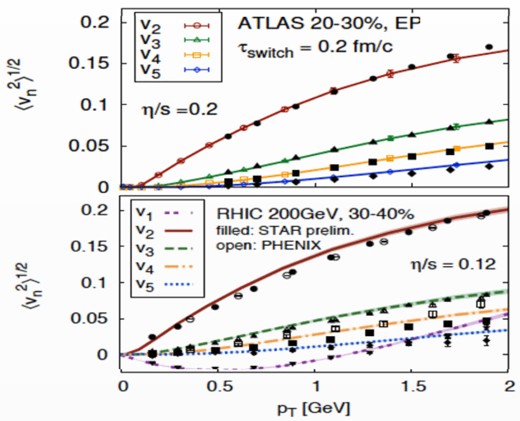
- ✓ strangeness enhancement in QGP contradicts with the observed collision energy dependence
- ✓ strangeness suppression in pp within canonical suppression models reproduces most of results except for ϕ(1020)

❖ System size scan for (multi)strange baryon and meson production is a key to understanding of strangeness production → unique capability of the MPD in the NICA energy range

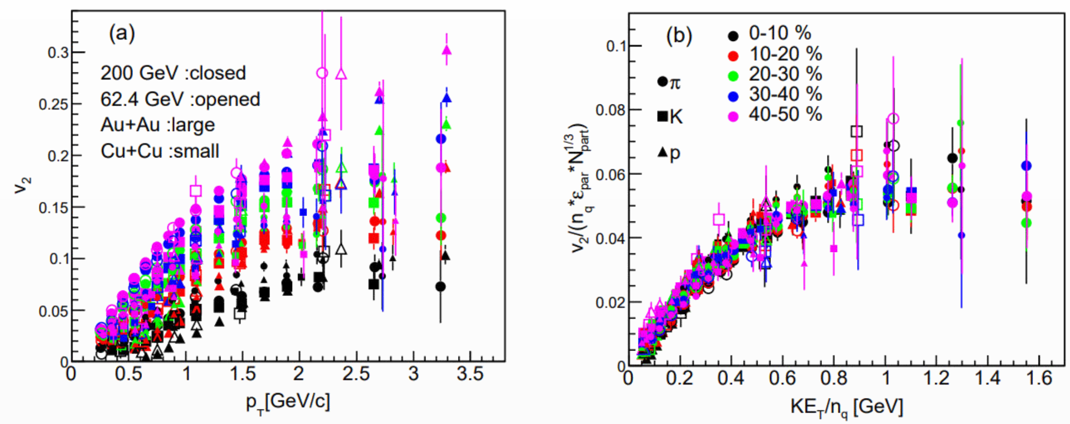
Anisotropic flow in large/small systems

- A+A: initial eccentricity and its fluctuations drive v_n with specific viscous modulation

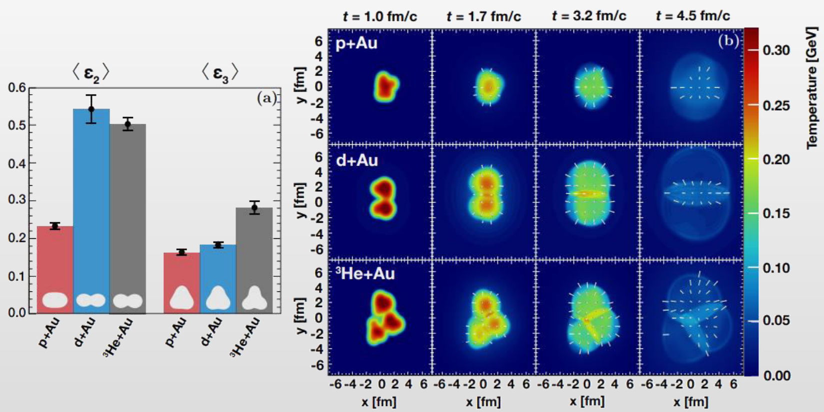
Gale, Jeon et al., Phys. Rev. Lett. 110, 012302



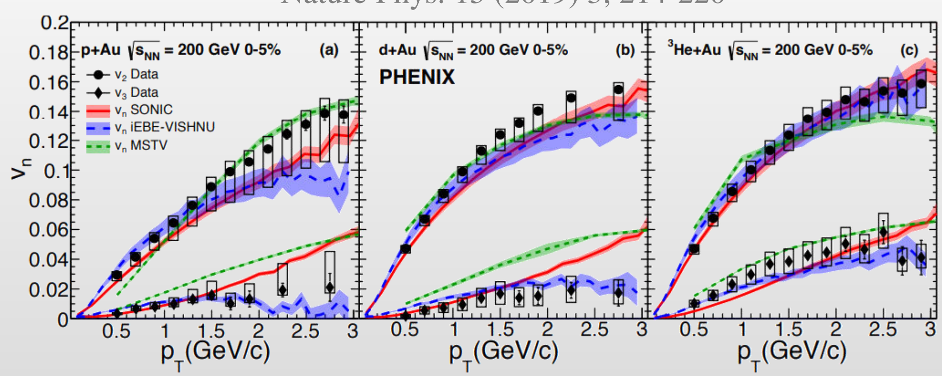
Phys.Rev.C 92 (2015) 3, 034913



- p/d/^{3}He+A: v_n's are correlated to the initial geometry, the only explanation is formation of short-lived QGP droplets in collisions of light and heavy nuclei



Nature Phys. 15 (2019) 3, 214-220

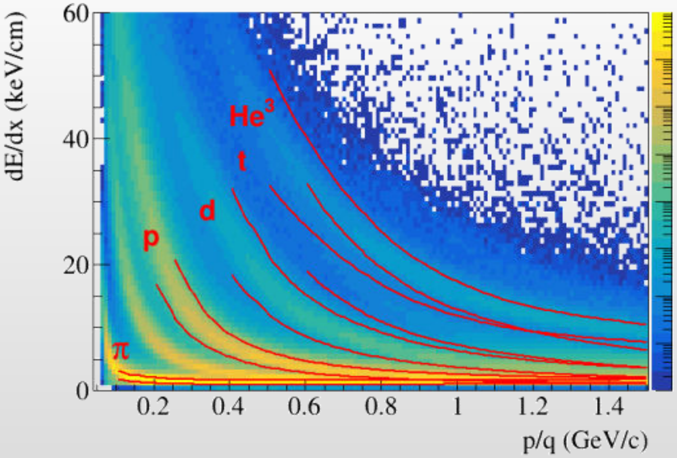


System size scan for flow measurements is vital for understanding of the medium transport properties and onset of the phase transition → unique capability of the MPD in the NICA energy range

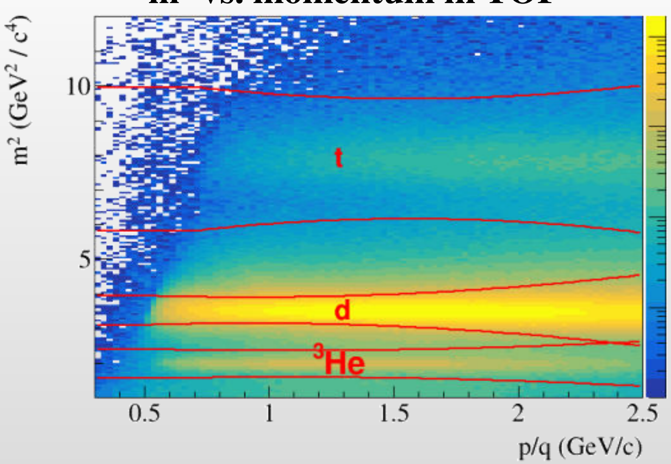
High-energy heavy-ion reaction data

- Galactic Cosmic Rays composed of nuclei (protons, … up to Fe) and E/A up to 50 GeV
- Cosmic rays are a serious concern to astronauts, electronics, and spacecraft.
- The damage is proportional to Z^2, secondary production of p, d, t, ^{3}He, and ^{4}He is also significant
- Need input information for transport codes for shielding applications (Geant-4, Fluka, PHITS, etc.):
  - ✓ total, elastic/reaction cross section
  - ✓ particle multiplicities and coallecense parameters
  - ✓ outgoing particle distributions: $d^2N/dEd\Omega$
- NICA can deliver different ion beam species and energies:
  - ✓ Targets of interest (C = astronaut, Si = electronics, Al = spacecraft) + He, C, O, Si, Fe, etc.
- No data exist for projectile energies > 3 GeV/n

dE/dx vs. momentum in TPC



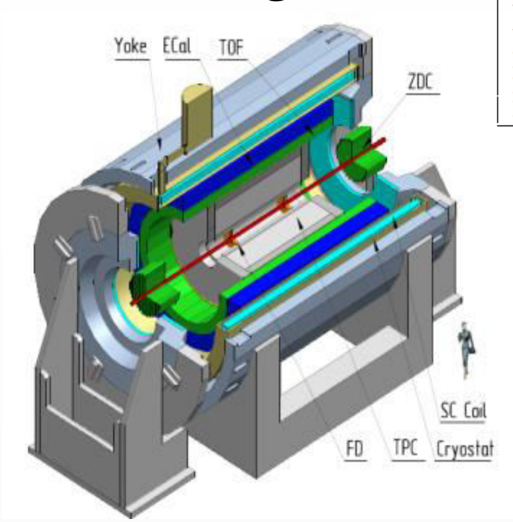
m² vs. momentum in TOF



Light fragment identification in a wide y-range → <u>unique capability of the MPD</u> in the NICA range

Multi-Purpose Detector

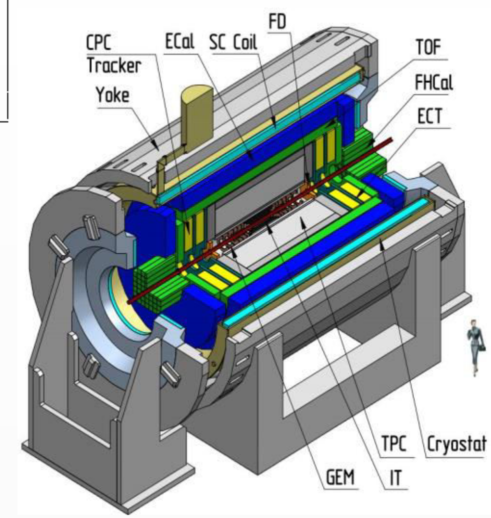
Stage- I



Length	340 cm
Vessel outer radius	140 cm
Vessel inner radius	27 cm
Default magnetic field	0.5 T
Drift gas mixture	90% Ar+10% CH_4
Maximum event rate	7 kHz ($L = 10^{27}$ $cm^{-2}s^{-1}$)

upgrade

Stage- II



TPC: $|\Delta\varphi| < 2\pi$, $|\eta| \leq 1.6$

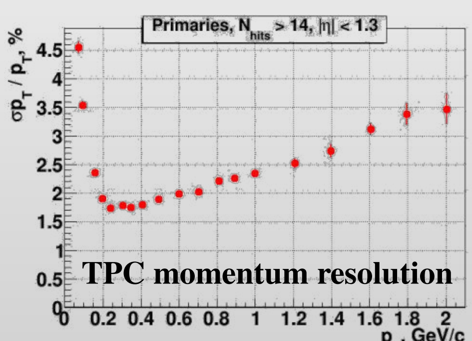
TOF, EMC: $|\Delta\varphi| < 2\pi$, $|\eta| \leq 1.4$

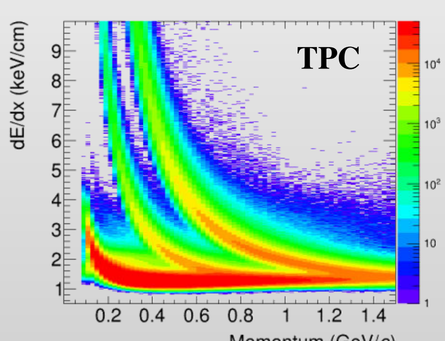
FFD: $|\Delta\varphi| < 2\pi$, $2.9 < |\eta| < 3.3$

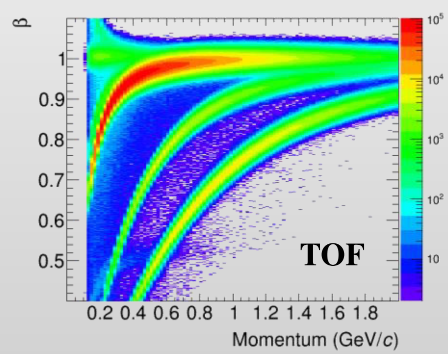
FHCAL: $|\Delta\varphi| < 2\pi$, $2 < |\eta| < 5$

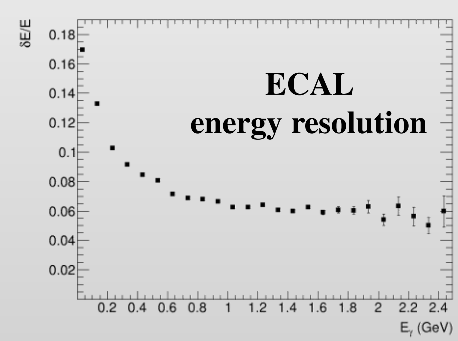
+ **ITS** (heavy-flavor measurements)
+ **forward spectrometers**

Au+Au @ 11 GeV (UrQMD + full chain reconstruction)

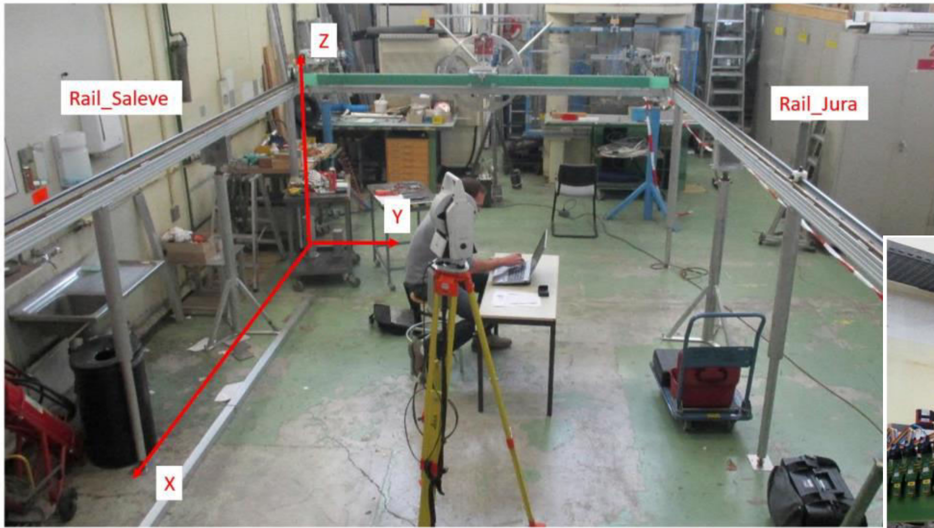




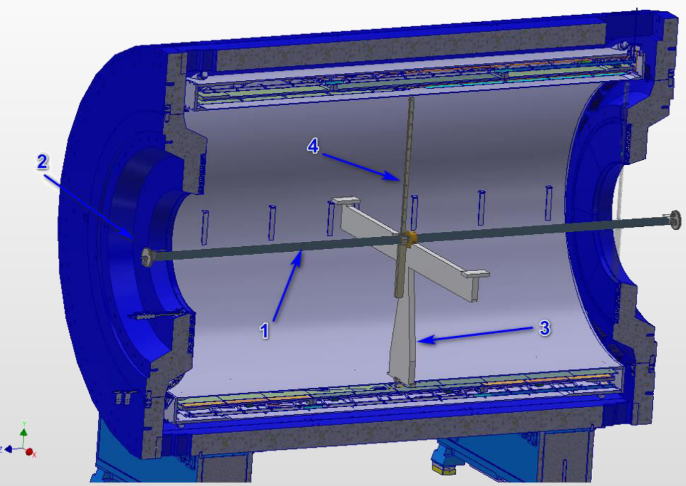




Magnetic field measurements



❖ CERN design of mapper :
- ✓ 38 Hall probes move in z and ϕ directions
- ✓ accuracy – 1.5-2.0 Gs
- ✓ range of fields 0.57 -0.5 T



❖ Concept of Novosibirsk INP mapper:
- ✓ 1 Hall 3D probe moves in 3 directions: z, R, ϕ
- ✓ accuracy: 0.3 – 0.5 Gs
- ✓ range of fields: 0.2-0.57 T

1. Aluminum (carbon fiber plastic) guiding rod
2. End cap fixation
3. Intermediate support
4. Carbon fiber plastic carriage