Warsaw University of Technolgy in the NICA Project at JINR

Adam Kisiel

The NICA-PL Consortium

Warsaw University of Technology

National Center for Nuclear Research in Świerk

University of Warsaw

Jan Kochanowski University in Kielce

NICA-PL Consortium

- Agreement of the four Polish institutions (Warsaw University of Technology, Warsaw University, National Center of Nuclear Research in Świerk, Jan Kochanowski University of Kielce) "to carry out scientific research, specialist education, design and construction of the scientific and control equipment for the purpose of the NICA research complex at the Joint Institute of Nuclear Research in Dubna".
- Consortium is open for new members and foresees the addition of more polish institutions (University of Wrocław)
- Members of the Consortium have joined MPD and/or BM@N Collaborations, three MoUs being signed today
- Consortium will be a common vehicle for application for funding in various funding agencies (national and European)

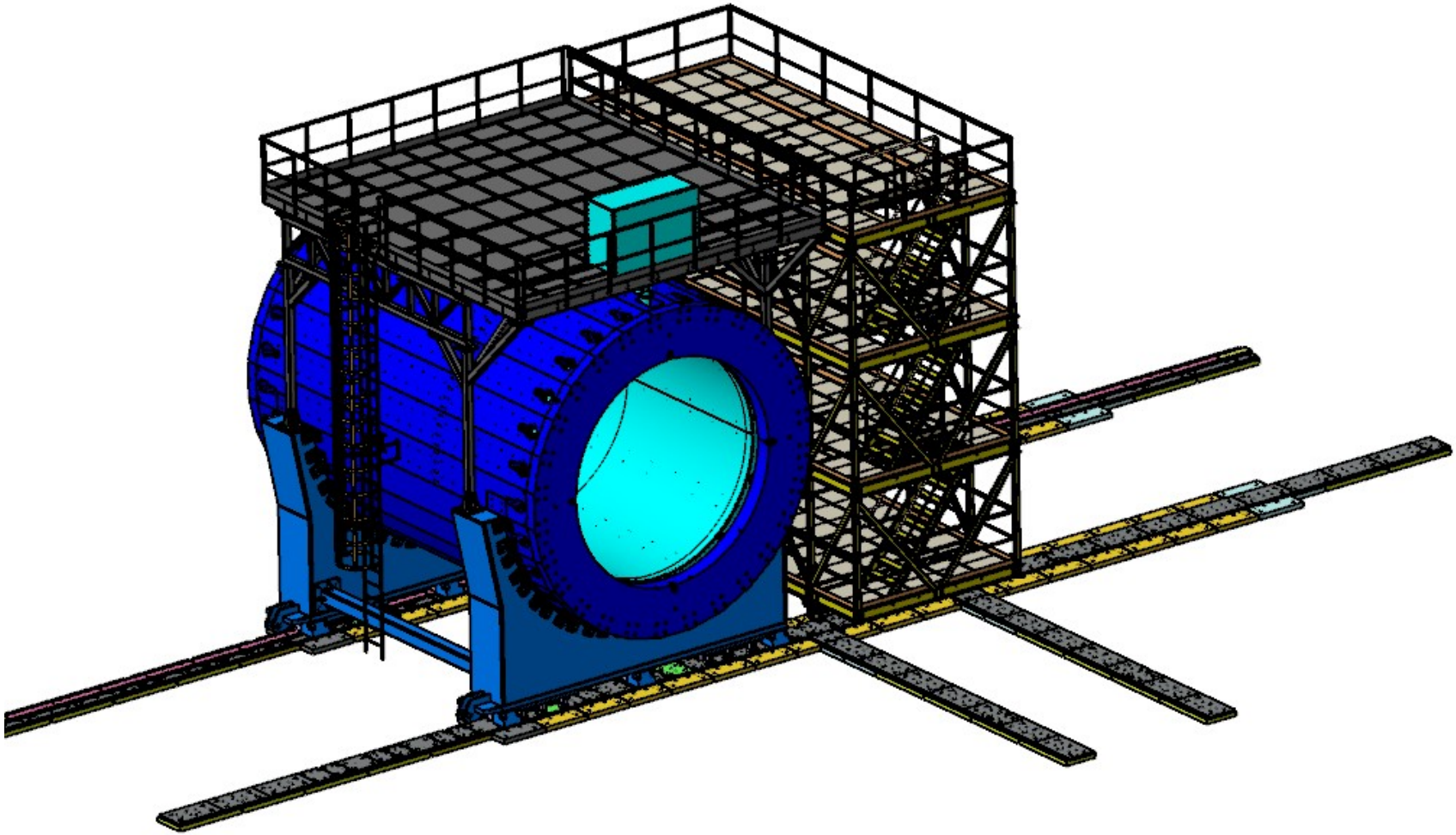
WUT at NICA (JINR)

- Established local group at JINR
  - Adam Kisiel – MPD Spokesperson
  - Marek Peryt – head of the Engineering Sector
  - Two PhDs permanently at JINR full-time + 2 more since 2019
  - Long-term stays of engineers at VBLHEP (up to 6 months)
  - Intensive summer practices (2 weeks, 4 weeks)
  - "Team for the future of NICA" programme – 3-month, student stays at JINR, rapidly growing
- Example activities at JINR
  - Organization of the MPD Collaboration activities
  - Gas system for the MPD TOF detector
  - Engineering Support group leadership
  - EqDB Database Environment
  - Design of the MPD Experimental Platform
  - MCORD detector
  - Participation in Slow Control System for MPD and BM@N

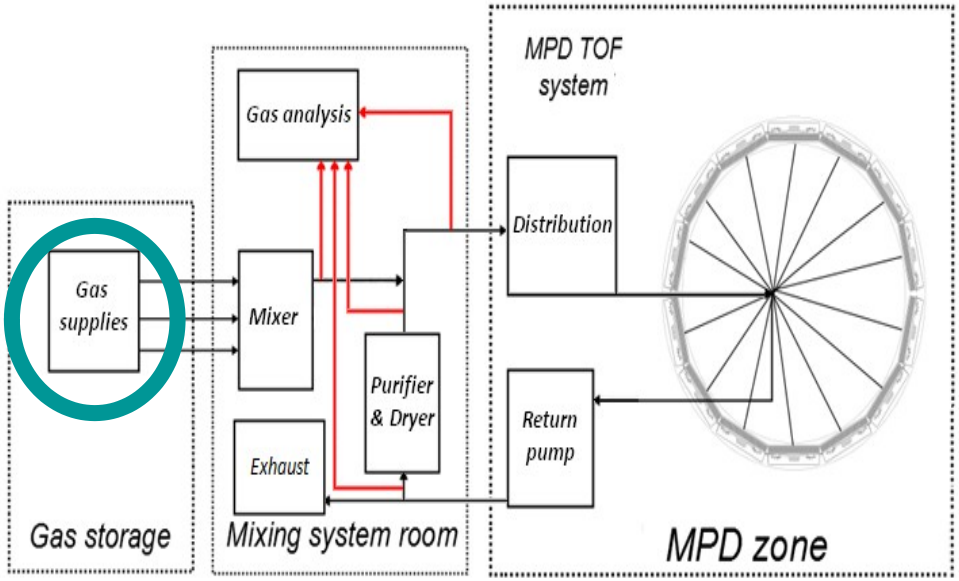
JINR and NICA impact on WUT

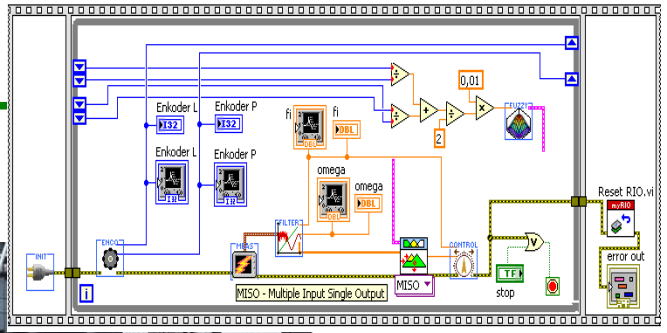
- Collaboration Framework Agreement betwen WUT and JINR
  - Enhancing the international nature of research and teaching
  - Important aspect of WUT application for Research University status, as part of the Priority Research Area
- Participation in the experimental Collaborations
  - 14 staff + 4 PhD students officially members of the MPD Collaboration
- Cross-faculty collaboration
  - Interdisciplinary groups from Faculties of: Physiscs, Electronics and Information Technology, Mechatronics, Chemistry and others
  - Activities within the Platform for High Energy Physics Experiments

NICA Multi Purpose Detector – Engineering Support Platform

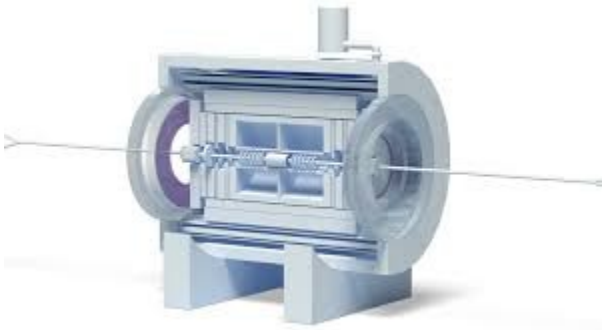


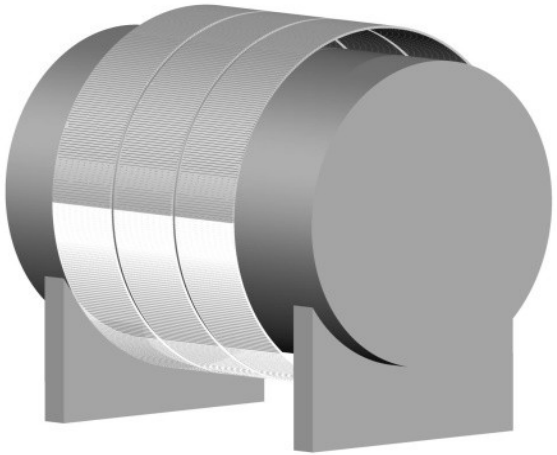
Gas system for the TOF Detector

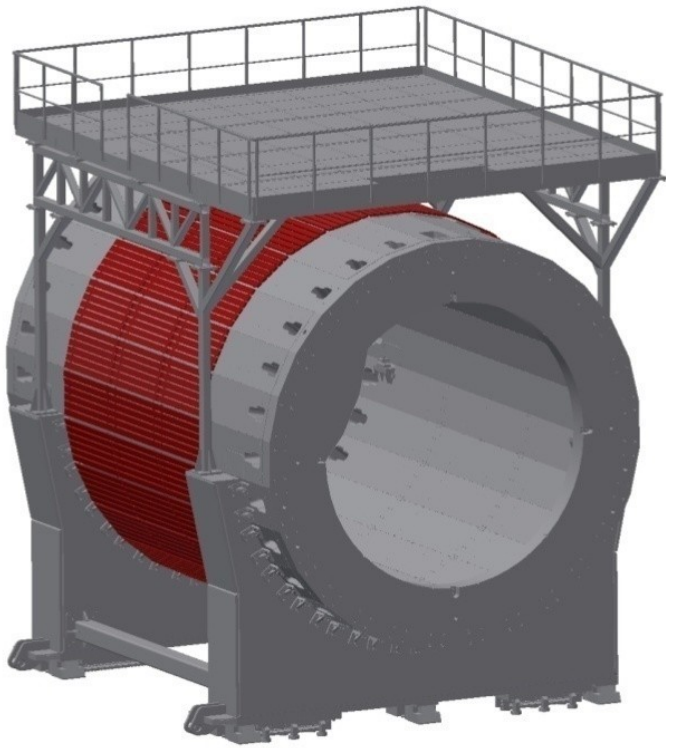




MPD Cosmic Ray Detector (MCORD) - proposal







Single surface on full circumference
Scintillator slabs read out by SiMP modules (both ends)

Expansion of possibilities

- Strong interest from Faculty of Electronics and Information Technology
  - Experience in electronics for HEP experiments (CMS muon trigger)
  - Experience in industrial system automation and control, SCADA
  - Strong software group (databases, computer graphics, event visualization, machine learning, big data)
- Significant collaboration possible thanks to continuous support from the Polish Plenipotentiary and MNiSW
- First European funding obtained via the CREMLIN+ project (electronics for BM@N)
- Establishment of the Collaboration and signing of the MoU a basis for applications for collaboration-specific funding

Partners in Poland

- Collaboration with NICA-PL consortium partners and other Polish institutions
  - Proposal, design, approval and production of the MCORD subsystem
  - Collaboration with industrial partners for the construction of MPD Platform and other Engineering Support equipment
- Benefiting from decades of experience in physics of heavy-ion collisions
  - Close cooperation with groups from ALICE (CERN) and STAR (BNL)
  - MPD/NA61 Joint Session during this conference
  - Education and development of young scientists in the physics and detector construction and operation at MPD and BM@N

Exemplary Collaboration

- JINR Directorate at WUT
- WUT visits at JINR

“Team for the future of NICA”

- Student internship program co-financed by JINR and WUT attracting young dedicated staff to the NICA project (more than 30 participants in 2017 and 2018)

“Team for the future of NICA” - explosive growth

- In 2019 more than 60 students participated in the TeFeNICA programme, significant increase over past years
- Students return to JINR for long-term stays, thesis preparation

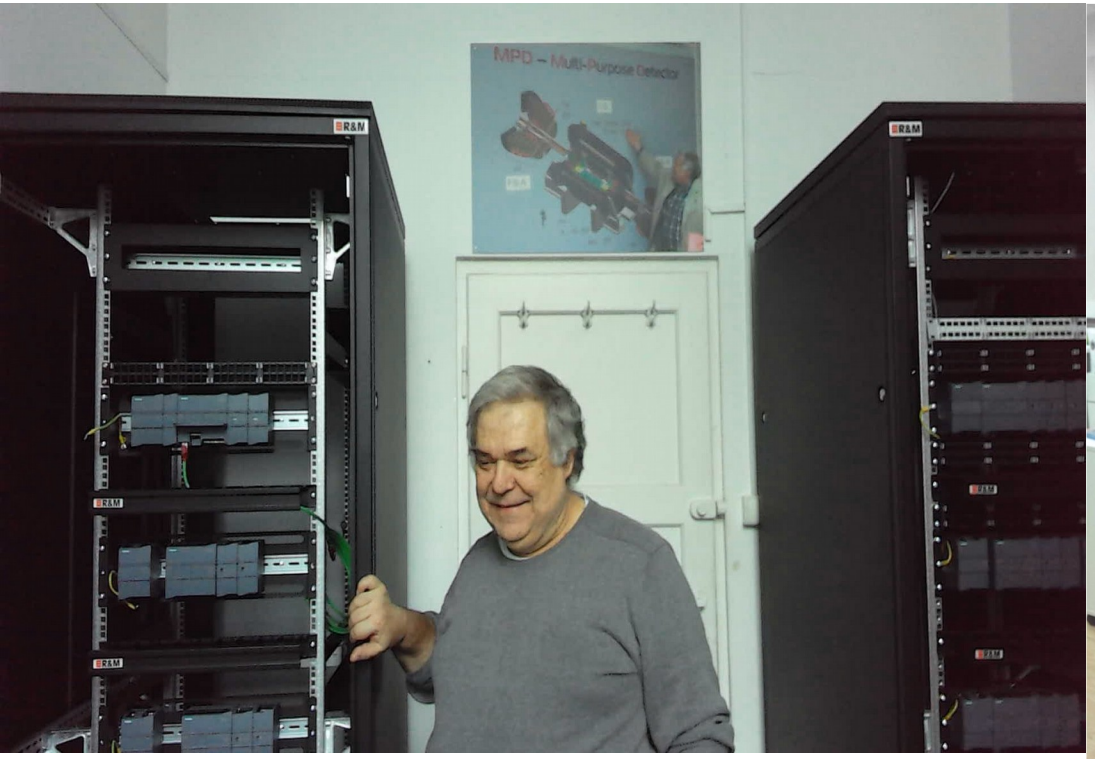
Organization of meetings

- Regular NICA Days meetings: 2015, 2017, 2019 with growing participation
- Slow Control conference every year – reports from students activities during the summer practices
- Organizer of the first MPD Collaboration Meeting outside JINR, coupled to NICA Days 2019


Welcome to:
NICA Days 2019 and
the IV-th MPD Collaboration Meeting
Center for Innovation and
Technology Transfer Management
Warsaw University of Technology
Warsaw

Slow Control System

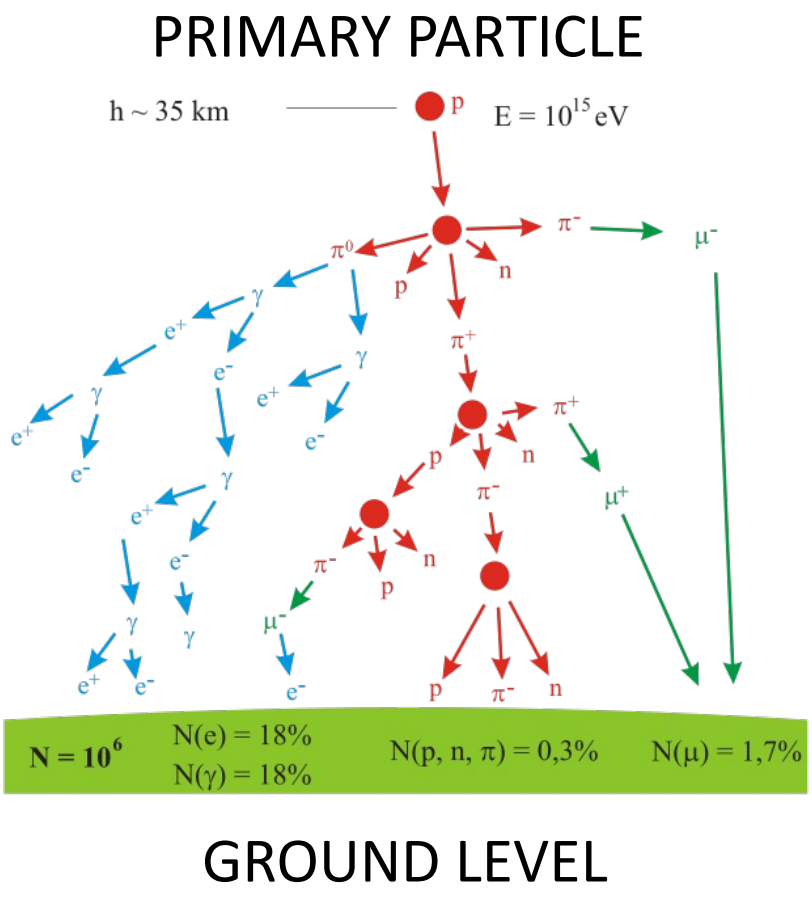
–IMPLEMENTATION; BASE UNIT 42U;

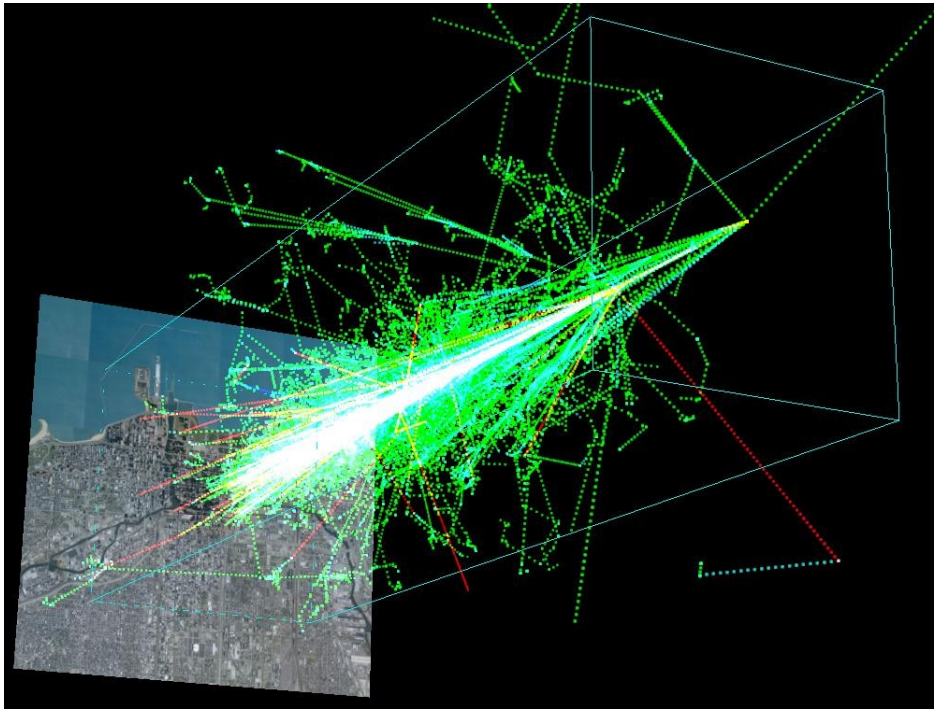


Gas System for the TOF detectors

90% $C_2H_2F_4$ + 5% i-C_4H_{10} + 5% SF_6

Cosmic Ray Detector – Goals

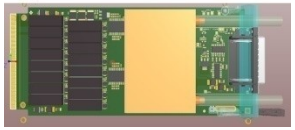




Cosmic ray air shower created by a 1TeV proton hitting the atmosphere 20 km above the Earth. The shower was simulated using the AIRES package.

MCORD - MicroTCA configuration

Analog Front-End module



FPGA mezzanine card (FMC)

AMC FMC carrier board

MTCA Carrier Hub

Standard MTCA crate
5 or 12 AMC modules
Crate number depends on channel count and sampling speed

At 250MS/s: 192 channels / crate
At 125MS/s: 384 channels / crate
At 80MS/s: 576 channels / crate
At 50MS/s: 768 channels / crate

For several MTCAs one main MCH concentrates data from slave MHCs to generate final muon trigger

- Density frontier is less explored area
  of the QCD phase diagram and its study
  could *lead to interesting discoveries*

- NICA complex has a potential for competitive research
  in the field of baryon rich matter

- Cooperation with CERN plays an essential role
  in MPD construction

- Preparations of MPD experiment
  is going close to the schedule

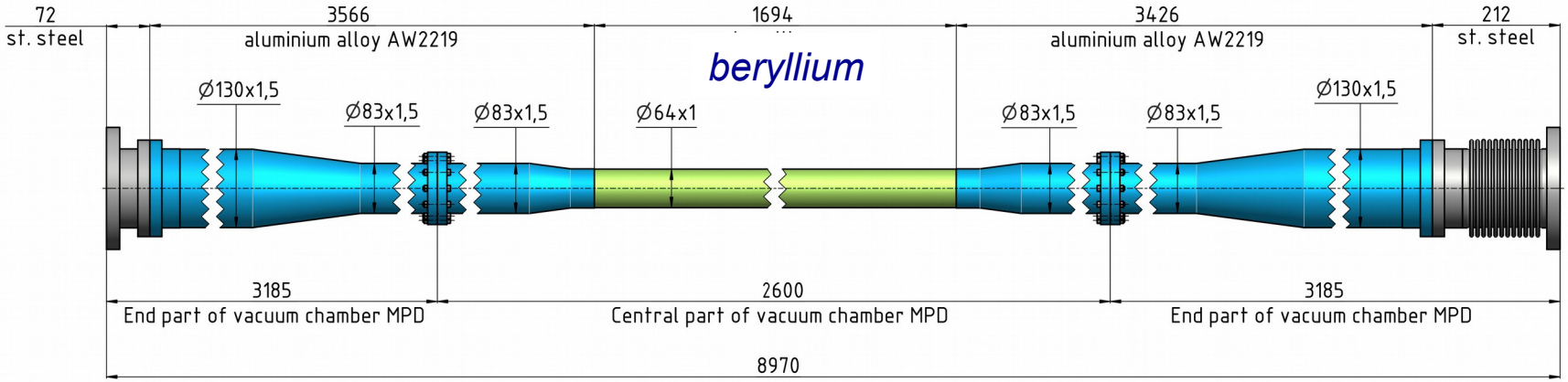
- NICA got a recognition as a part
  of European research infrastructure

- It helps to form large international MPD collaboration

beam pipe

possible cooperation with CERN

Stage I: *64 mm in diameter*



?

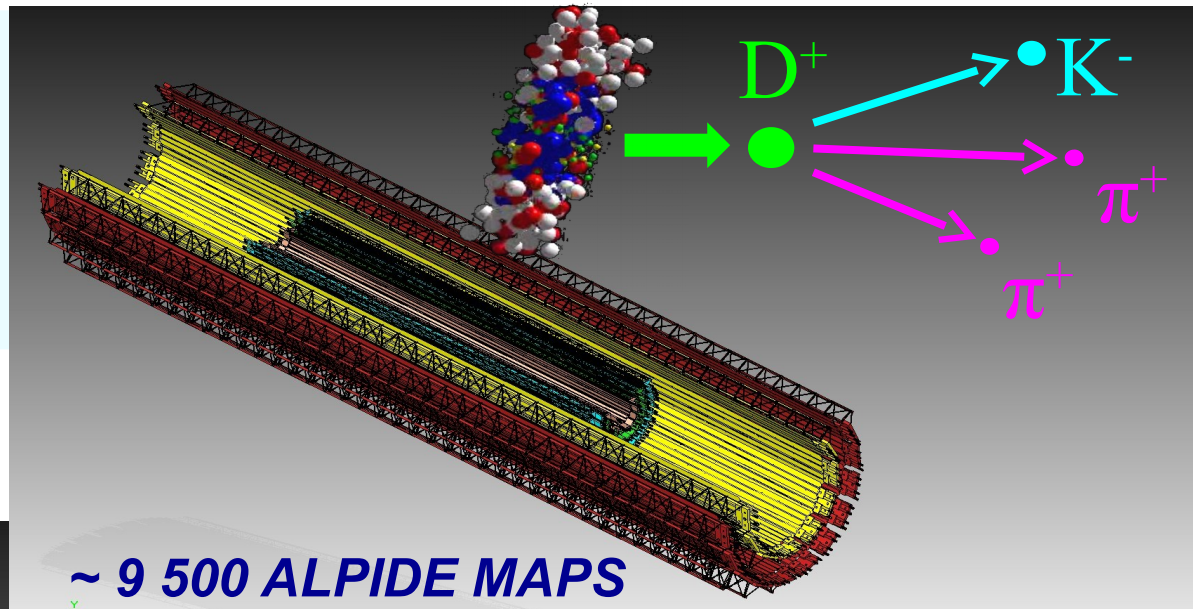
Stage II: *38 mm in diameter*

Inner Tracker System *(MPD stage II)*

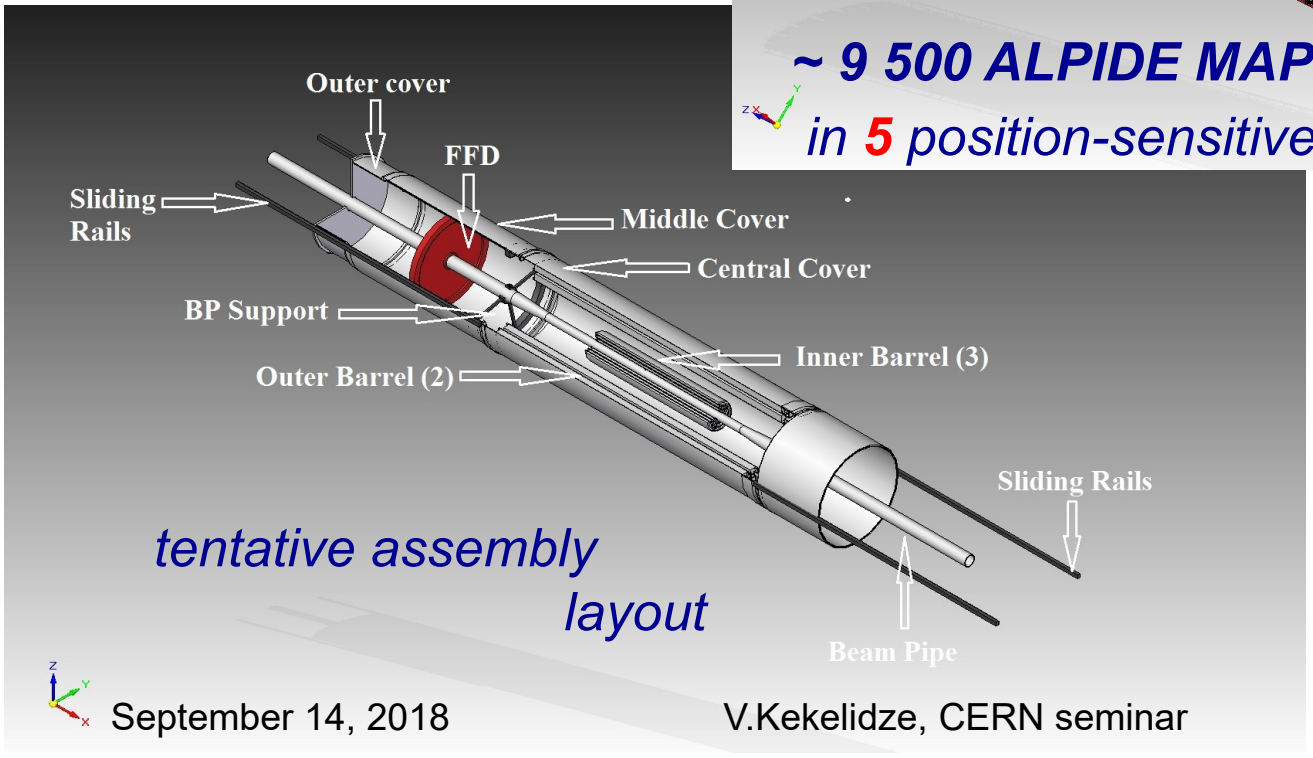
ALICE/CERN *technology transfer to* ***MPD/JINR:***

- ***MAPS*** *of new* ***ALICE ITS*** *for* ***MPD***
- *carbon fiber space frames;*

CERN*: L. Musa*
JINR*: Yu. Murin*



~ 9 500 ALPIDE MAPS
in ***5*** *position-sensitive cylinders of* ***two*** *barrels*



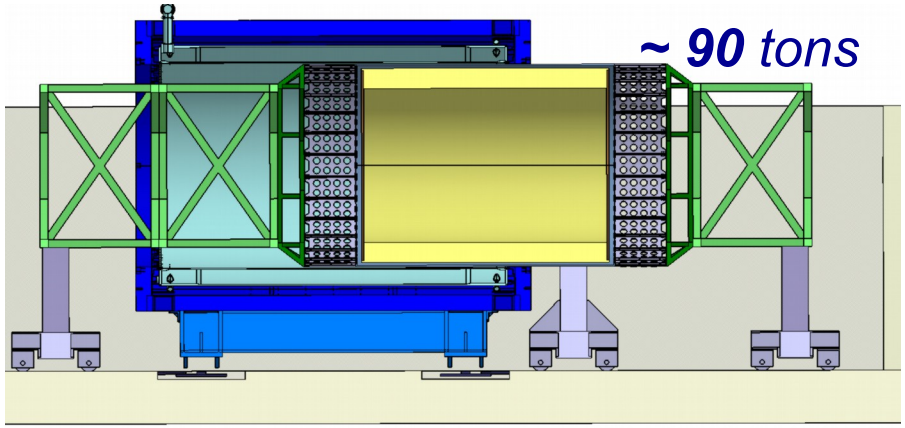
tentative assembly layout

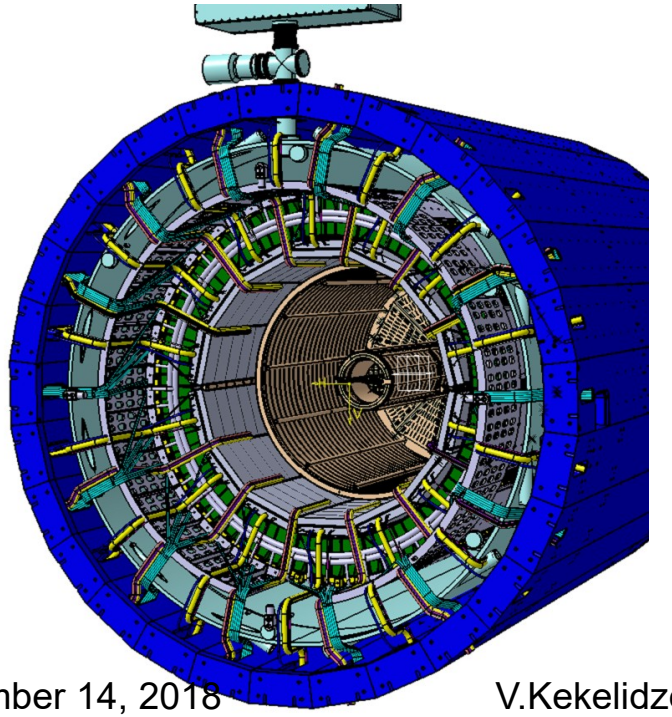
4,9 · 10⁹ *pixels*
active area ***3,9 m²****.*

max bandwidth:
400 – 1200 *Mbps*

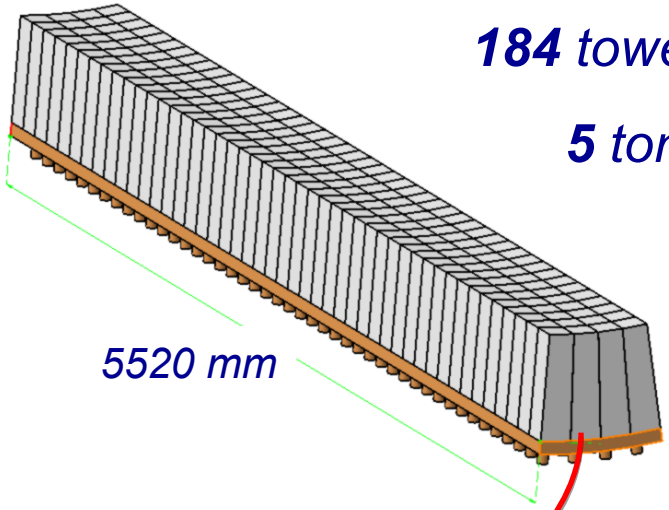
two scenarios of ECal integration

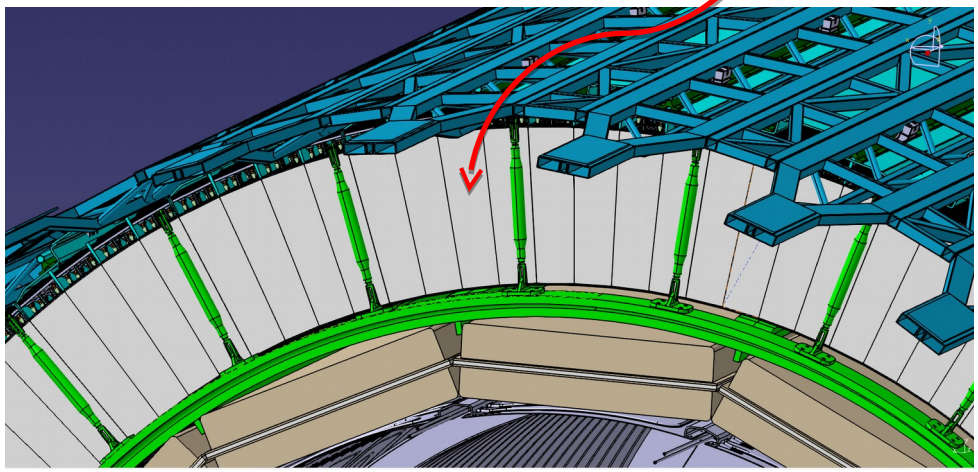
scenario A





scenario B

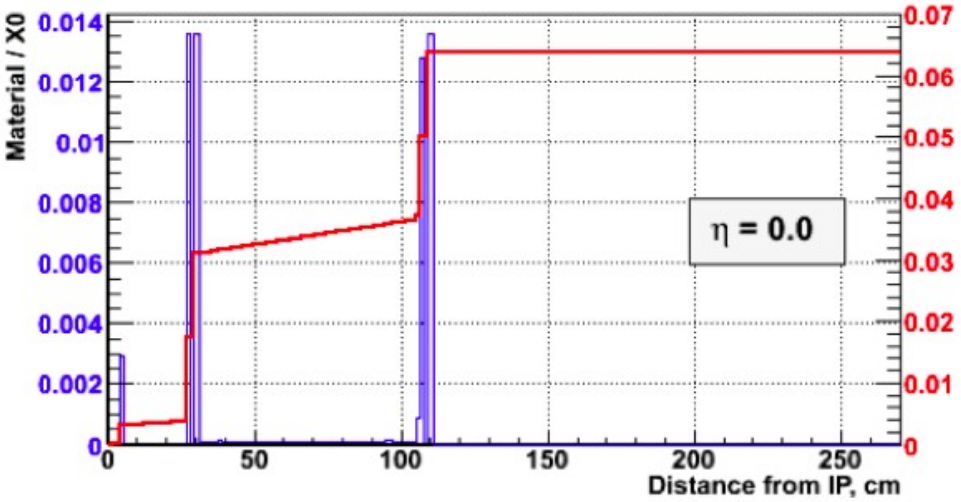


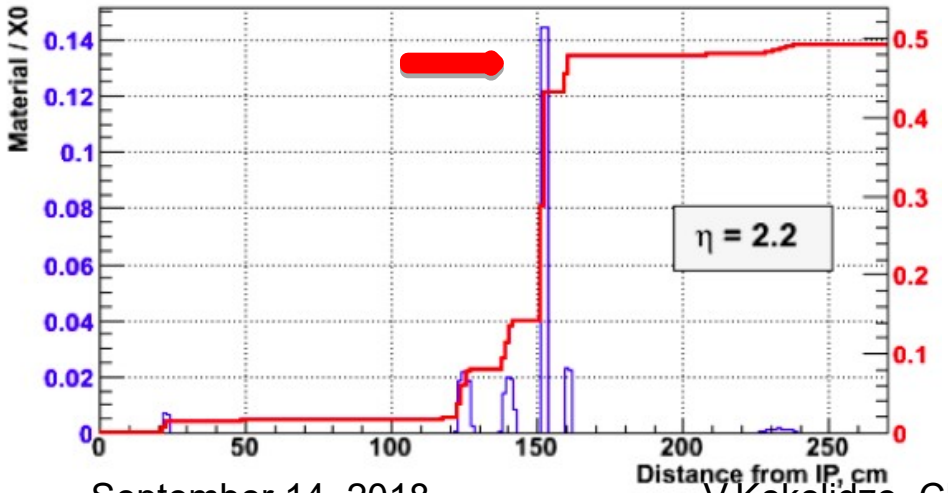


Material budget

Stage I

MWPC *based TPC readout (~* ***45%****)*





Stage II

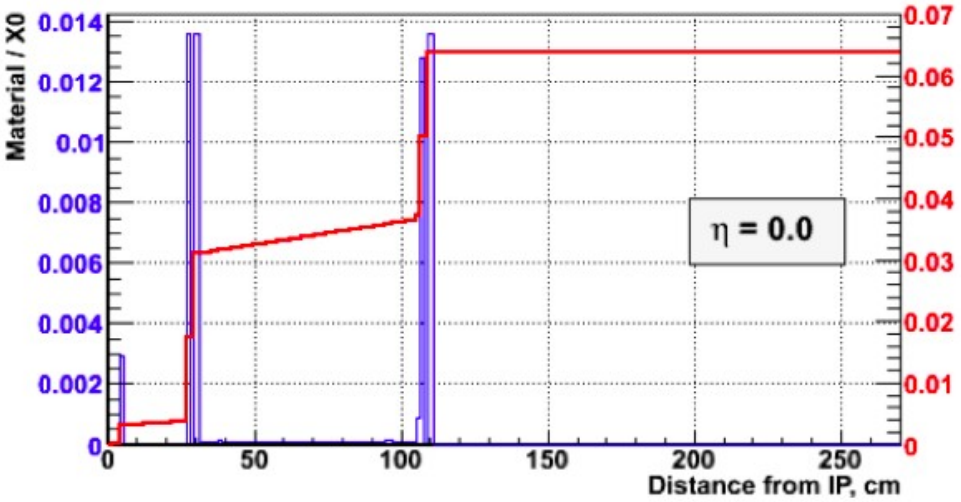
*readout chambers -> **GEM***

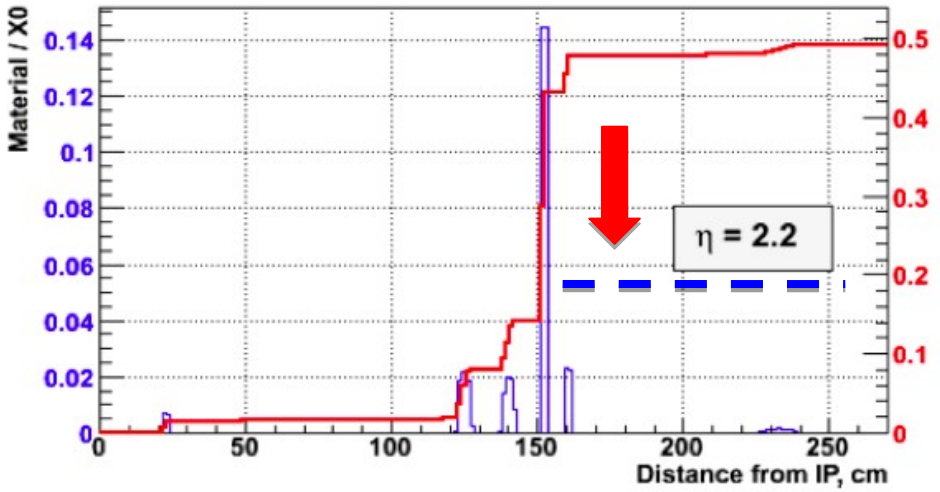
GEM *production for* ***BM@N*** *in close cooperation with* ***CERN***

Material budget

Stage I

MWPC *based TPC readout (~* ***45%****)*





Stage II

GEM *based TPC readout (<* ***20%*** *)*

Upgrade	
Gem-based chamber	X/X0,%
1.4 GEM foils Cu, 8x5 μm = 40 μm Kapton 4x50 μm = 200 μm	0.32
2. Pad plane h=1.5 mm	1.00
3. Insulating plate h=1.5 mm	0.775
4. Carbon panel h=25 mm	0.30
5. Epoxy glue (2x0.1 mm)	0.056
Air gap L=10 cm	0.03
Total:	~2.5 - 3.72
FE (based on SAMPA chip)	
FE single layer FE - 4 layers	1.0 5.0
FE Cooling	
Al pipes + plates on chips	2.5
TPC thermos-screen	1.69
Total:	~17.5

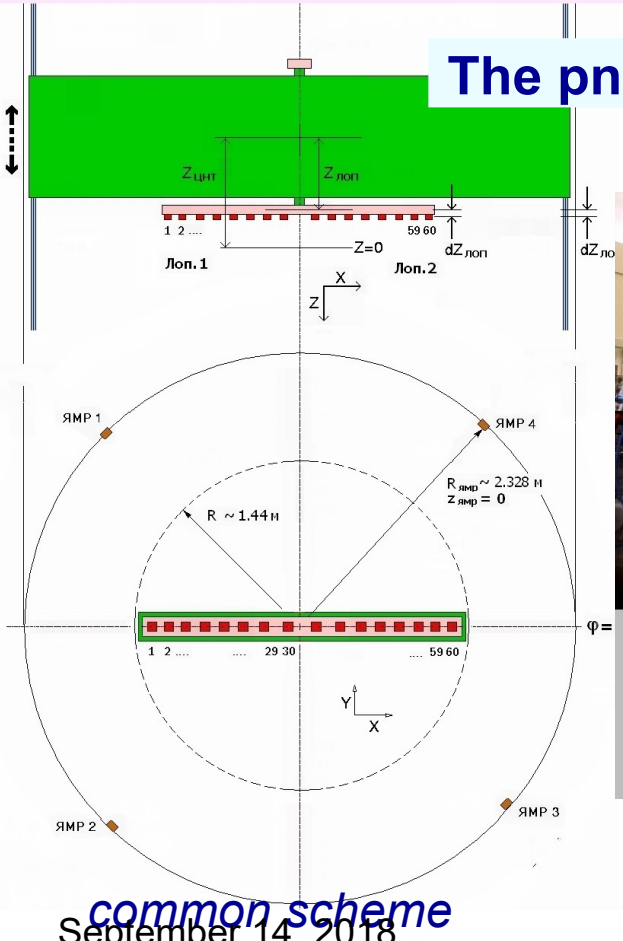
magnetic field measurement: *cooperation with **CERN***

***JINR**: V .Dodokhov, E. Koshurnikov, A. Vodopyanov;*
***CERN**: F. Bergsma, P-A. Giudichi.*

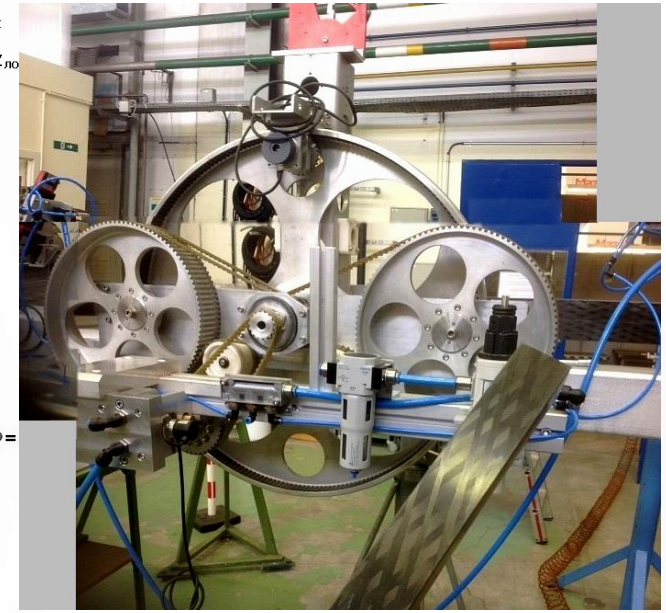
*the area occupied by **TPC**:*
***2 814** mm in diameter; **3 400** mm in length*
***Bx, Br, Bz** to be measured in ~ **8×10³** points.*

Bench layout inside cryostat

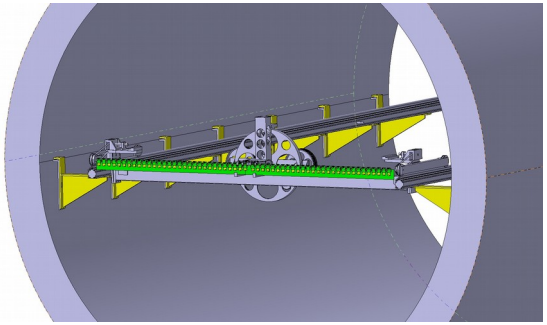
The pneumatic mapper:

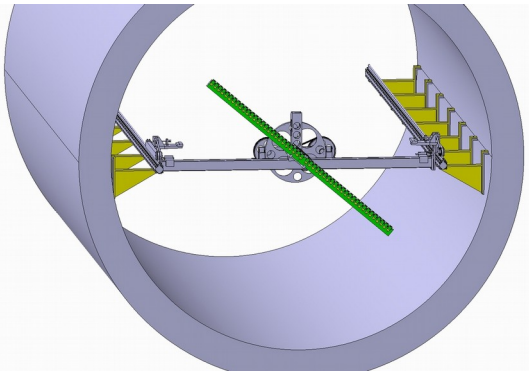


common scheme



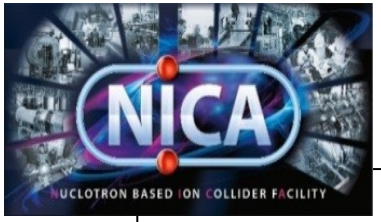
a view



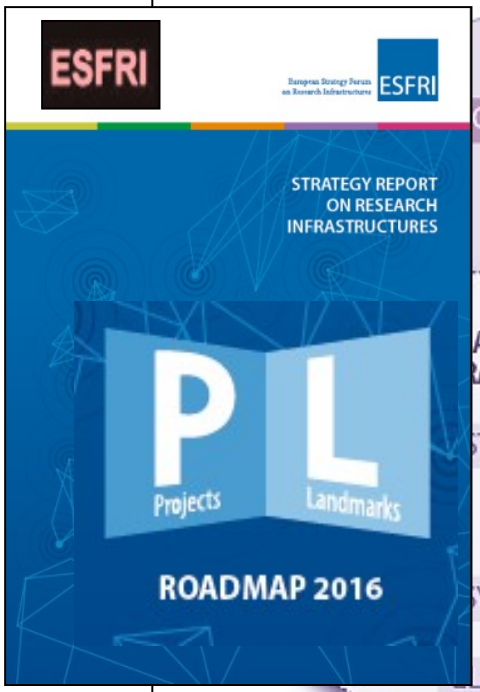


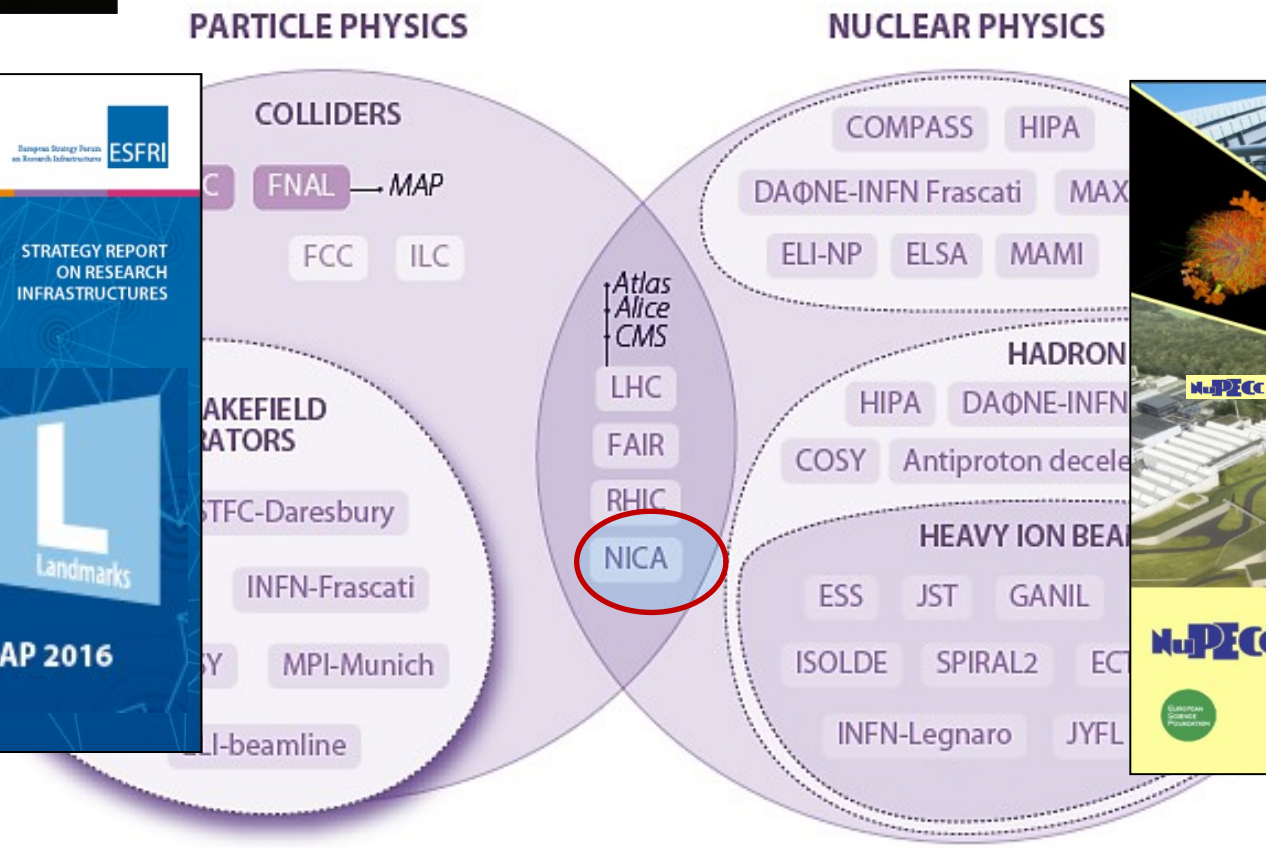
BARYONIC MATTER DENSITY FRONTIER

NICA is included in the ESFRI ROADMAP-2016 and in the NuPECC Long Range Plan 2017 - Perspectives in Nuclear Physics



Main Research Infrastructures in Particle and Nuclear Physics





kick-off meeting on formation of the MPD and BM@N Collaborations

carried out in Dubna on 11-13 April, 2018

https://indico.jinr.ru/conferenceDisplay.py?ovw=True&confId=385

Second MPD Collaboration Meeting
29-30 October 2018

New member institutes (now 32 institutes from 10 countries)
Spokesperson election: Adam Kisiel (WUT, Poland)
IB Board Chair election: Fuqiang Wang (ZJHU, China)
Project manager endorsement: Slava Golovatyuk (JINR)