

NICA-PL Consortium Status and Plans

Adam Kisiel
Warsaw University of Technology, Poland

For the NICA-PL Consortium

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, University of Warsaw, 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
- Members of the Consortium show explicit desire to join MPD and/or BM@N Collaborations
- Consortium can be a common vehicle for application for funding in various funding agencies (national and European)

Scientific background



- Collaboration of the group from Faculty of Physics (WUT) and JINR since 50 years
- Group creation by prof. Strugalski
- Since the beginning a focus on heavy-ion collisions (initially pi-Xe, measured in the liquid Xeon chamber)

Long term involvement in Collaborations

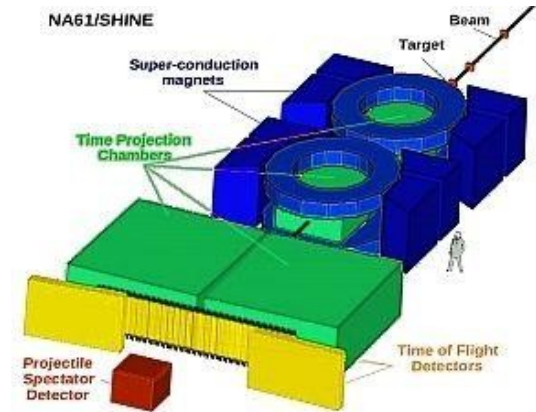
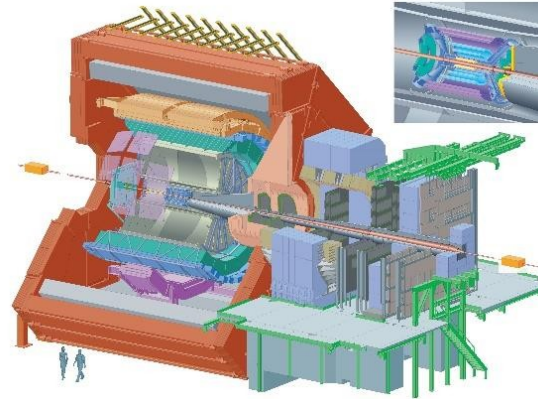
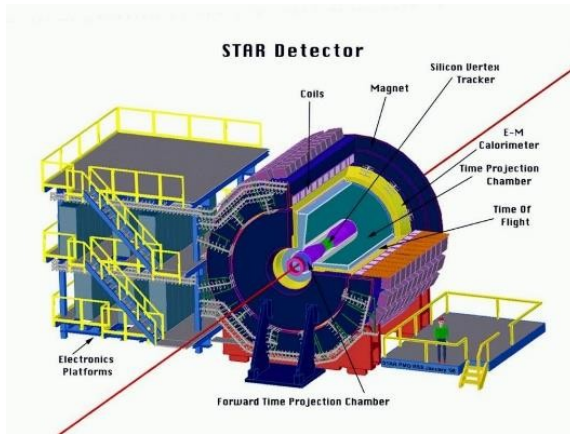
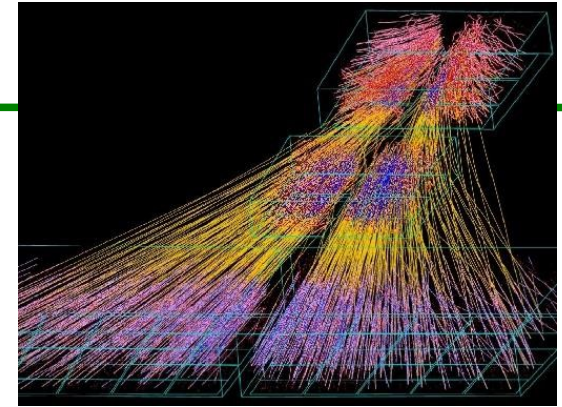
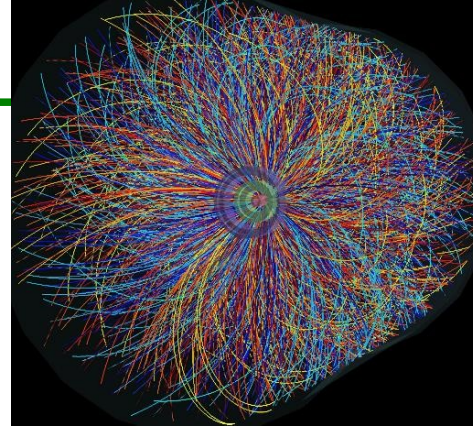
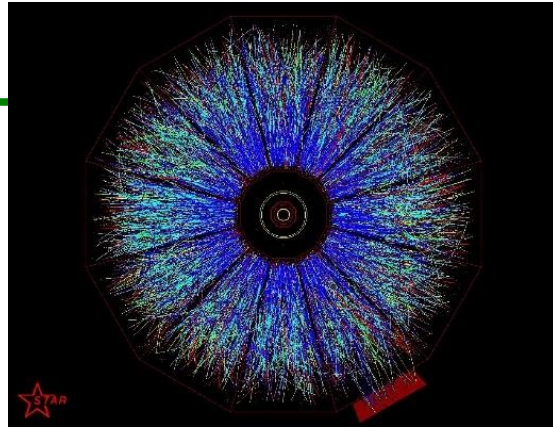


- **Two-Particle correlations:**

- First formalism by Kopylov and Podgoretsky
- Solution of the FSI problem: Lednicky and Lyuboshitz
- Creation of the group at WUT by prof. Jan Pluta

- Since then a close collaboration between WUT and JINR in this field
 - 20 years of participation in the STAR experiment (Au+Au, p+p at 200 GeV)
 - 15 years of participation in the ALICE experiment (Pb+Pb at 2.76 TeV, p+p at 7, 8 and 13 TeV)
 - Collaboration in the GDRE framework (JINR, Moscow, Kiev, WUT, Nantes)

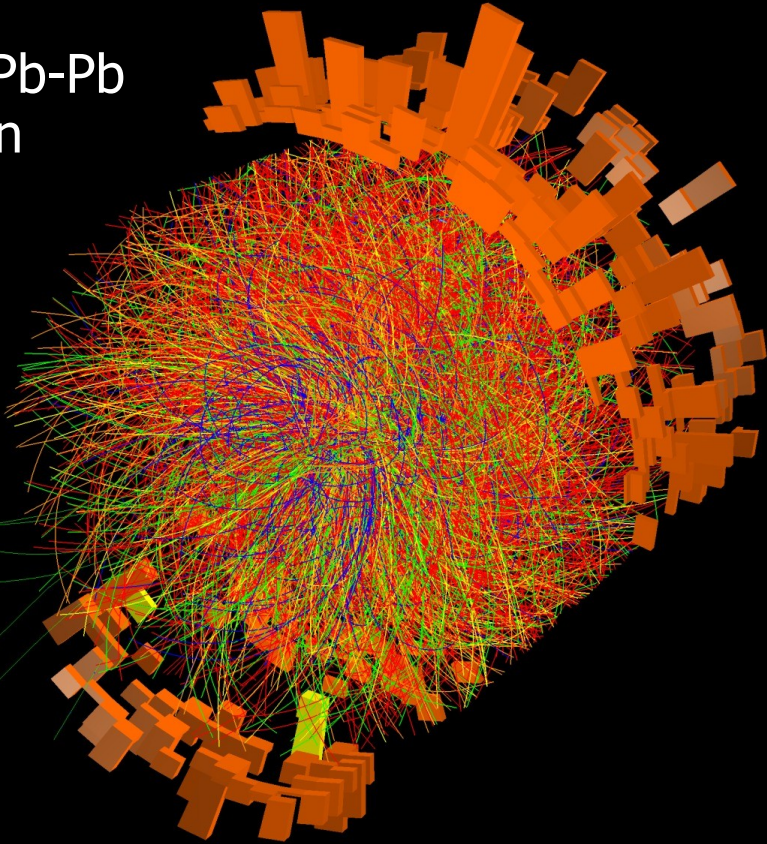
New physics directions



- Heavy-ion collisions in STAR, ALICE, NA49/61 – phase diagram of strongly interacting matter at vanishing baryon density
- New perspective: NICA and FAIR – large baryon densities
- Complimentary to SPS and RHIC Beam Energy Scan program

Using existing expertise

ALICE Pb-Pb
Collision



- **Physics interests:**
 - Particle correlations: femtoscopy, angular correlations, event-wide correlations
 - Event-by-event fluctuations and correlations
 - Bulk observables (spectra, elliptic flow)
 - NN, YN and YY interactions via femtoscopy of baryons
- **Preparation of data analysis and simulation software**

- **MPD – collider geometry (STAR, ALICE)**
- **Experience in data analysis framework**

Recent activities

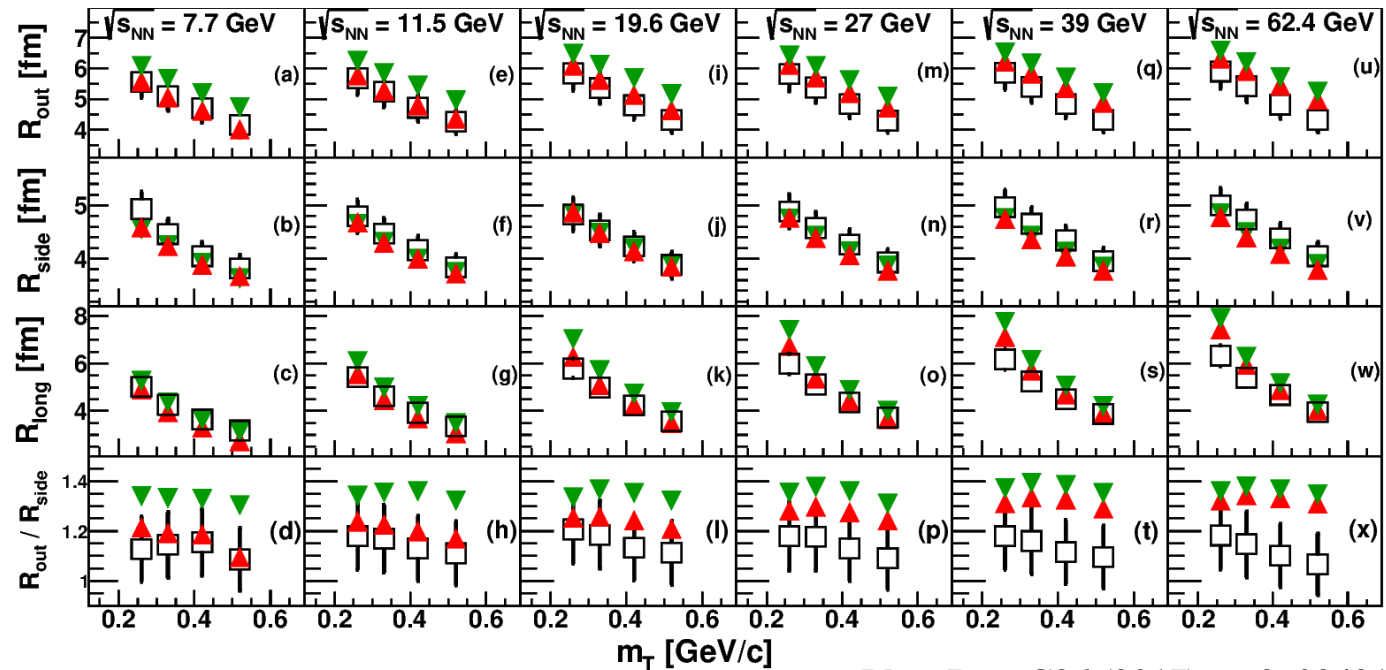
- Group led by Marek Peryt active in the NICA Project:
 - Gas system for the MPD TOF detector
 - Engineering Support in the Slow Control System for MPD and [BM@N](#)
 - Hardware framework for the Slow Control System
 - EqDB Database Environment
- Rapidly expanding group
 - 3 physics scientists, 1 dedicated PhD, students
 - 1 staff full-time at JINR
 - Two PhDs permanently at JINR full-time
 - Intensive summer practives (2 weeks, 4 weeks)
 - “Team for the future of NICA” program – 3-month, student stays at JINR, this year extended to 12-month stays

Expansion of possibilities

- Strong interest from Faculty of Electronics and Information Technology (currently 10 electronics/IT scientists, possibility to expand up to 20-30 people)
 - 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)
 - Strong hardware development group (measurement and control systems; analog, digital and mixed circuits and systems including but not limited to high speed and high sensitivity instrumentation; embedded systems)
- Interest in participation in the development, design and construction of the MPD, special interest in Slow Control
- Interest in participation in preparation of the cosmic ray detector (high-level trigger system, electronics)
- Possibility for three-way collaboration JINR-WUT-FAIR in MPD-CBM

Investigating physics at the MPD

- Poland-JINR Research Program "Towards Extreme Baryon Densities"
 - Transfer of experience from STAR/ALICE to MPD in Physics, Software, Simulations, Reconstruction
 - Focus on physics of soft (bulk) observables and correlations
 - Extensive training of young researchers



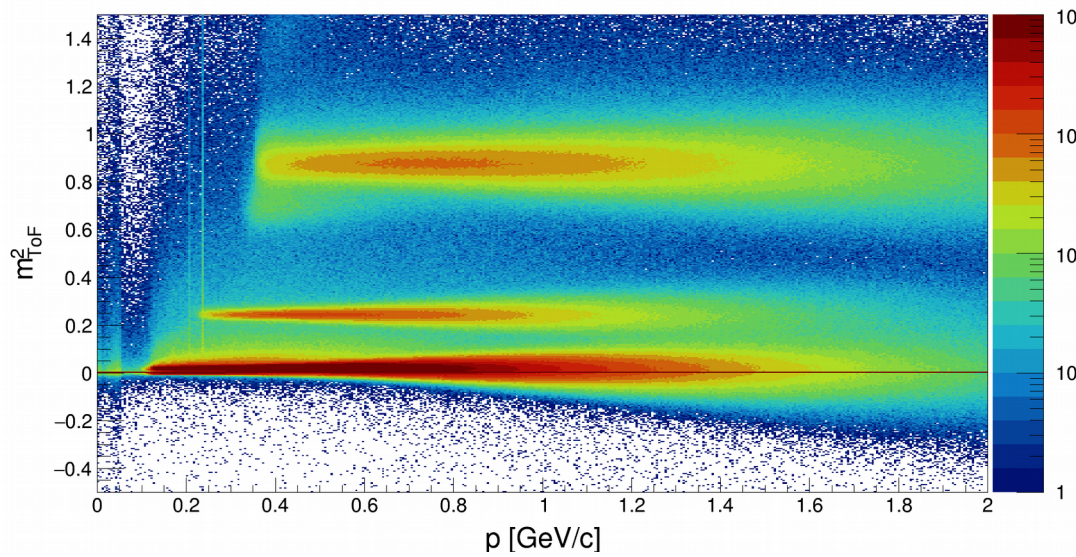
Phys.Rev. C96 (2017) no.2, 024911

Computing resources

- MPD software running at the computing center at NCBJ(Swierk)
 - Up to 14K CPU, several hundred TB of disk space available
 - Simulation, reconstruction, data analysis currently working (up to 100k ev./day simulation)
 - Ability to quickly test latest reconstruction software developments
- Existing WLCG Tier-2 computing center for ALICE at WUT
 - Provides significant part of the Polish contribution to ALICE Computing
 - Stable operation since the beginning (~1 year)
 - Configured with flexible virtualization-based resource allocation
 - Could be included in MPD computing if needed

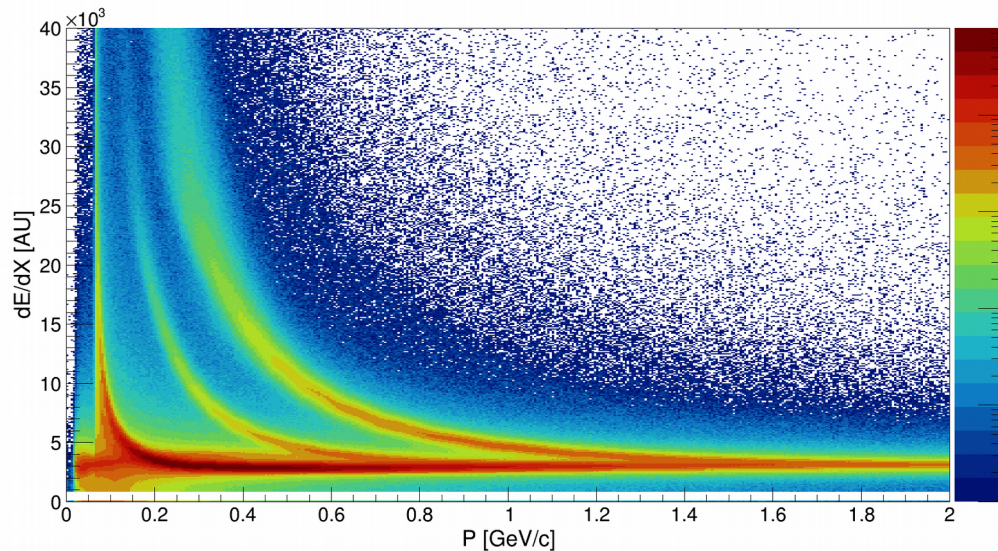
Example simulation results

MPD TOF

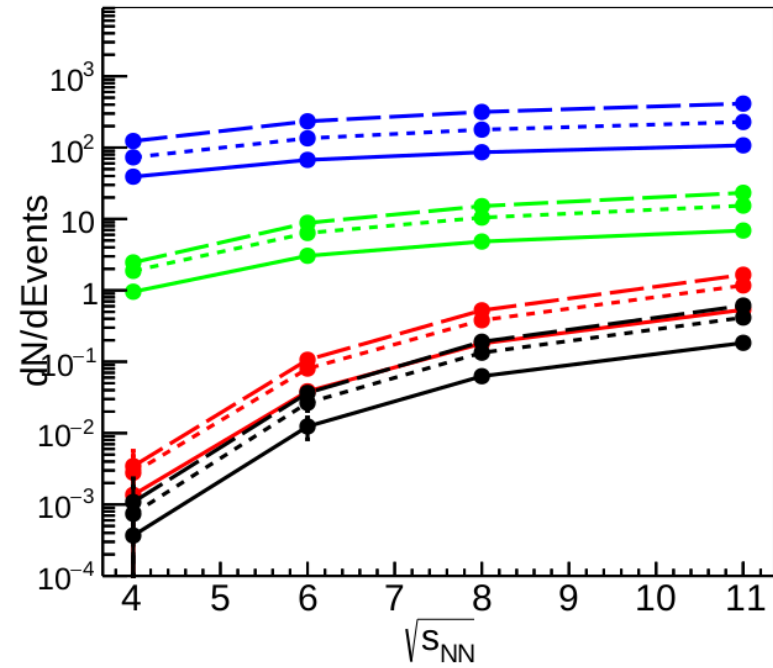


- UrQMD simulation with MPD reconstruction chain

MPD TPC

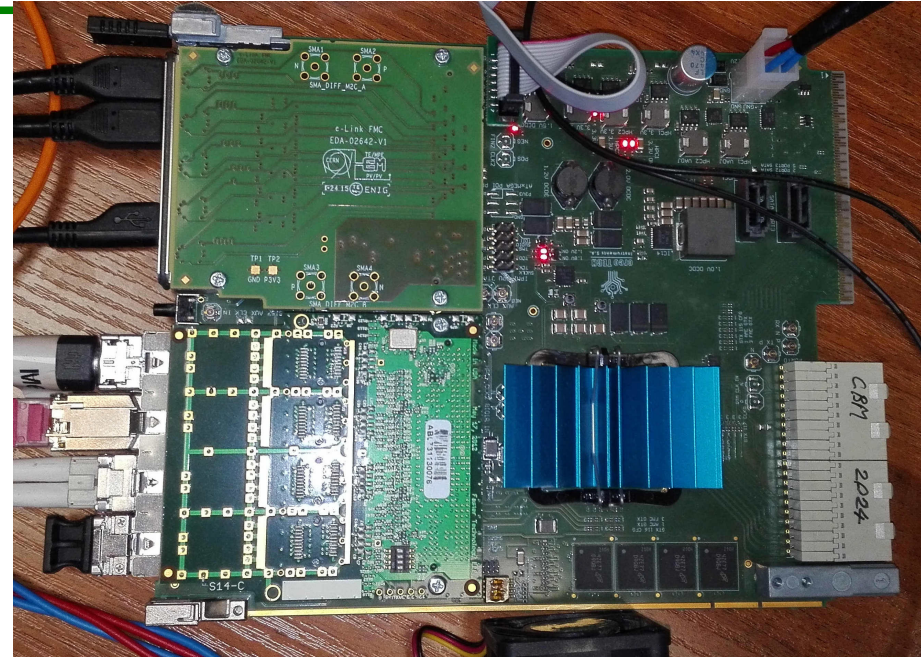


- Akc. A
- - Akc. B
- Akc. C
- π^+
- K^+
- p
- Λ

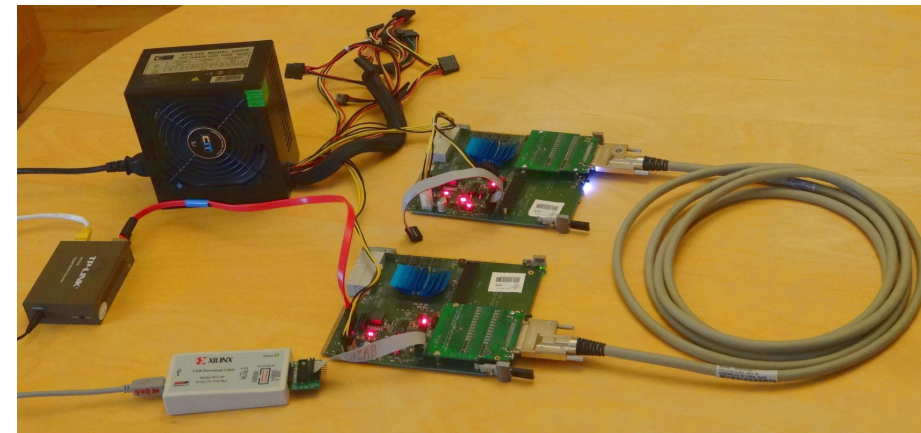


Synergy between CBM and MPD

- Dr Wojciech Zabołotny (ISE, WUT) – current team: 4 staff + 2 PhD students
- Design of the Data Processing Board (DPB) prototype for development
- Development of the communication protocol for the STS-XYTER FEE ASIC (together with AGH and GSI)
- Design of the DPB firmware used for current development (together with GSI)
- Selection of the final CRI board to be used for data concentration in the CBM (together with GSI)
- Planning of the CRI firmware
- Planning of limited emulation of GBTX in FPGA



DPB prototype based on AFCK



Test setup used for testing of STS-XYTER protocol

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

NICA Days 2017

- NICA Days 2017 conference <http://nica2017.if.pw.edu.pl>
- Co-organized by WUT, NCBJ and JINR
- 5 days of scientific and technical sessions on NICA
- 136 registered participants (WUT, NCBJ, UW, UJK and other Polish Institutions, JINR delegation headed by the Director of the Institute, representatives of polish business and industry)
- Signing of "Addendum" establishing "Team for the future of NICA"
- Signing of the founding document of the "NICA-PL Consortium"
<https://www.biuletyn.pw.edu.pl/Wspolpraca-uczelnia/NICA-Days-2017>
- Development of the common projects between WUT and Polish Institutions

National Center for Nuclear Research

Involvement in physics of high-energy nucleus-nucleus collisions



National Centre for Nuclear Research

Since 1970s experiments at Dubna, CERN, BNL



- Leading Polish research laboratory in the field of nuclear physics
- Several decades of involvement in high-energy physics experiments in JINR, BNL, CERN and others
- Strong manufacturing capabilities and expertise for scientific equipment (example: LINAC4 elements for CERN)
- Current involvement: 6 PhD scientists, possibility to significantly increase of manpower for specific projects and activities

Jan Kochanowski University (Kielce)



Institute of Physics, Jan Kochanowski University



- Group of 4 PhD scientists (Institute of Physics) with long-term involvement and experience in heavy-ion physics experiments
- Topics of expertise: Fluctuations and correlations in multi-particle production processes, cosmic-ray physics
- Very significant contribution to design, construction and operation of the NA61/SHINE experiment at CERN SPS at energy range comparable to NICA MPD – possible significant overlap
- Interest in participation in the MCORD cosmic ray detector

University of Warsaw

Background: long-time involvement in nucleus-nucleus collisions at

- SIS-18 (GSI Darmstadt): experiments **FOPI** (decommissioned) and **HADES** (running, planned to be moved to SIS100 in the future)
- SPS (CERN) – experiment **NA61/SHINE**

Interest in:

- Production of particles, particularly with open and hidden strangeness ($K^{\pm,0}$, Λ , $\varphi(1020)$)
- Detector development

Manpower: 3 permanent staff members (2 professors with employment history at JINR many years ago)

**Looking forward to strong
participation of Polish scientists
in MPD, BM@N and NICA**