Warsaw University of Technology 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

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- 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 between 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: Physics, 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

Gas supplies

Gas storage

Mixer

Purifier & Dryer

Exhaust

Gas analysis

Distribution

Return pump

MPD TOF system

MPD zone

A. Kisiel, WUT

NICA Days 2019, 21 Oct 2019
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% C₂H₂F₄ + 5% i-C₄H₁₀ + 5% SF₆
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

- 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

- Analog Front-End module
- FPGA mezzanine card (FMC)
- AMC FMC carrier board
- MTCA Carrier Hub
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
ALICE/CERN technology transfer to MPD/JINR:
- MAPS of new ALICE ITS for MPD
- carbon fiber space frames;

CERN: L. Musa
JINR: Yu. Murin

Inner Tracker System (MPD stage II)

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

4,9 \cdot 10^9 \text{ pixels}
active area 3,9 m^2.

max bandwidth: 400 – 1200 Mbps
two scenarios of ECAL integration

scenario A

~ 90 tons

scenario B

184 towers

5 tons

5520 mm

September 14, 2018

V.Kekelidze, CERN seminar
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%)**

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### Upgrade

<table>
<thead>
<tr>
<th>Material</th>
<th>(X/\sqrt{X_0}), %</th>
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<tbody>
<tr>
<td>Gem-based chamber</td>
<td>0.32</td>
</tr>
<tr>
<td>1.4 GEM foils Cu,</td>
<td></td>
</tr>
<tr>
<td>8x5 (\mu)m = 40 (\mu)m</td>
<td></td>
</tr>
<tr>
<td>Kapton 4x50 (\mu)m = 200 (\mu)m</td>
<td></td>
</tr>
<tr>
<td>2. Pad plane (h=1.5) mm</td>
<td>1.00</td>
</tr>
<tr>
<td>3. Insulating plate (h=1.5) mm</td>
<td>0.775</td>
</tr>
<tr>
<td>4. Carbon panel (h=25) mm</td>
<td>0.30</td>
</tr>
<tr>
<td>5. Epoxy glue (2x0.1 mm)</td>
<td>0.056</td>
</tr>
<tr>
<td>Air gap (L=10) cm</td>
<td>0.03</td>
</tr>
<tr>
<td>Total:</td>
<td>(~2.5 - 3.72)</td>
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<tr>
<td>FE (based on SAMPA chip)</td>
<td>1.0</td>
</tr>
<tr>
<td>FE single layer</td>
<td>5.0</td>
</tr>
<tr>
<td>FE Cooling</td>
<td>2.5</td>
</tr>
<tr>
<td>Al pipes + plates on chips</td>
<td>1.69</td>
</tr>
<tr>
<td>TPC thermos-screen</td>
<td></td>
</tr>
<tr>
<td>Total:</td>
<td>(~17.5)</td>
</tr>
</tbody>
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*September 14, 2018*  
*V.Kekelidze, CERN seminar*
magnetic field measurement: cooperation with CERN

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

*The area occupied by TPC:*

- 2814 mm in diameter;
- 3400 mm in length

*Bx, Br, Bz* to be measured in ~ $8 \times 10^3$ points.

### Bench layout inside cryostat

**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
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)