Summary of the Joint Session: Mexico and Poland groups

Mario Rodríguez Cahuantzi

17.12.2020

MexNICA Collaboration Winter Meeting 2020

Contribution list

09:00	**The NICA Complex and the MPD Experiment at the Joint Institute for Nuclear Research in Dubna**	*Prof. Adam KISIEL*
	MCORD - MPD Cosmic ray detector	*Dr. Marcin BIELEWICZ* 09:25 - 09:50
	Dosimetric System for MPD detector Control System	*Dr. Aleksandr BANCER* 09:50 - 10:15
10:00	**Status of BeBe proposal for MPD-NICA**	*Dr. Lucina Gabriela ESPINOZA BELTRÁN* 10:15 - 10:40
	Status of miniBeBe proposal for MPD-NICA	*Mr. Pedro A. NIETO* 10:40 - 11:05
11:00		

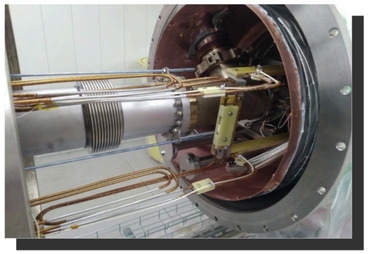
09:00 **The NICA Complex and the MPD Experiment at the Joint Institute for Nuclear Research in Dubna** *Prof. Adam KISIEL*

Adam Kisiel (MPD spokesperson) reported the status of MPD experiment and NICA facilities

NICA

- Bi beams are planned. Not possible for Au for the first stage.
- Reduced luminosity.
- Expected energy 9.46 GeV (c.m.e.)

- ✓ ***all magnets in the tunnel***
- ✓ ***95% connected***
- ✓ ***ring He-system***
  assembled 95%, tested 50%
- ✓ ***beam pipe 55%***



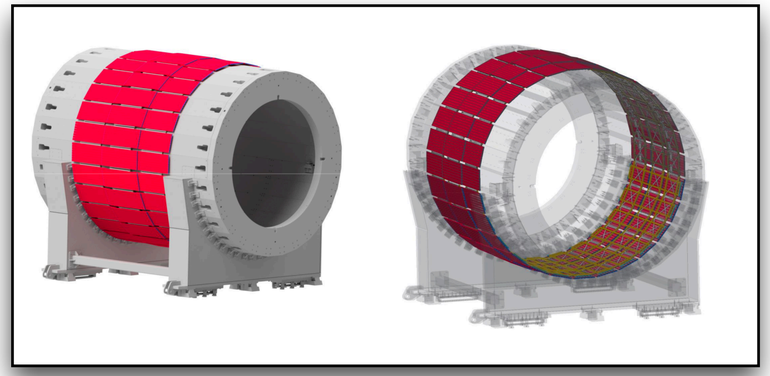
MPD

- MPD hall ready
- Assembly of the magnet yoke started
- MPD solenoid delivered to MPD Hall last November
- the construction of MPD sub-systems is a work in progress

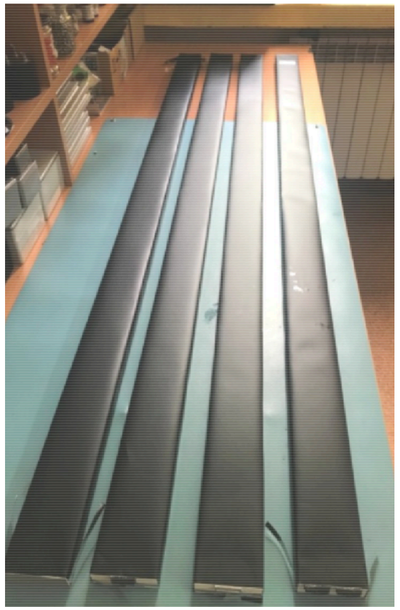
MCORD - MPD Cosmic ray detector — *Dr. Marcin BIELEWICZ*

09:25 - 09:50

Marcin Bielewicz (MCORD group leader) reported the status of the cosmic-ray trigger detector for MPD experiment

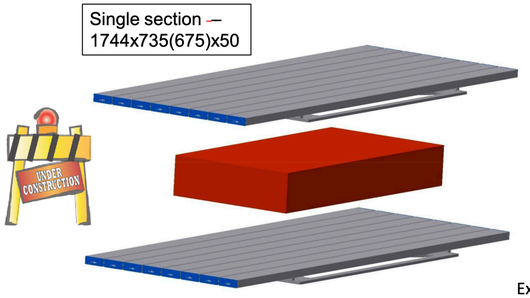


- 28 plastic scintillator long strips (Nuvia).
- Light collection through optical fibers (WLS, Kuraray)
- Light photo sensor: SiPM (MPPC Hamamatsu)



3. Demonstrator

Two sections (2x8 scintillators) will be build with dedicated electronic and full signal analysis.

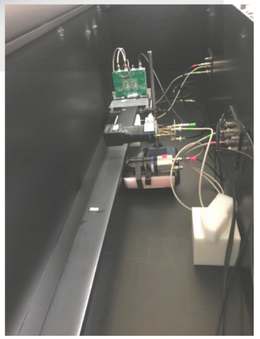


Example: testing of the TOF module

4. Laboratory tests

Plastic detector + 2 plastic hodoscopes (muon triggers)
DAQ: CAEN DT5730

Standard CAEN electronics



Main MCORD task: trigger for TPC
Potential physics with MCORD:

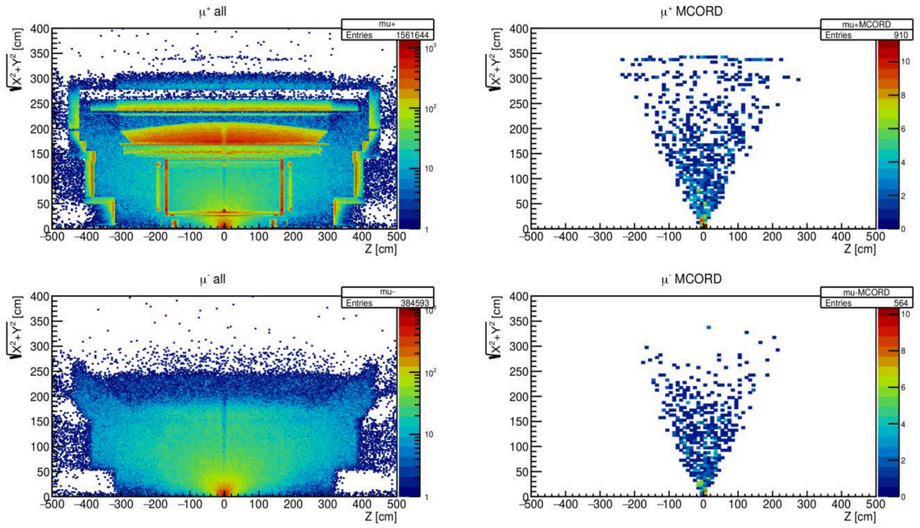
- selection of dimuon events in HI collisions
- cosmic-ray physics with atmospheric muons

MCORD - MPD Cosmic ray detector — *Dr. Marcin BIELEWICZ*

09:25 - 09:50

Marcin Bielewicz (MCORD group leader) reported the status of the cosmic-ray trigger detector for MPD experiment

6. Simulations (Collisions)



The points of creation of negative and positive muons.

Top plots corresponds to μ^+ whereas μ^- are at the bottom. Left plots represents points of creations any muon whereas right plots shows points of creations muons that can be detected by MCORD. The structure of detector (contribution from decays of "stationary" particles) is clearly visible for positive muons.

NARODOWE CENTRUM BADAŃ JĄDROWYCH ŚWIERK

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Not clear the origin of this asymmetry

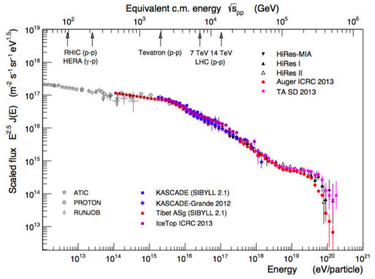
Ad. 3 – Astrophysics

GZK-cutoff problem
- 4x10E19 eV
- 50 Mega Parsec
- Cosmic Microwave Background

Example: DECOR exp. 2002-2003y (near horizontal observation (60-90 deg. angular range)
1-10 PeV primary particle) (see ref. 2)

Bibliography:

1. Pavluchenko, V. P.; Beisembaev, R. U., Muons of Extra High Energy Horizontal EAS in Geomagnetic Field and Nucleonic Astronomy, 1995 ICRC....1..646P
2. Yashin I. et al., Investigation of Muon Bundles in Horizontal Cosmic, 2005 (28) ICRC p.1147-1150
3. Neronov A. et al., Cosmic ray composition measurements, 2017, arXiv:1610.01794v2 [astro-ph.IM]
4. Shih-Hao Wang, 2017_Cosmic ray Detection ARIANNA Station, PoS ICRC2017_358



All-particle cosmic-ray energy spectrum derived from direct and indirect (air shower experiments) measurements, as well as results from different hadronic models

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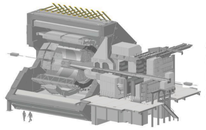
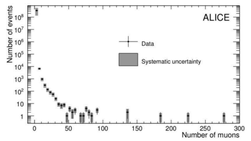
Ad. 3 Astrophysics

Examples from other experiments



ALICE Exp.
55 m under.
thr. 16 GeV
2010-2013 y



ALEPH Exp.
140 m under. (thr. 70 GeV)
(1997-99y)

DELPHI Exp.
100 m under. (thr. 52 GeV)
(99-2000y)

For high multiplicities (only few events) results are almost an order of magnitude above the simulations results.

Problem with current hadronic interaction model for extremely high energy >10E15 eV ???

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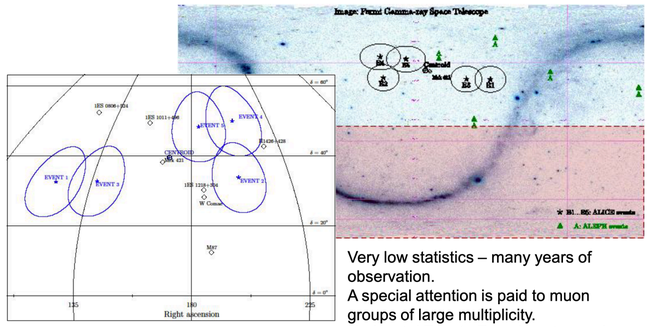
Ad. 3 – Astrophysics

The position identification of Extremely high energy particle source



ALICE (multi events data) sphere position recognition

Very low statistics – many years of observation.
A special attention is paid to muon groups of large multiplicity.
Horizontal Events Experiments needs more data.

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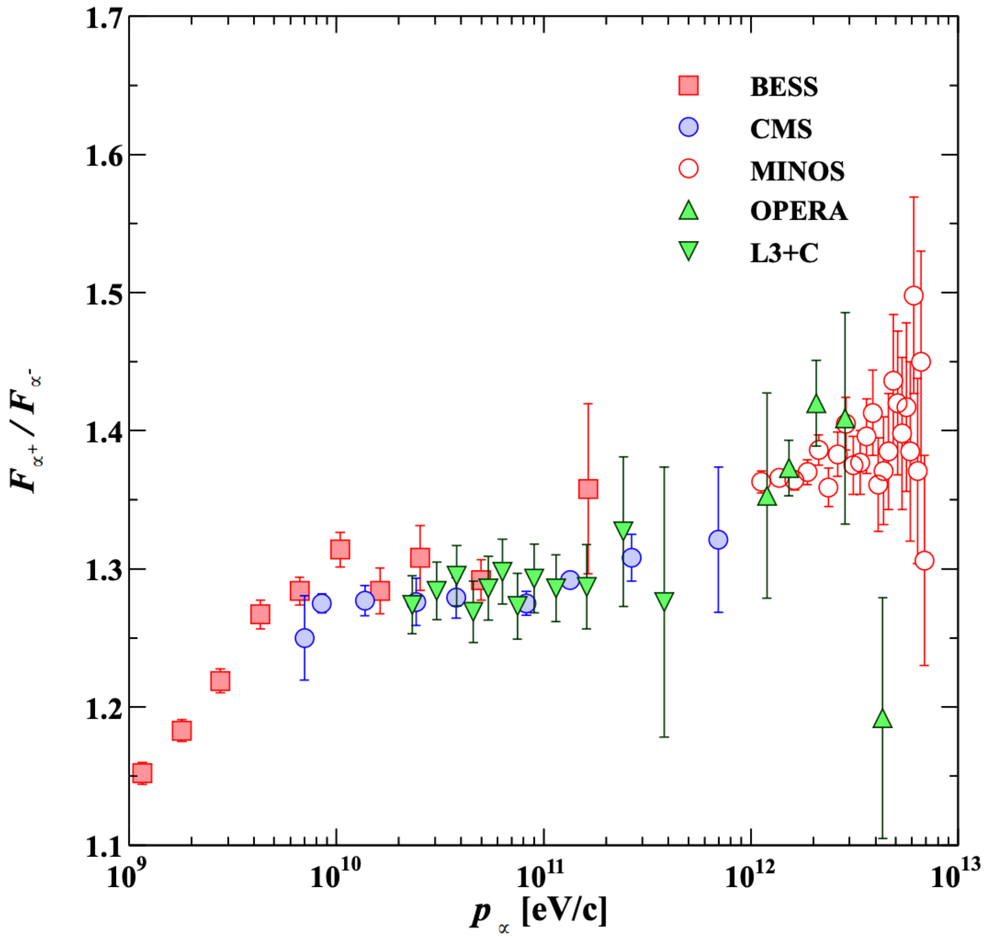
MCORD can provide a trigger for collecting muon bundles from extensive air showers.
Not clear what kind of physics can be done with MCORD: MPD is a small detector compared with respect to extensive surface arrays like Pierre Auger Observatory and TA among others.
Expected short live time. Only during commissioning and not beam conditions.

MCORD - MPD Cosmic ray detector — *Dr. Marcin BIELEWICZ*

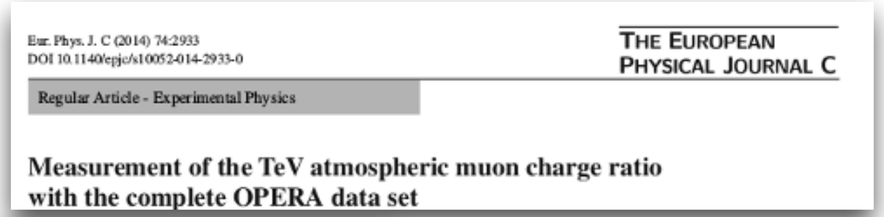
09:25 - 09:50

Marcin Bielewicz (MCORD group leader) reported the status of the cosmic-ray trigger detector for MPD experiment

M. Tanabashi et al. (Particle Data Group), Phys. Rev. D 98, 030001 (2018) and 2019 update 6th December, 2019 11:47am



At low momentum the cosmic charge ratio may be used also to calibrate the TPC reconstruction. This is a well known value.
At higher momentum?


Eur. Phys. J. C (2014) 74:2933
DOI 10.1140/epjc/s10052-014-2933-0

THE EUROPEAN PHYSICAL JOURNAL C

Regular Article - Experimental Physics

Measurement of the TeV atmospheric muon charge ratio with the complete OPERA data set

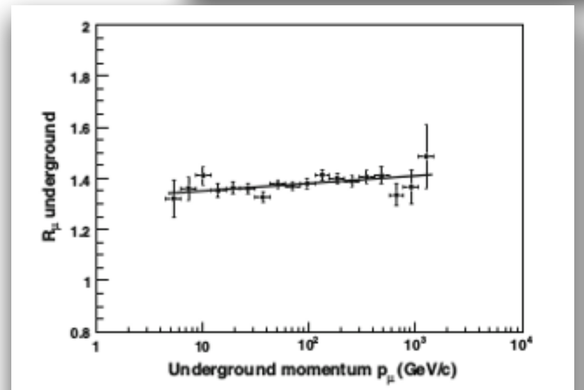


Fig. 2 The muon charge ratio measured by OPERA as a function of the underground muon momentum p_μ. Data are fitted to $R_\mu(p_\mu) = a_0 + a_1 \log_{10}(p_\mu/(\text{GeV/c}))$

4 Conclusions

The atmospheric muon charge ratio R_μ was measured with the complete statistics accumulated along the five years of data taking. The combination of the two data sets collected with opposite magnet polarities allows reaching the most accurate measurement in the high energy region to date. The underground charge ratio was evaluated separately for single and for multiple muon events. For single muons, the integrated R_μ value is

$$R_\mu(n_\mu = 1) = 1.377 \pm 0.006(stat.)^{+0.007}_{-0.001}(syst.)$$

while for muon bundles

$$R_\mu(n_\mu > 1) = 1.098 \pm 0.023(stat.)^{+0.015}_{-0.013}(syst.)$$

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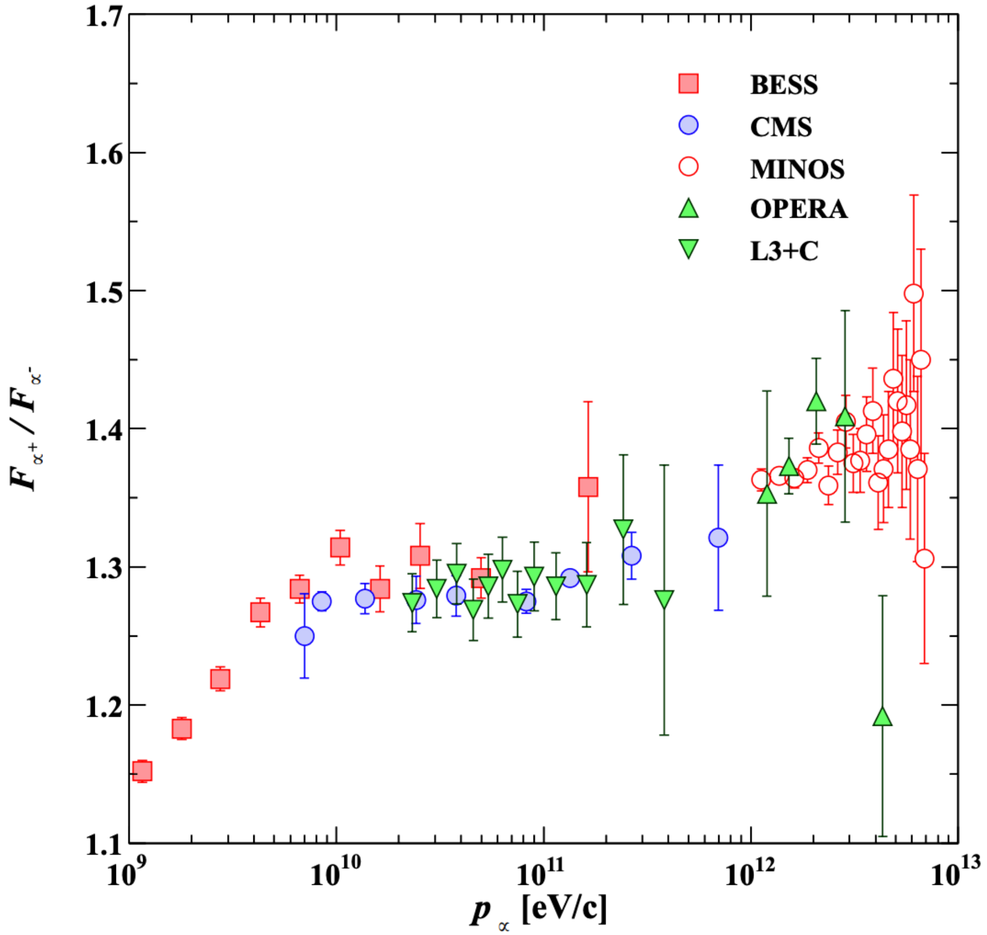


At low momentum the cosmic charge ratio may be used also to calibrate the TPC reconstruction. This is a well known value.
At higher momentum?

What about this ratio for multi-muon events?

- we could observe muons coming from heavy-nucleus component of the primary cosmic ray
- the cosmic charge ratio for single muon events is around 1.28 —> this reflects larger abundance of protons (light cosmic ray component) over heavier elements (Fe)
- for multi-muon events, do this effect must be diminished ?
- at high energies, the heavy flavor component of the EAS and the primary cosmic ray composition may be significant.

This kind of studies may be included in first physics program (PWG-1). We need the TPC in its nominal position with B ON.

10:00

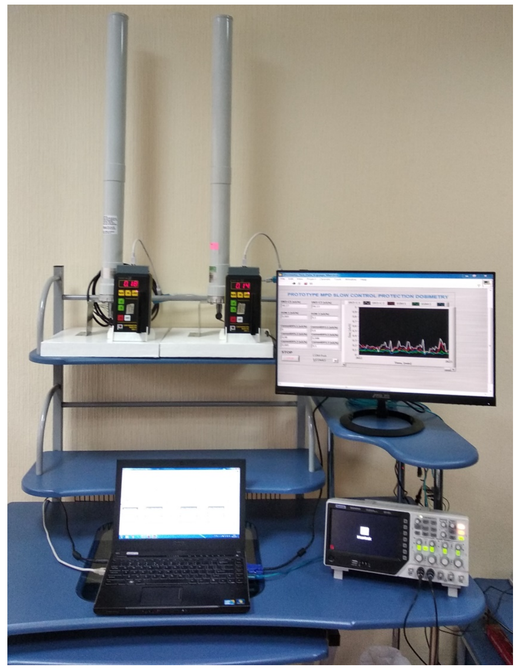
Dosimetric System for MPD detector Control System — *Dr. Aleksandr BANCER*

09:50 - 10:15

Alexander BANCER reported the status of a dosimetric system for MPD DCS (detector control system)

Measuring set-up and results

- All dosimeters connected to half-duplex RS-485 bus
- Special connectors made based on RJ-50 connector
- RS-485 Bus connected to PC with USB-RS485 converter
- The RS-485 Bus is expandable
- The Run Panel GUI displayed on additional monitor
- Testing RS-485 signals on oscilloscope

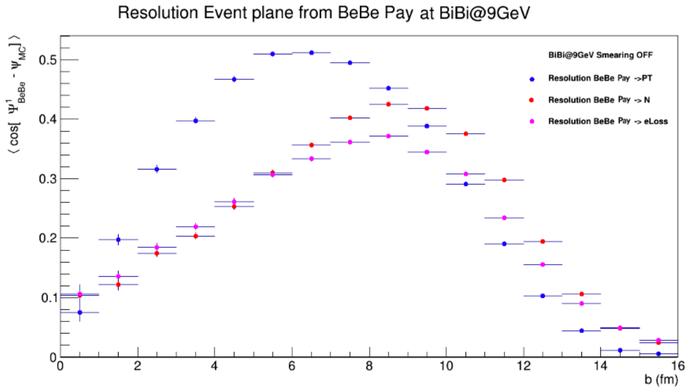


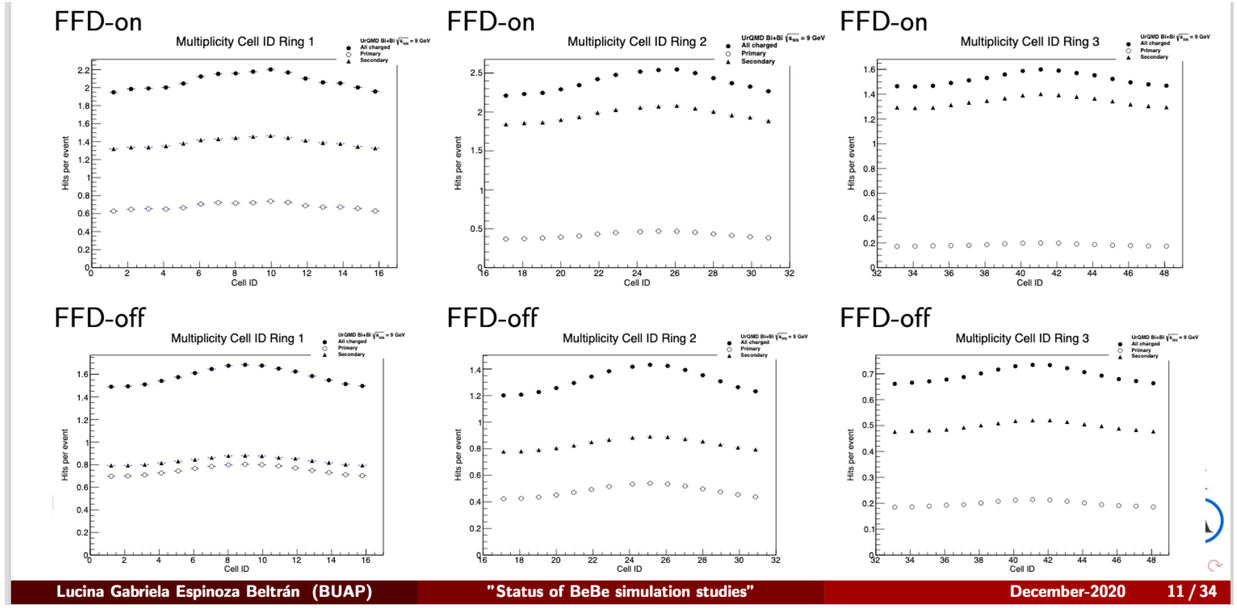
Test stand (Demonstrator) in JINR

- All the information will be available for the MPD members.
- Maybe we need to take into account this system for miniBeBe and BeBe detectors

Gabriela Espinoza reported the status of BeBe detector simulations

Event plane resolution: Since we get Ψ^1_{BeBe} and Ψ_{MC}, the resolution of the event plane with different weight functions:





This analysis should be repeated for different granularities. Maybe we can reduce the number of rings or the number of segments

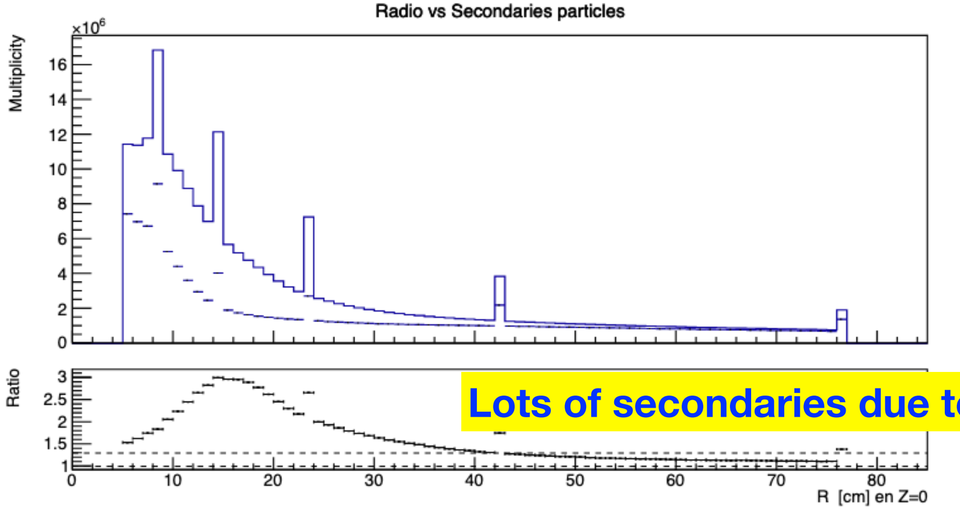
Status of BeBe proposal for MPD-NICA *Dr. Lucina Gabriela ESPINOZA BELTRÁN*

10:15 - 10:40

Gabriela Espinoza reported the status of BeBe detector simulations

Process: BiBi@9GeV with smearing.

Ratio secondary charged particles vs Radius



Lots of secondaries due to FFD reach BeBe inner rings

BUAP

MEX NICA

Status of BeBe proposal for MPD-NICA *Dr. Lucina Gabriela ESPINOZA BELTRÁN*

10:15 - 10:40

Gabriela Espinoza reported the status of BeBe detector simulations

Time window for collisions: Central value 7 ns with a width of +- 3 ns (All charged particles).

Transport Detectors: mbb+BeBePay, 1,000,000 events				
Process	BBR	BBL	BBRandBBL	BBRorBBL
PP@9GeV Con	56.07 %	57.86 %	16.79 %	95.17 %
PP@9GeV Sin	71.99 %	72.05 %	49.01 %	95.03 %
PP@11GeV Con	57.66 %	57.46 %	19.26 %	95.85 %
PP@11GeV Sin	73.35 %	73.43 %	51.25 %	95.53 %
BiBi@9GeV Con	100 %	100 %	100 %	100 %
BiBi@9GeV Sin	100 %	100 %	100 %	100 %
AuAu@11GeV Con	100 %	100 %	100 %	100 %
AuAu@11GeV Sin	100 %	100 %	100 %	100 %

Con= with Smearing flat Z=60 cm, Sin= without smearing

This analysis should be repeated for different number of rings. What is the effect of the secondaries for different time windows?

Status of miniBeBe proposal for MPD-NICA — *Mr. Pedro A. NIETO*

10:40 - 11:05

11:00

Pedro Nieto reported the status of miniBeBe

CDR Results

The conceptual design of the miniBeBe detector proposed for NICA-MPD

Ramón Acevedo Kado[1], Mauricio Alvarado Hernández[1], Alejandro Ayala[1,2], Marco Alberto Ayala-Torres[3], Wolfgang Bietenholz[1], Dario Chaires[4], Eleazar Cuautle[1], Isabel Domínguez[5], Alejandro Guirado[6], Ivonne Maldonado[5], Julio Maldonado[7], Eduardo Moreno-Barbosa[8], P. A. Nieto-Marín[5], Miguel Enrique Patiño Salazar[1], Lucio Rebolledo[4], Mario Rodríguez-Cahuantzi[8], D. Rodríguez-Figueroa[9], Valeria Z. Reyna-Ortiz[8], Guillermo Tejeda-Muñoz[8], María Elena Tejeda-Yeomans[4], Luis Valenzuela-Cázares[6], and C. H. Zepeda Fernández[8,10]

Accepted for publication in JINST: arXiv:2007.11790

1. Energy deposited.
2. Time of flight.
3. Hits.
4. Trigger capabilities (Efficiency, multiplicity, time information and beam-gas).

Congratulations to MexNICA group for this effort.

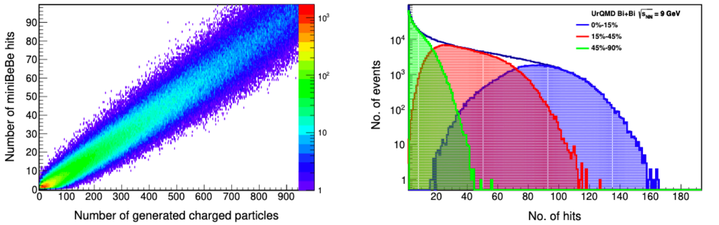


Figure: Number of charged particles that hit the miniBeBe vs. the generated number of charged particles (left). MiniBeBe multiplicity per centrality range. (right)

Adam asked to think about what kind of measurement can be performed to give as much as valuable information to NICA group: beam conditions related with collision characteristics.

09:00 **The NICA Complex and the MPD Experiment at the Joint Institute for Nuclear Research in Dubna** *Prof. Adam KISIEL*

Is there any input from DAC to the miniBeBe proposal?

miniBeBe

Preparation for beam test at JINR

Beam test ar JINR

Star writing a draft of TDR for miniBeBe

miniBeBe: electronics and detector prod.

miniBeBe: TDR ready for revision

miniBeBe: cosmic ray run (Mexico)

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miniBeBe: cosmic ray run (JINR)

miniBeBe: installation (JINR)

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miniBeBe: installation (JINR)

Milestones of MPD assembling in 2020-2022

Year 2020

1. July 15th - MPD Hall and pit are ready to store and unpack Yoke parts
2. August - The first 13 plates of Magnet Yoke are assembled for alignment checks
3. Sept 15th - Oct 1st - Solenoid is ready for transportation from ASG (Italy)
4. November 10th - Solenoid is in Dubna
5. Nov-Dec - Assembling of Magnet Yoke and Solenoid at JINR

Year 2021

6. Jan- April - Preparation for switching on the Solenoid (Cryogenics, Power Supply et cet.)
7. May - June - Magnetic Field measurement
8. July - Installation of Support Frame
9. Jul- Dec - Installation of ECal and TOF, Electronics Platform, Cabling

Year 2022

11. Jan- Mar - Installation of TPC, Electronics Platform, Cabling
12. March - Installation of beam pipe, FHCal, Cosmic Ray test system
13. April-Dec - Cosmic Ray tests
14. December - Commissioning

preparation of Phase-0 should happens here

Year 2023

15. March - Run on the beam

Adam Kisiel, JINR/WUT MexNICA Collaboration Winter Meeting, 16 Dec 2020 21/29

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BeBe

Preparation for beam test at JINR and update of CDR

Beam test ar JINR and call for a DAC meeting to present BeBe detector proposal

Star writing a draft of TDR for miniBeBe

BeBe: electronics?, and detector prod.

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Year 2023

15. **March - Run on the beam**

Adam Kisiel, JINR/WUT — MexNICA Collaboration Winter Meeting, 16 Dec 2020 — 21/29

Is there any input from DAC to the miniBeBe proposal?

WARNING: I'm not including mechanics, offline, online monitoring and detector control system

miniBeBe

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09:00 **The NICA Complex and the MPD Experiment at the Joint Institute for Nuclear Research in Dubna** *Prof. Adam KISIEL*

- BeBe and miniBeBe multiplicities studies; centrality and event plane (phase-0)
- Cosmic-ray physics?

MPD Physics Programme

G. Feofilov, A. Ivashkin

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

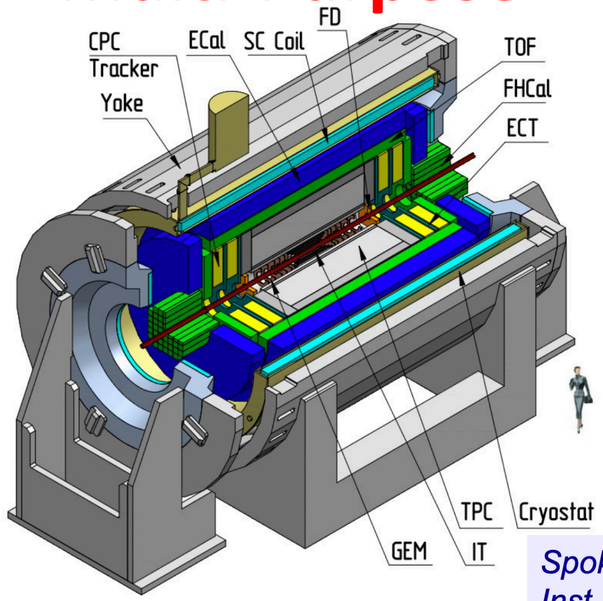
Wangmei Zha, A. Zinchenko

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

09:00 **The NICA Complex and the MPD Experiment at the Joint Institute for Nuclear Research in Dubna** *Prof. Adam KISIEL*

Multi-Purpose Detector (MPD) Collaboration



11 *Countries,* ***>500*** *participants,*
39 *Institutes and* ***JINR***

NICA

Spokesperson: ***Adam Kisiel***
Inst. Board Chair: ***Fuqiang Wang***
Project Manager: ***Slava Golovatyuk***

Deputy Spokespersons:
Victor Riabov, Zebo Tang

AANL, Yerevan, ***Armenia;***
Baku State University, NNRC, ***Azerbaijan;***
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Kurchatov Institute, Moscow, ***Russia;***
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SINP, Moscow, ***Russia;***
PNPI, Gatchina, ***Russia;***

MexNICA

miniBeBe
- electronics
- detector control system
- online monitoring
- offline
- detector construction
- detector installation
- detector commissioning

BeBe
- electronics
- detector control system
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Physics
- lambda polarization
- <pT> and Nch
- PID
- magnetic fields
- photons?
- cosmics?

Maybe it is time to split the detector responsibilities: two groups (miniBeBe and BeBe)

MPD Collaboration list

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28 MPD collaborators from mexican institutions:

- **ICN**: 7 (25%)
- **UAS**: 6 (21.4%)
- **BUAP**: 6 (21.4%)
- **UCOL**: 3 (10.7%)
- **UNISON**: 3 (10.7%)
- **CINVESTAV**: 3 (10.7%)

Can the MexNICA group manage to produce 2 detectors for beam monitoring and trigger tasks in MPD and at the same time to produce physics results?

+ funding? …. :-S