# Beam Monitoring Detector (BMD) a proposal for MPD-NICA

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# Outline

- Introduction
- Detector geometry
- Simulations
- Final comments

# Introduction

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***How?***

- To study, from theoretical point of view, the mechanism responsible for the restoration of chiral symmetry.

- To study, from theoretical point of view, the QCD phase diagram at finite values of temperature and density.

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To contribute in the study of the QGP phase diagram (CEP?)

***How?***

- To study, from experimental point of view, signatures that allows to locate the CEP.
- To study, from experimental point of view, the inclusion of a detector that allows to MPD increase its pseudo-rapidity acceptance.

  - ***Bonus***: optimization of event plane resolution, multiplicity reference estimator, trigger system (for MB, background rejection and veto) and beam monitoring

# Introduction

We report the current status of the simulations to be used as an input for the proposal of a **Beam Monitoring Detector (BMD)** for the MPD-NICA Project at JINR made by a group of physicists from Mexicans institutions (see *Final comments* slides). Preliminar ideas about the prototype are also shown (see Luis Manuel slides).

# Introduction

In collider experiments, the inclusion during commissioning or regular operations of a detector capable to monitor the beam activity is desirable. With the information provided with such kind of apparatus, it is possible to setup a trigger system to identify and to discriminate beam-beam minimum bias or centrality events from background and beam-gas interactions. In addition, these types of systems can be used for the reconstruction of physical observables of interest in heavy-ion collisions such as

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- **Luminosity measurement**: used to determine the absolute cross section of reaction processes

- **Multiplicity of charged particles**: key observable for the determination of the *centrality* of the collision events and the *event plane resolution*

# Detector geometry

As a first approach, the BMD system will consists of two detectors located at 2 meters away from the interaction point of the MPD-NICA, BMD-1 and BMD-2 respectively. Each detector is composed by an array of 80 cells made of plastic scintillator arranged in five rings forming a sixteen sectors disk of 153.26 centimeters of diameter. The pseudo-rapidity coverage of BMD would be $1.69 < |\eta| < 4.36$.

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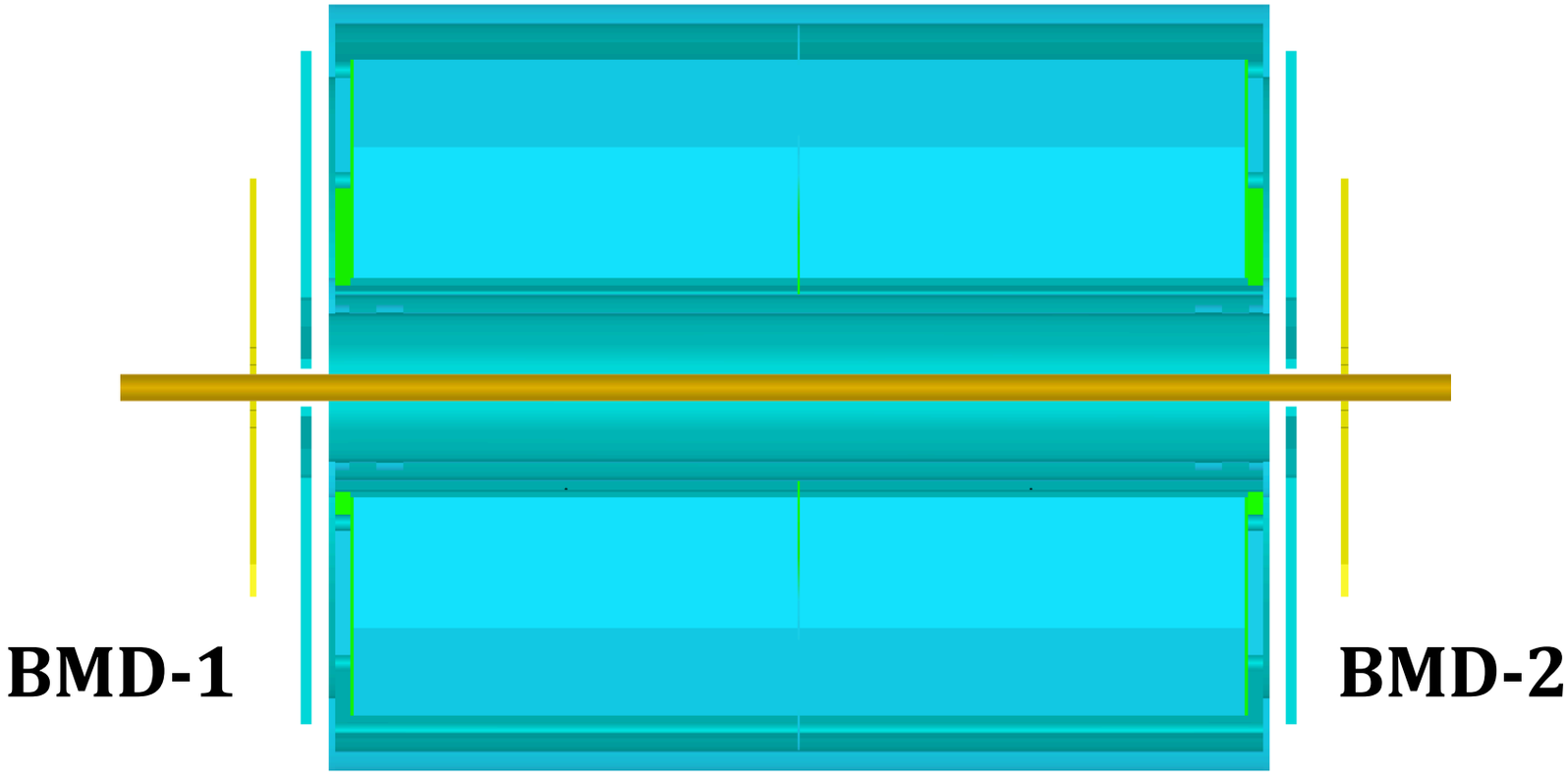


Geometry implemented in MPD-ROOT

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Position Side A: (x,y,z) = (0,0,-200.0) [cm]

| **Detector** | **Radius min (cm)** | **Radius max (cm)** | Acceptance $\eta$ |
|---|---|---|---|
| Ring 1 | 5.1 | 8.3 | $-4.36 < \eta < -3.88$ |
| Ring 2 | 8.5 | 14.5 | $-3.85 < \eta < -3.32$ |
| Ring 3 | 14.7 | 23.4 | $-3.31 < \eta < -2.84$ |
| Ring 4 | 23.6 | 42.0 | $-2.83 < \eta < -2.27$ |
| Ring 5 | 42.2 | 76.63 | $-2.26 < \eta < -1.69$ |

Pseudorapidity range side A: $-4.36 < \eta < -1.69$

Position Side C: (x,y,z) = (0,0,200.0) [cm]

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- ***1.69 < |η| < 4.36*** : this can be modified if needed (enough space?)

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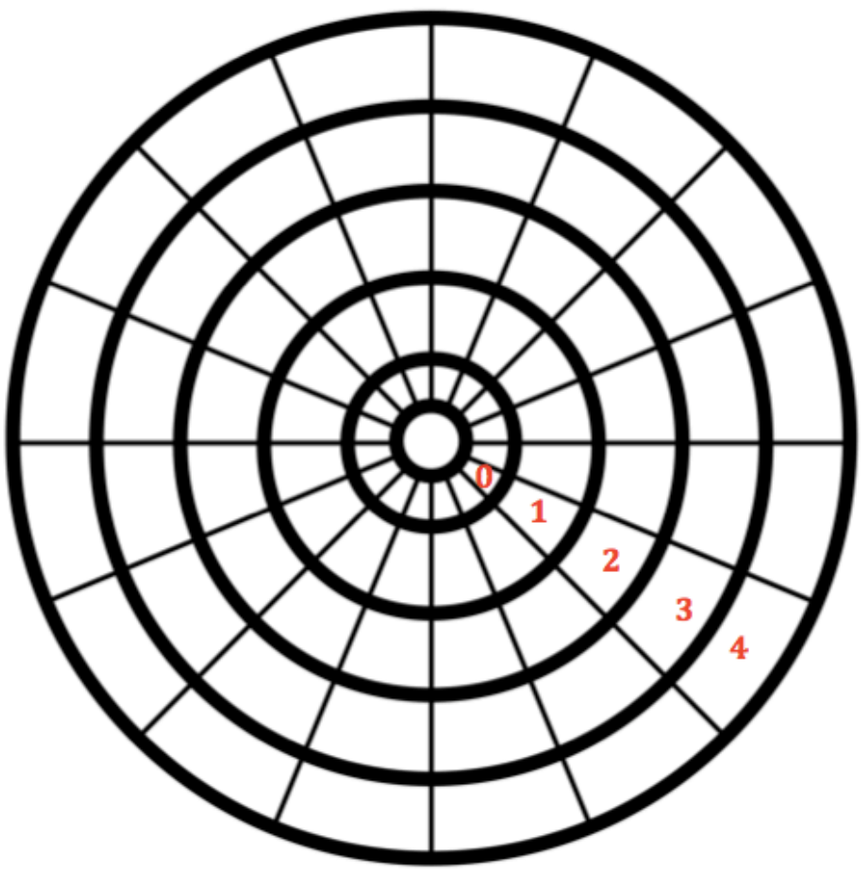


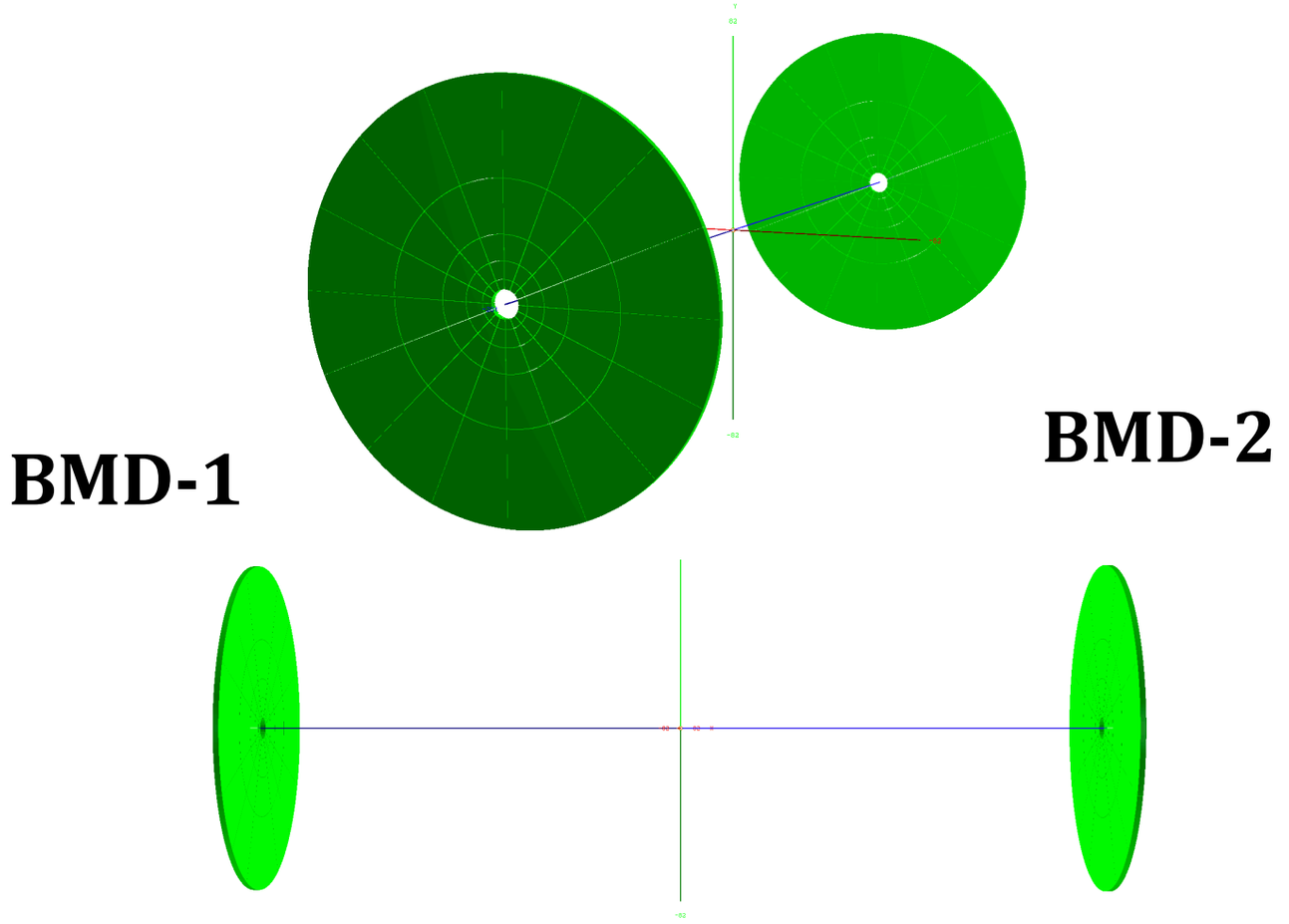


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- Generator used: URQM
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**This time, we only present a first study on the physics performance of BMD for the event plane resolution**

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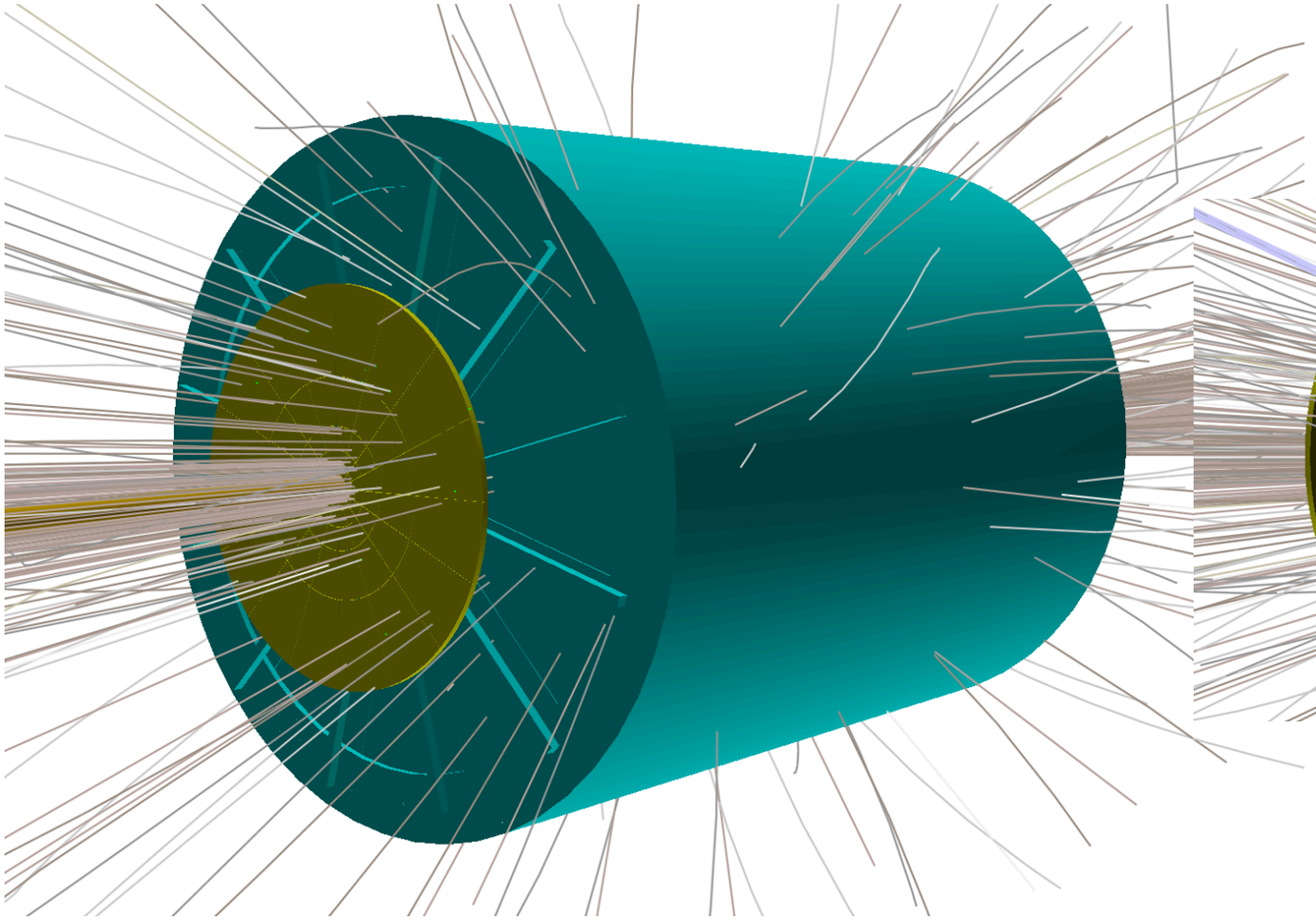

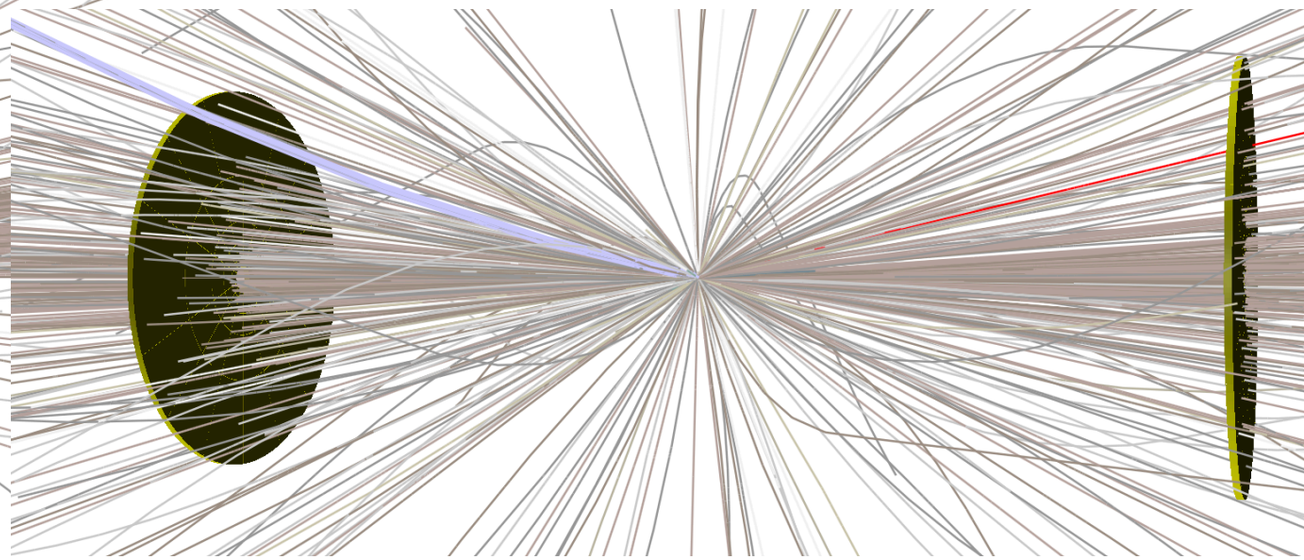



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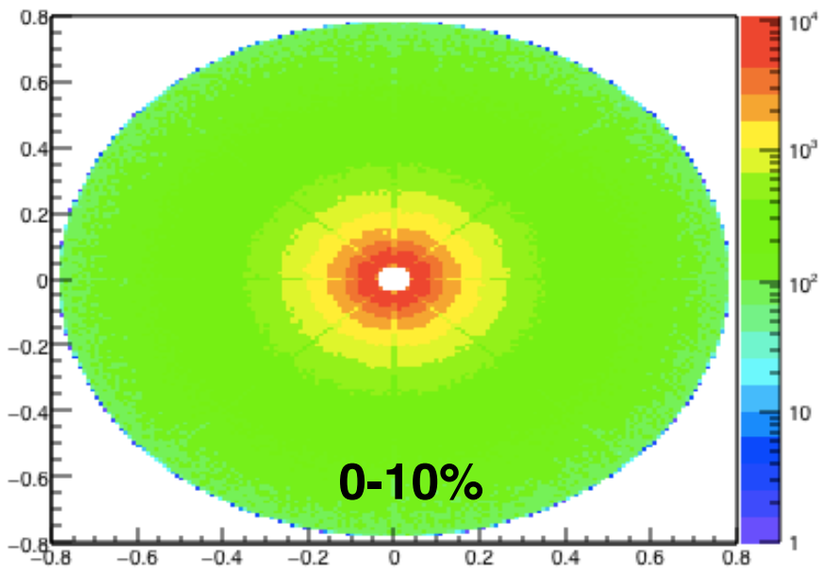


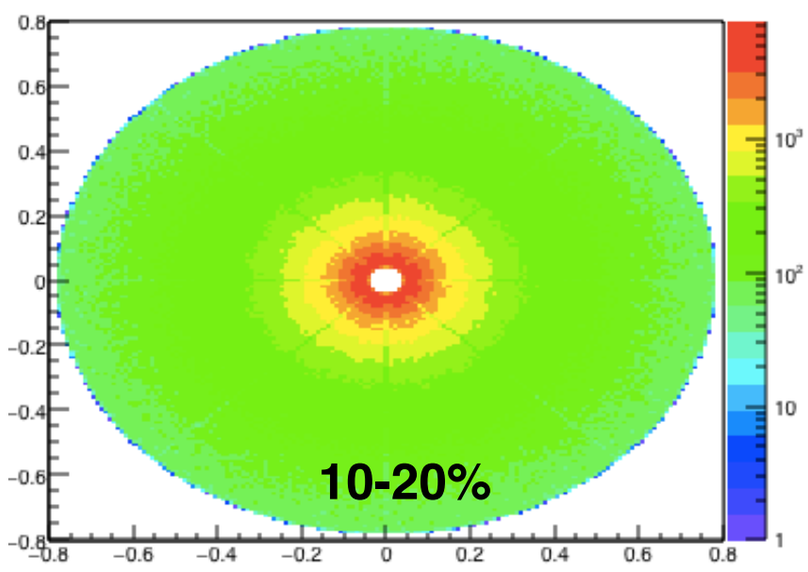


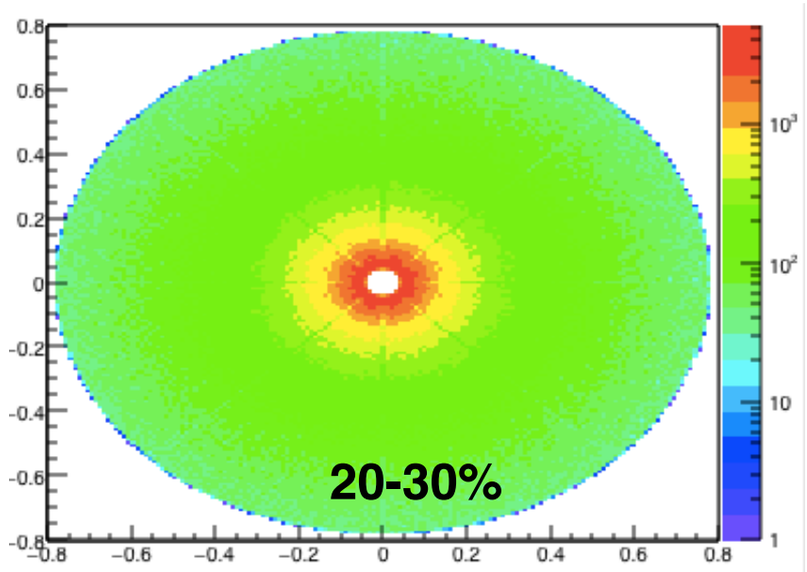


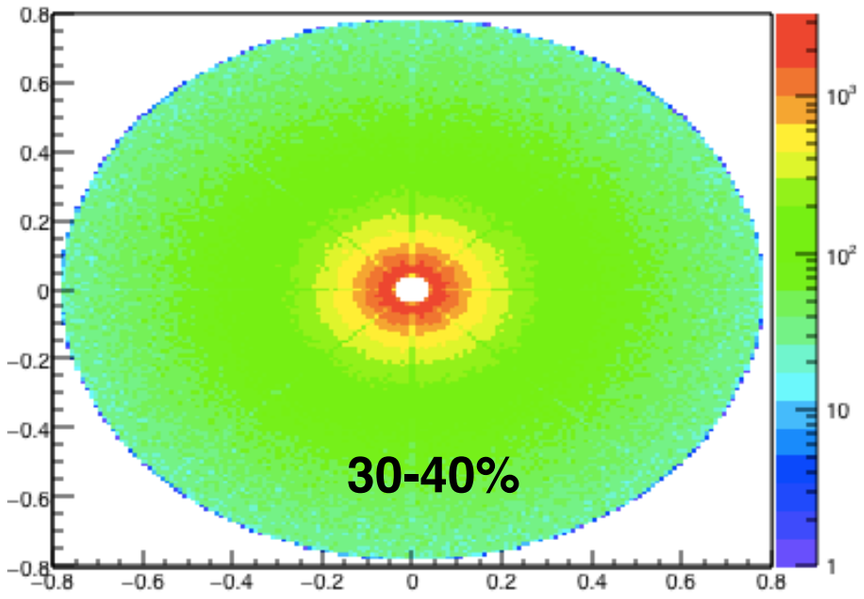


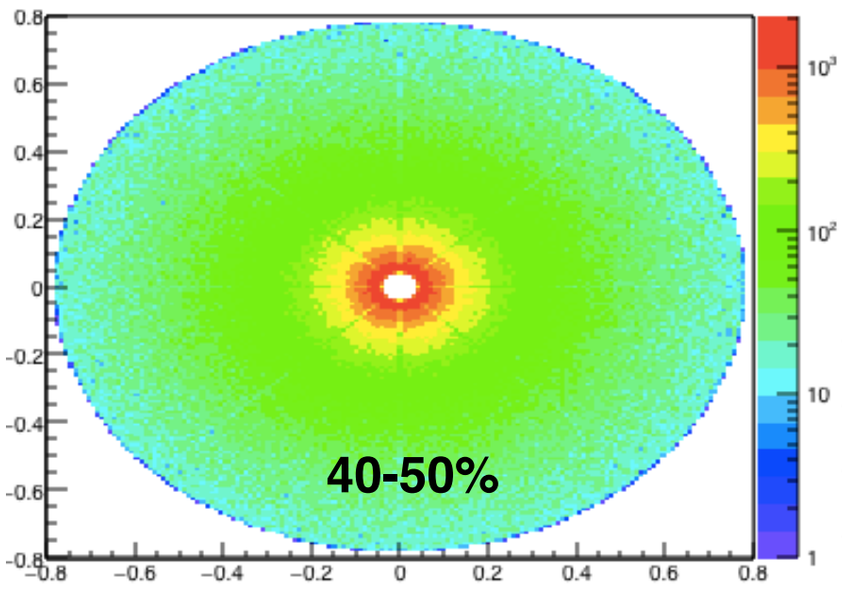


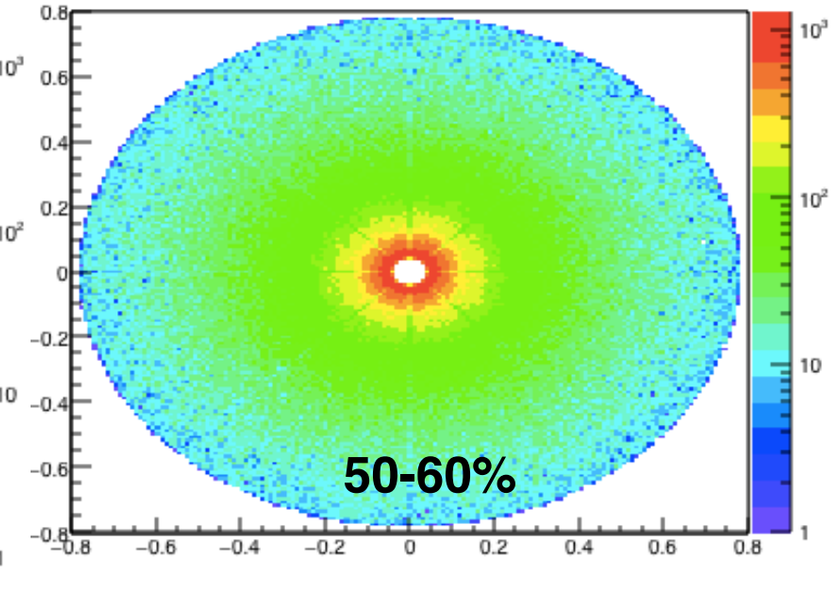

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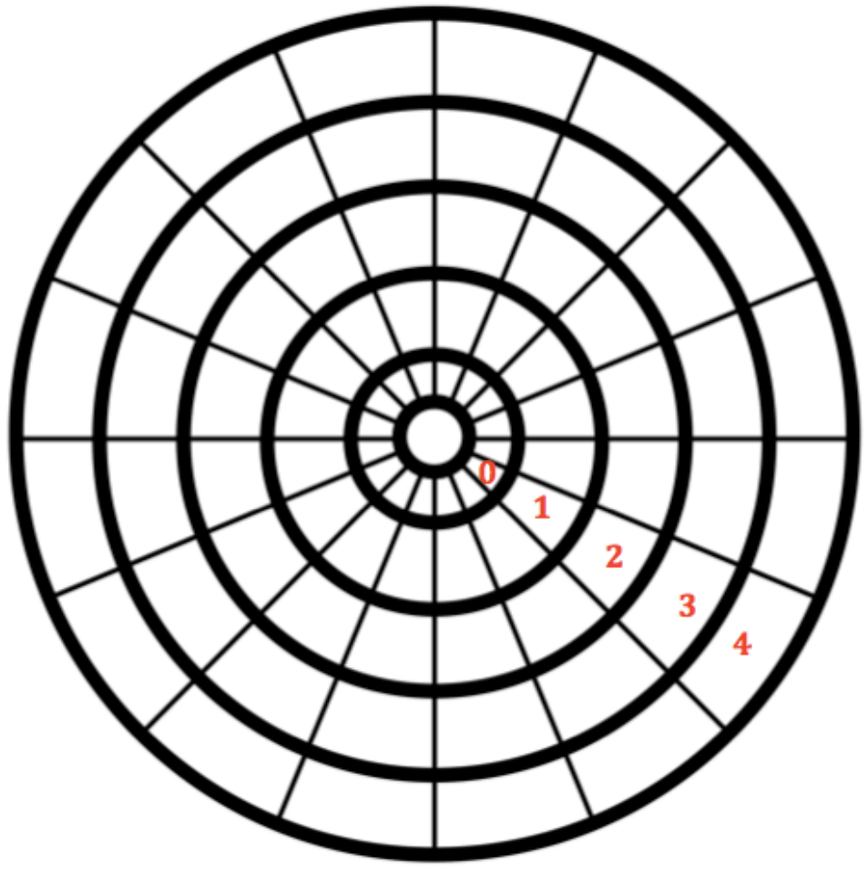
$$\Psi_2 = \frac{1}{2}\tan^{-1}\left(\frac{\sum_{i=0}^{ch=31} w_i \cos\left(2\varphi_i\right)}{\sum_{i=0}^{ch=31} w_i \sin\left(2\varphi_i\right)}\right)$$




$\Phi_i$ → cell angle
$w_i$ → multiplicity in *i-cell*

<cos (2*[$\psi_{FIT(V0A+)}$ - $\psi_{MC}$])> → resolution of the EP

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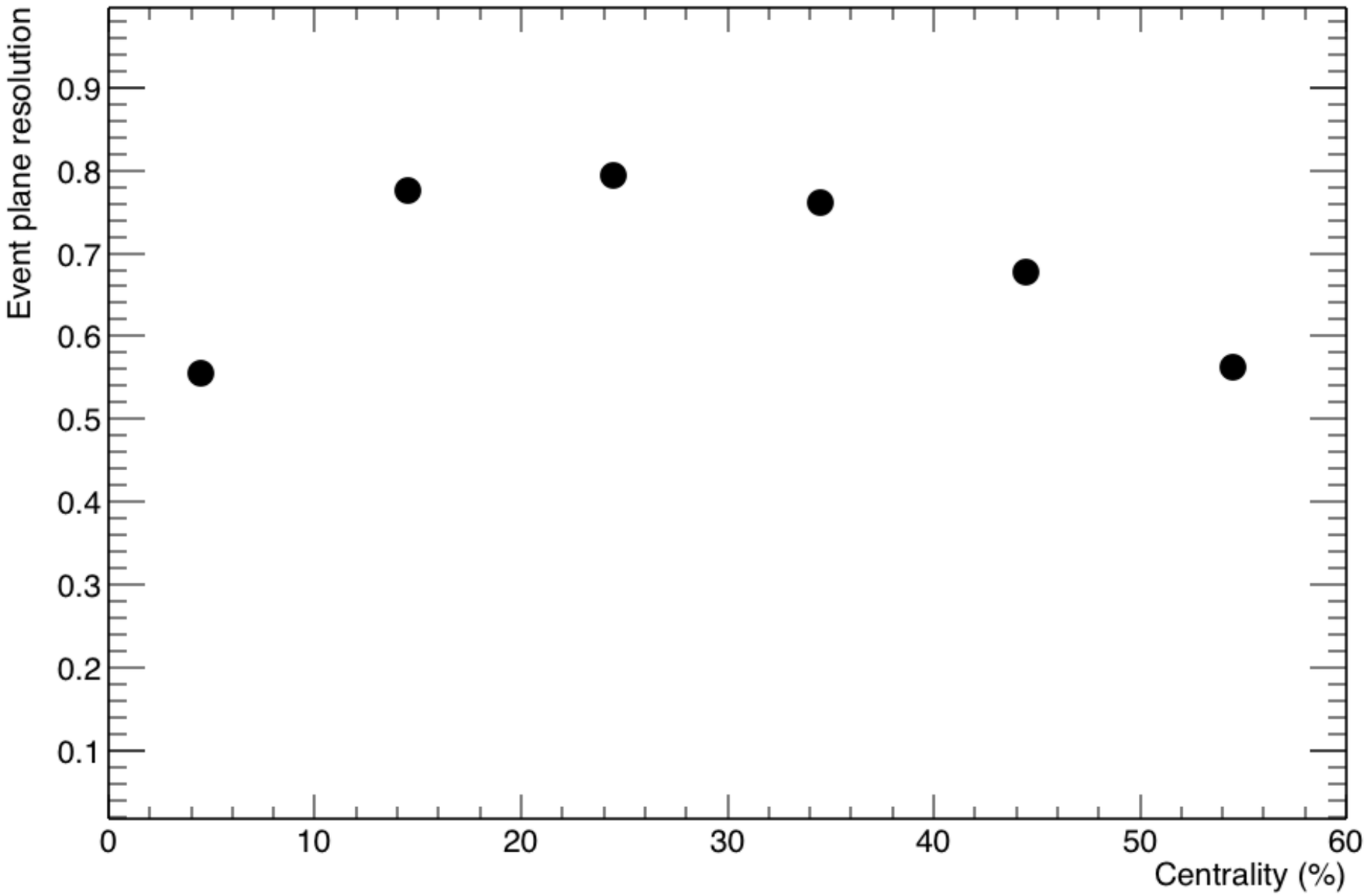

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We presented a first approach for the BMD. This detector could accomplish the pseudo-rapidity coverage needed by MPD

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**this summer two students from Mexico will visit JINR. They can work on some of this tasks.**

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The first version of the BMD geometry is implemented in MPD-ROOT interface.

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*LNS-BUAP*

- *268 nodes (under demand)*
- *1000 Tb of storage (under demand)*
- *1.43 Tflops peak*

# Final comments

**MEXnICA**

Mexican group joining to the MPD-NICA efforts at JINR.

List of participants institutions (strict alphabetical order)

- BUAP
- CINVESTAV (Física)
- UAS
- UNISON
- UNAM (II, FC & ICN)


Estados Unidos Mexicanos
División estatal
115°
105°
95°
N
O
E
S
Estados Unidos de América
30°
Isla Ángel de la Guarda
Isla Guadalupe
Isla Cedros
Isla Tiburón
Baja California
Sonora
Chihuahua
Coahuila de Zaragoza
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23° 27'
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# Final comments

**MEXnICA group**

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Luis Valenzuela
Heber Zepeda
Rodolfo Palomino (since 2017)
E. Moreno (since 2017)
Victor Manuel Velazquez Aguilar (since 2017)
Lauro Santiago Cruz (since 2017)
Sergio Solis (since 2017)
Pedro Gonzalez Zamora (since 2017, posdoctoral fellow)
Mario Rodríguez Cahuantzi