Status report from MexNICA team to PWG1

The present slides summarize the activities of MexNICA team at PWG1. Some of the results has been presented, while other not yet. The results are at different levels: generation and/or reconstruction on the pseudorapidity region of BeBe detector. On phenomenology: magnetic fields and average transverse momentum. **All the analysis are beginning.**

✓ Centrality vs multiplicity (using UrQMD)
(Luis Valenzuela, Maria Elena Tejeda, Isabel Domínguez)

✓ Simulation of kinematic variables using PHSD event generator
(Dario Chaires, Maria Elena Tejeda)

✓ Particle identification
(Julio Maldonado, Isabel Dominguez)

✓ Studies of Lambda hyperon
(Ivonne Maldonado)

✓ Magnetic field at RHIC and NICA
(Alejandro Girado, Pedro Nieto, Maria Elena Tejeda, Isabel Dominguez)

✓ Event plane resolution
(Alejandro Girado, Maria Elena Tejeda, Oleg)

✓ Average transverse momentum studies
(Valeria Reyna, Mario Rodriguez, Eleazar Cuautle)

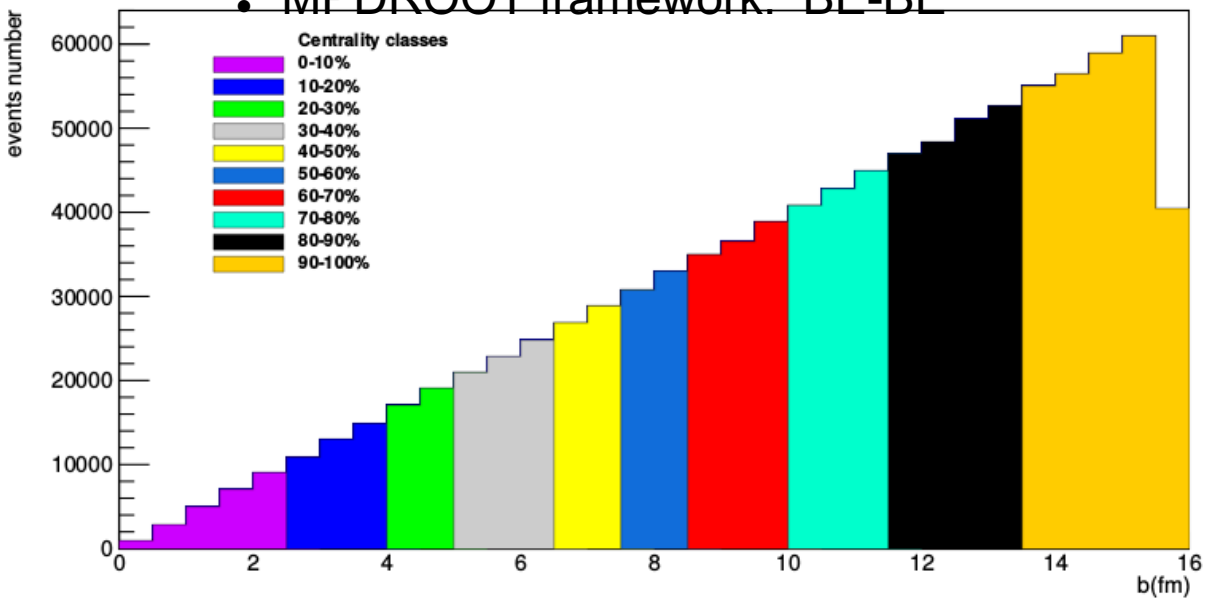
Centrality vs multiplicity (using UrQMD)

(Luis Valenzuela, Maria Elena Tejeda, Isabel Domínguez)

Centrality classes of Multiplicity (using rings 3-6 from BeBe: 2.2 <|η|< 3.2)

Simulation details

- Beam - target: Au-Au
- Generator: UrQMD v. 3.4
- Events: 1 000 000 mbias (0-16 fm)
- Energy: $\sqrt{s}$ = 11 GeV
- MPDROOT framework: BE-BE



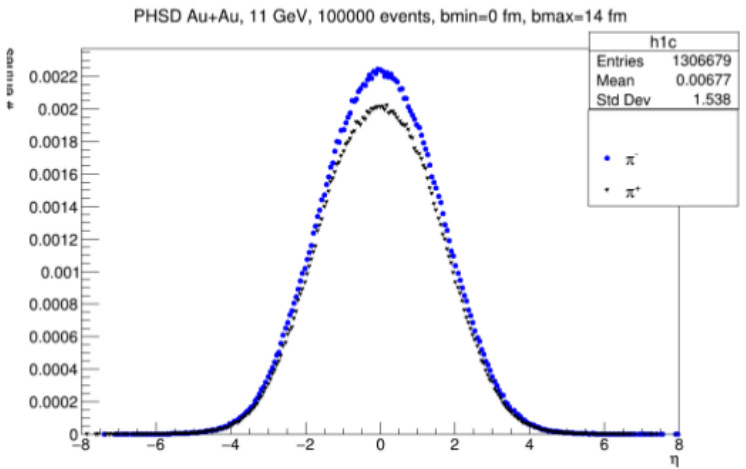
Class %	bi (fm)	bf (fm)
0-10	0	2.7895
10-20	2.7895	4.0005
20-30	4.0005	4.9805
30-40	4.9805	5.8605
40-50	5.8605	6.6995
50-60	6.6995	7.5505
60-70	7.5505	8.4495
70-80	8.4495	9.4605
80-90	9.4605	10.7505
90-100	10.7505	14.9605

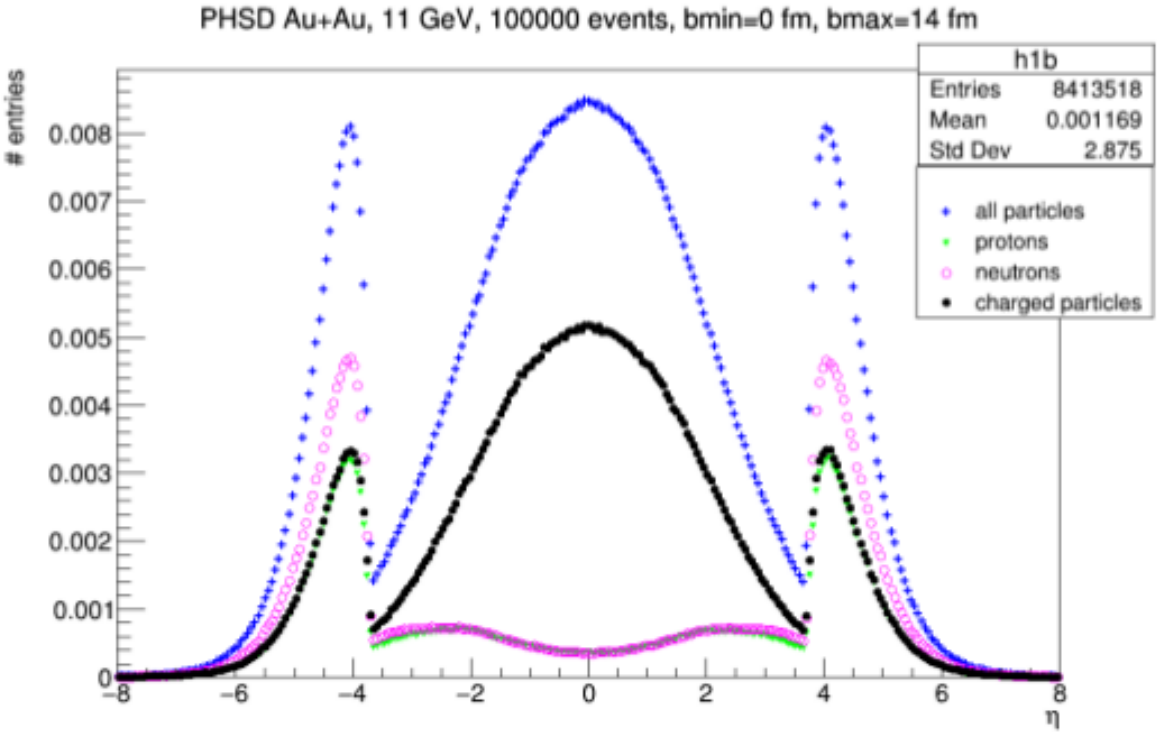
Simulation of kinematic variables using PHSD event generator

(Dario Chaires, Maria Elena Tejeda)

kinematic Variables of identified particles (PHSD event generator)

Generator: PHSD
Events: 10 000
Impact parameter 0-14 fm
$\sqrt{s_{NN}}$ = 11GeV
Framework: ROOT





Particle identification

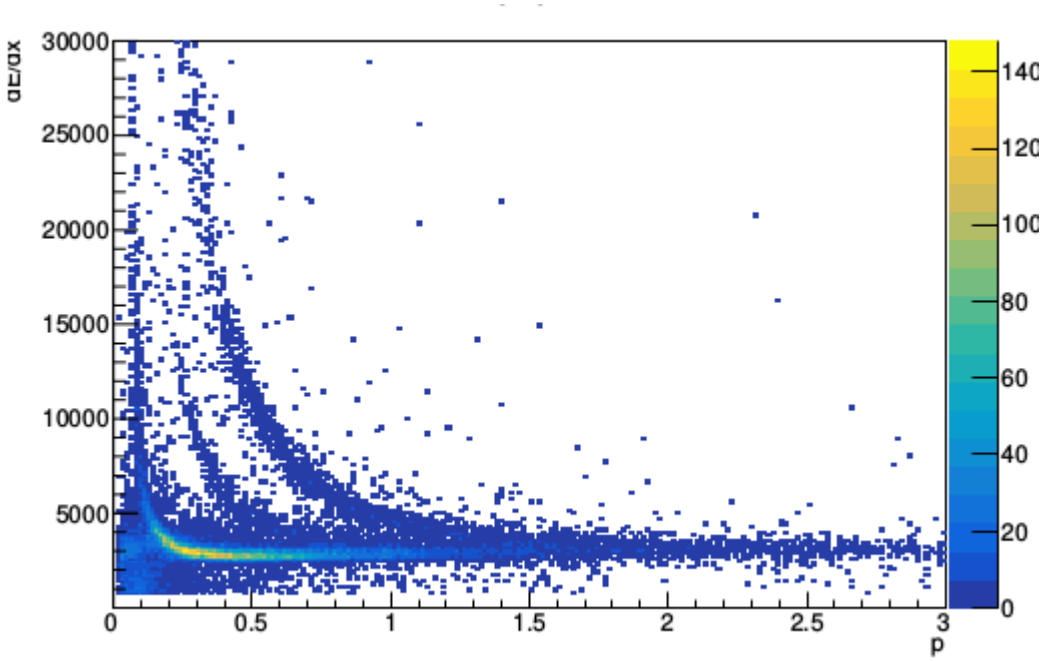
(Julio Maldonado, Isabel Dominguez)

Particle identification with TPC of MPD

Identification of charged particle through deposition energy in the TPC.

After reconstruction a 100 Au+Au events generated with UrQMD at 11 GeV.

Interesting to test alternative algorithms to identify particles.

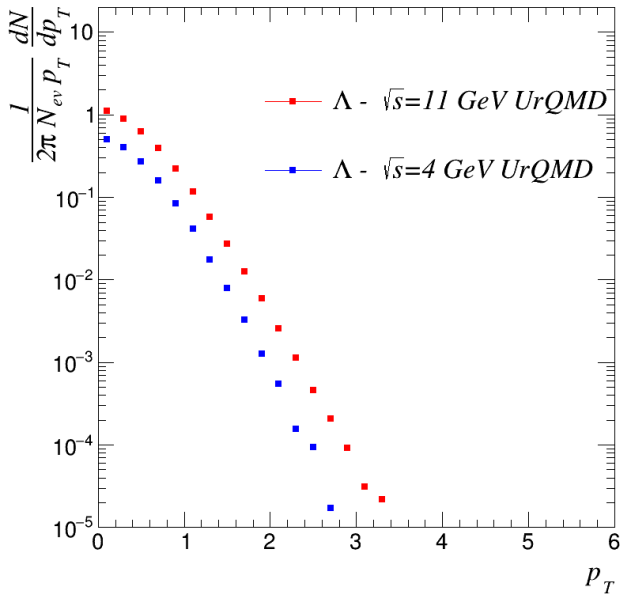


Studies of Λ hyperon

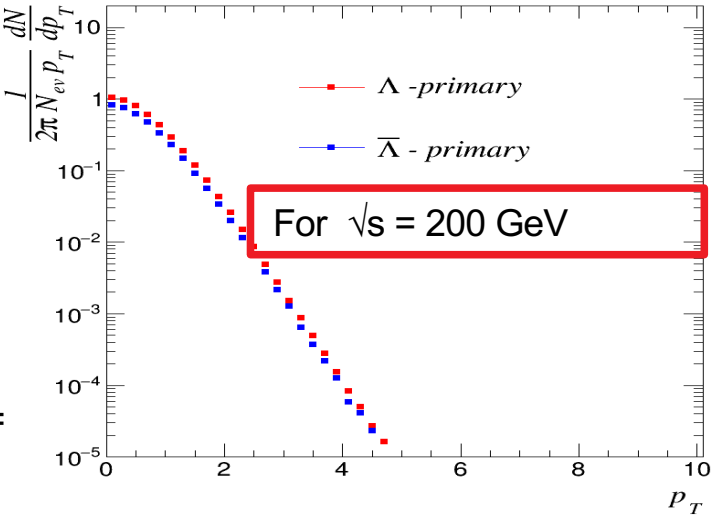
(Ivonne Maldonado)

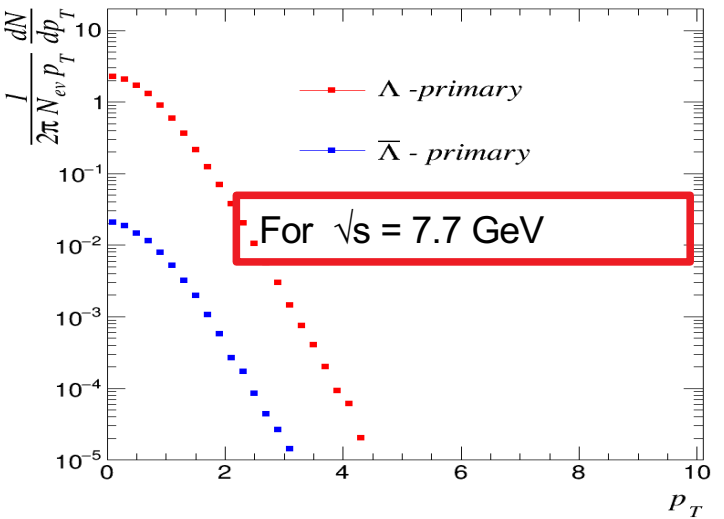
Study of hyperons: Production of Λ at different event generators and energies

UrQMD input parameters:
4 and 11 GV



- **Therminator** Input parameters:
  - Events = 100000
  - FreezeOutModel = SingleFreezeOut
  - τ = 9.74
  - ρ_{Max} = 7.74





Λ Production helps to understand production of strangeness, as well as polarization and spin alignment among other topics.

1)**Magnetic field at RHIC and NICA**

2) (Alejandro Girado, Pedro Nieto, Maria Elena Tejeda, Isabel Dominguez)

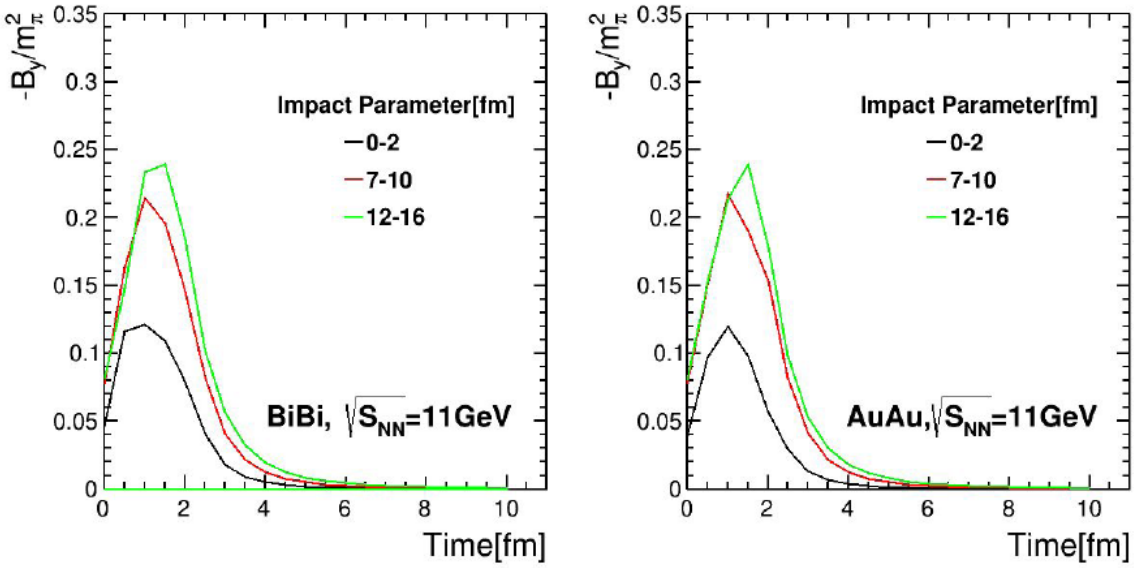
Magnetic Fields at NICA Energy

Lienard-Wiechert potential describe the electromagnetic fields of a moving charge distribution in terms of the vector (**A**) and scalar (φ) potential.

$$\phi(\mathbf{r},t) = \frac{q}{4\pi\epsilon_0}\left[\frac{1}{R-\mathbf{R}\cdot\mathbf{v}(t)}\right]_{t=t_{ret}}$$

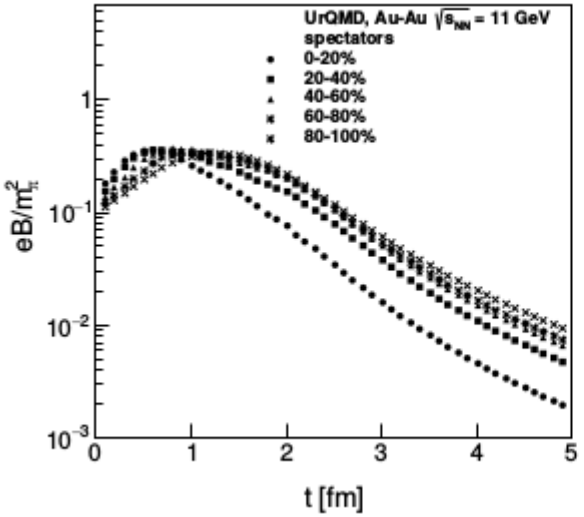
$$\mathbf{A}(\mathbf{r},t) = \frac{\mu_0}{4\pi}\left[\frac{q\mathbf{v}(t)}{R-\mathbf{R}\cdot\mathbf{v}(t)}\right]_{t=t_{ret}}$$

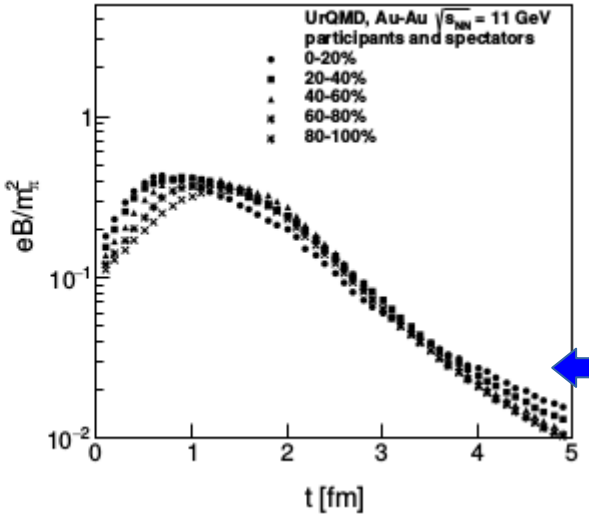
$$t_{ret} = t - \frac{|\mathbf{r}-\mathbf{r}'|}{c} = t - \frac{|\mathbf{R}|}{c}$$



Magnetic field on perpendicular direction to reaction plane, produced by spectator protons in Bi+Bi and Au+Au collisions at 11 GeV for 3 centrality ranges.

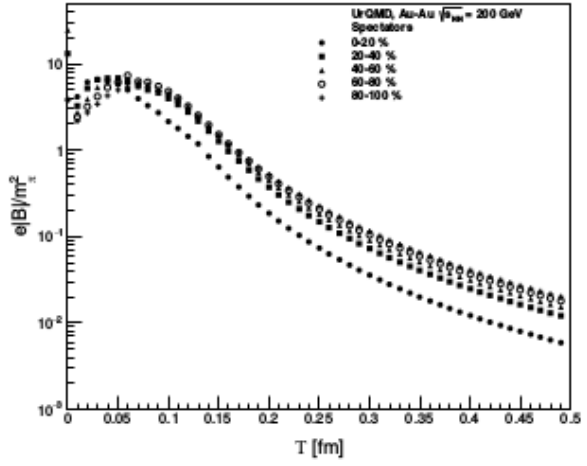
Magnetic Field for Au+Au at 11 and 200 GeV

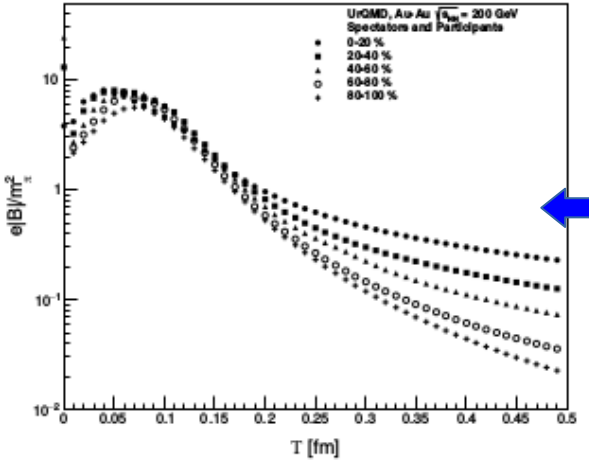




Mean magnetic field strength produced by spectators (left) and spectator+participants (right), for centrality bins.

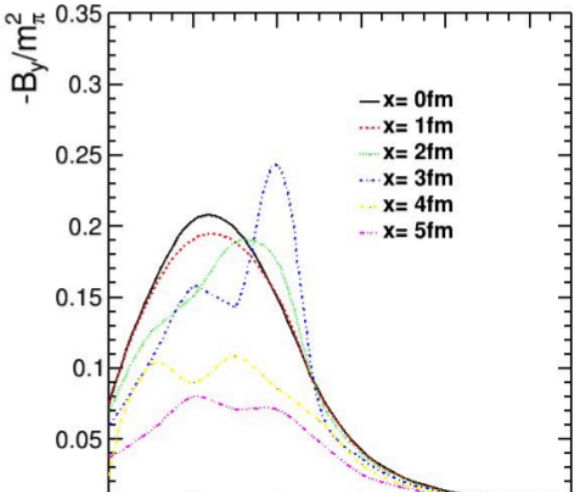
Au+Au at 11 GeV

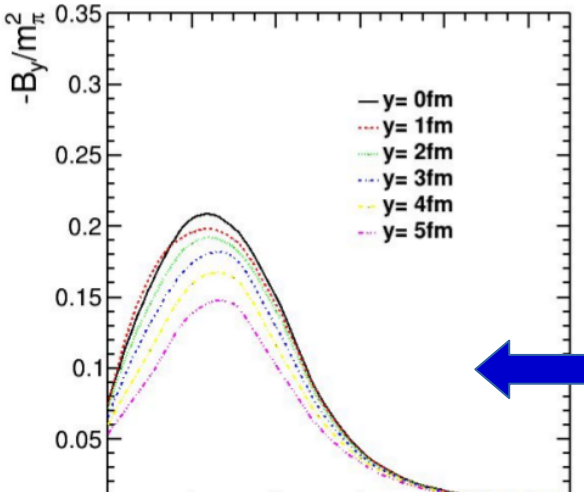


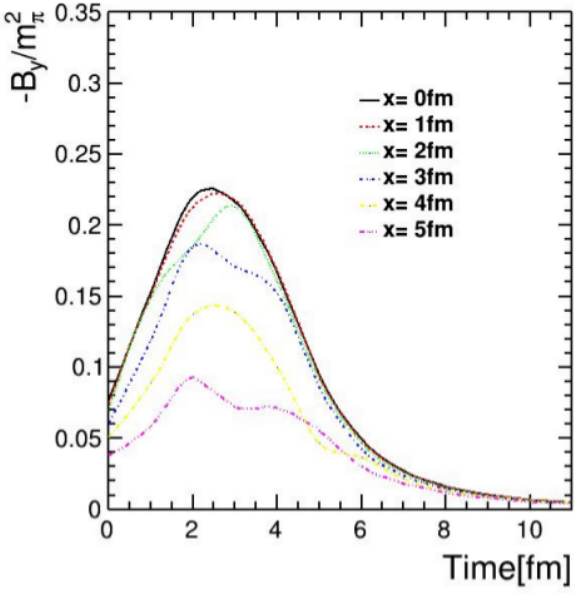


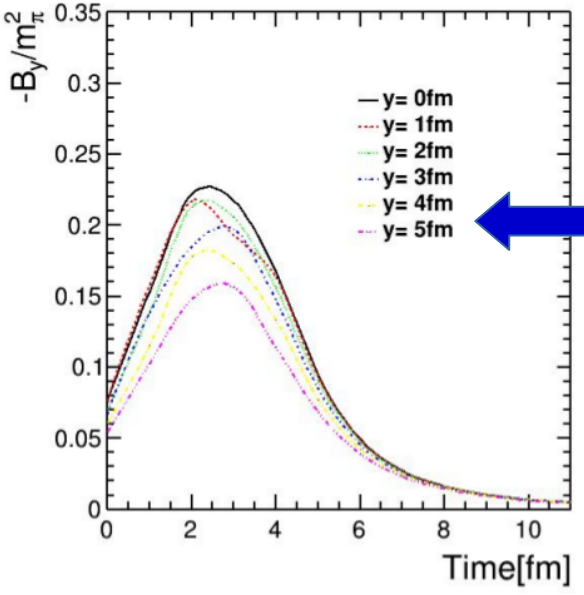
Au+Au at 200 GeV

Magnetic Field for Au+Au and Bi+Bi at 11 GeV









Magntic field perpendicular to the reaction plane for different position values (x,y), produced by the proton spectator:

Au+Au collision at 11 GeV and impact parameter (0-16) fm

Bi+Bi collision at 11 GeV and impact parameter (0-16) fm

Event plane resolution

(Alejandro Girado, Maria Elena Tejeda, Oleg)

Event plane resolution (with BeBe detector)

$$Q_{n,x} = \sum_{i}^{N} w_i cos(n\phi_i) = \mathbf{Q}_n cos(n\Psi_n)$$

$$Q_{n,y} = \sum_{i}^{N} w_i sin(n\phi_i) = \mathbf{Q}_n sin(n\Psi_n)$$

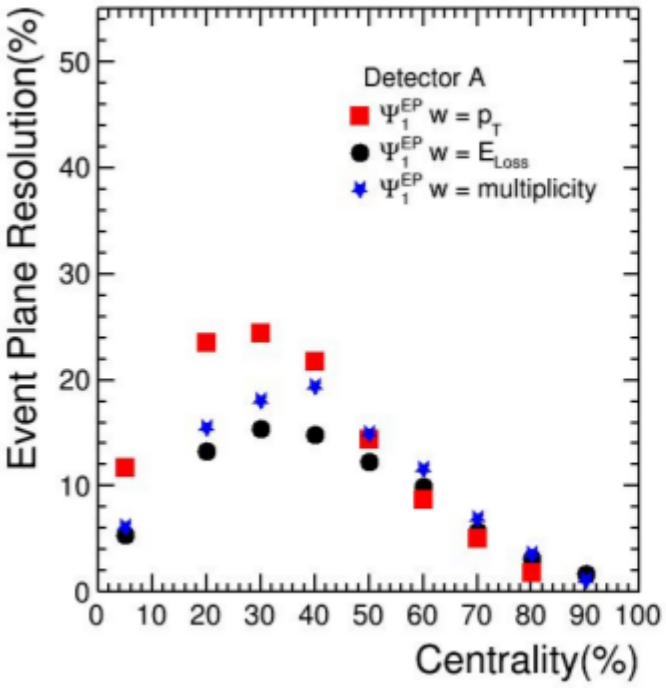
$$\frac{Q_{n,y}}{Q_{n,x}} = \frac{sin(n\Psi_n)}{cos(n\Psi_n)} \quad \longrightarrow \quad \Psi_n = \frac{1}{n} tan^{-1}\left[\frac{Q_{n,y}}{Q_{n,x}}\right]$$

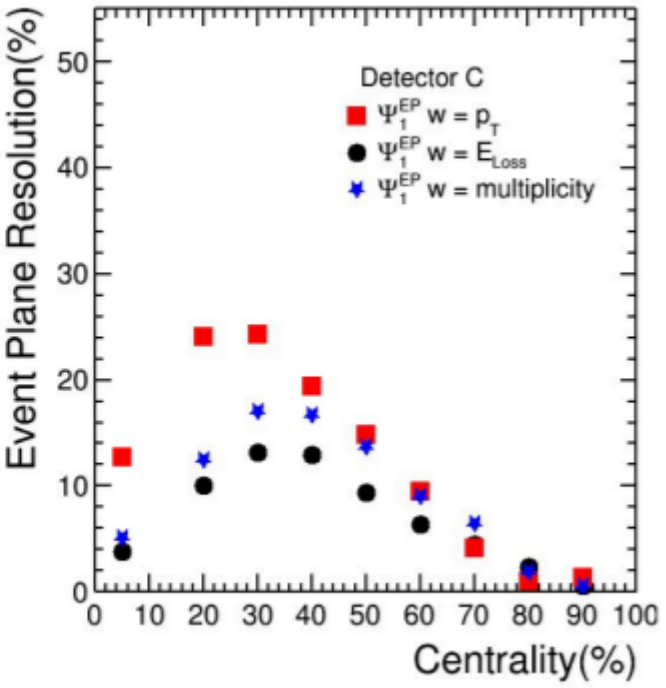
$$= tan^{-1}\left[\frac{\sum_i^N w^i sin(n\phi_i)}{\sum_i^N w^i cos(n\phi_i)}\right]$$

$$\mathcal{R}_1 = \langle cos[\Psi_1 - \Psi_{RP}] \rangle$$

Event plane resolution for centrality range

Event plane resolution using BeBe detector





Event plane resolution extracted with BeBe detector and calculated using different weighs: transverse momentum, energy loss, multiplicity.

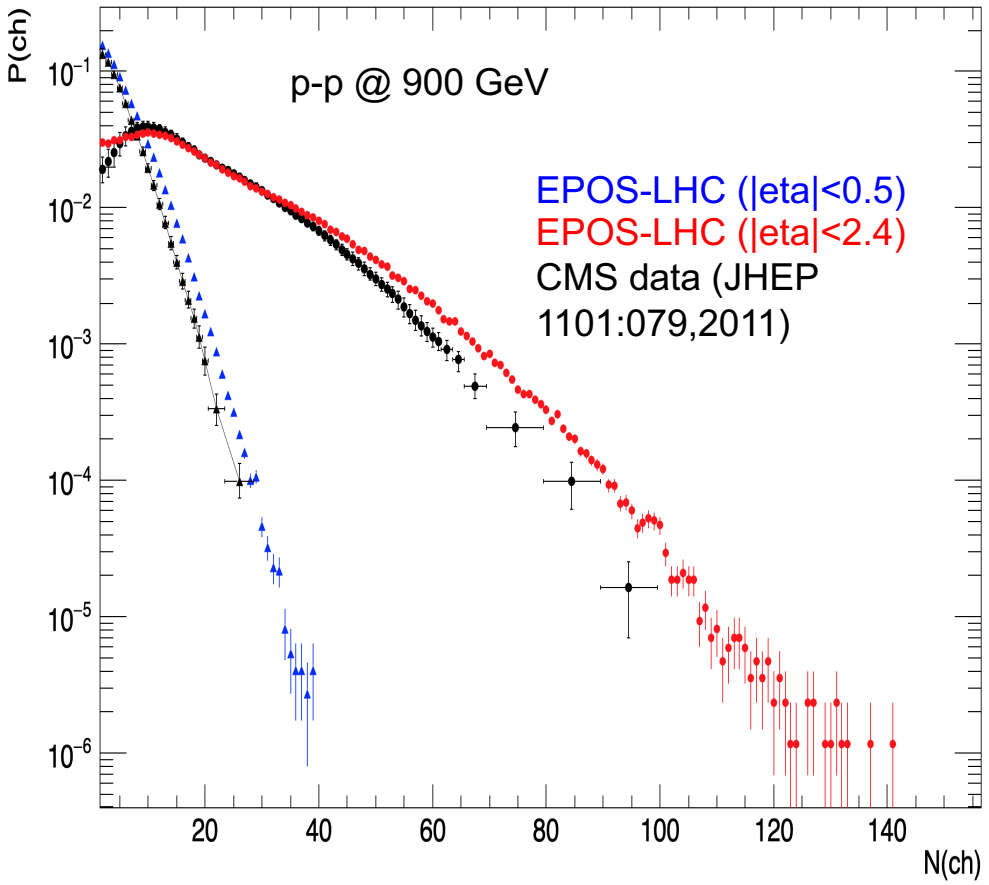
Average transverse momentum vs multiplicity

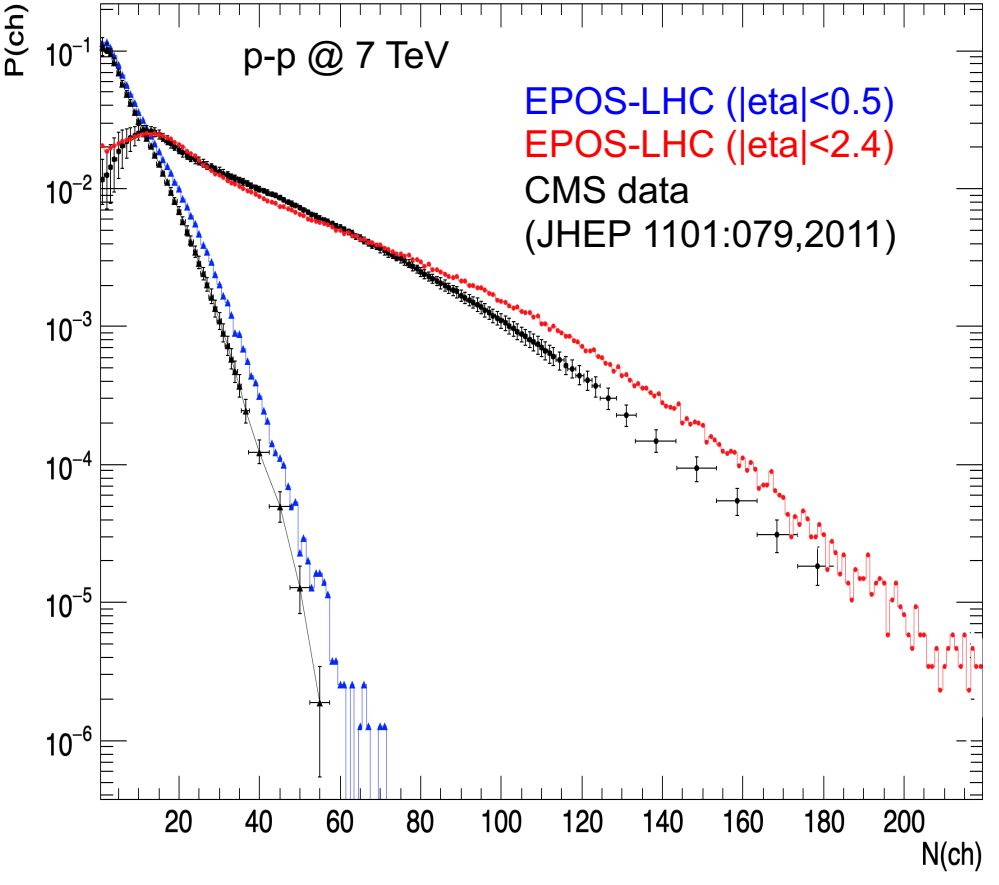
1) (Valeria Reyna, Mario Rodriguez, Eleazar Cuautle)

The goal of the analysis is to investigate the average transverse momentum versus multiplicity. There are discrepancies at low multiplicity between data and Color Glass Condensate which is attributed to flow effects. We will investigate the flow effect with different event generators.

Multiplicity distribution with EPOS versus CMS data

10^4 events with EPOS. It overestimates the charged particle multiplicity





Transvere area ($S_T = \pi R^2$) in pp, pPb collisions

Nucl. Phys. A 916, 210 (2013).
CMS data

$$\frac{dN_g}{dy} = \frac{K}{\Delta\eta} \times \frac{3}{2}\left(\frac{dN}{d\eta}\right)^{1/3}$$

$$R_{\rm pPb} = 1\ {\rm fm} \times f_{\rm pPb}\left(\sqrt[3]{dN_g/dy}\right)$$

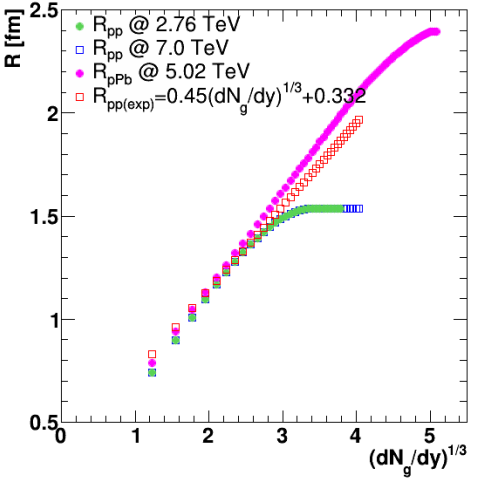
with

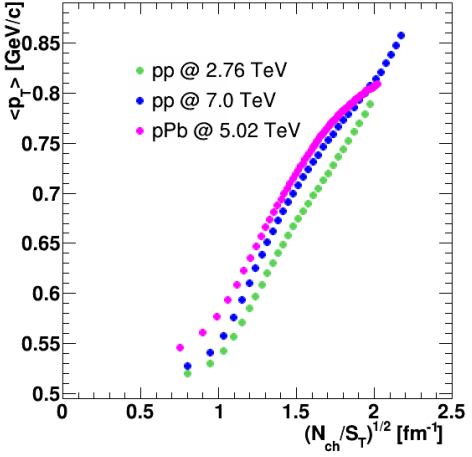
$$f_{\rm pPb}(x) = \begin{cases} 0.21 + 0.47x & \text{if } x < 3.5, \\ 1.184 - 0.483x + 0.305x^2 - 0.032x^3 & \text{if } 3.5 \leqslant x < 5, \\ 2.394 & \text{if } x \geqslant 5. \end{cases}$$

$$x = \left(\frac{dN_g}{dy}\right)^{1/3}$$

$$f_{\rm pp}(x) = \begin{cases} 0.387 + 0.0335x + 0.274x^2 - 0.0542x^3 & \text{if } x < 3.4, \\ 1.538 & \text{if } x \geqslant 3.4. \end{cases}$$

Our calculation with ALICE data





According to CGC model $\langle p_T \rangle$ seem to scale with transverse area of the collision S_T. At low multiplicity flow effects could affect and should be investigated. Analysis is being done with ALICE data (PLB727, 371, 2013).

PYTHIA Average transverse momentum vs ALICE data

PYTHIA version 8.235
Soft QCD p+p at 900 GeV
5 millions of events

Color reconnection produce flow like effects and allow to explain ALICE average transverse momentum versus multiplicity.

We would like to study different event generator (EPOS, UrQMD) including hydrodynamic flow.