Some Global observables studies in simulated and reconstructed data for BiBi@9.2 GeV¶

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MPD Cross-PWG Meeting, 12 Nov 2024

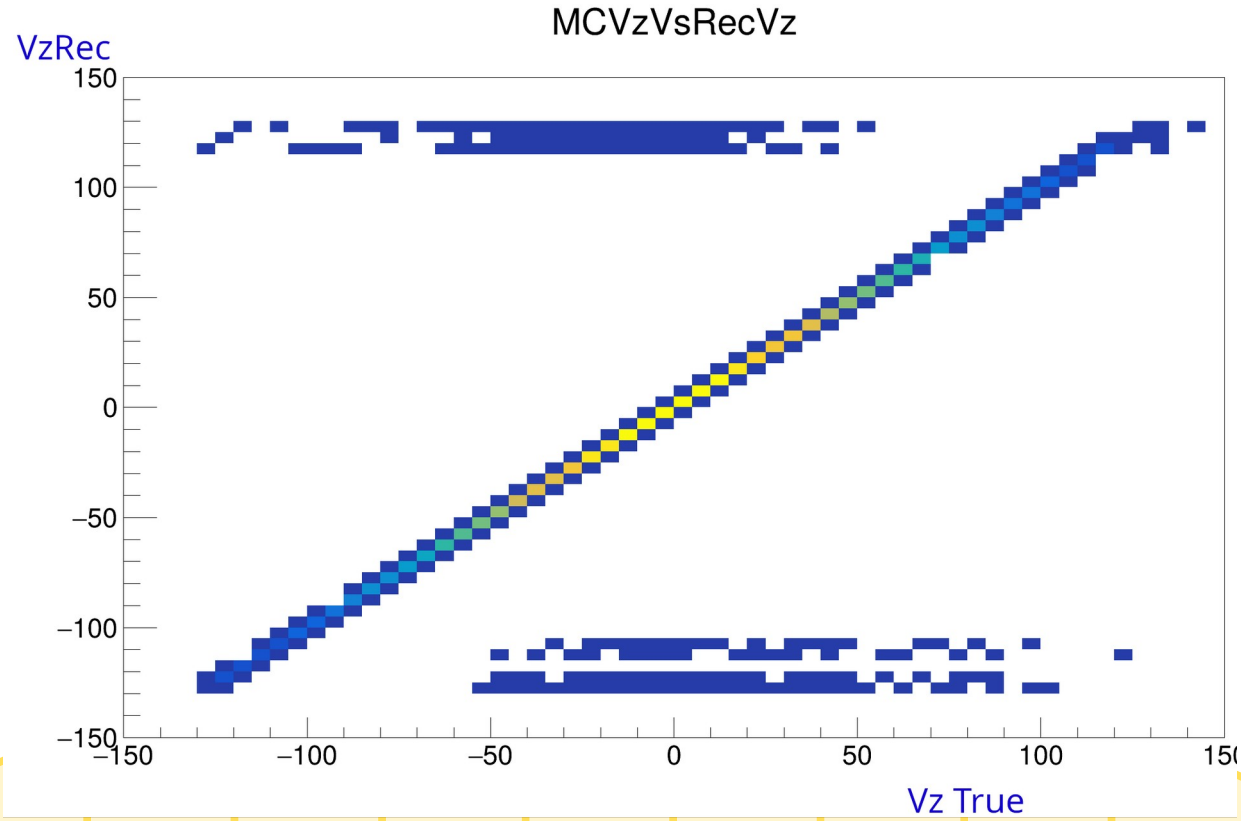
Datasets

- Request 25 production: Bi+Bi@9.2 AGeV (UrQMD)
- Request 34 production: Bi+Bi@9.2 AGeV (UrQMD) for some cross-check

Event Selection

- event should have at least two pure MC tracks (with GetMotherId() = -1) within experimental TPC acceptance
- event should have reconstructed vertex
- Centrality should be defined (getCentrTPC within 0-100%)
- mPrimaryVertex.Z() != 0 - not reconstructed (==0)

Vertex position — vertex displacement for encrease of rapidity range



Track selection/definitions

Pure MC track: **MC good primary**
its motherid=-1
Or coming from EM or strong interaction decay (check with mother radius)
and it passed MC track cuts

Reconstructed track: **Rec good**
it passed Rec track cuts

Reconstructed track: **Rec good selected**
it passed Rec track cuts and its matched pure MC track is good primary

Pure MC track cuts

accept only **charged** pions, kaons, protons, muons and electrons

Rec track cuts

distance of closest approach (clearly to the reconstructed primary vertex)
- if (fabs(mpdtrack->GetDCAX()) > mParams.mDcaCut) return false;
- if (fabs(mpdtrack->GetDCAY()) > mParams.mDcaCut) return false;
- if (fabs(mpdtrack->GetDCAZ()) > mParams.mDcaCut) return false;
- mDcaCut =1 cm

minimal number of TPC hits
- if (mpdtrack->GetNofHits() < mParams.mNofHitsCut) return false;
- mNofHitsCut = 16

Efficiency/Contamination

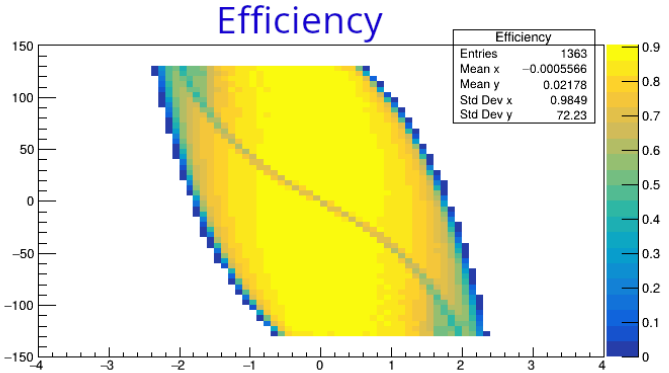
Efficiency = **Rec good selected / MC good primart**

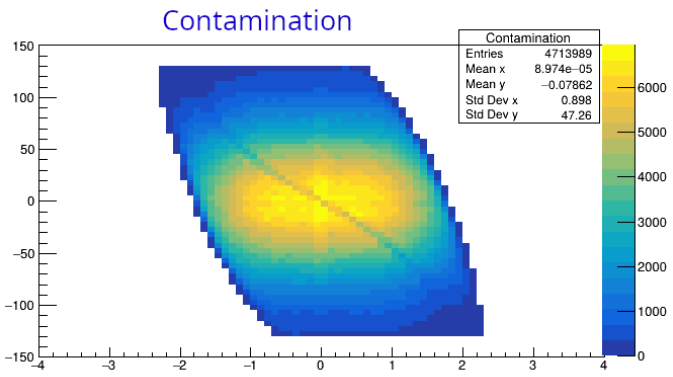
Contamination = **Rec good - Rec good selected**

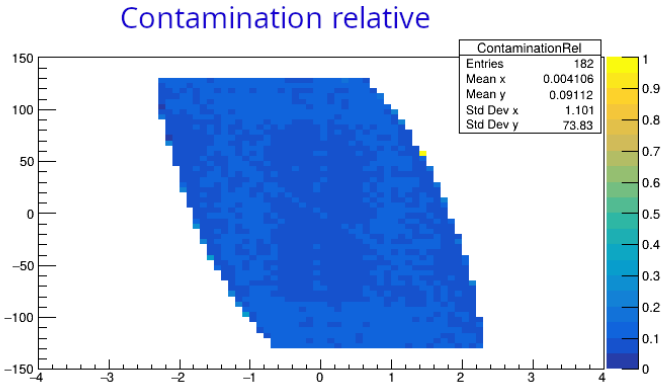
Contamination relative = (**Rec good - Rec good selected) / Rec good**

Data corrected = **Data Rec good * (1 -** Contamination relative) / Efficiency

Efficiency/Contamination on eta vs Vz





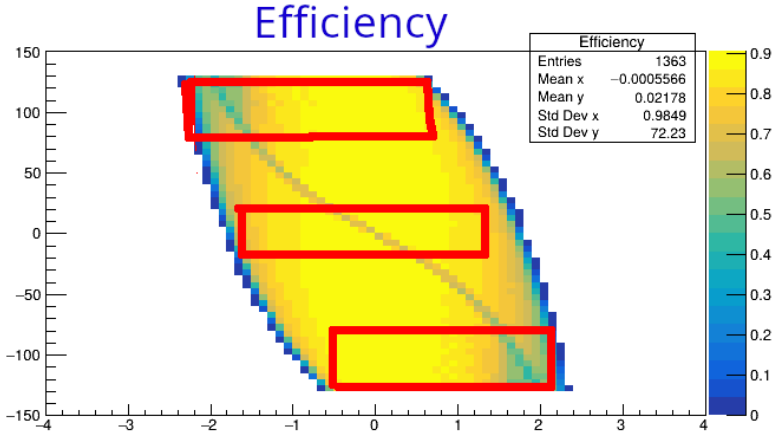


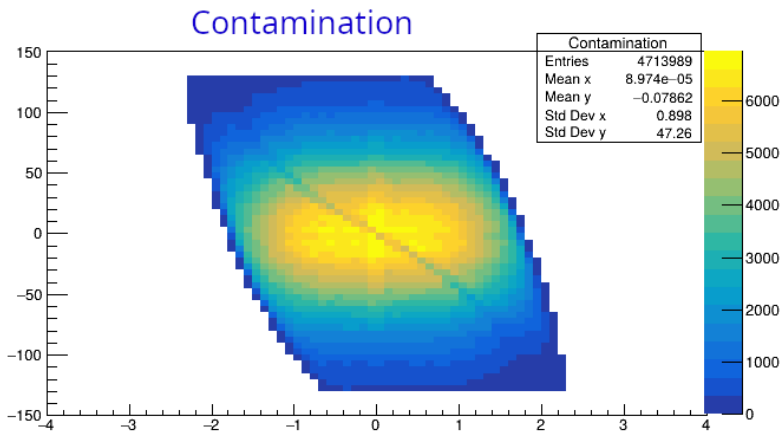
Wide randge of useful eta and Vz

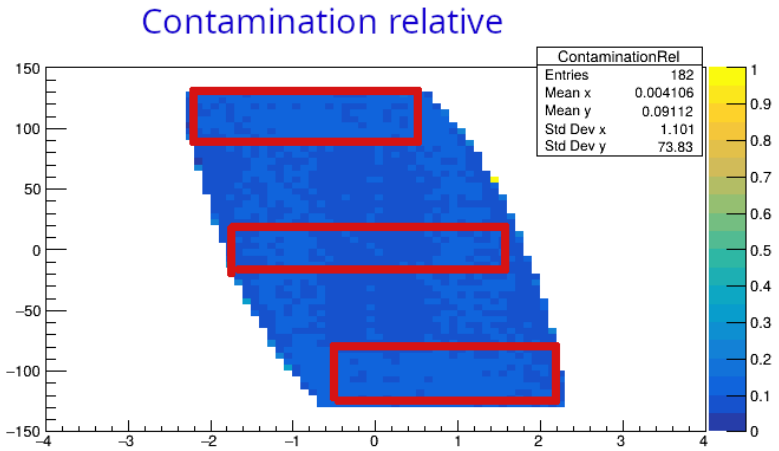
Membrane (?) effect at eta=0 or other eta if Vz displaced

Up to ~ eta=2 accessible

Efficiency/Contamination on eta vs Vz





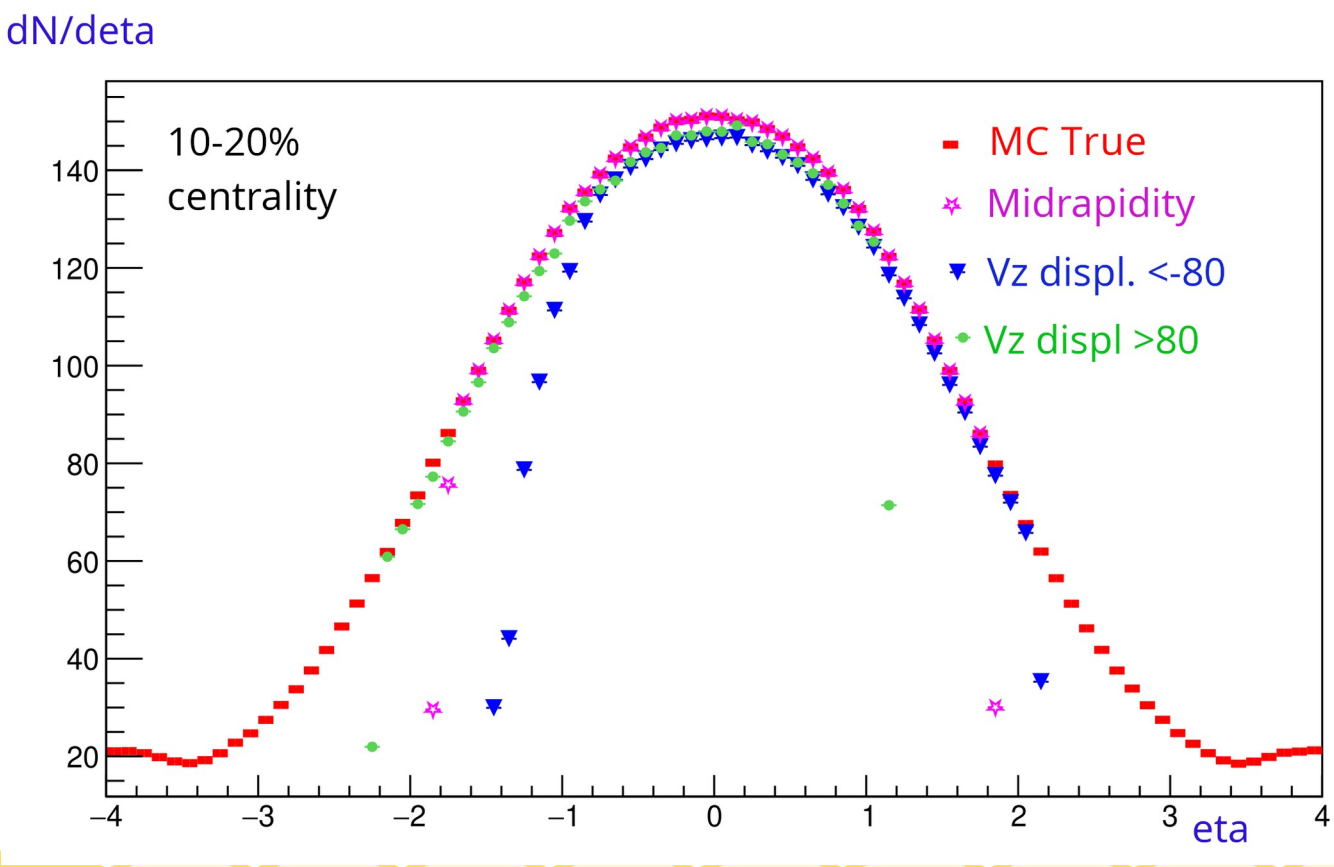


Use Vz cut to extend pseudo rapidity range

Select dedicated Vz windows

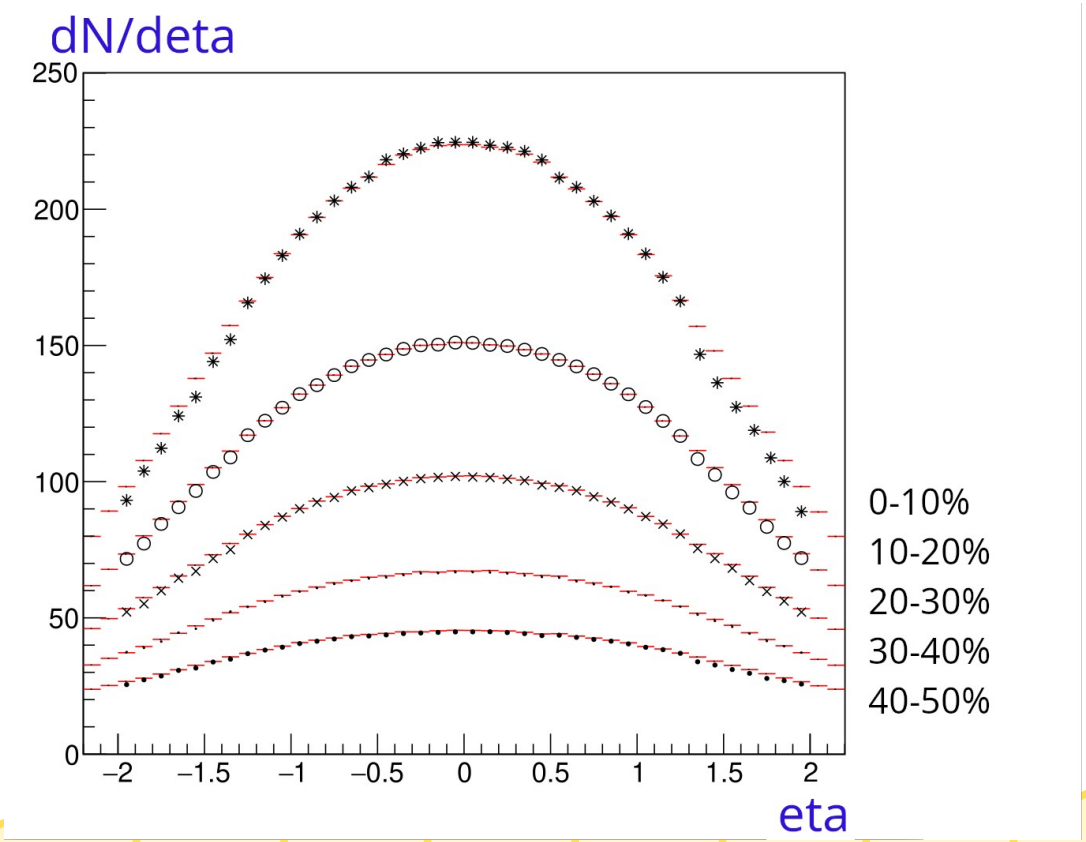
-110<Vz<-80; -20<Vz<20; 80<Vz<110

Results — pseudorapidity distribution



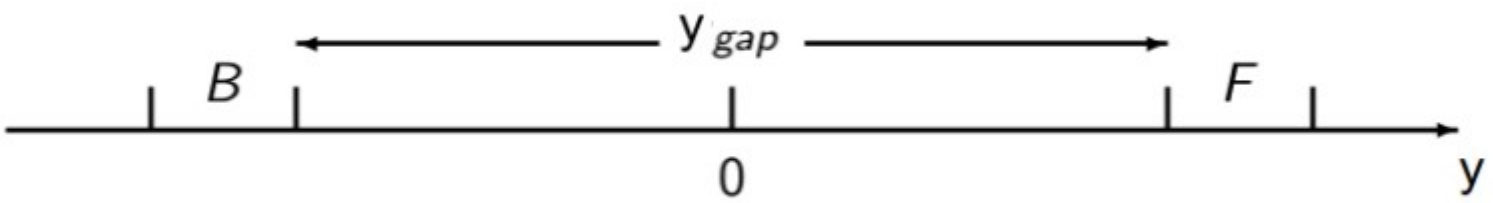
There are overlaps between different selection — can be combined

Results — centrality dependence of multiplicity pseudorapidity distribution



Multiplicity correlations in separated rapidity windows

1. Long Range Correlations:



$$b_{BF} \equiv \frac{\langle FB \rangle - \langle F \rangle \langle B \rangle}{\langle F^2 \rangle - \langle F \rangle^2} = \frac{\mathrm{cov}(F, B)}{D_F}.$$

Dependence on the centrality bin width

Multiplicity correlations in separated rapidity windows

2. Strongly intensive variables

M.I. Gorenstein, M. Gazdzicki, Phys.Rev.C 84 (2011) 014904:

$$\Sigma(A,B) \equiv \frac{\langle A\rangle\, \omega_B + \langle B\rangle\, \omega_A - 2\,\mathrm{cov}(A,B)}{\langle A\rangle + \langle B\rangle}\ ,$$

Andronov, E.V., Theor Math Phys 185, 1383–1390 (2015).

$$\Sigma(n_F,\ n_B) \equiv \frac{\langle n_F\rangle\, \omega_{n_B} + \langle n_B\rangle\, \omega_{n_F} - 2\mathrm{cov}(n_F,\ n_B)}{\langle n_F\rangle + \langle n_B\rangle},$$

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Track cuts

DcaCut =1 cm, NofHitsCut = 16

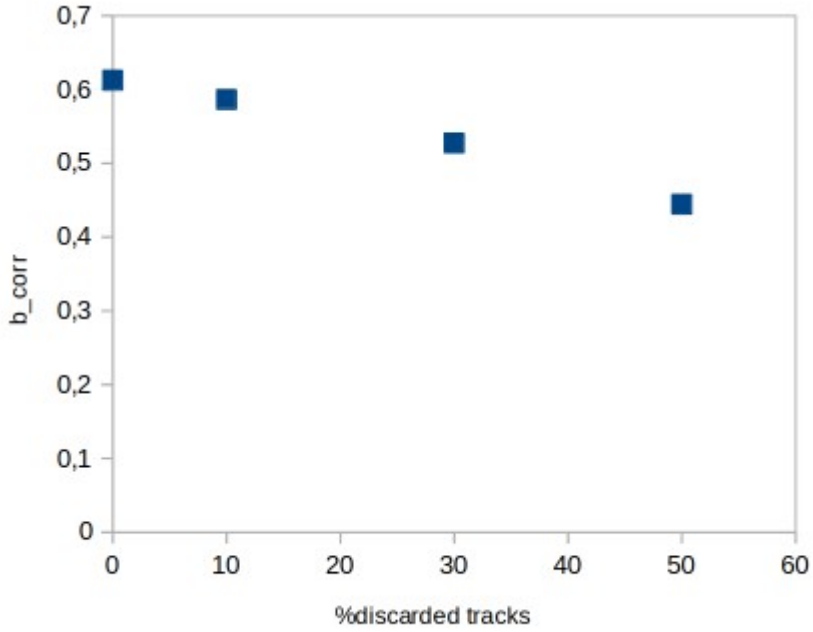
0.15 < pT < 2 GeV/c

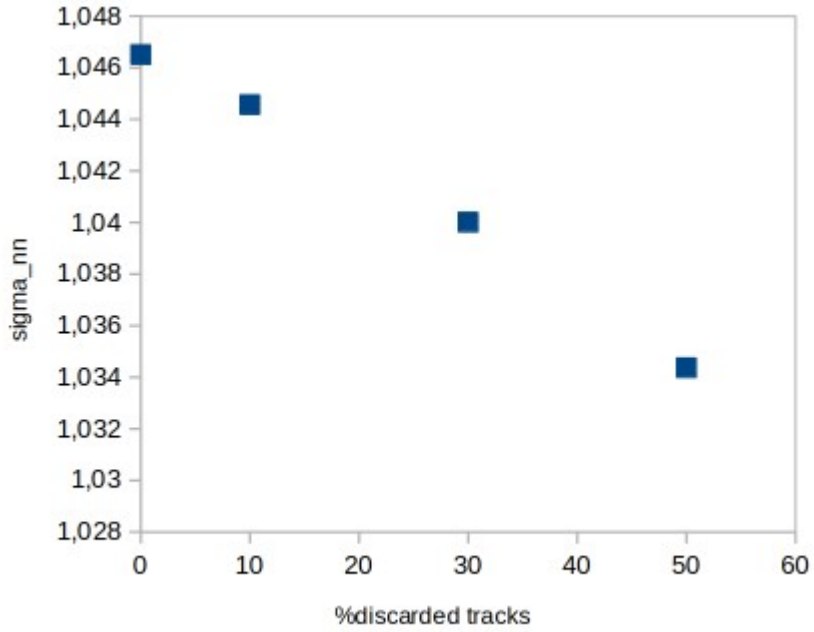
-1 < eta < 1

Rapidity windows: -1 .. -0.5, 0.5 .. 1
Rapidity windows: -1 .. 0, 0 .. 1

Vertex Z:
-50<Vz<-10 or 10<Vz<50

Efficiency correction — random track rejection



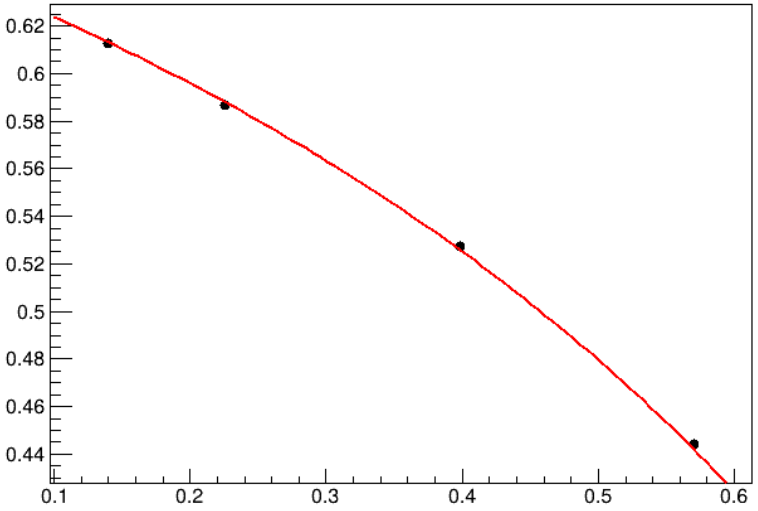


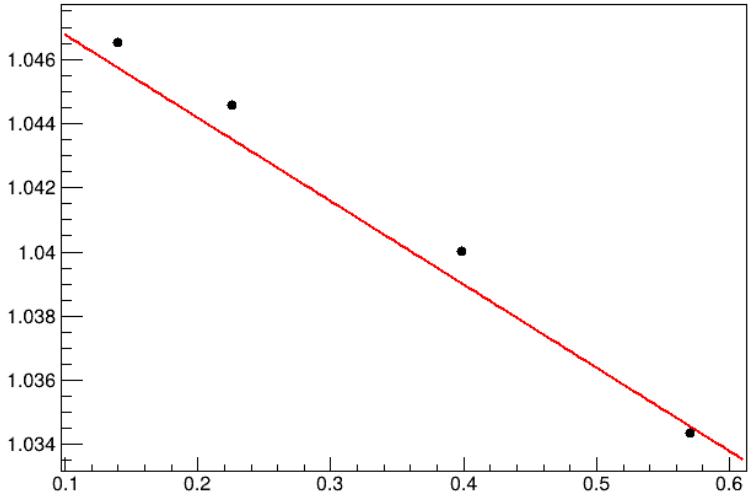
$$b_{corr}(f)=\frac{a(1-f)}{1+a(1-f)}$$

$$\Sigma_{nn}(f)=1+a(1-bf)$$

Clear dependence on the fraction rejection

Efficiency correction — random track rejection





$$b_{corr}(f)=\frac{a(1-f)}{1+a(1-f)}$$

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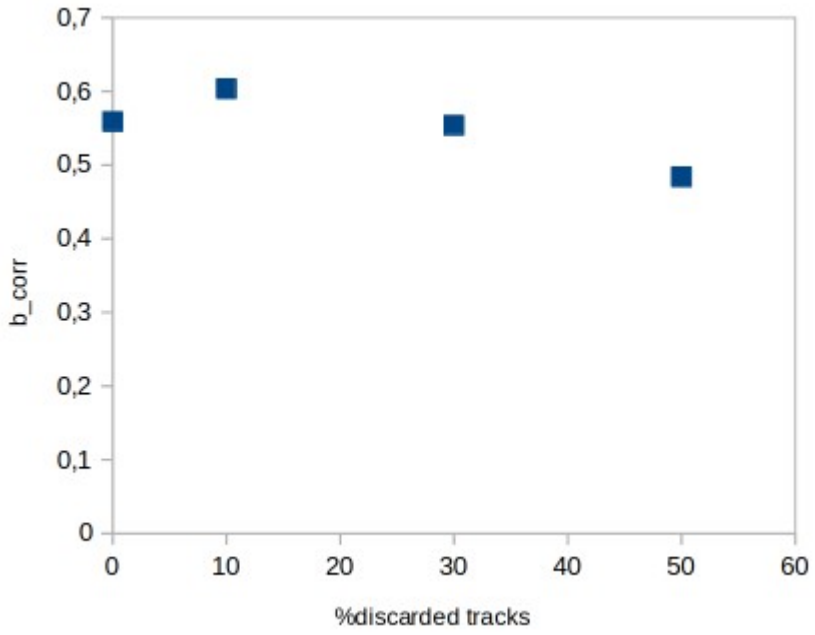
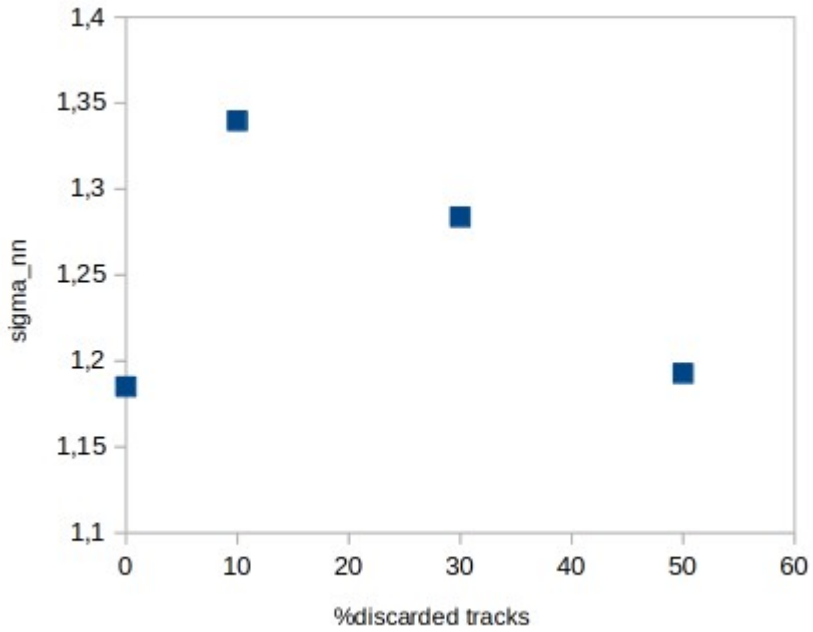
Clear dependence on the fraction rejection

Rec tracks — with contamination





No monotonic behavior
Sigma differs too much from MC True
Not clear how to correct — **tight rec cuts** to suppress contamination as much as possible
2-dimentional unfolding

Conclusions

Pseudro-Rapiditity distribution of charged multiplicity can be measured in a extended rapidity range if use displaced vertex (Vz) and take under control efficiency and contamination maps

The Fluctuation observables b_corr and Sigma_NN need to control contamination more deep (tightening cuts, 2-dimentional unfolding)
- work to be coninued.