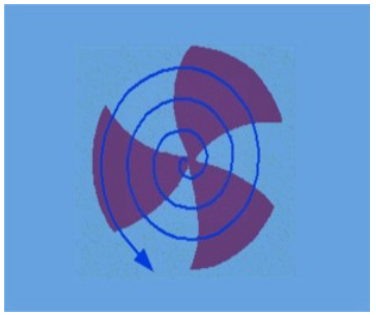


Balance Function With PID

Noor Alam

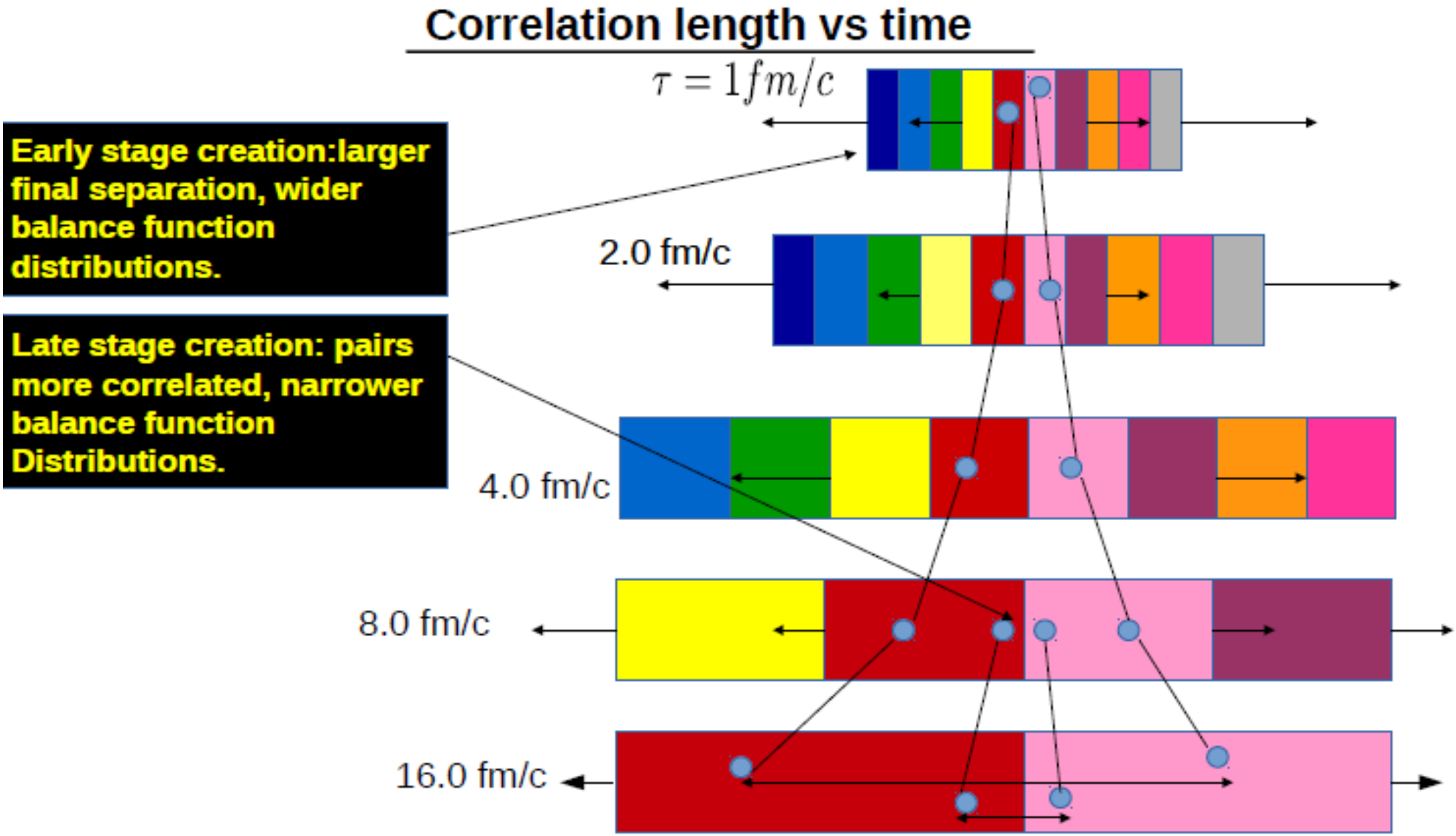
VECC, Kolkata

Outline:

1. Introduction and Motivation
2. Method of Particle Identification
3. Results
4. Summary and Plan

Introduction and Motivation

To know the answear of the fundamental questions concerning charge creation mechanism and hadronization in heavy ion collisions , the method charged balance function were suggested.



- Balance function observable sensitive to the charge-charge correlation function in the QGP
- By studying Balance functions of several hadronic species, and calculating width of BF ,one can go insight into the chemical evolution of the QGP. It also give the hints of radial flow.

Observable – Balance Function

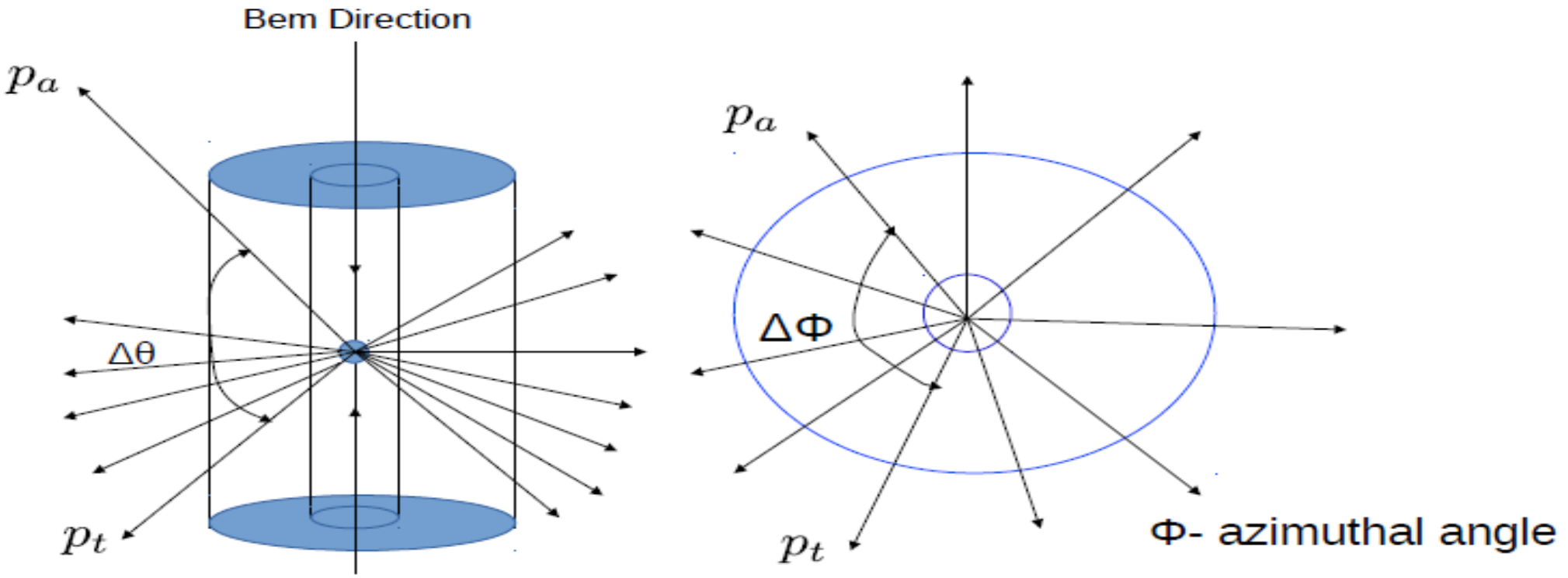
The BF is defined as the difference of the correlation function of oppositely and same charged particles normalised to the total number of trigger particles

The balance function is a conditional probability that a particle a in the bin p1 will be accompanied by a particle b of opposite charge in the bin p2.

$$B(p_2|p_1) = \frac{1}{2}\left\{\rho(b,p_2|a,p_1) - \rho(b,p_2|b,p_1) + \rho(a,p_2|b,p_1) - \rho(a,p_2|a,p_1)\right\}$$

Where $\rho(b,p_2|a,p_1) = \frac{N(b,p_2|a,p_1)}{N(a,p_1)}$

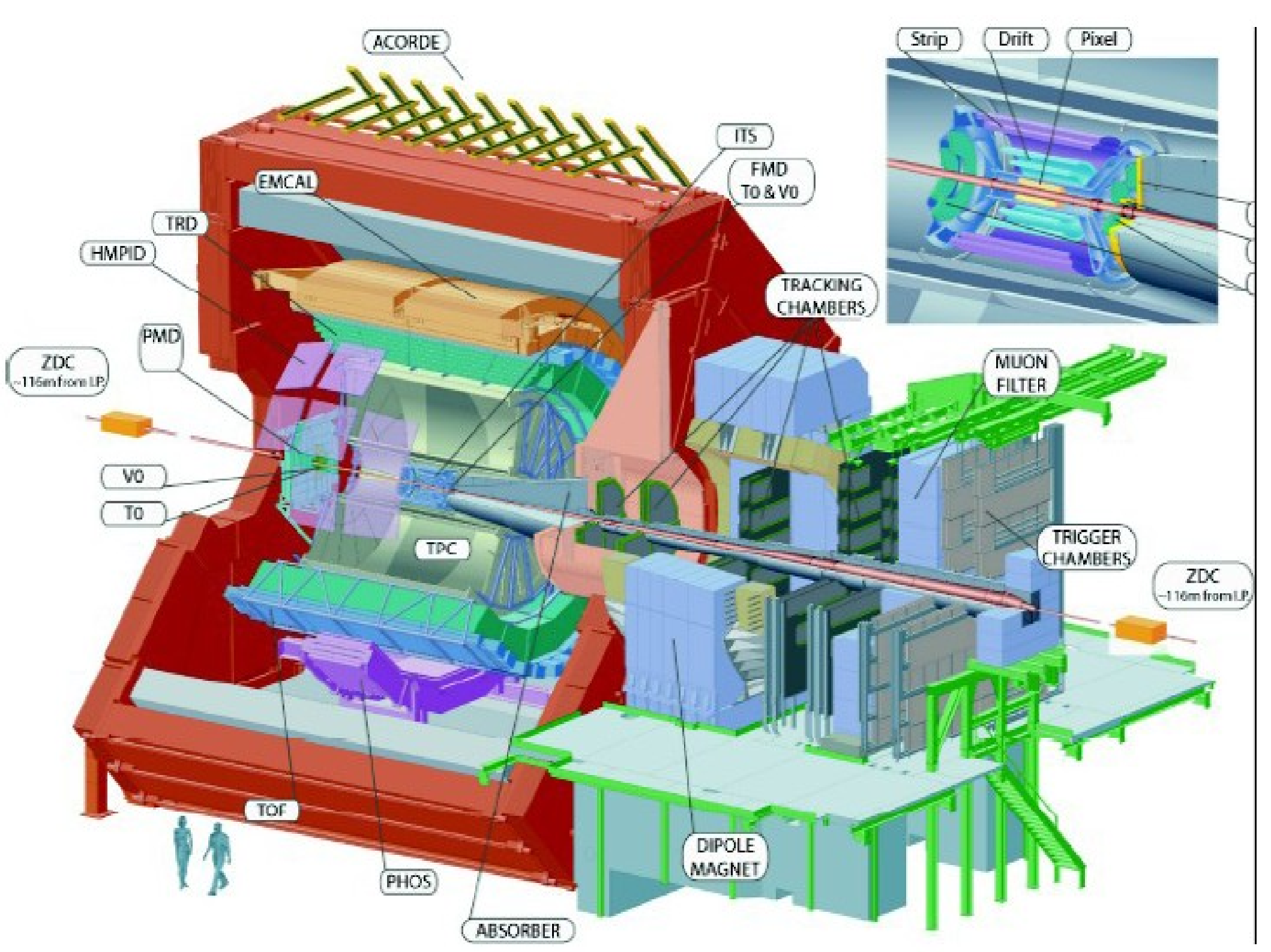
Width of the Balance Function $< \Delta\eta >= \frac{\sum_{i=0}^{k}(B_i.\Delta\eta_i)}{\sum_{i=0}^{k} B_i}$



p- Particle momentum , θ- Polar angle, η = -ln(tan(θ/2)

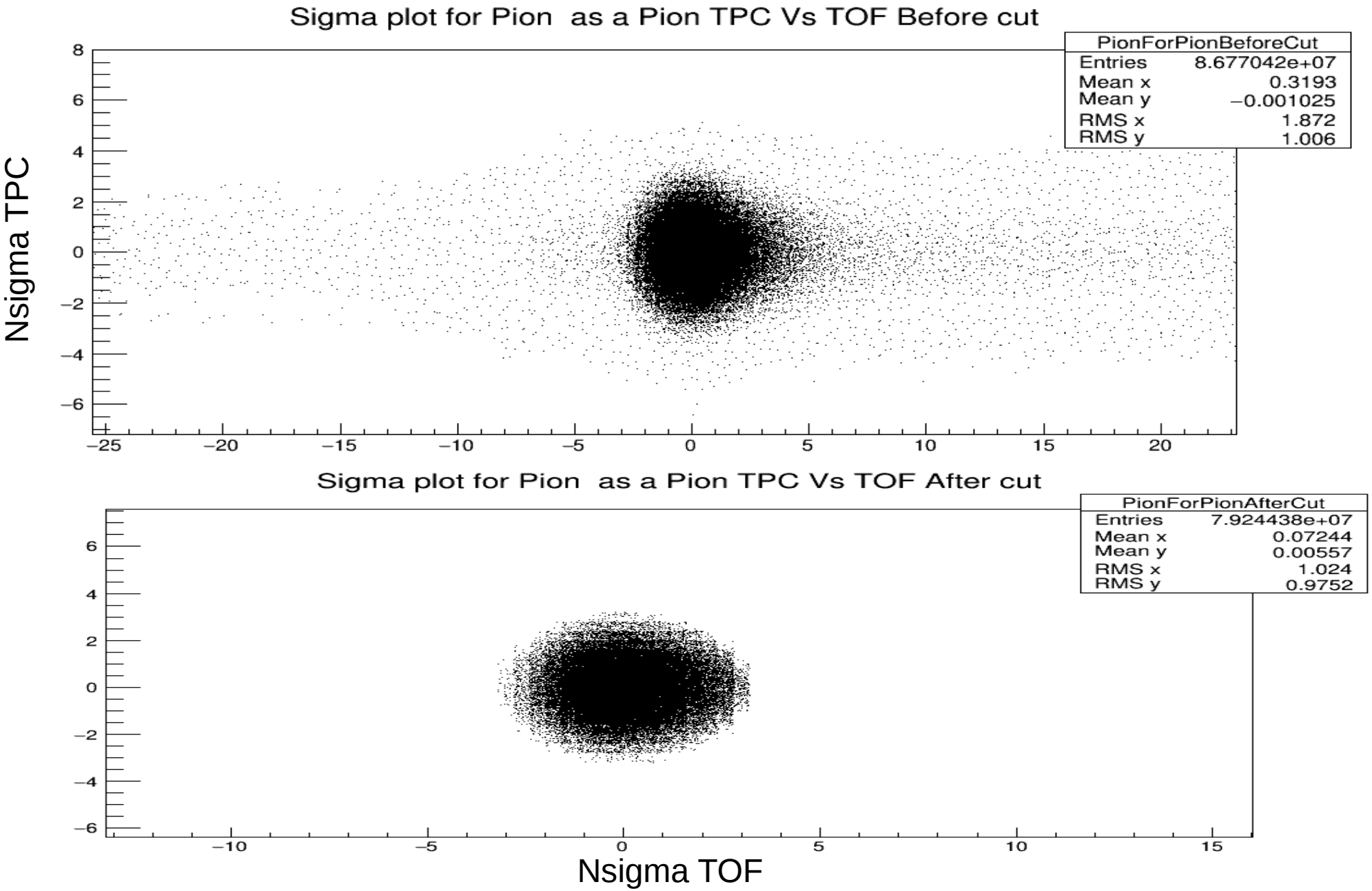
Select a trigger particle with η_t, ϕ_t and P_t and second(associated) particle with η_a, ϕ_a and P_a

$\Delta\eta = \eta_t - \eta_a$ and $\Delta\phi = \phi_t - \phi_a$

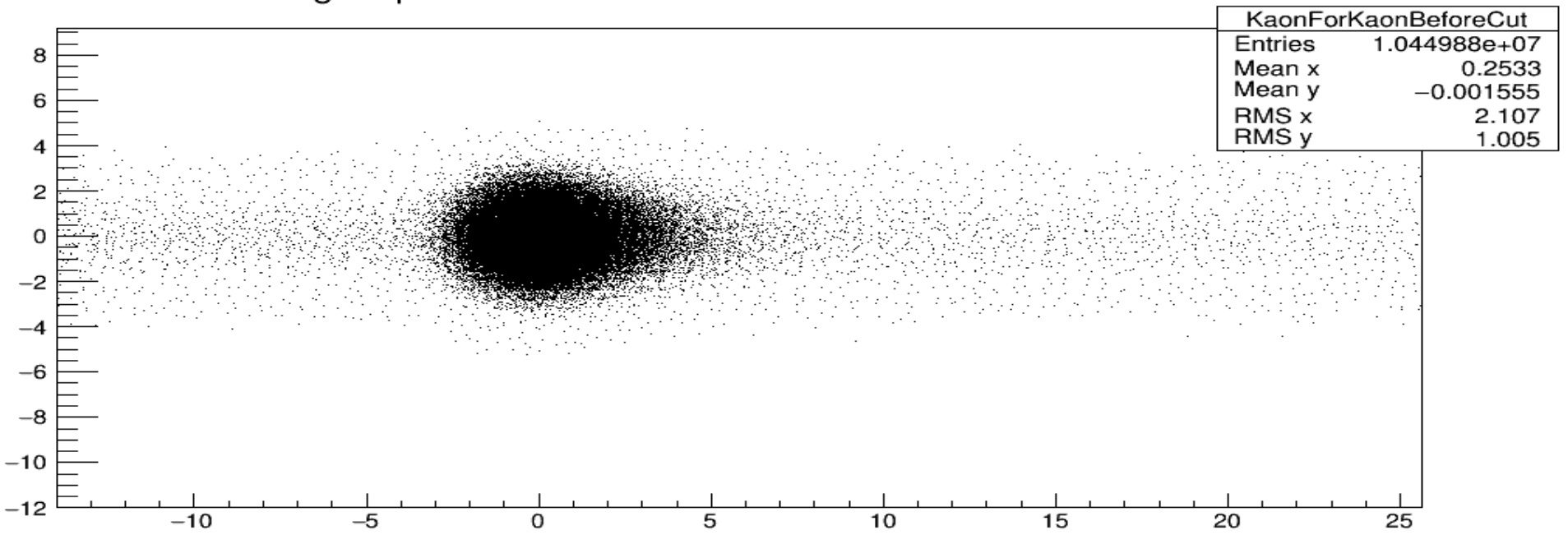

ACORDE
ITS
FMD
T0 & V0
EMCAL
TRD
HMPID
TRACKING
CHAMBERS
PMD
ZDC
~116m from I.P.
MUON
FILTER
V0
T0
TPC
TRIGGER
CHAMBERS
ZDC
~116m from I.P.
TOF
PHOS
DIPOLE
MAGNET
ABSORBER
Strip
Drift
Pixel

1. Particle Identification Performance with TPC and TOF

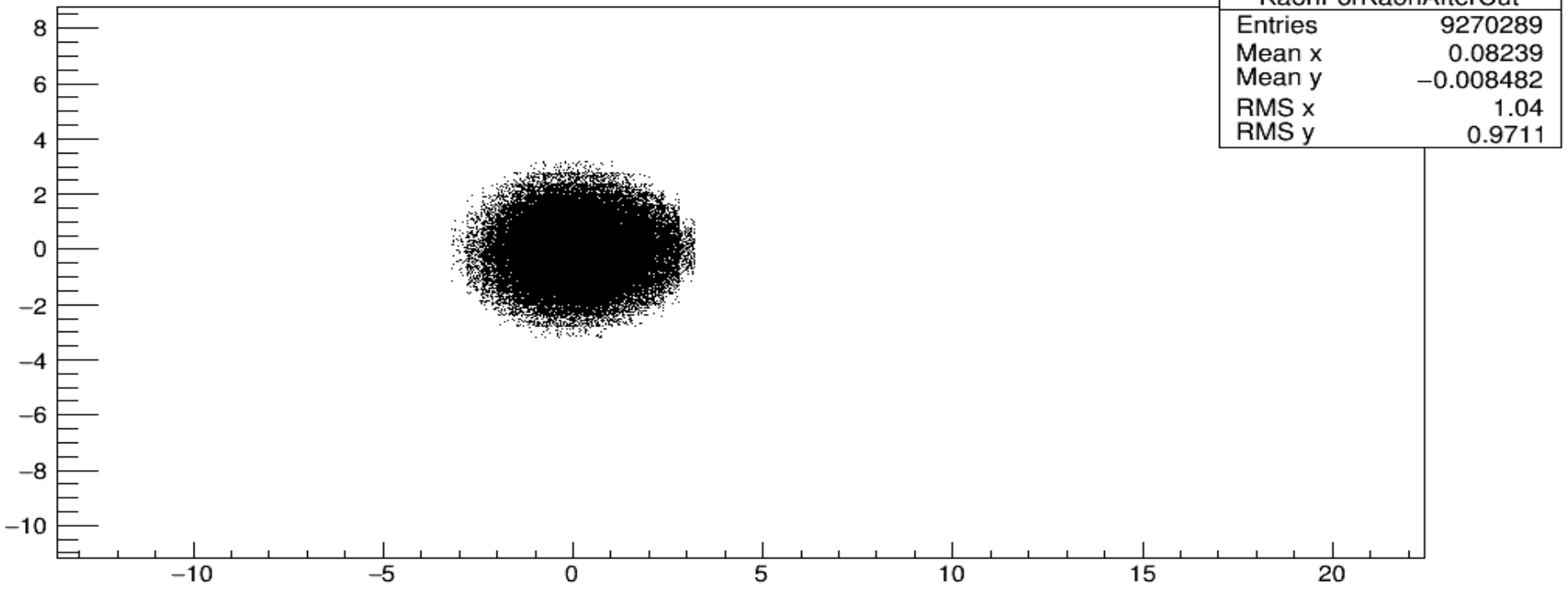
n σ TOF vs TPC distribution using Pion , Kaon and Proton before and after cut

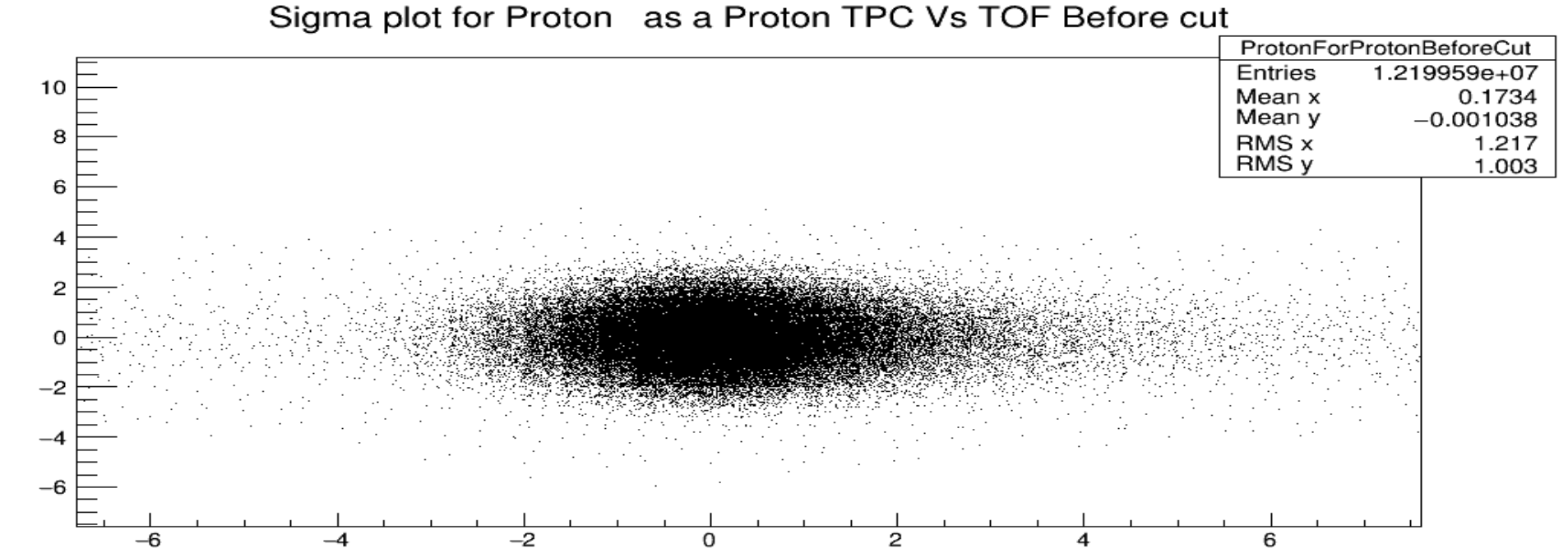


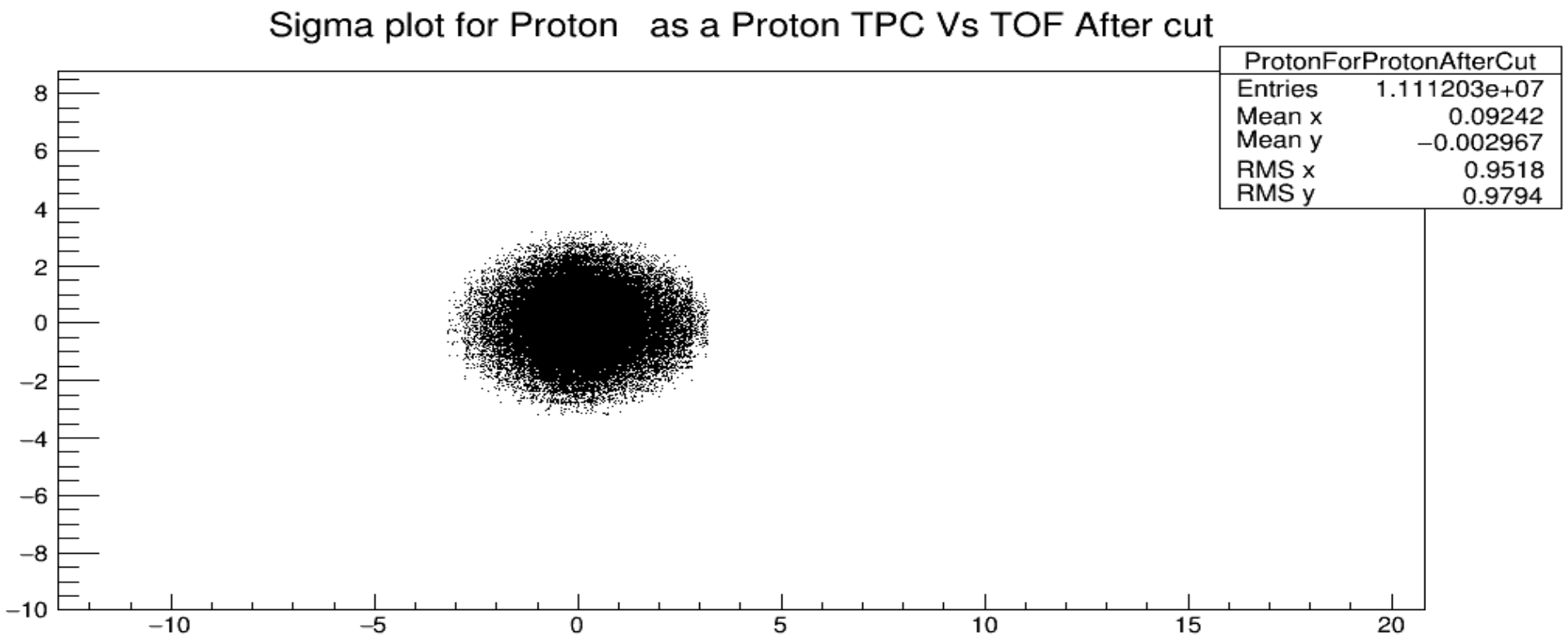
Sigma plot for Kaon as a Kaon TPC Vs TOF Before cut



Sigma plot for Kaon as a Kaon TPC Vs TOF After cut



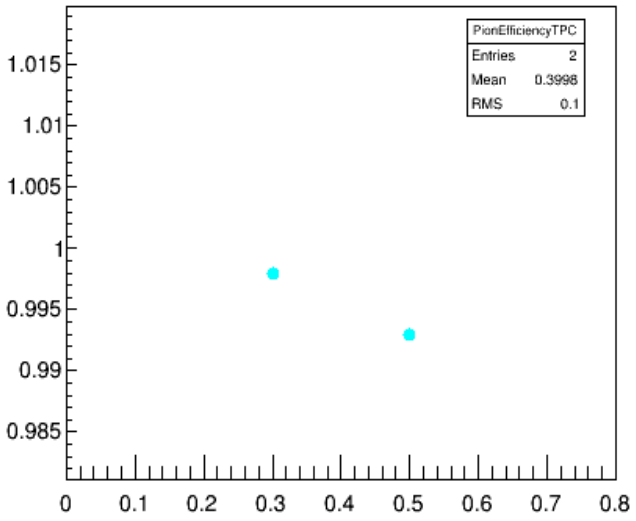

Sigma plot for Proton as a Proton TPC Vs TOF Before cut
ProtonForProtonBeforeCut
Entries 1.219959e+07
Mean x 0.1734
Mean y −0.001038
RMS x 1.217
RMS y 1.003


Sigma plot for Proton as a Proton TPC Vs TOF After cut
ProtonForProtonAfterCut
Entries 1.111203e+07
Mean x 0.09242
Mean y −0.002967
RMS x 0.9518
RMS y 0.9794

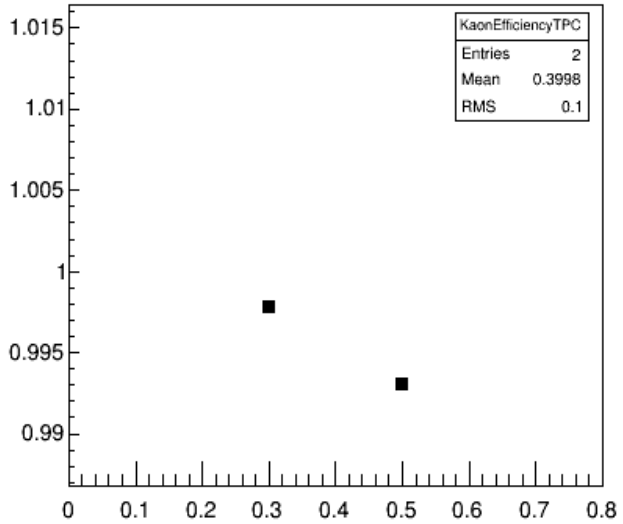
Cut – – > nsigmaPion<3.0 , nsigmaKaon<3.0 , nsigmaProton<3.0

Efficiency with Pt (0.2< Pt <3.0)

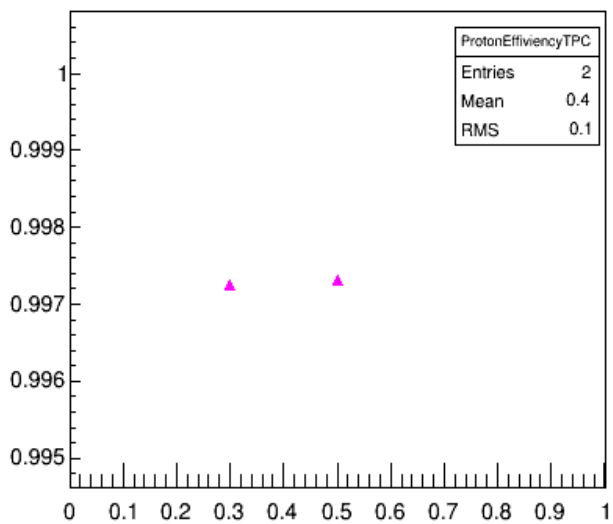
Efficiency with Pt for Pion From TPC



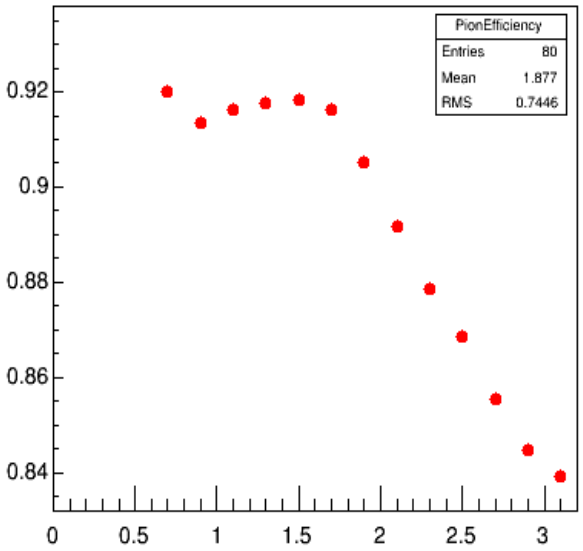
Efficiency with Pt for Kaon From TPC



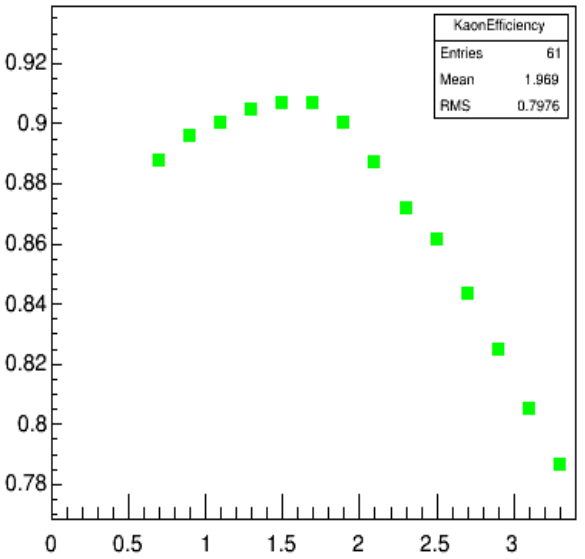
Efficiency with Pt for Proton From TPC



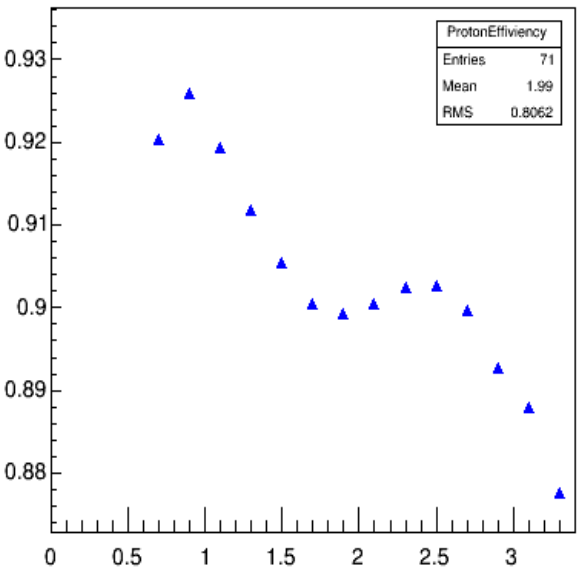
Efficiency with Pt for Pion



Efficiency with Pt for Kaon



Efficiency with Pt for Proton



Particle Identification are studied using TPC and TOF detector.

Identification of Pion , Kaon and Proton are done upto 3 Gev(Transverse momentum).

I have given below the details of identification of Particles.

	Pion	Kaon	Proton
Pion	0.913265	0.0594343	0.0273008
Kaon	0.047013	0.887119	0.0658683
Proton	0.00942819	0.0797194	0.910852

Dataset, event and track selection

Data sets AODs:

FILTERPb-Pb086LHC10h , FILTER_Pb-Pb_145_LHC11h

Analysis Cut Details:

Centrality estimator: VZERO multiplicity

Event primary: vertex $|V_Z| < 10$ cm.

Kinematic Cuts : $|eta| < 0.8$, $0.2 < Pt < 2.0$

Filter Bit: 272

Analysis Train Tags AOD86: PWGCF/CF_PbPb/2119_20160118-1737

PWGCF/CF_PbPb/2131_20160121-1506

Analysis Train Tag AOD145: PWGCF/CF_PbPb/2141_20160125-1626

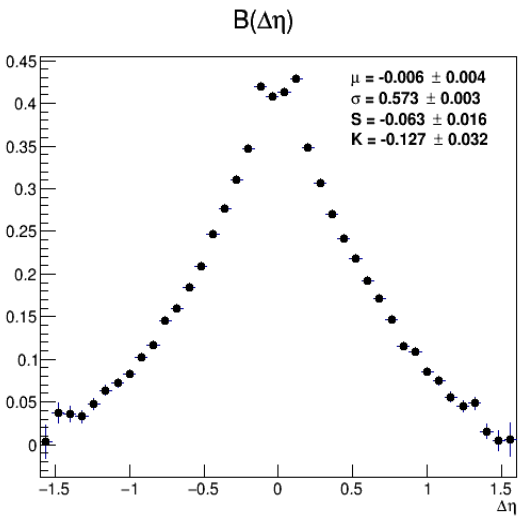
Balance Function With All Charged Particles

Here we have taken Phi range from TMath::Pi() +- TMath::Pi()/6 for Mixed Events for obtaining the correlation function

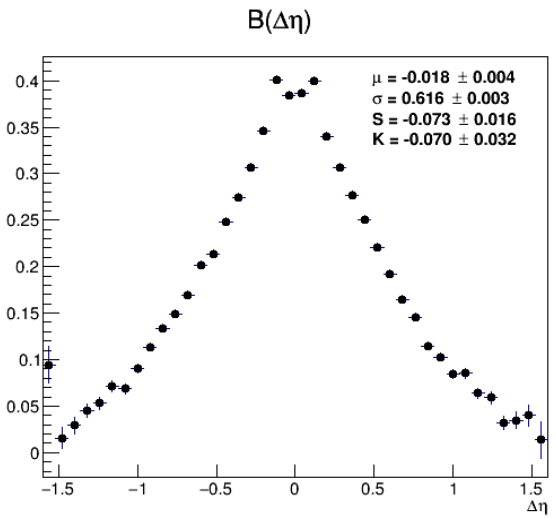
LHC10hPass2 data set

B(Delta Eta)

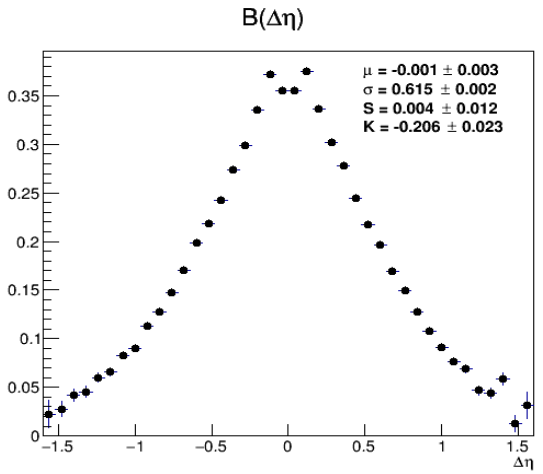
0 To 5 % Centrality



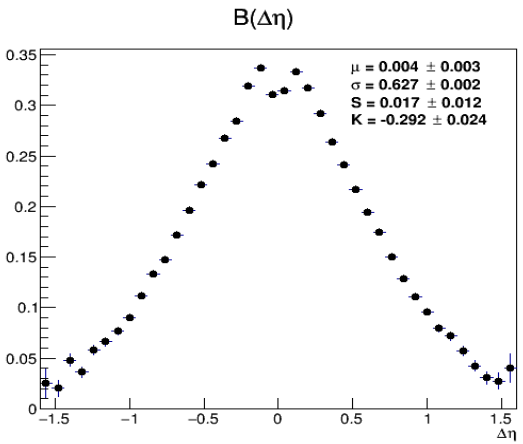
5 To 10 % Centrality



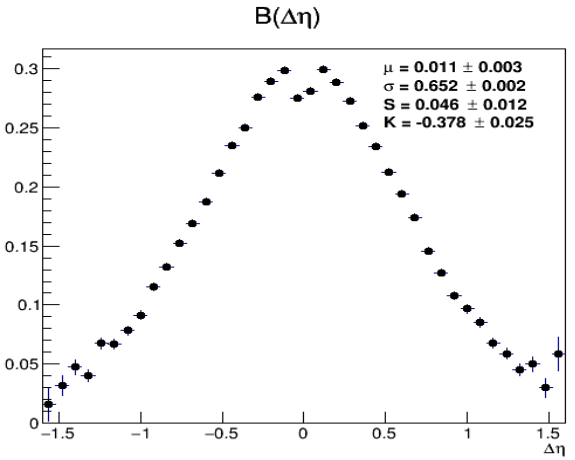
10 To 20 % Centrality



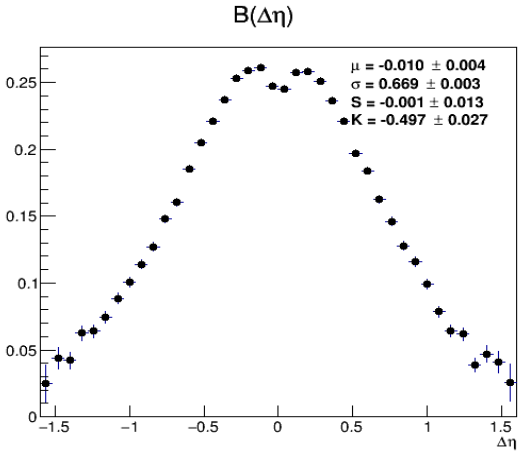
20 To 30 % Centrality



30 To 40 % Centrality

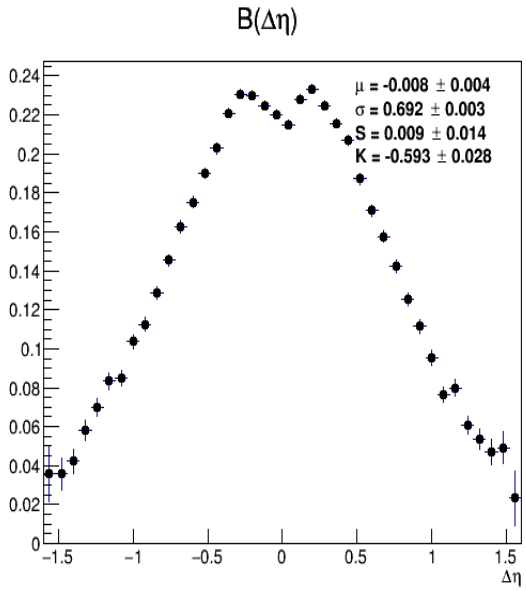


40 To 50 % Centrality

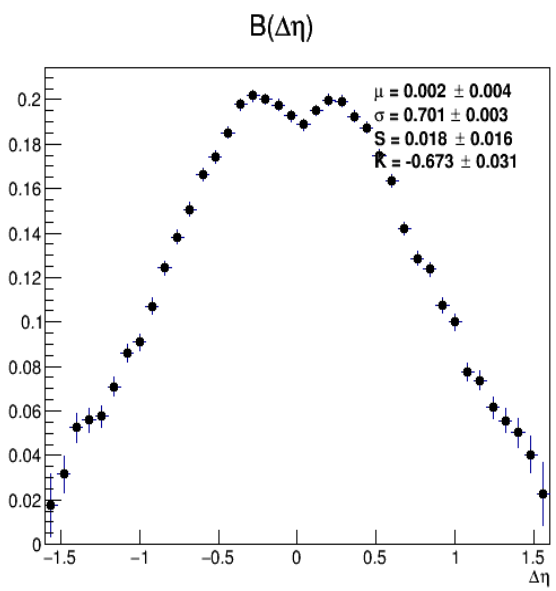


LHC10hPass2 data set

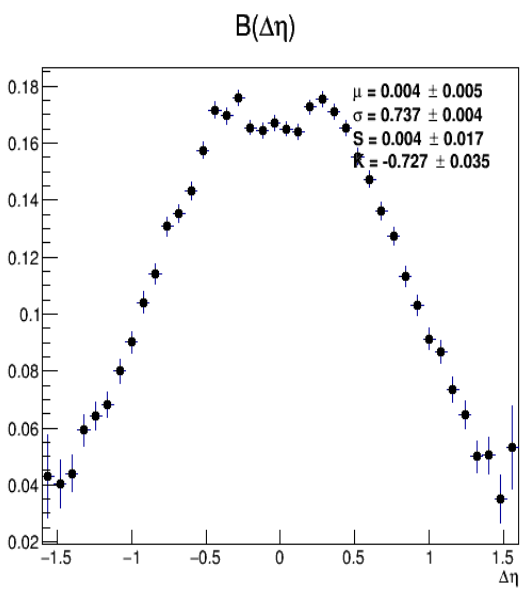
50 To 60% Centrality



60 To 70 % Centrality

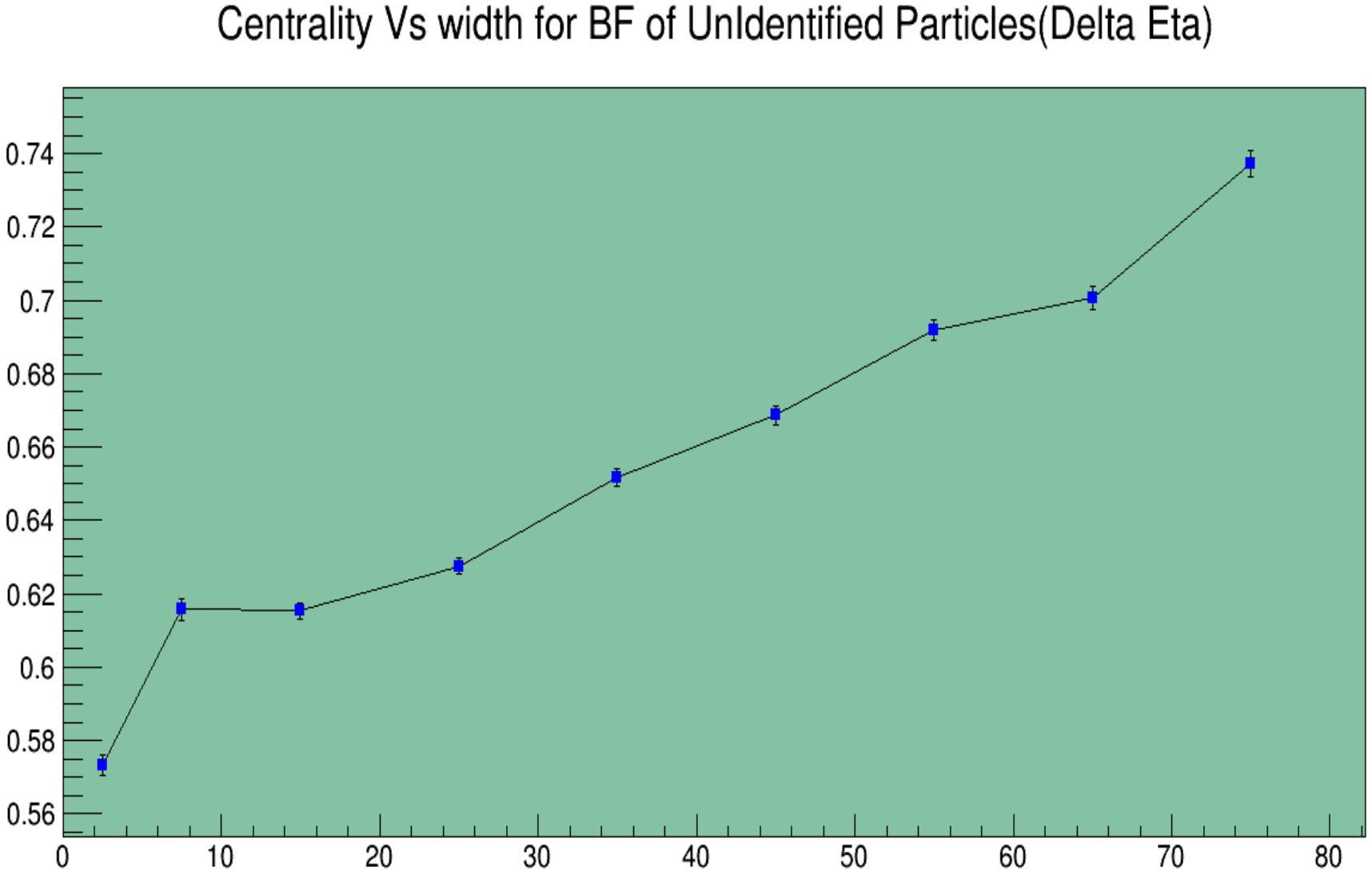


70 To 80 % Centrality



Centrality Vs BF Width

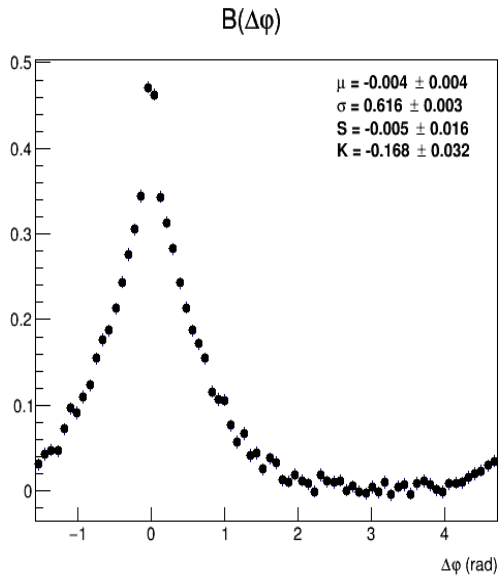
Cent	BF Width	Error
2.5	0.573377	0.0026849
7.5	0.615674	0.00282922
15.0	0.615325	0.00206043
25.0	0.627489	0.00217651
35.0	0.65181	0.00234699
45.0	0.668676	0.00256065
55.0	0.69196	0.00282178
65.0	0.700589	0.00315643
75.0	0.737356	0.00368703



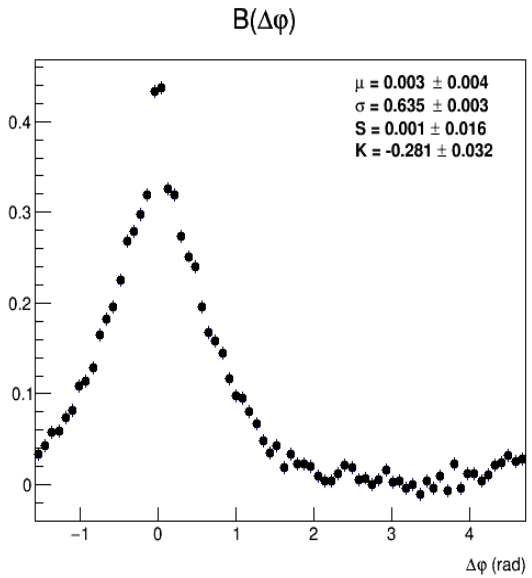
Width increasing from most central to peripheral collision

LHC10hPass2 data set
B(Delta Phi)

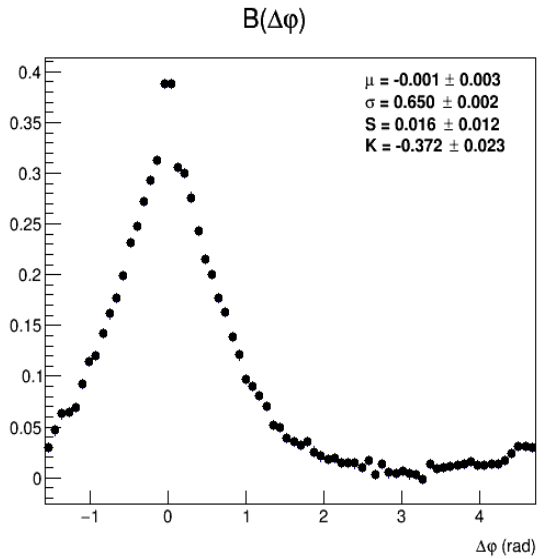
0 To 5 % Centrality



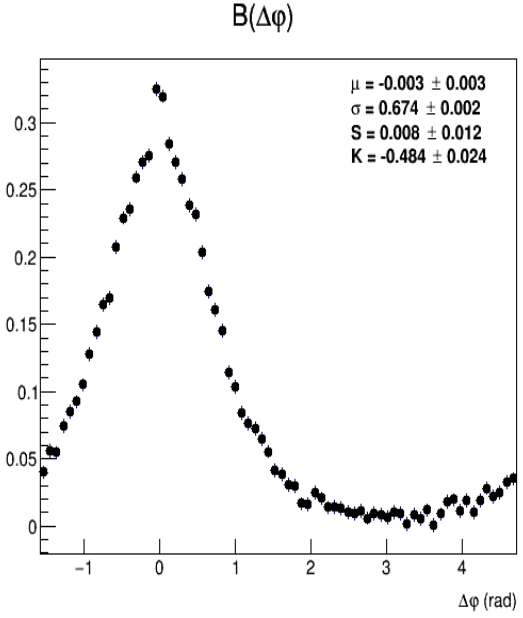
5 To 10 % Centrality



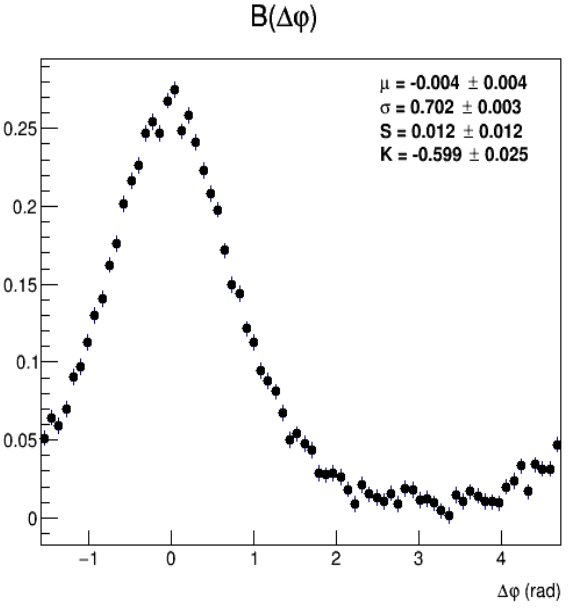
10 To 20 % Centrality



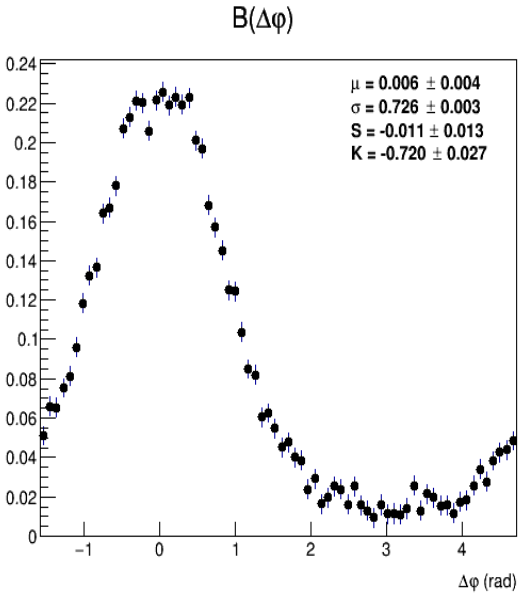
20 To 30 % Centrality



30 To 40 % Centrality

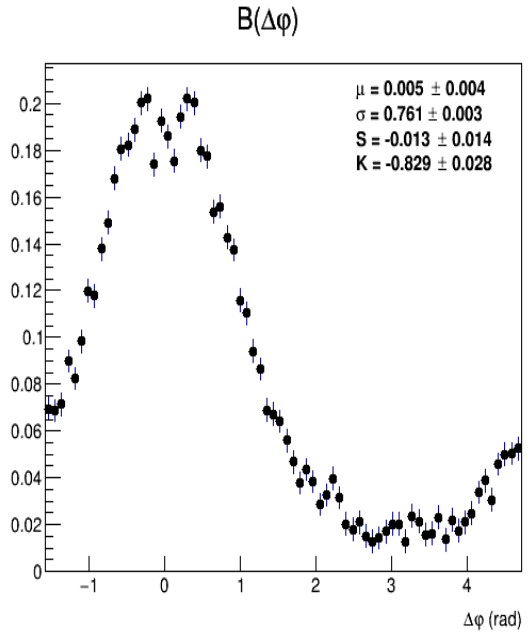


40 To 50 % Centrality

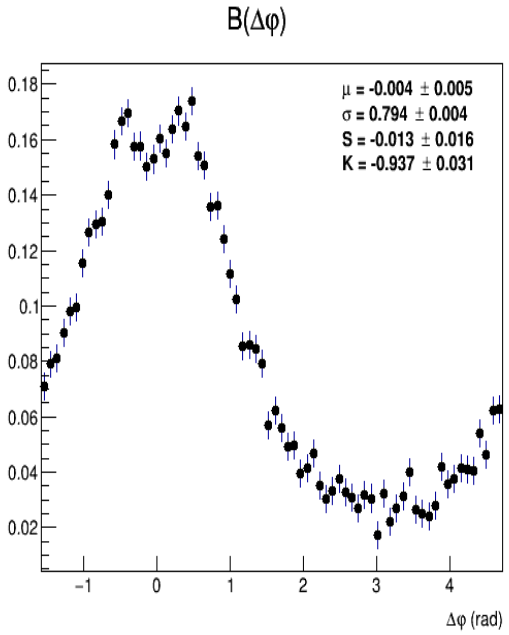


LHC10hPass2 data set

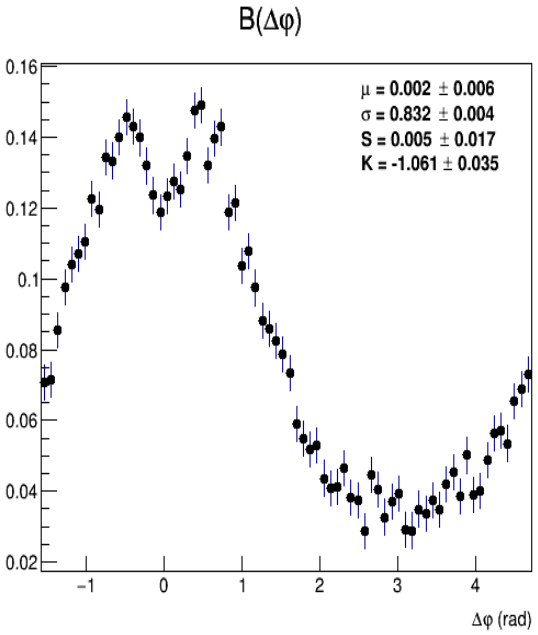
50 To 60% Centrality



60 To 70 % Centrality

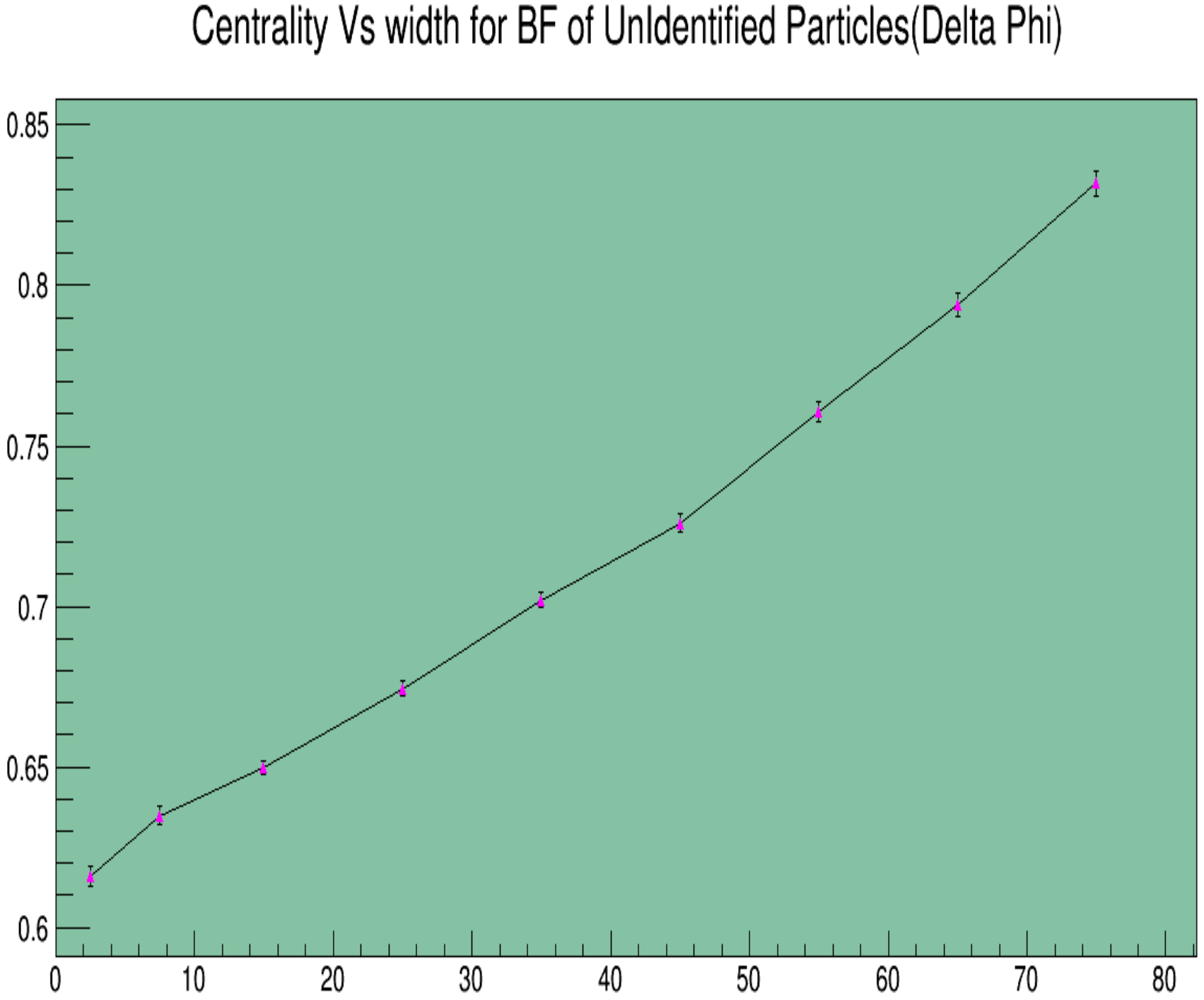


70 To 80 % Centrality



Centrality Vs BF Width

Cent	BF Width	Error
2.5	0.615977	0.00288437
7.5	0.634865	0.00291741
15	0.64979	0.00217584
25	0.674357	0.00233908
35	0.702055	0.00252791
45	0.72593	0.0027799
55	0.760899	0.00310291
65	0.79411	0.00357778
75	0.831758	0.00415906


Centrality Vs width for BF of UnIdentified Particles(Delta Phi)
0.85
0.8
0.75
0.7
0.65
0.6
0
10
20
30
40
50
60
70
80

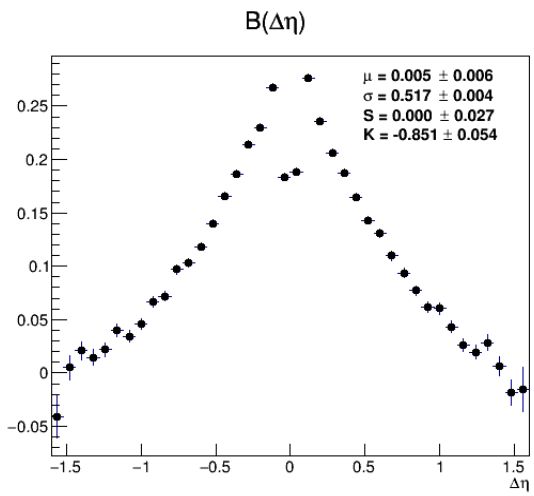
Balance Function With Pion

Here we have taken Phi range from TMath::Pi() +- TMath::Pi()/6 for Mixed Events for obtaining the correlation function

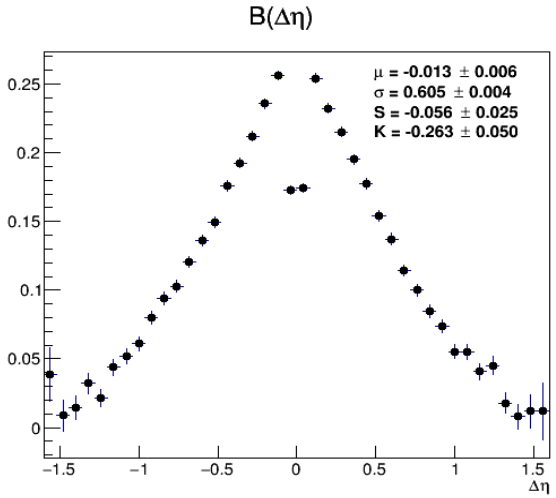
LHC10hPass2 data set

B(Delta Eta)

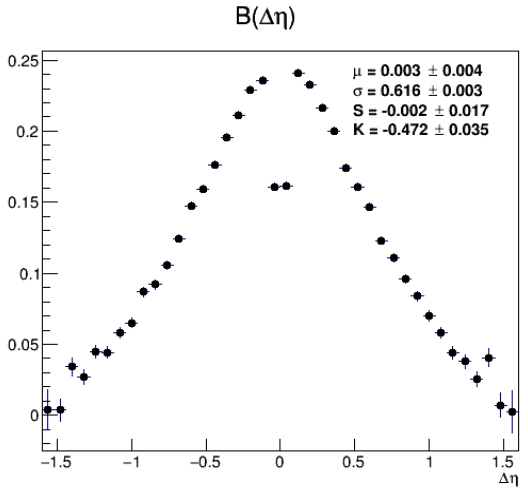
0 To 5 % Centrality



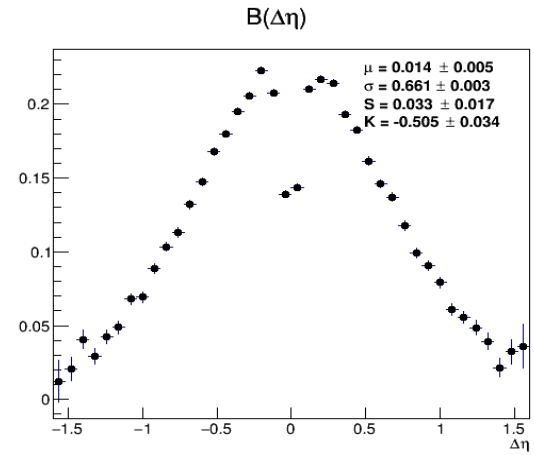
5 To 10 % Centrality



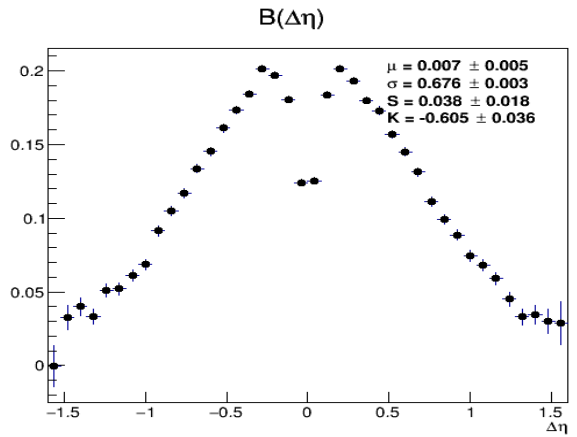
10 To 20 % Centrality



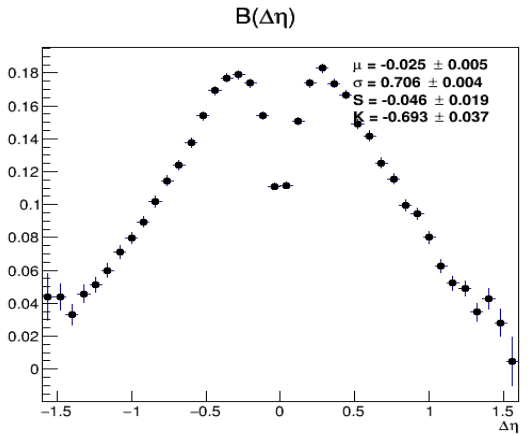
20 To 30 % Centrality



30 To 40 % Centrality

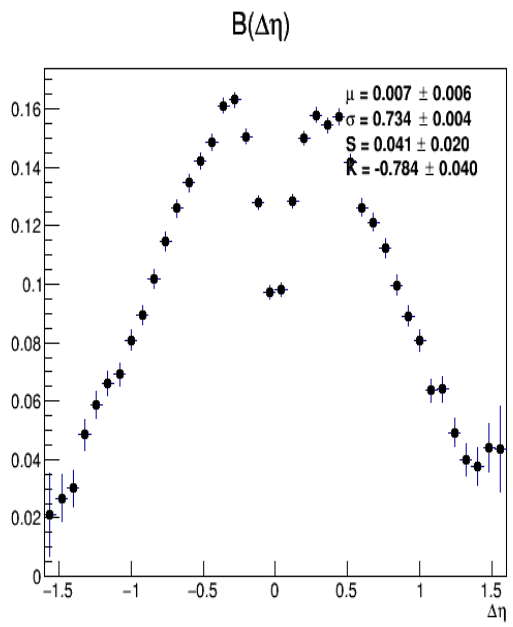


40 To 50 % Centrality

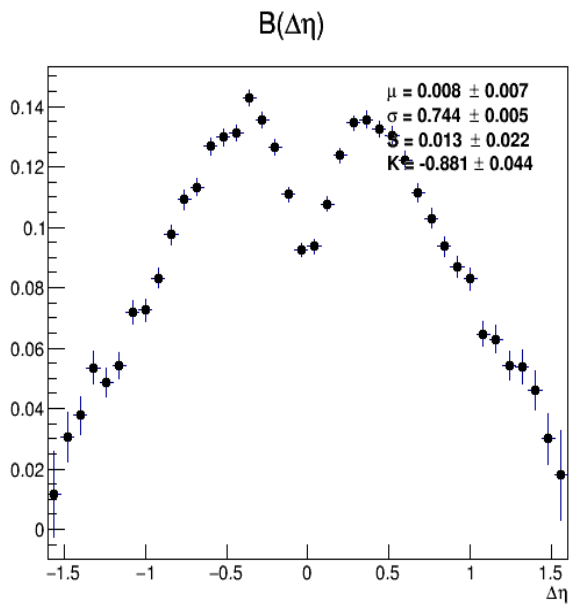


LHC10hPass2 data set

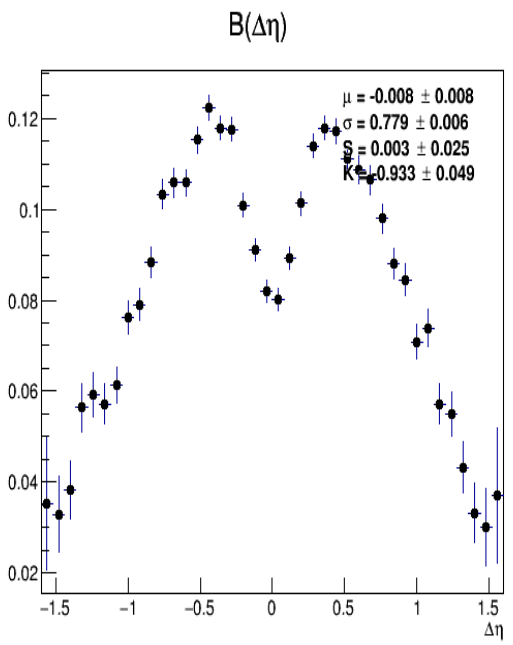
50 To 60% Centrality



60 To 70 % Centrality

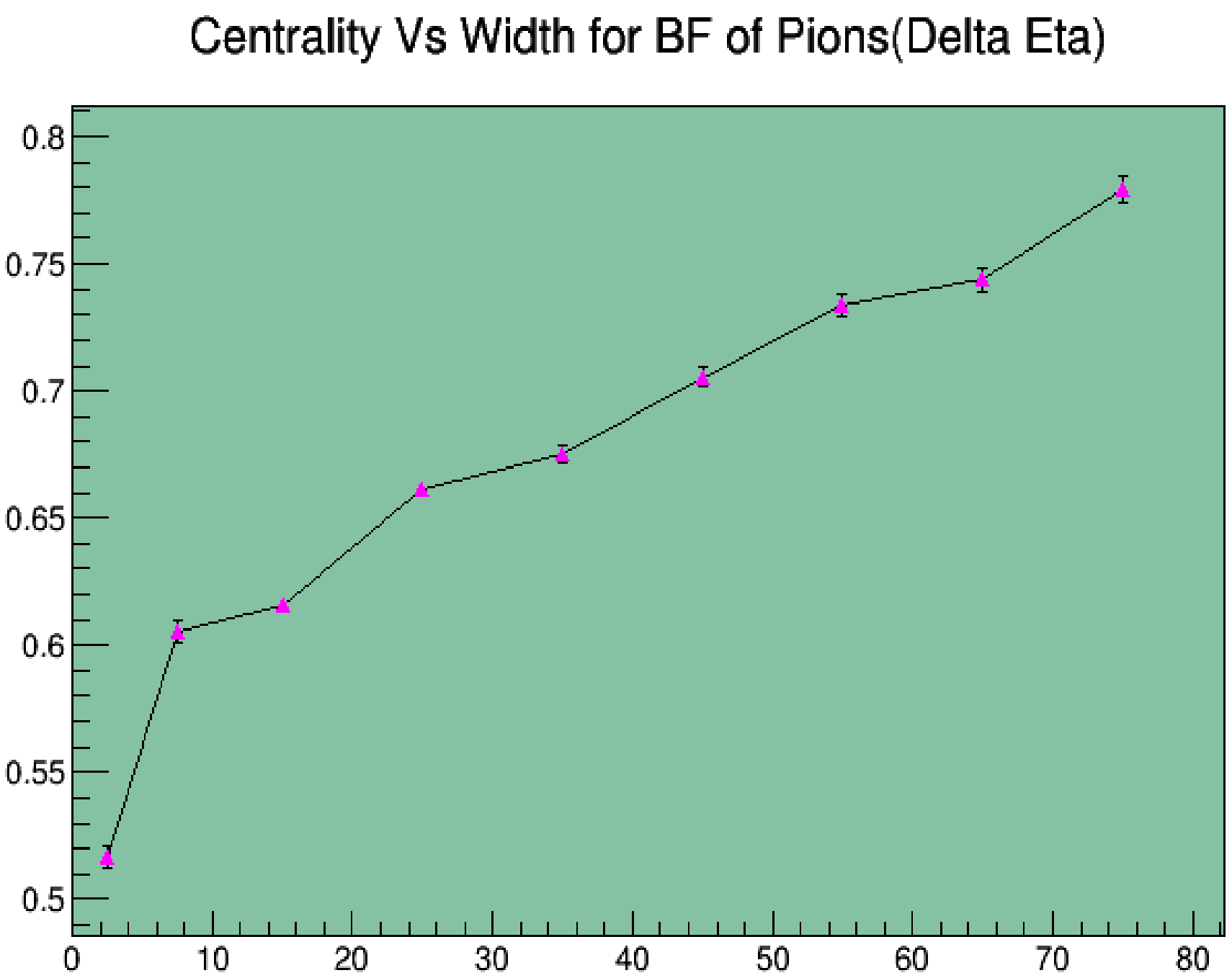


70 To 80 % Centrality



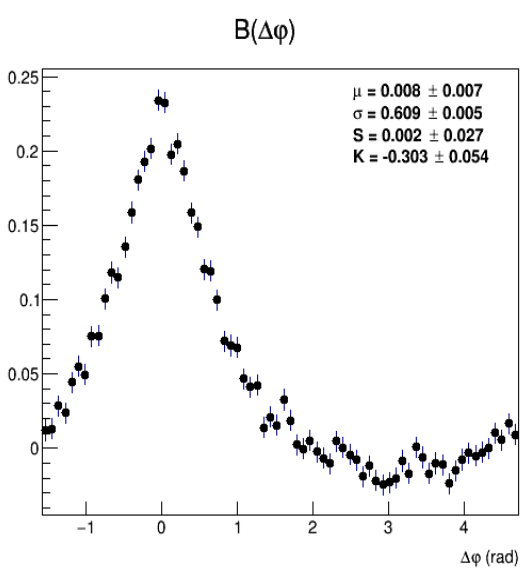
Centrality Vs BF Width

Cent	BF Width	Error
2.5	0.516874	0.0040395
7.5	0.605255	0.00435248
15	0.615616	0.00309822
25	0.661485	0.00326308
35	0.675529	0.00348263
45	0.705689	0.00380016
55	0.73367	0.0042055
65	0.743736	0.00471758
75	0.779414	0.00551444

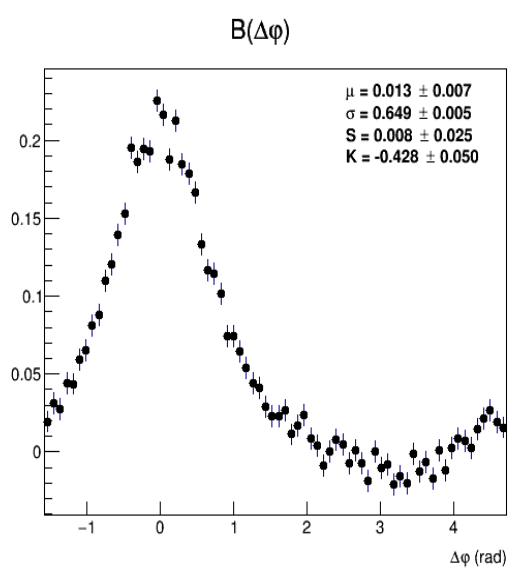

Centrality Vs Width for BF of Pions(Delta Eta)
0.8
0.75
0.7
0.65
0.6
0.55
0.5
0
10
20
30
40
50
60
70
80

LHC10hPass2 data set
B(Delta Phi)

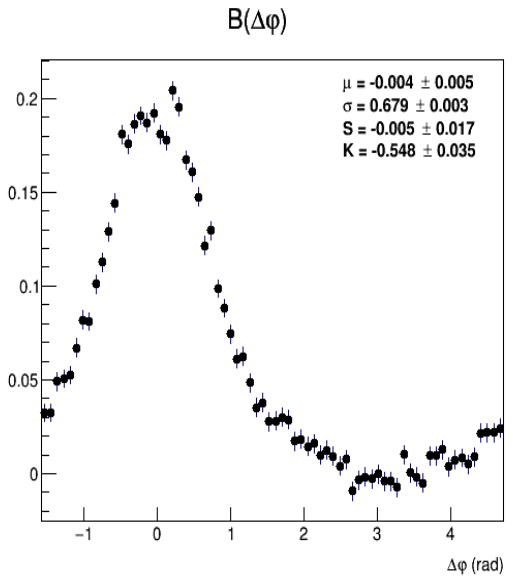
0 To 5 % Centrality



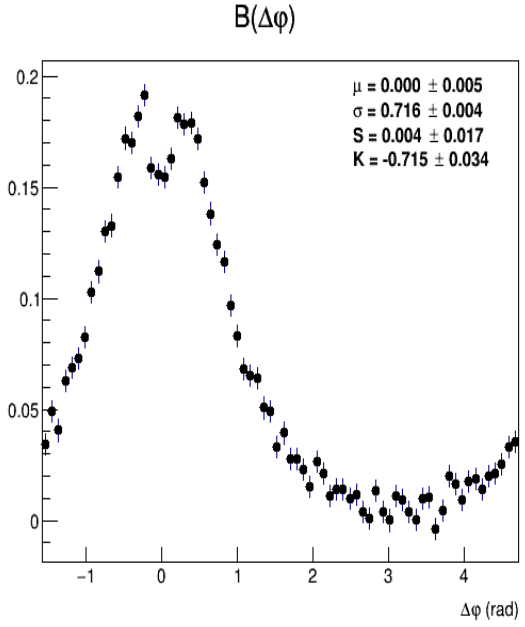
5 To 10 % Centrality



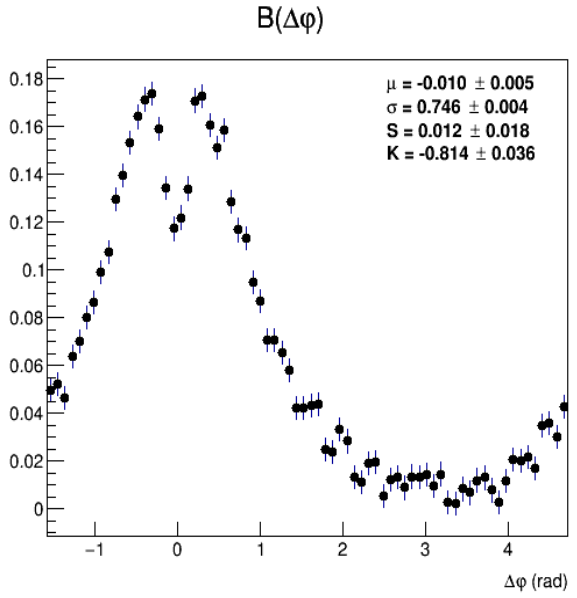
10 To 20 % Centrality



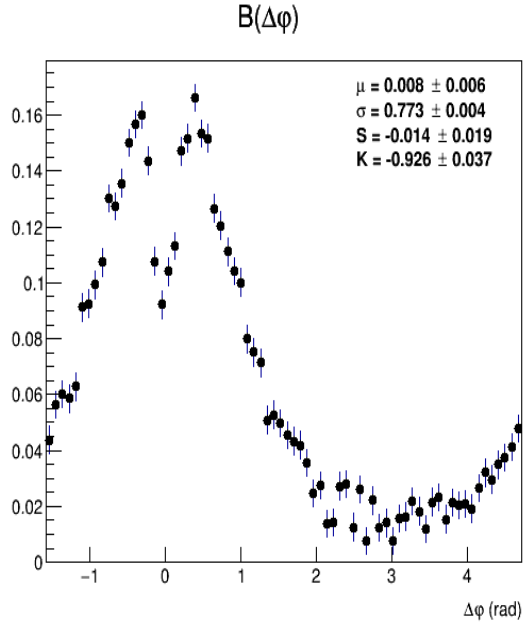
20 To 30 % Centrality



30 To 40 % Centrality

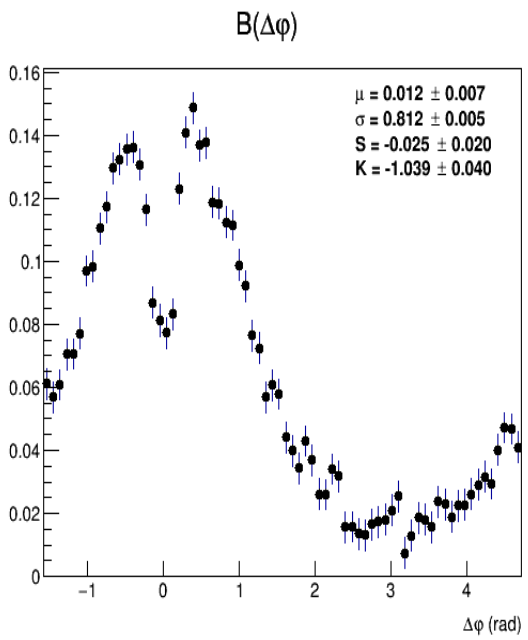


40 To 50 % Centrality

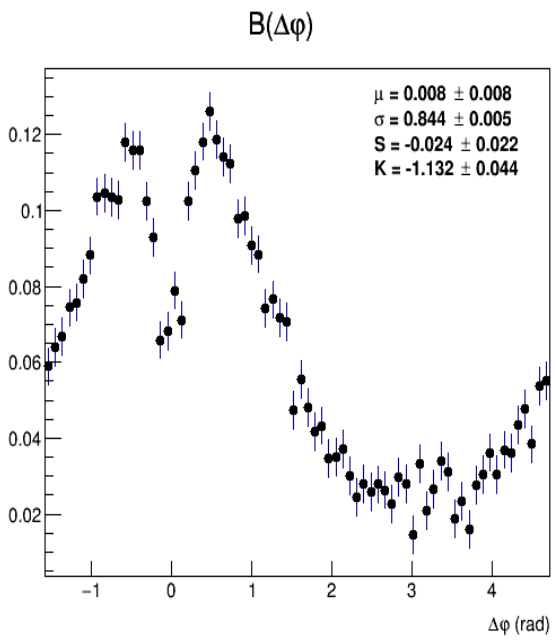


LHC10hPass2 data set

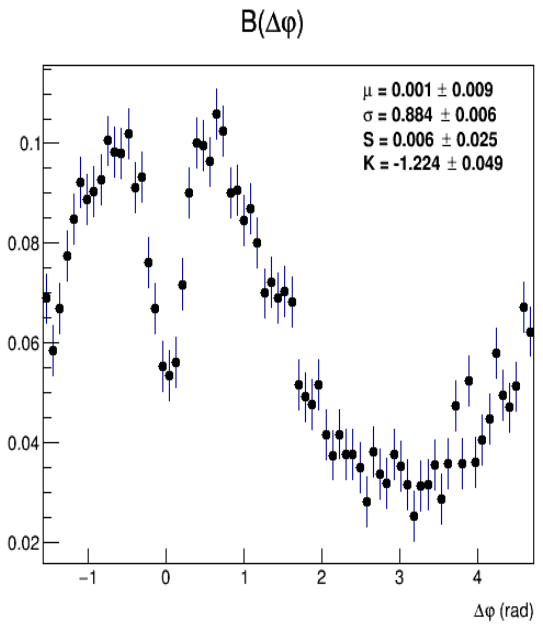
50 To 60% Centrality



60 To 70 % Centrality

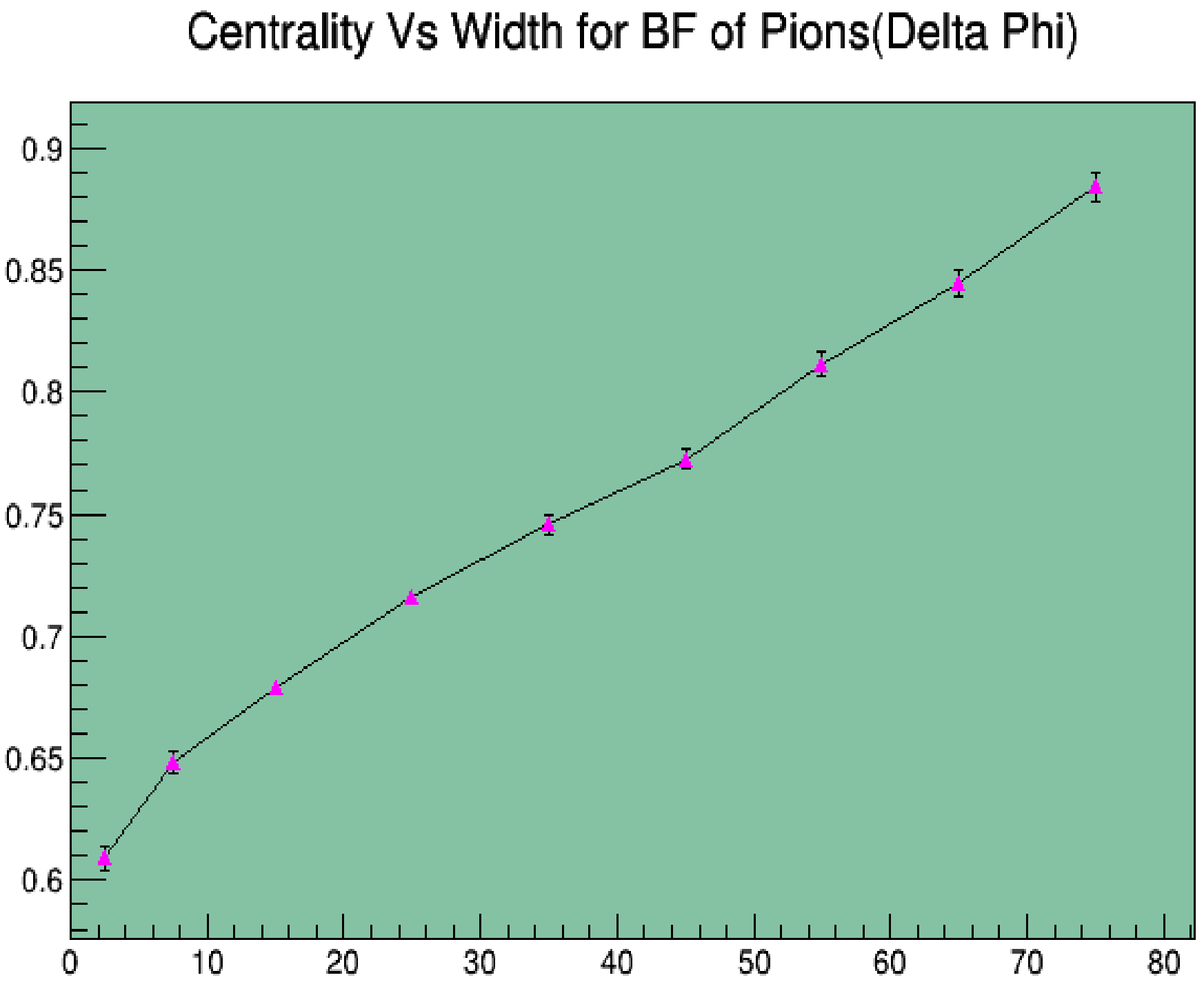


70 To 80 % Centrality



Centrality Vs BF Width

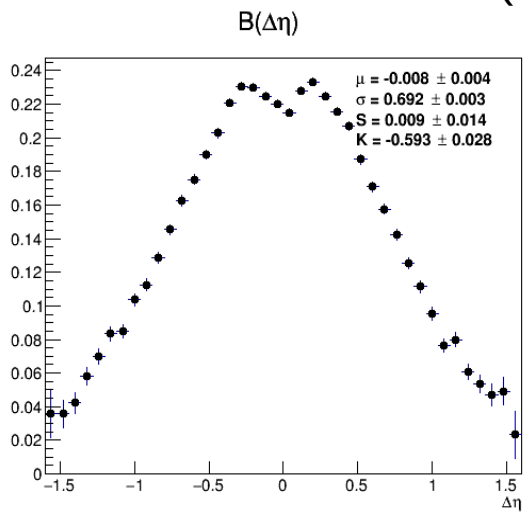
Cent	BF Width	Error
2.5	0.609205	0.00476109
7.5	0.648619	0.00466431
15	0.679206	0.00341825
25	0.715763	0.00353084
35	0.745685	0.00384431
45	0.772527	0.00416008
55	0.811574	0.00465205
65	0.844441	0.00535636
75	0.884054	0.00625479


Centrality Vs Width for BF of Pions(Delta Phi)
0.9
0.85
0.8
0.75
0.7
0.65
0.6
0
10
20
30
40
50
60
70
80

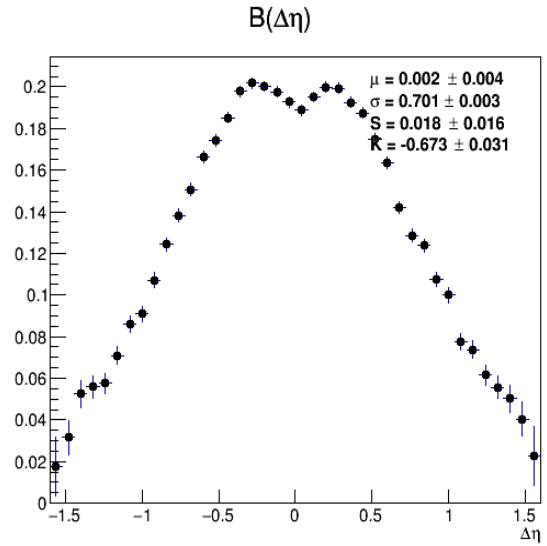
Comparision Of Pion's BF with All charge's BF

At Delta Eta =0 , there is a dip for Pion and all charged particle's BF . If one go from most central to peripheral collision then this dip size increase for Pion w.r.t All charged Particles

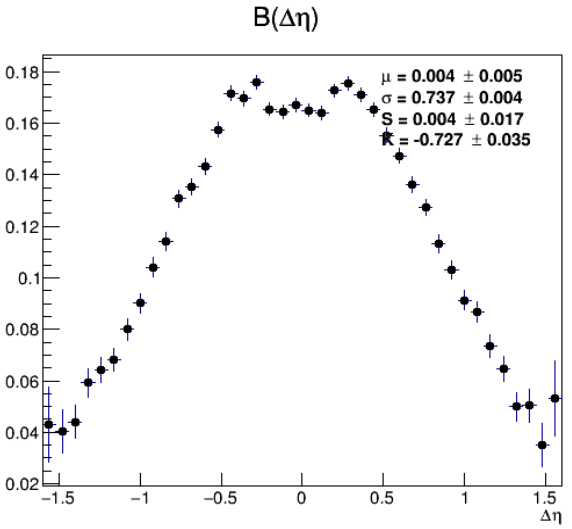
50 To 60 % Centrality (All)



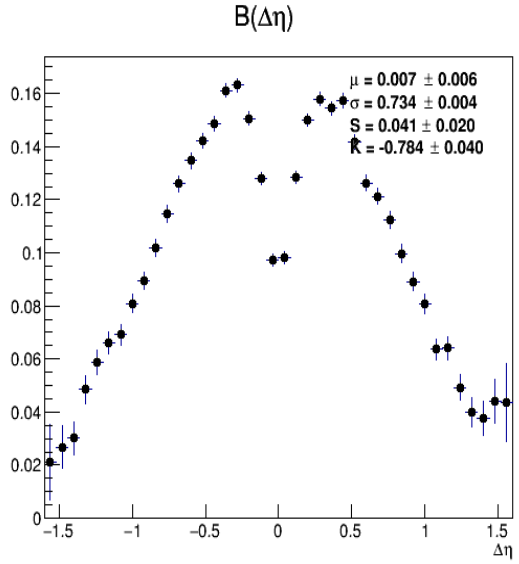
60 To 70 % Centrality

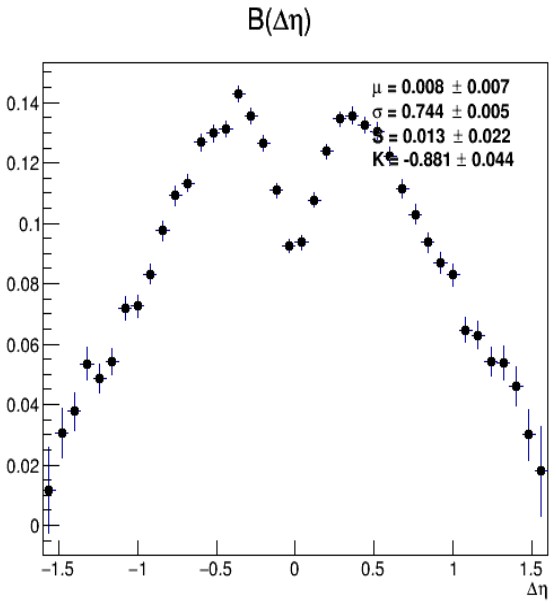


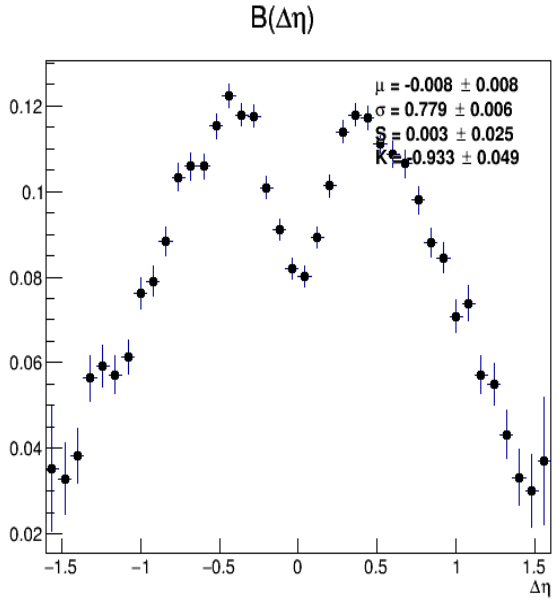
70 To 80 % Centrality



(Pion)





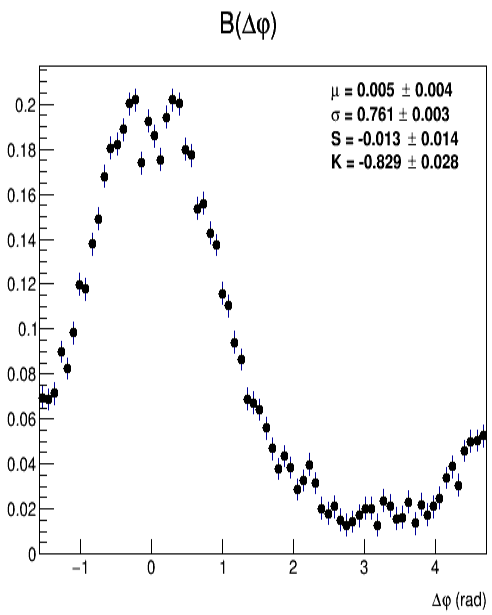


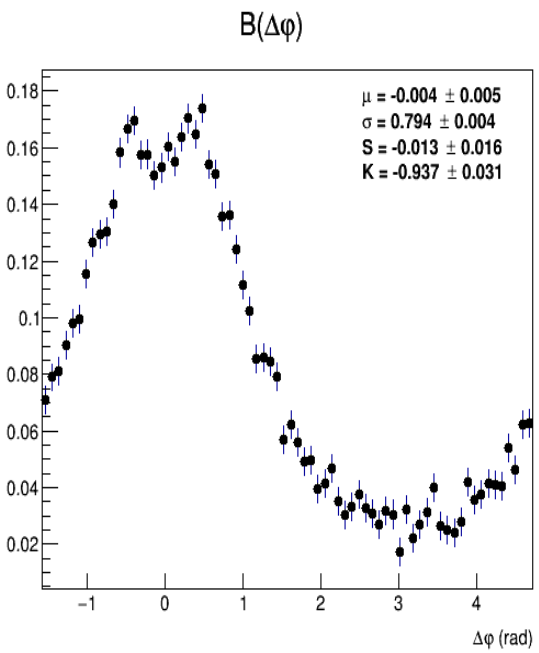
50 To 60 % Centrality

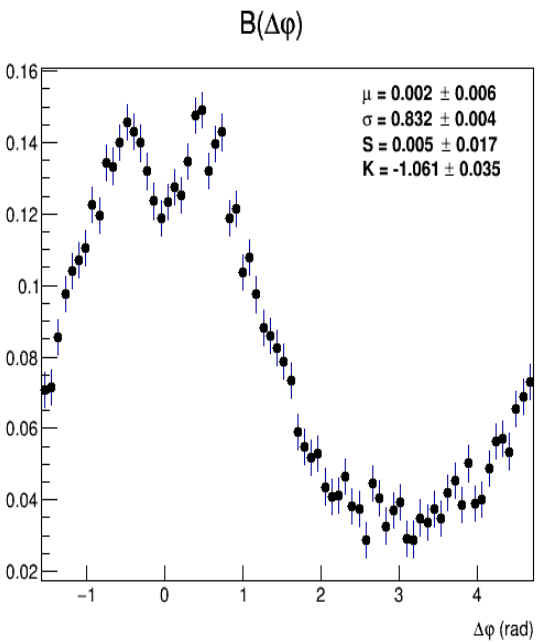
60 To 70 % Centrality

70 To 80 % Centrality

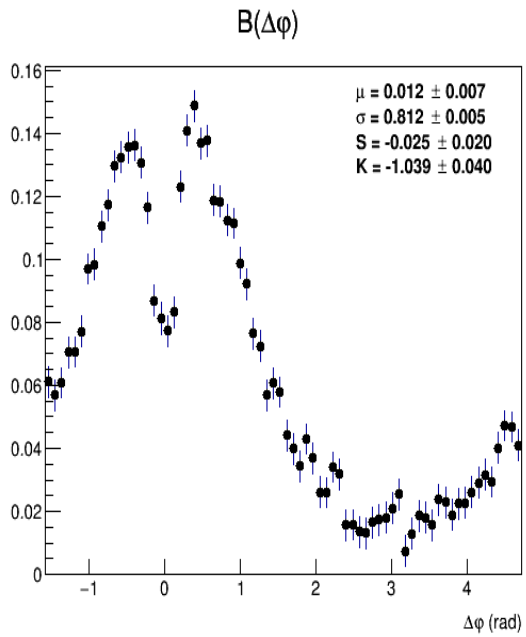
(All)

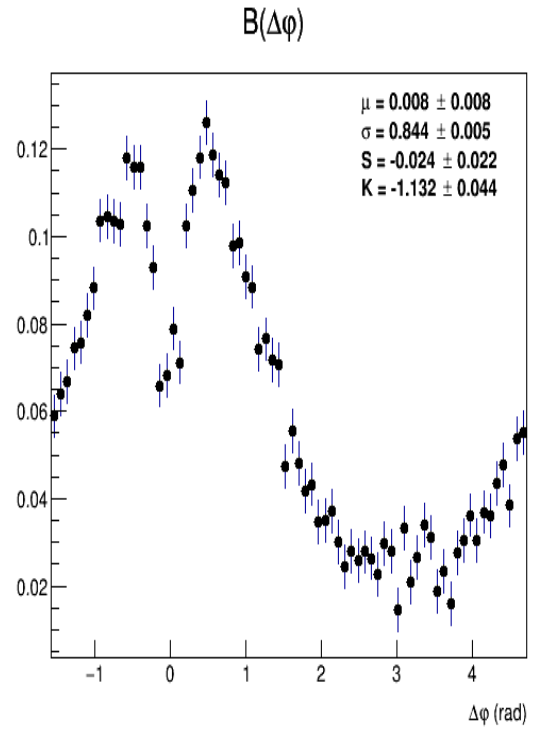


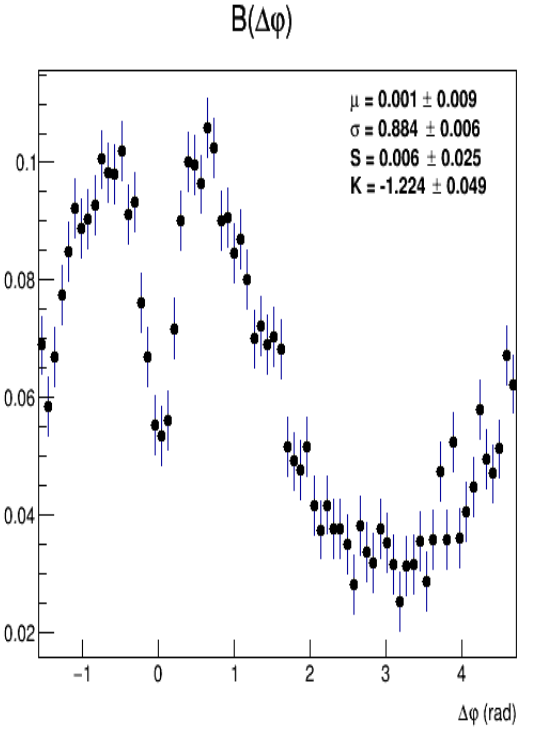




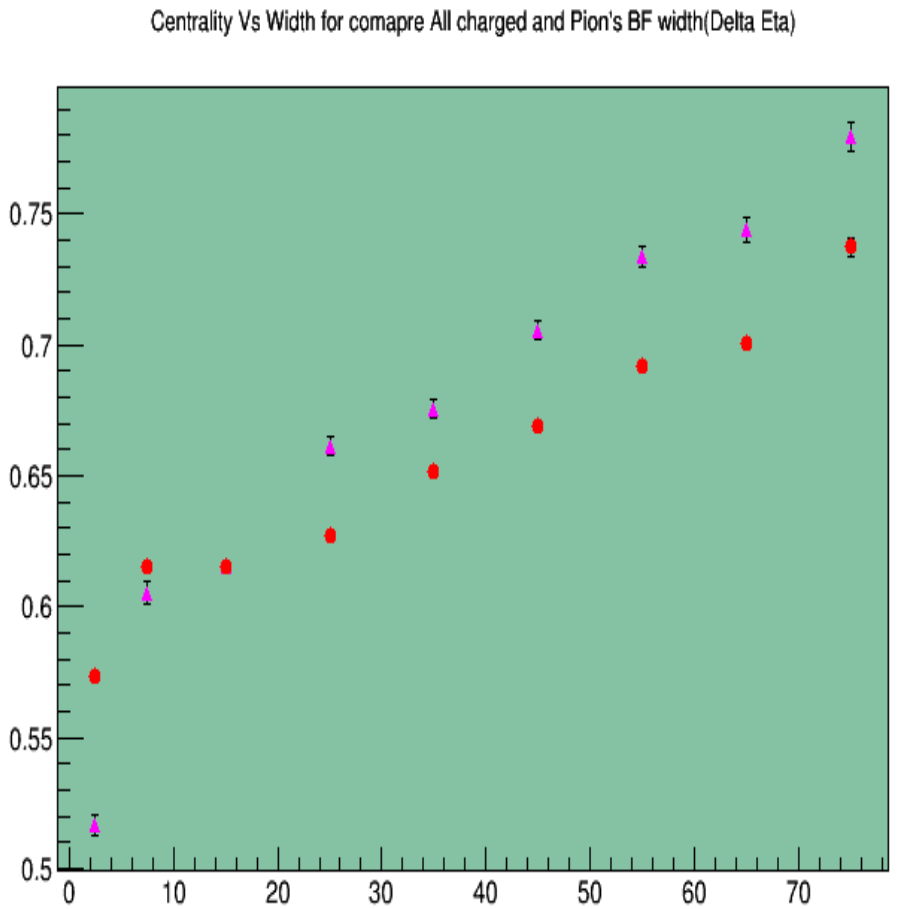
(Pion)

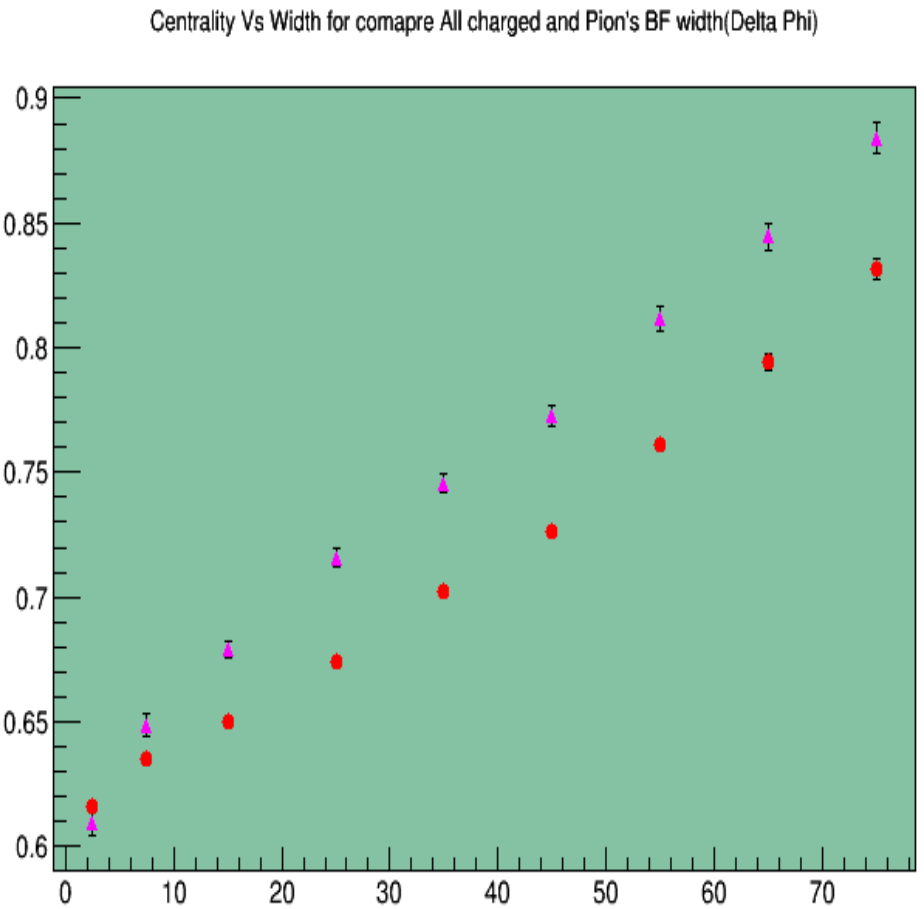






BF width comparision for Pion and All Charged Particles (Delta Eta)





Red Points for Unidentified particles and Pink for Pion

Here We observed that from 20 to 80 % Centrality BF width large corresponding to All charged Particle's BF.

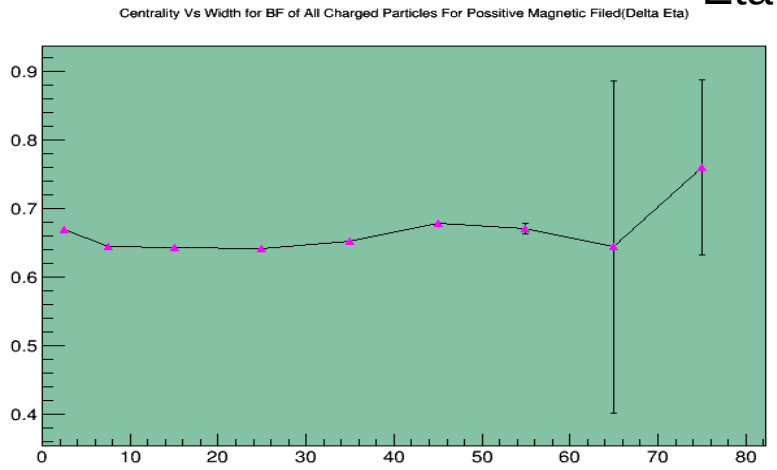
Statistics of Kaon and Proton for LHC10h data is small . So We take LHC11h AOD 145 data set

Here We have given the only Centrality Vs BF Width for All charged particles , Pion , Kaon and Proton

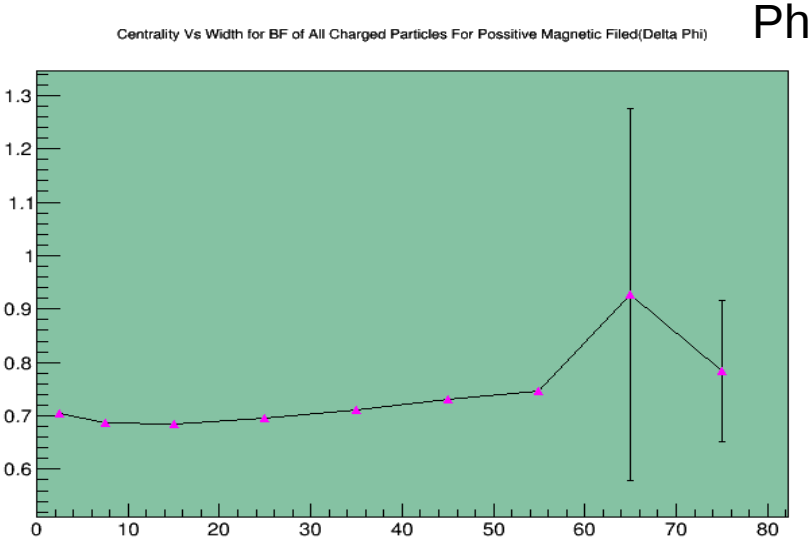
All Charged Particles

Positive Magnetic Field

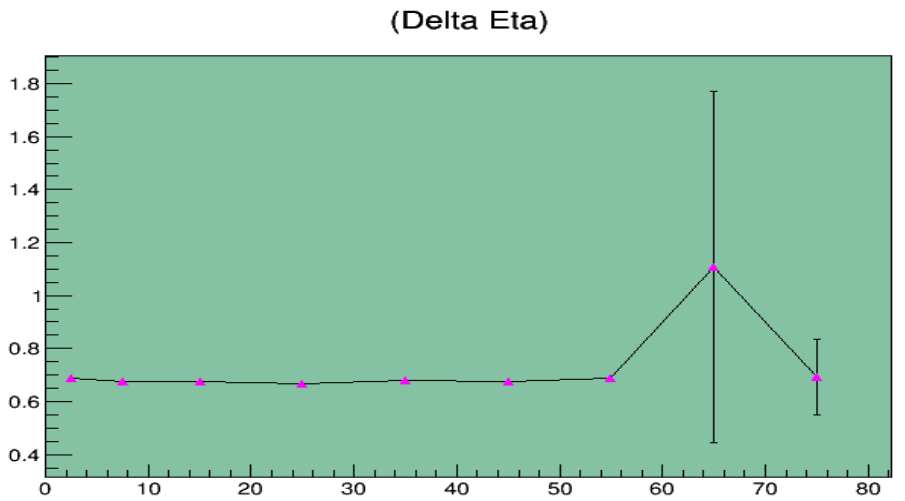
Eta

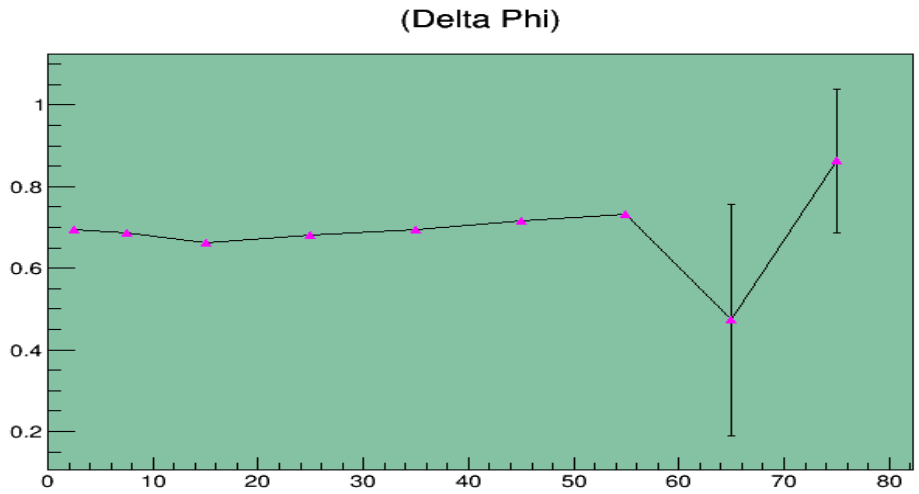


Phi



Negative Magnetic Field



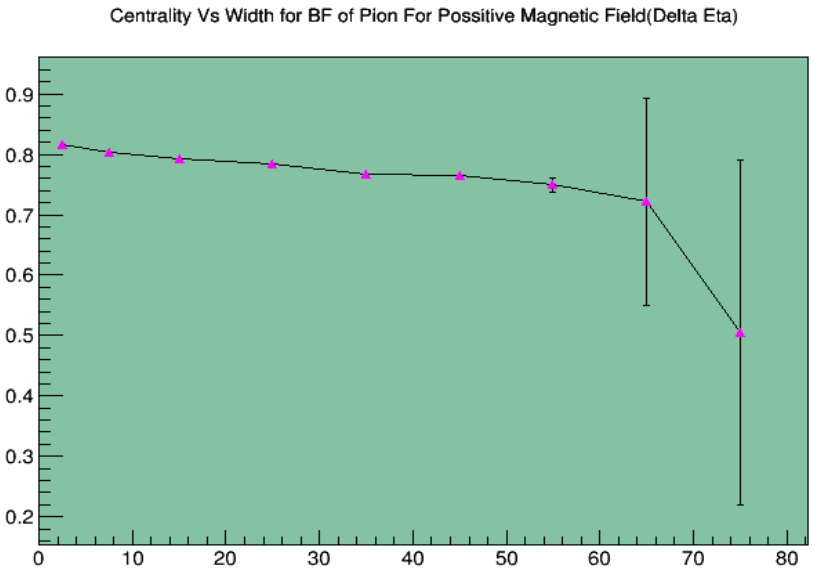


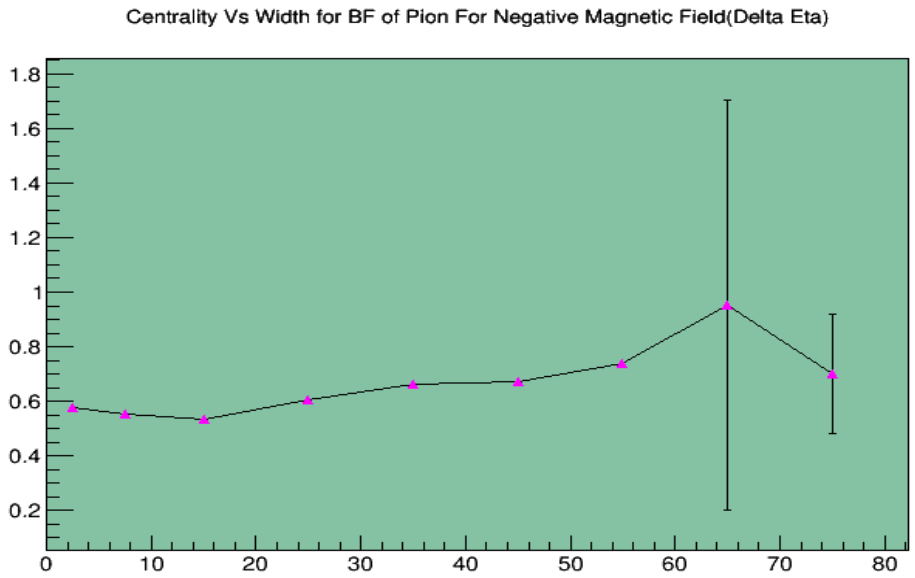
Pion

Positive Magnetic Field

Negative Magnetic Field

Eta





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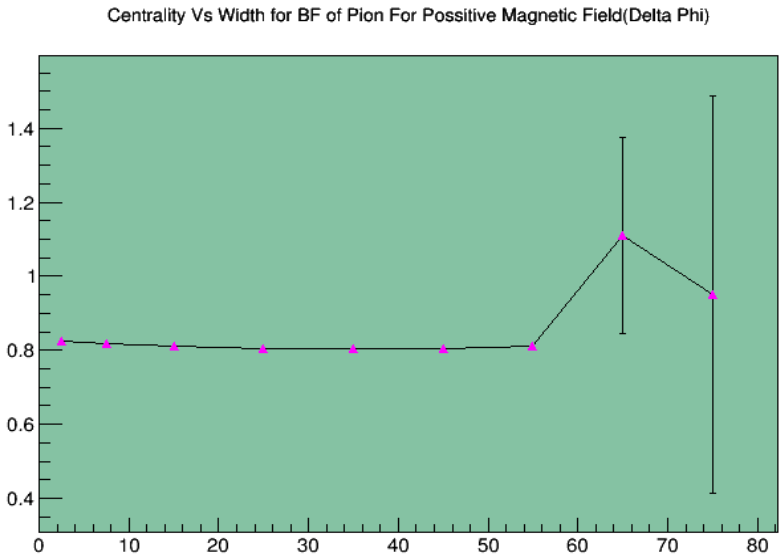
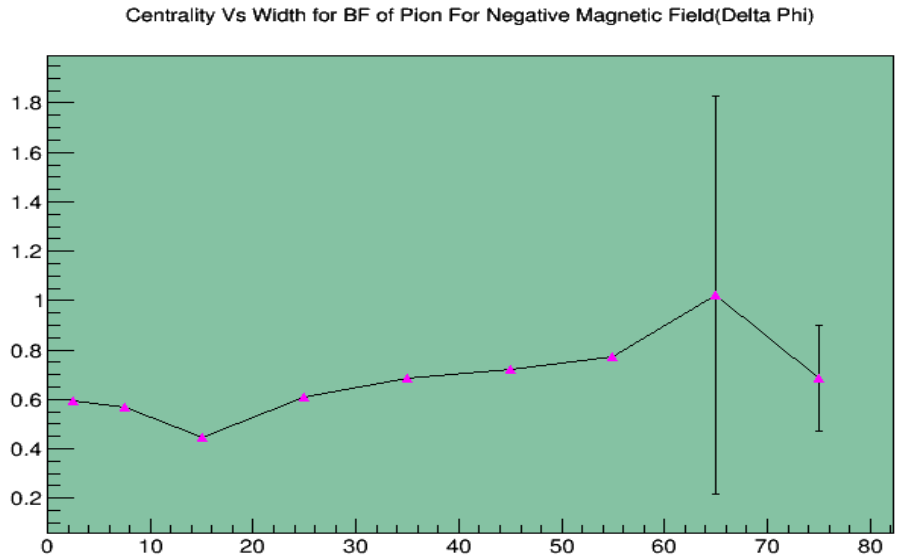


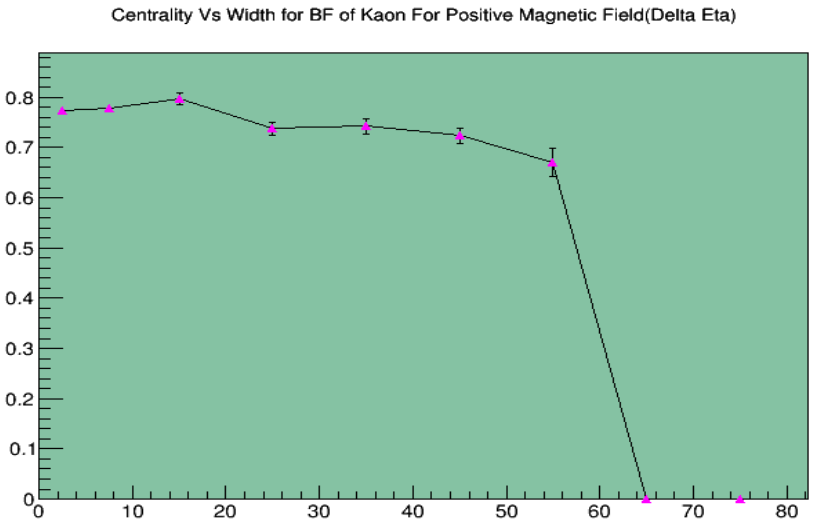


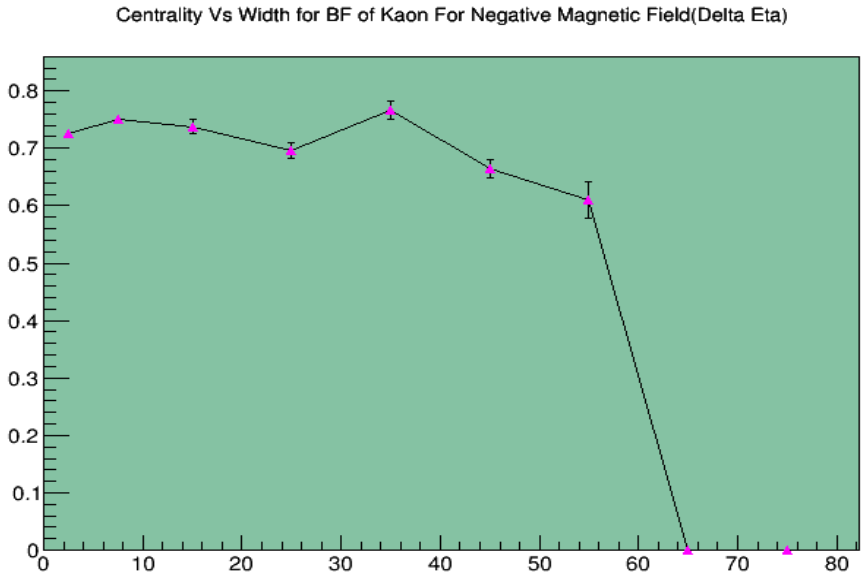
Kaon

Positive Magnetic Field

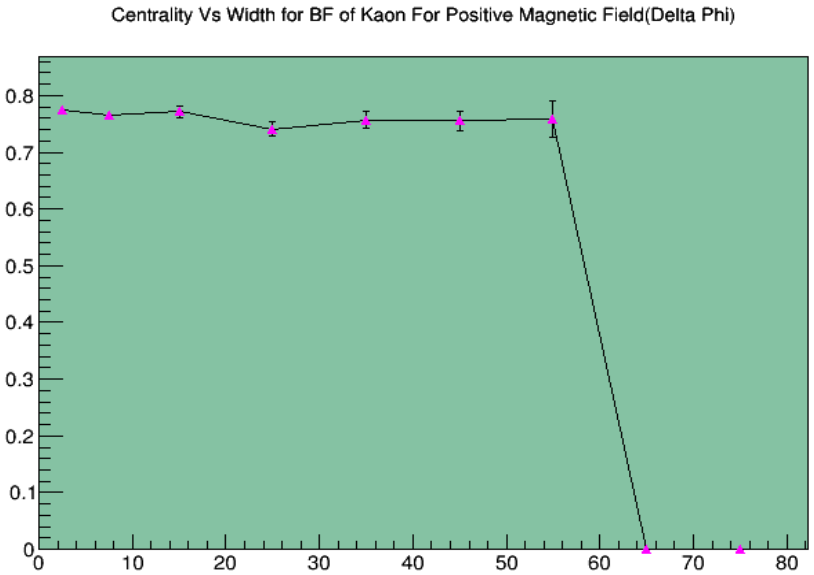
Negative Magnetic Field

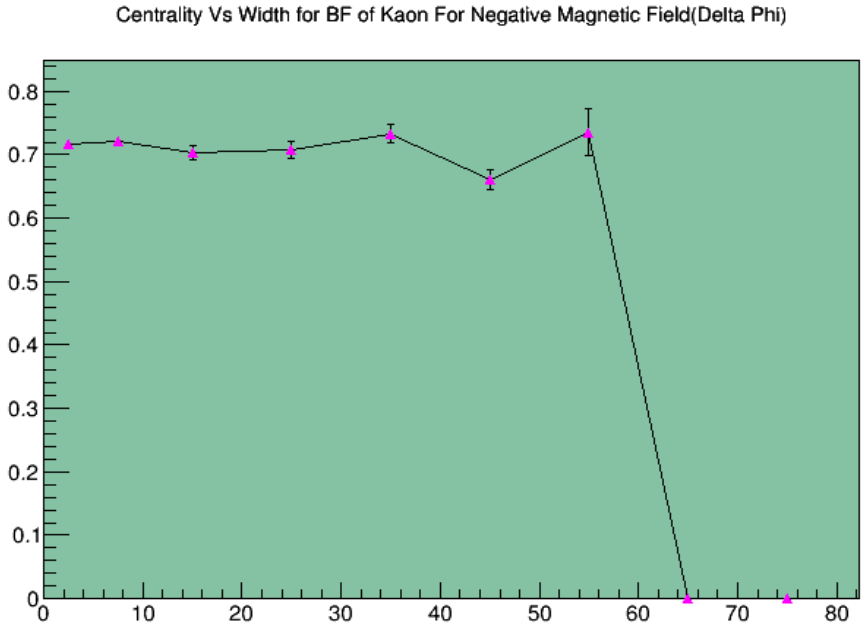
Eta





Phi



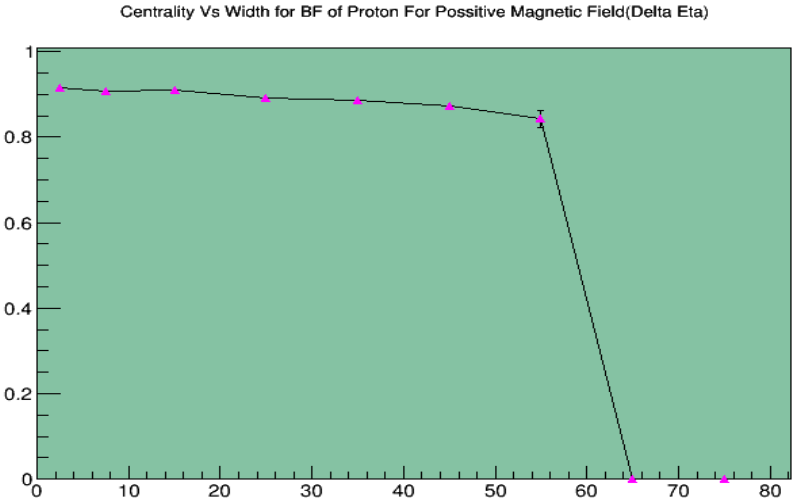


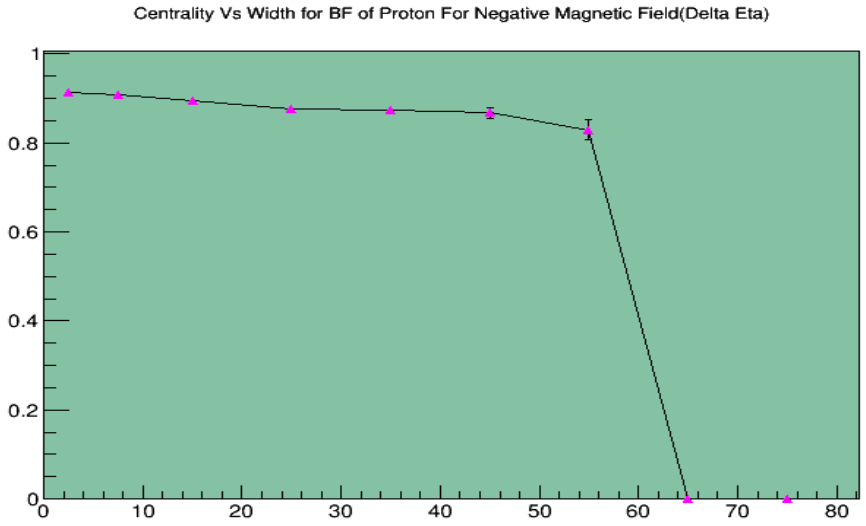
Proton

Positive Magnetic Field

Negative Magnetic Field

Eta





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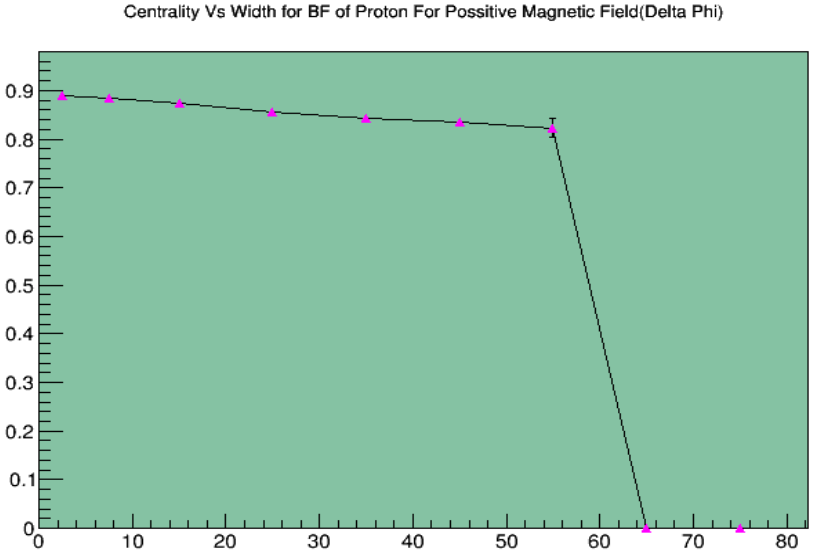

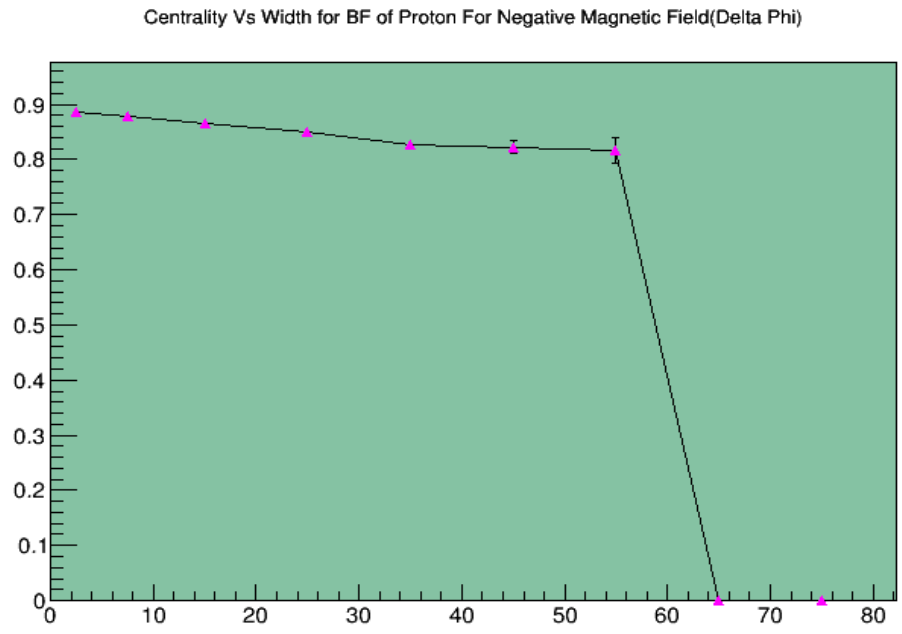

Summary and Plan

Summary:

=========

- Charge correlation measured in terms of balance function provide information on the time of hadronization of a partonic medium
- Balance function width reduces at delayed hadronization
- BF width for unidentified and identified particle(Pion) increase with central to peripheral collision and We observed that from 20 to 80 % Centrality BF width large corresponding to Unidentified Particle's BF. (LHC10h AOD86).
- At Delta Eta =0 , there is a dip for Pion and all charged particle's BF . If one go from most central to peripheral collision then this dip size increase for Pion w.r.t All charged Particles(LHC10h AOD86). We are digging the reason of this .
- For LHC11h AOD 145 data set , BF width does not change with centrality for Unidentified and Identified(pion , kaon and proton) for Both Positive and negative magnetic field. We are finding the problem.

Plan

==========

I am now doing some theory work. How the charge separation depends on magnetic field and its effects on BF width.

Thanks to

Michael Weber

Panos Chirstakoglou

My supervisor Subhasis Chattopadhyay