

ALICE



Sphericity analysis using V0M estimator

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ACO
meeting

Outline

- Comparison between methods V0M and reference $|\eta| < 0.3$ for spectra, for Mean P_T
- I'll compare what happens when I use Background rejection.
- Correlation p_t vs $\langle dN/d\eta \rangle_{|\eta| < 0.3}$
- We compare the V0M-REF ratio for:
 - N_{ch} in V0M $>$ $\langle N/d\eta \rangle_{|\eta| < 0.3}$
 - N_{ch} in V0M $<$ $\langle dN/d\eta \rangle_{|\eta| < 0.3}$
 - N_{ch} in V0M $=$ $\langle dN/d\eta \rangle_{|\eta| < 0.3}$
- Conclusions.

Analysis and run selection

Software: Aliroot:v5-07-20 Aliphysics:vAN-20160204

Event shape classes: (PWGLF/SPECTRA/Sphericity)

Analysis macros: AddTransverseEventShapeTask.C
AliAnaTransverseEventShapeTask.cxx
AliAnaTransverseEventShapeTask.h

LHC15f pass2: (55 mill of evts) (after all ev selection)

MC Pythia6 Perugia 2011 LHC15g3c3 50 mill.

MC Pythia8 Monash LHC15g3a3: 40 mill,

good runs*:

226500, 226495, 226483, 226476, 226472, 226468, 226466, 226452,
226445, 226444, 226225, 226220, 226170, 226062, 225768, 225766,
225763, 225762, 225757, 225753, 225719, 225717, 225716, 225710,
225709, 225708, 225707, 225705, 225587, 225586, 225582, 225580,
225579, 225578, 225576, 225322, 225315, 225314, 225313, 225310,
225309, 225307, 225305, 225106, 225052, 225051, 225050, 225043,
225041, 225037, 225035, 225031, 225026, 225016, 225011, 225000

(*) <http://twiki.cern.ch/twiki/bin/viewauth/ALICE/PWGLF13TeVanalysis>

Event, track and physics selection

Event Selection

Trigger: KINT7 (*Thanks to Gyula*)

Rejection of AliESDEvent::IsIncompleteDAQ (Not applied last time)

Vertex selection

Pile-up rejection

Background rejection (Not applied last time)

<https://twiki.cern.ch/twiki/bin/view/ALICE/PWGPPEvSelRun2pp>

Physics Selection

- MinNCrossedRowsTPC = 120; *
- MinRatioCrossedRowsOverFindableClustersTPC=0.8;
- MaxFractionSharedTPCCluster = 0.4;
- Maxchi2perTPCcl=4.;
- Max dcaz ITSTPC=2.0;
- SetDCAToVertex2D(kFALSE);
- SetRequireSigmaToVertex(kFALSE);
- RequireTPCRefit(kTRUE);
- RequireITSRefit(kTRUE);
- AcceptKinkDaughters(kFALSE);
- MaxDCAToVertexXYPtDep("0.0182+0.0350/pt^1.01"); *
- SetMaxChi2TPCConstrainedGlobal(36.);

Track selection taken for each analysis:

- So Analysis, Hybrid-track cuts for primary charged particles with $|\eta| < 0.3$ and $0.15 < p_T < 10$ GeV/c.
- $\langle p_T \rangle$ Analysis, Golden-track cuts with $|\eta| < 0.3$ and $0.15 < p_T < 10$ GeV/c.
- Multiplicity:
 - Reference multiplicity selection with $|\eta| < 0.3$
 - V0M percentil selection

Useful tools for Multiplicity estimators

- **Used libraries**

```
$ALICE_PHYSICS/OADB/COMMON/MULTIPLICITY/AliMultSelectionTask.cxx  
$ALICE_PHYSICS/OADB/COMMON/MULTIPLICITY/macros/AddTaskMultSelection.C
```

- **Snippets**

```
AliMultSelection *MultSelection = (AliMultSelection*) lVEvent->FindListObject("MultSelection");  
Float_t lMultiplicityPercentile = MultSelection->GetMultiplicityPercentile("V0M");
```

- **More:**

<https://twiki.cern.ch/twiki/bin/viewauth/ALICE/AliceHMTFEstimators>

- **AliPPVsMultUtils class from AliPhysics>=vAN-20151019-1 obsolete**

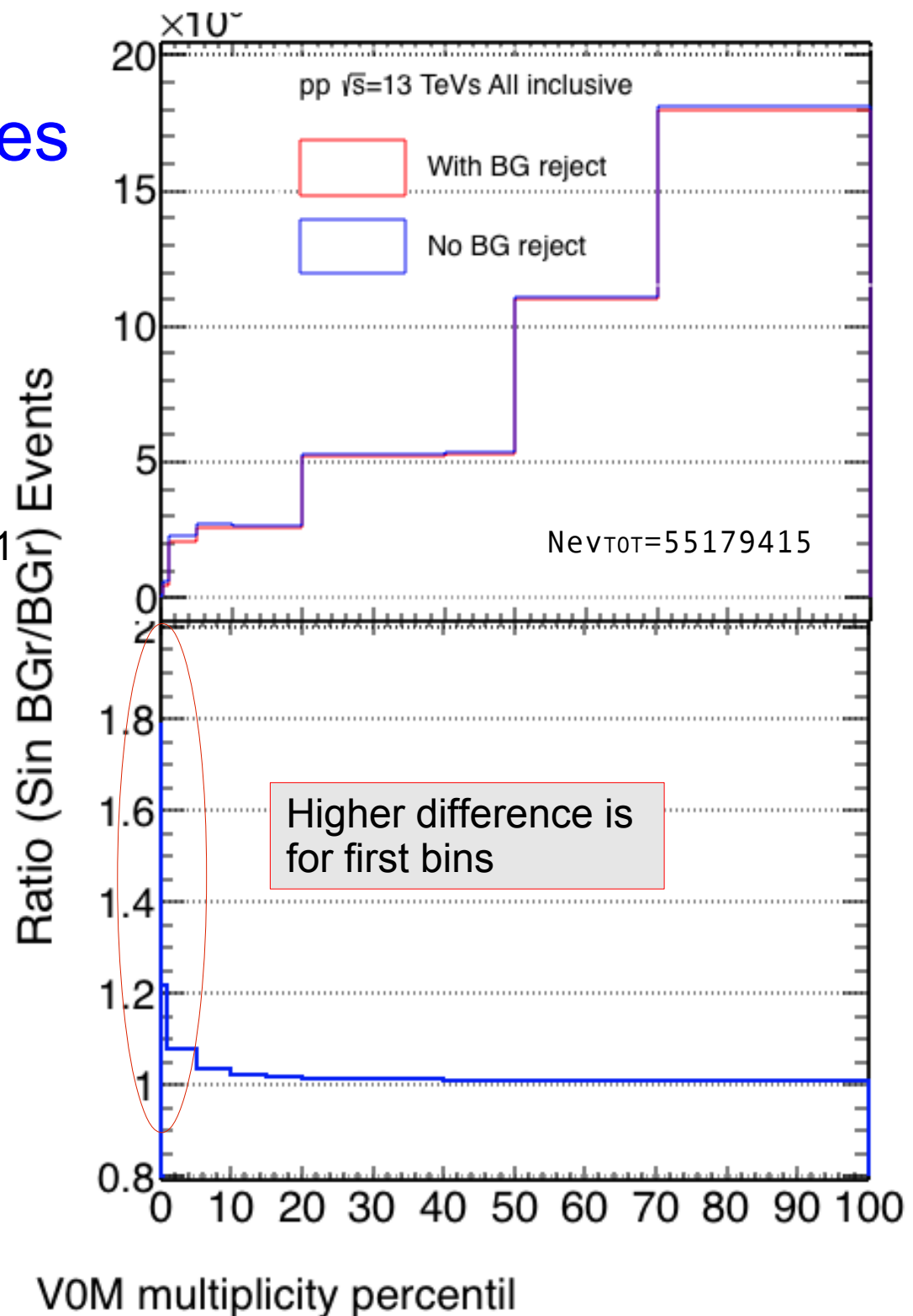
Thanks David for help.
and Vytautas for provide the binning

Events in V0M Multiplicity classes

In order to see what
happend

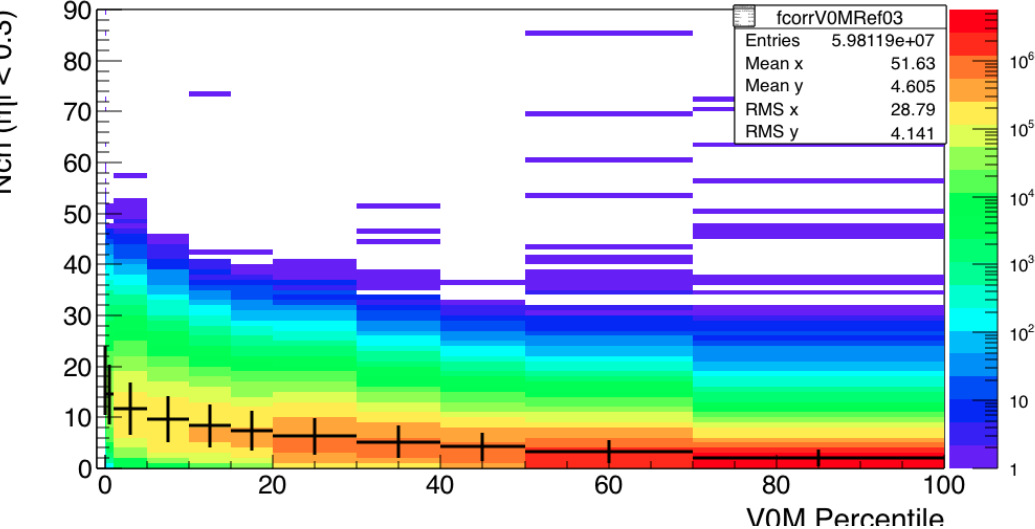
With BG rejection:

```
if( fNofITSClusters0+ fNofITSClusters1  
> 65+4*fNofTracklets) return;
```

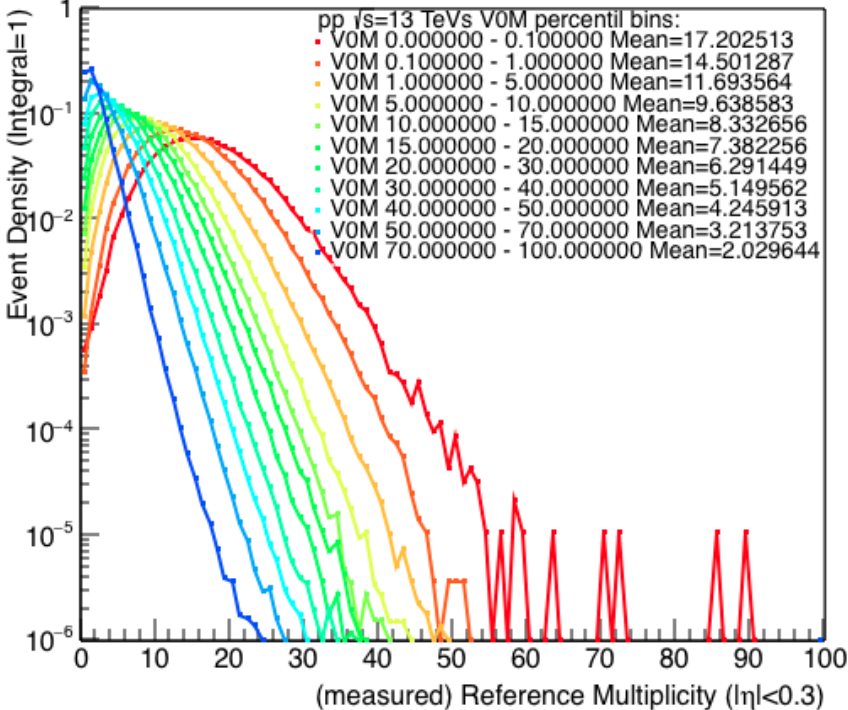


Some usefull plots for V0M Analysis

Multiplicity Correlation ($V0M$ and $|\eta| < 0.3$)



I reproduce the projections in order to ensure the value of $\langle dN/d\eta \rangle$



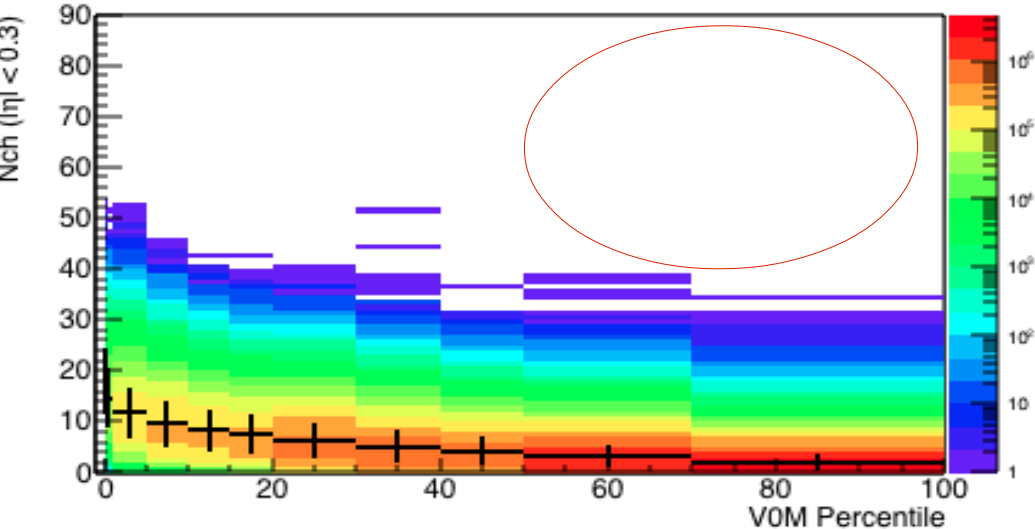
V0M percentil	$\langle dN/d\eta \rangle_{ \eta < 0.3}$
0.0-0.1,	17.20
0.1-1,	14.5
1-5,	11.69
5-10,	9.63
10-15,	8.33
15-20,	7.38
20-30,	6.29
30-40,	5.14
40-50,	4.24
50-70,	3.21
70-100	2.02

The number of events where taken from each multiplicity class

Some usefull plots for V0M Analysis

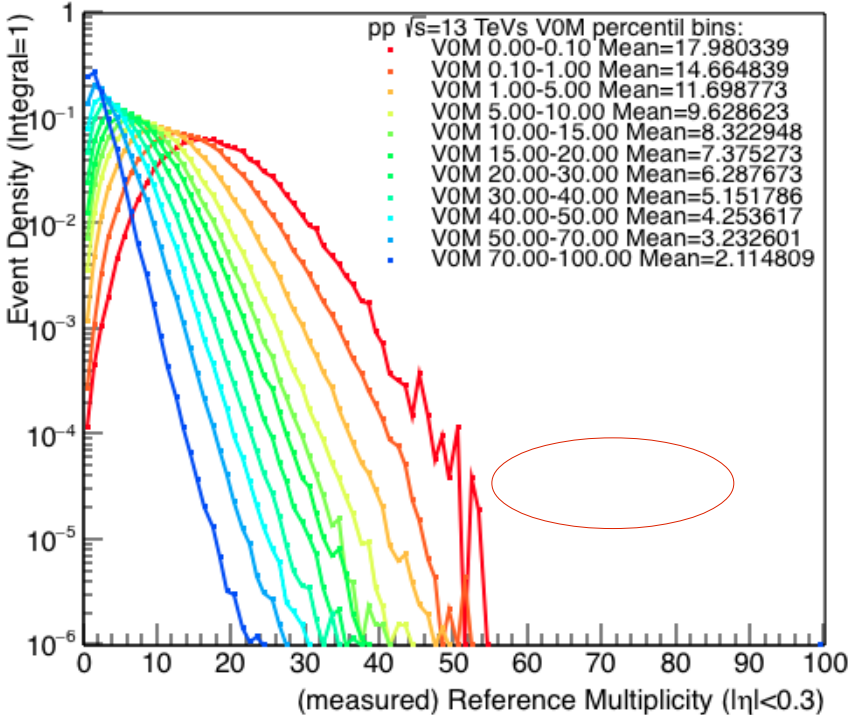
With BG rejection

Multiplicity Correlation (V0M and $|\eta| < 0.3$)



Multiplicity V0M

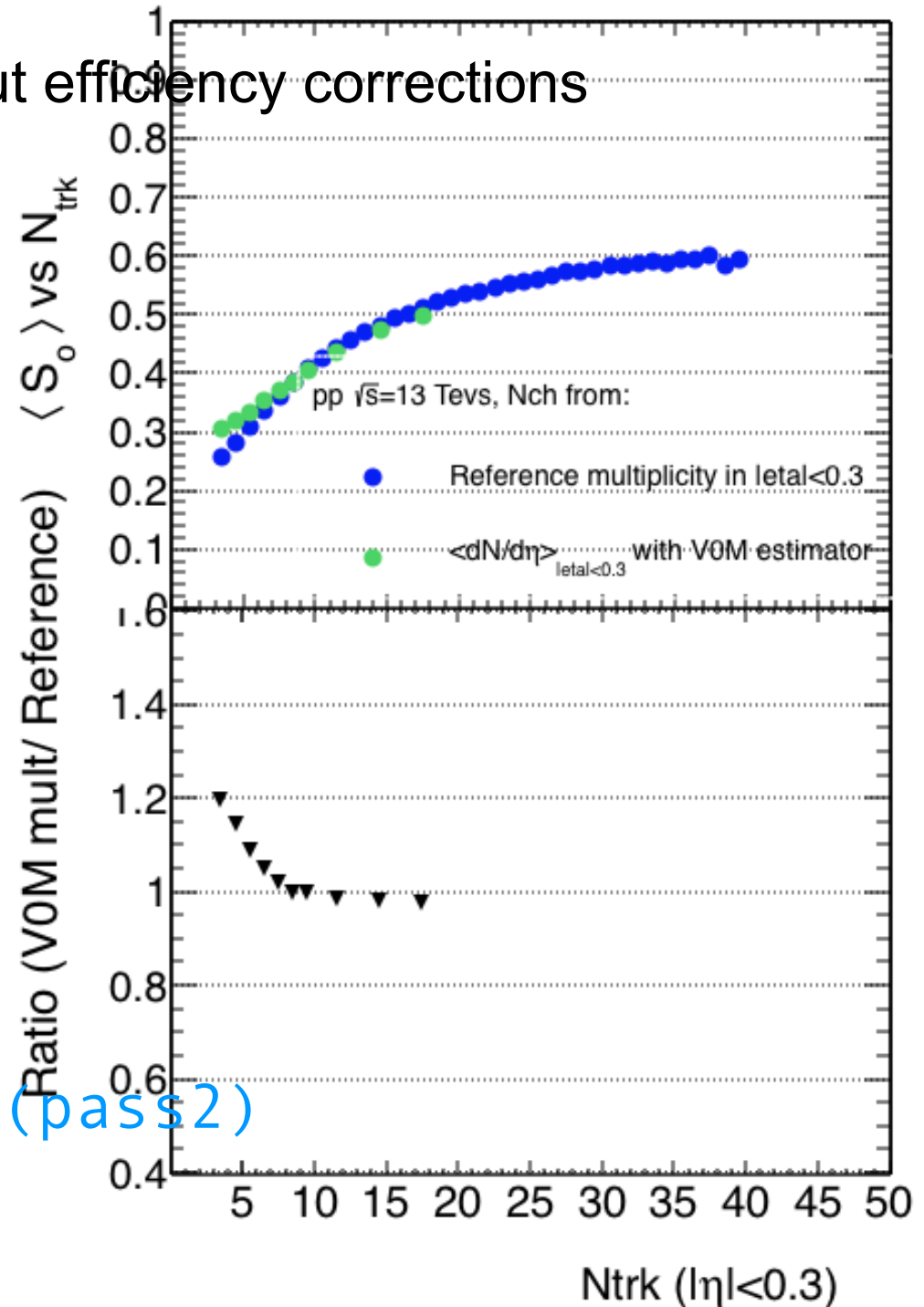
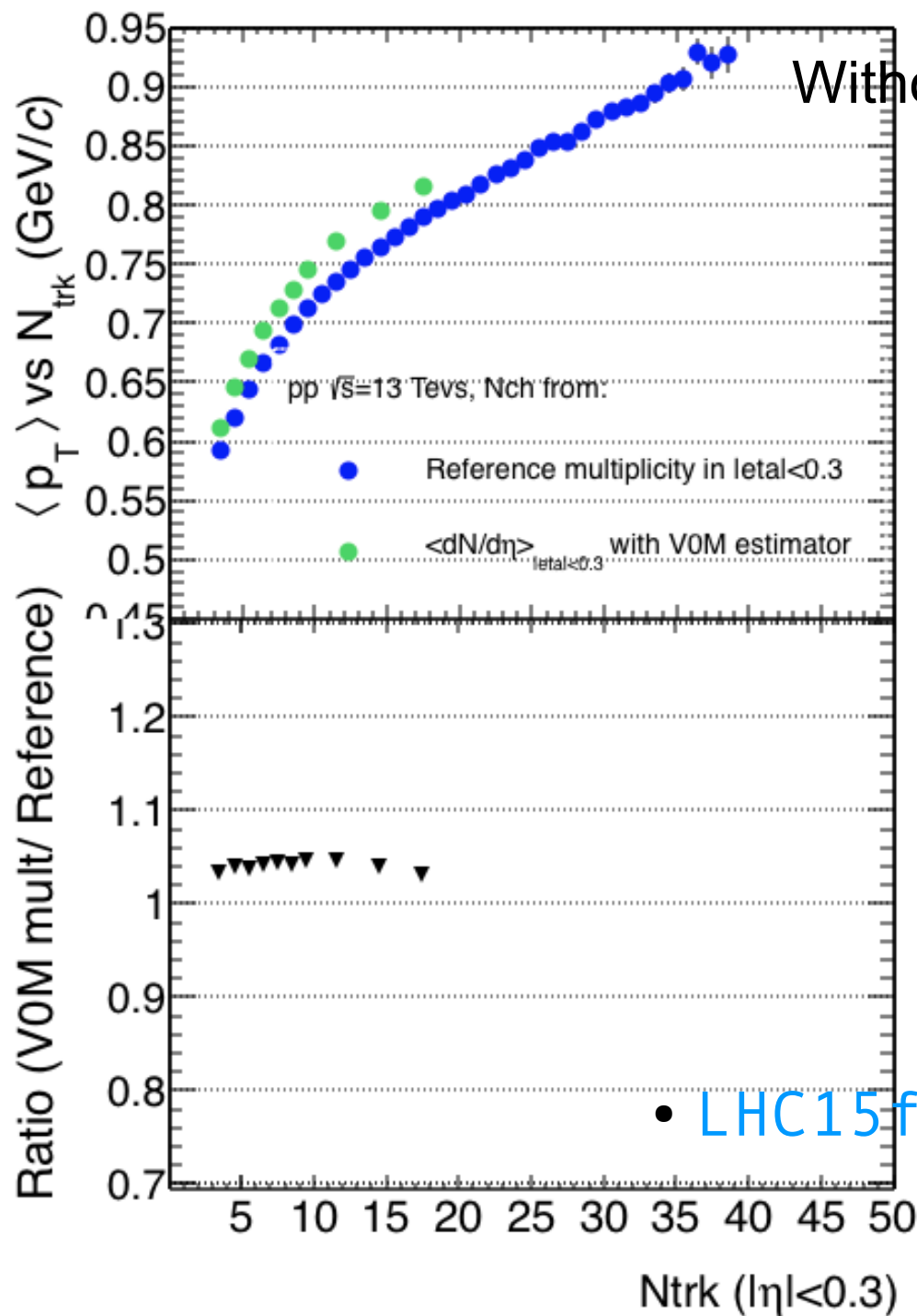
I reproduce the projections in order to ensure the value of $\langle dN/d\eta \rangle$



V0M percentil	$\langle dN/d\eta \rangle_{ \eta < 0.3}$
0.0-0.1,	17.98
0.1-1,	14.66
1-5,	11.69
5-10,	9.62
10-15,	8.32
15-20,	7.37
20-30,	6.28
30-40,	5.15
40-50,	4.25
50-70,	3.23
70-100	2.11

The number of events where taken from each multiplicity class

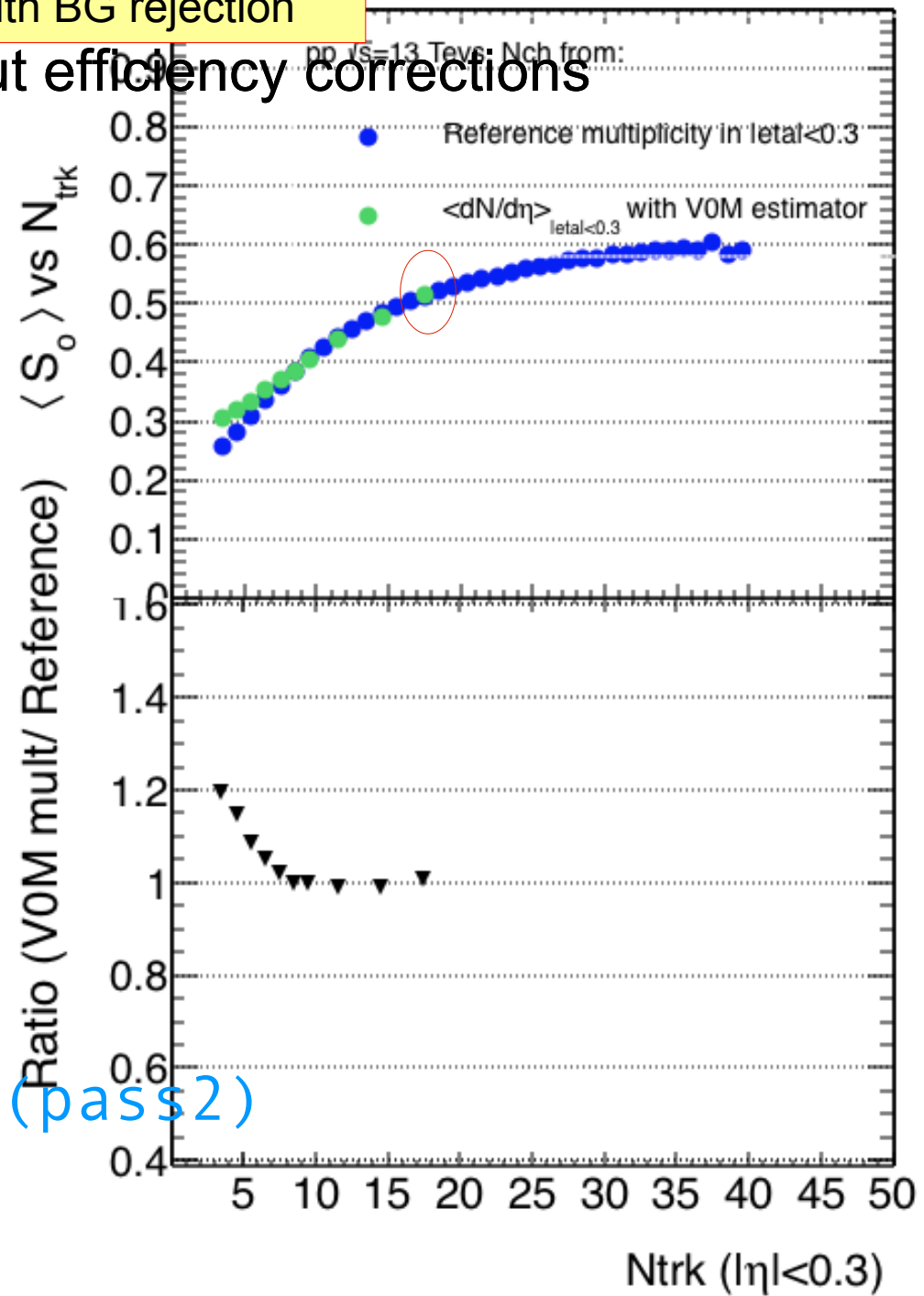
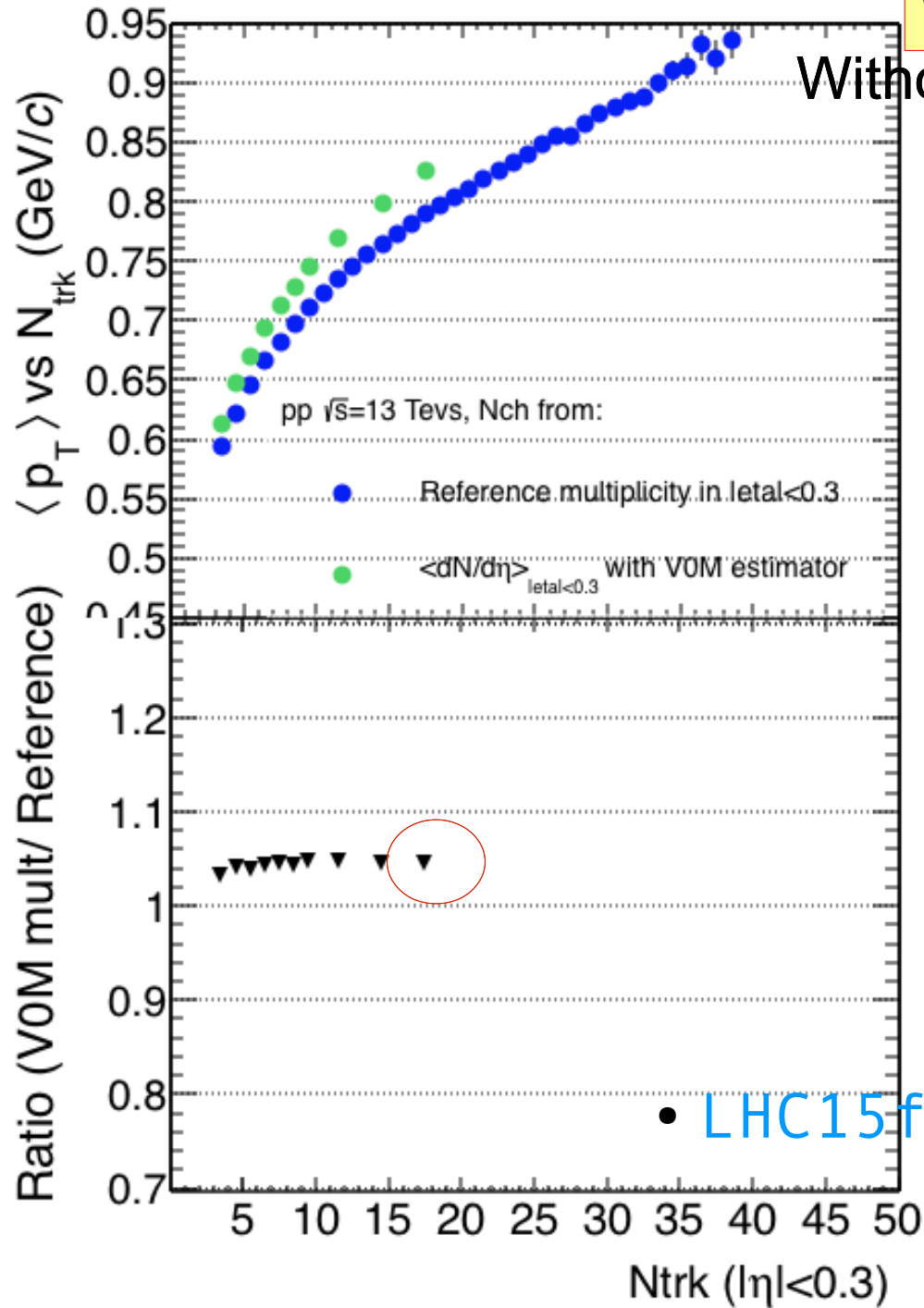
Comparing estimators V0M and Ref $|\eta| < 0.3$

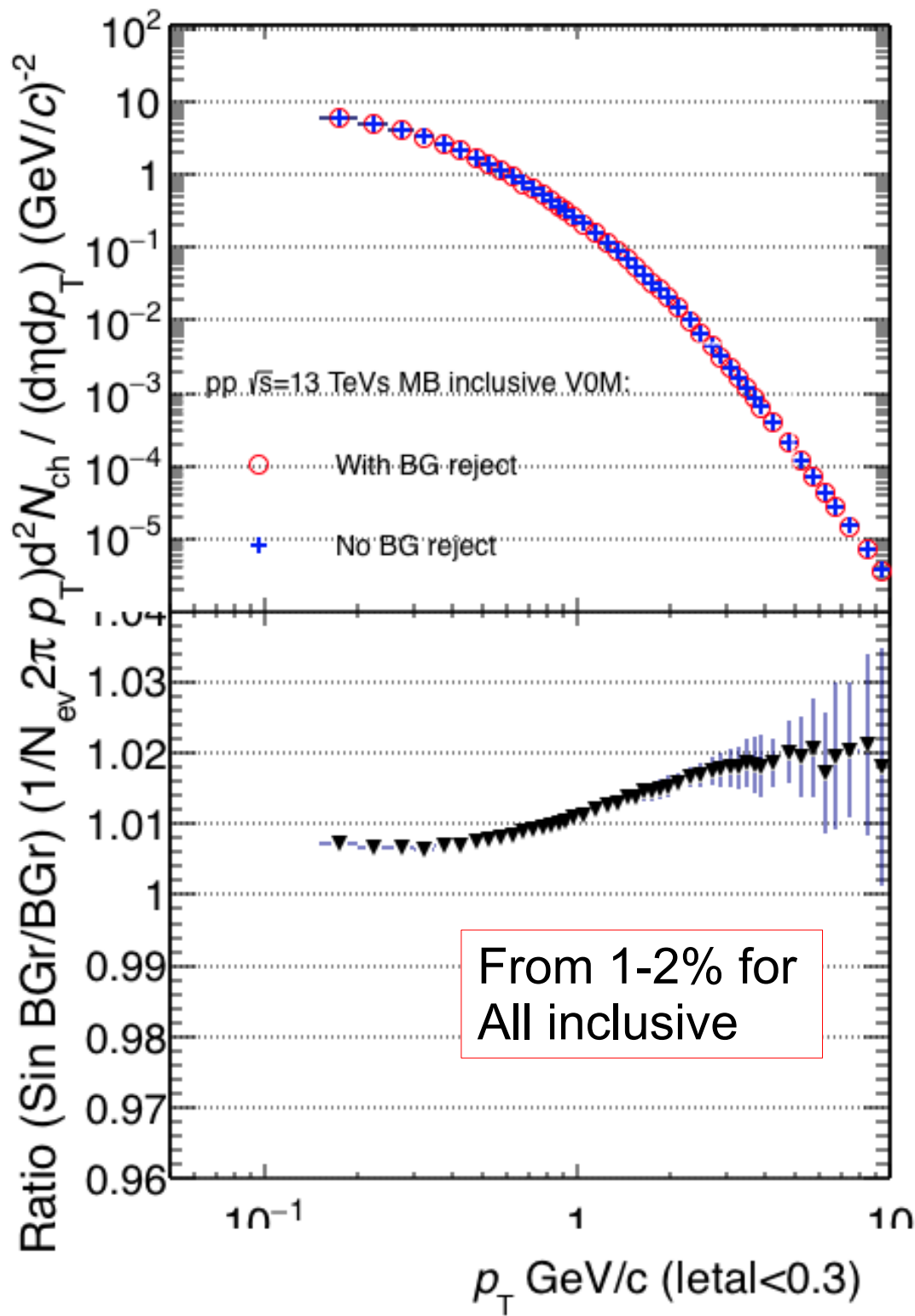


Comparing estimators V0M and Ref $|\eta| < 0.3$

With BG rejection

Without efficiency corrections

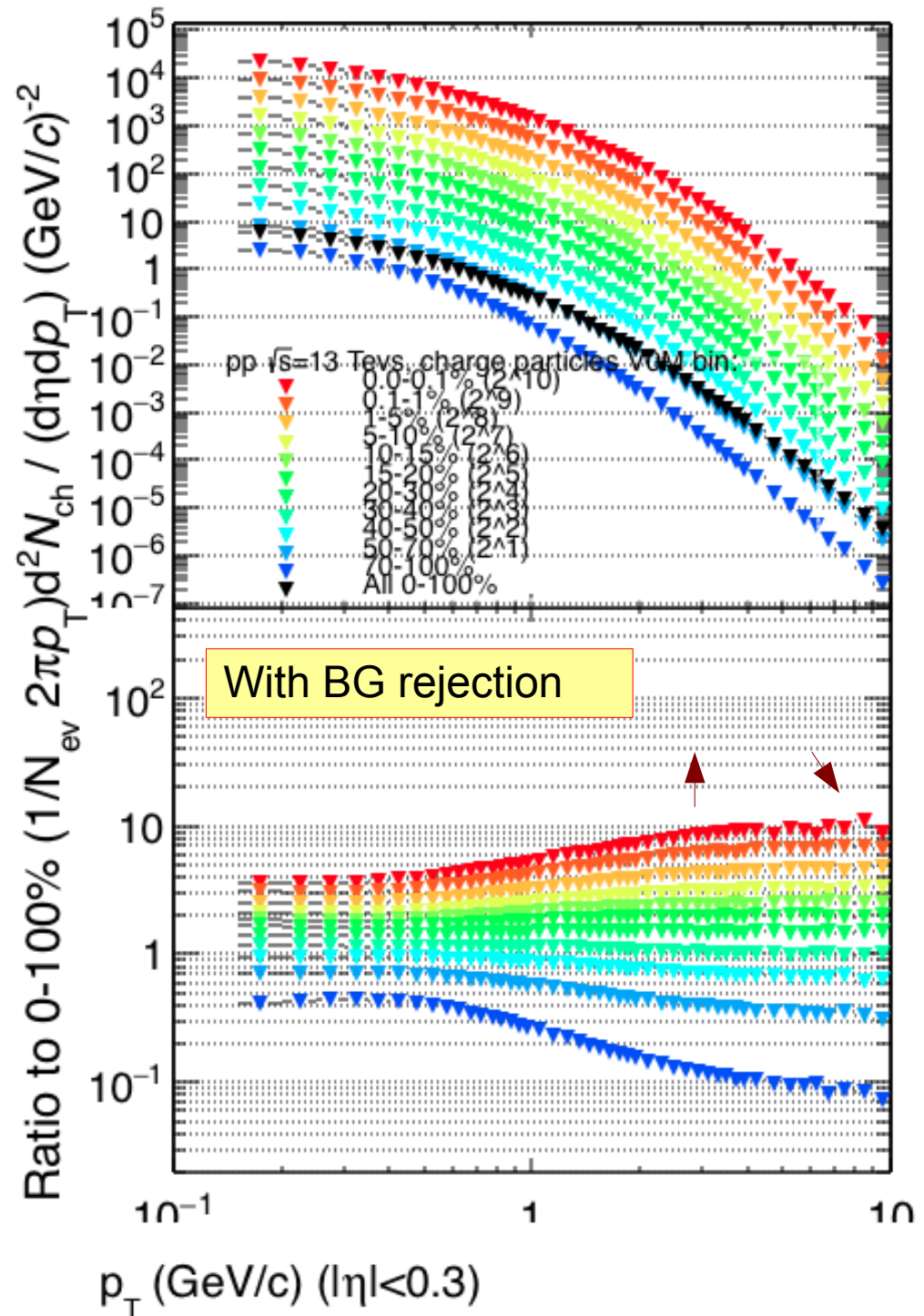
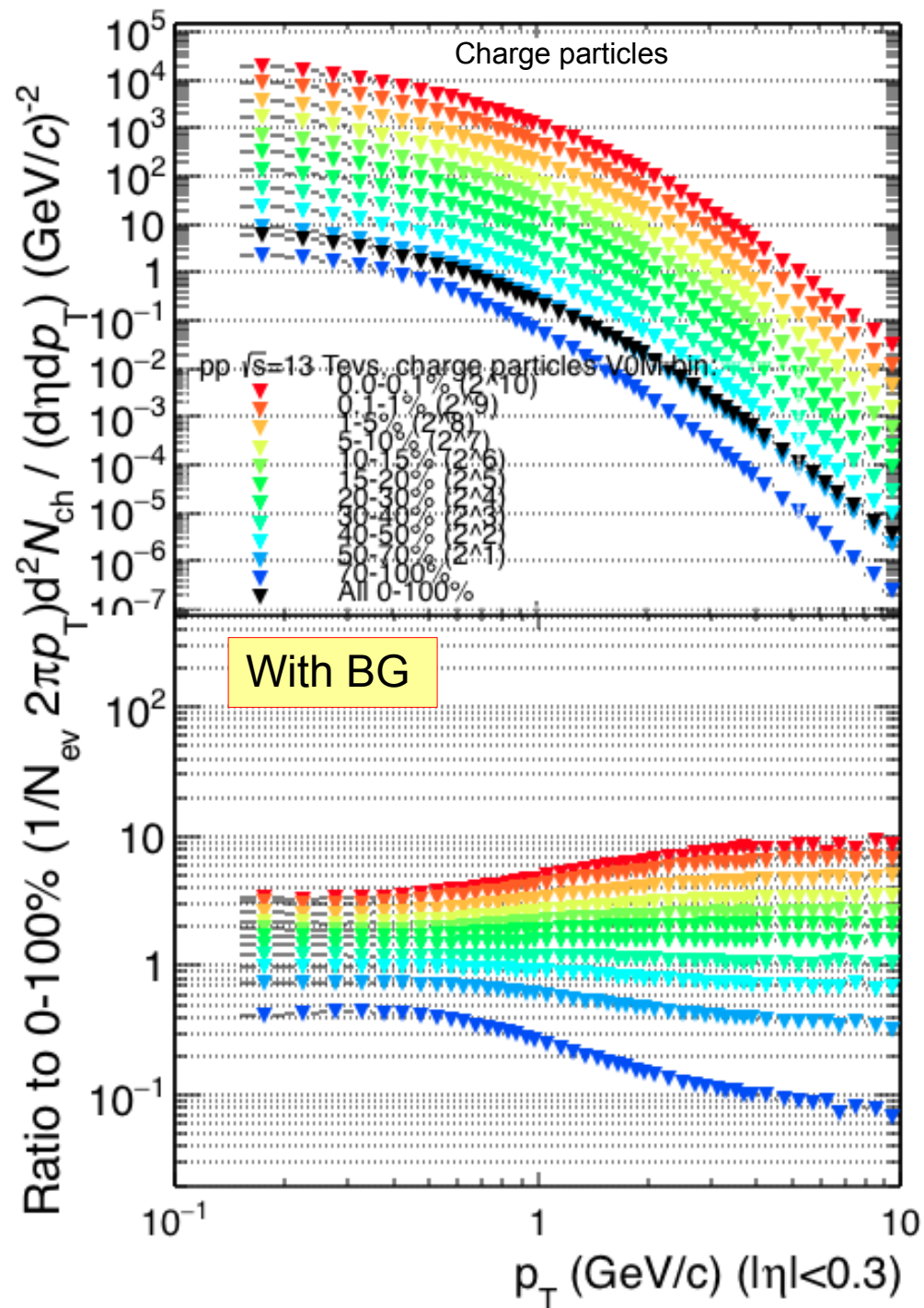




Comparing Yield of All Inclusive (MB V0M) with and without BG rejection:

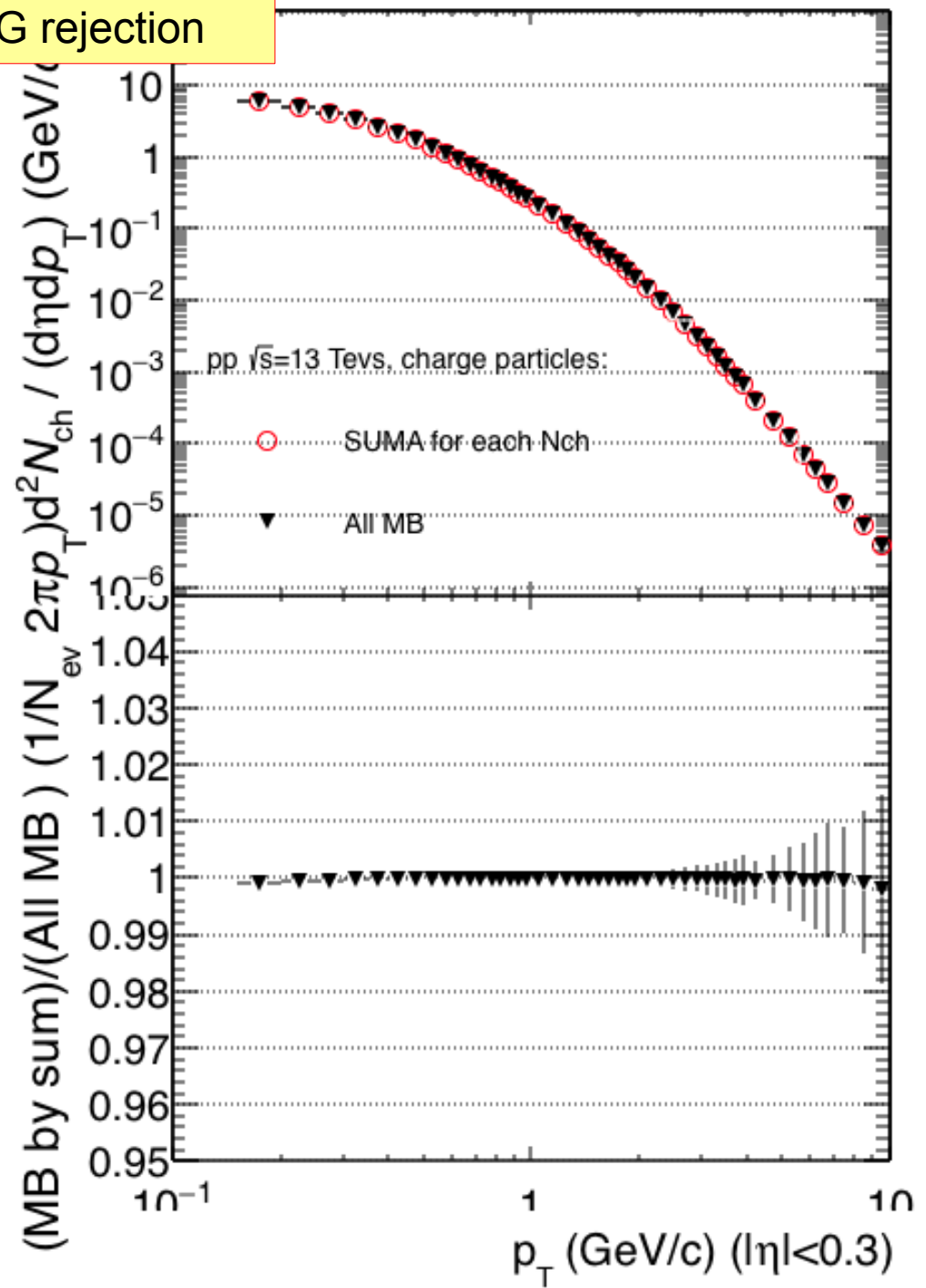
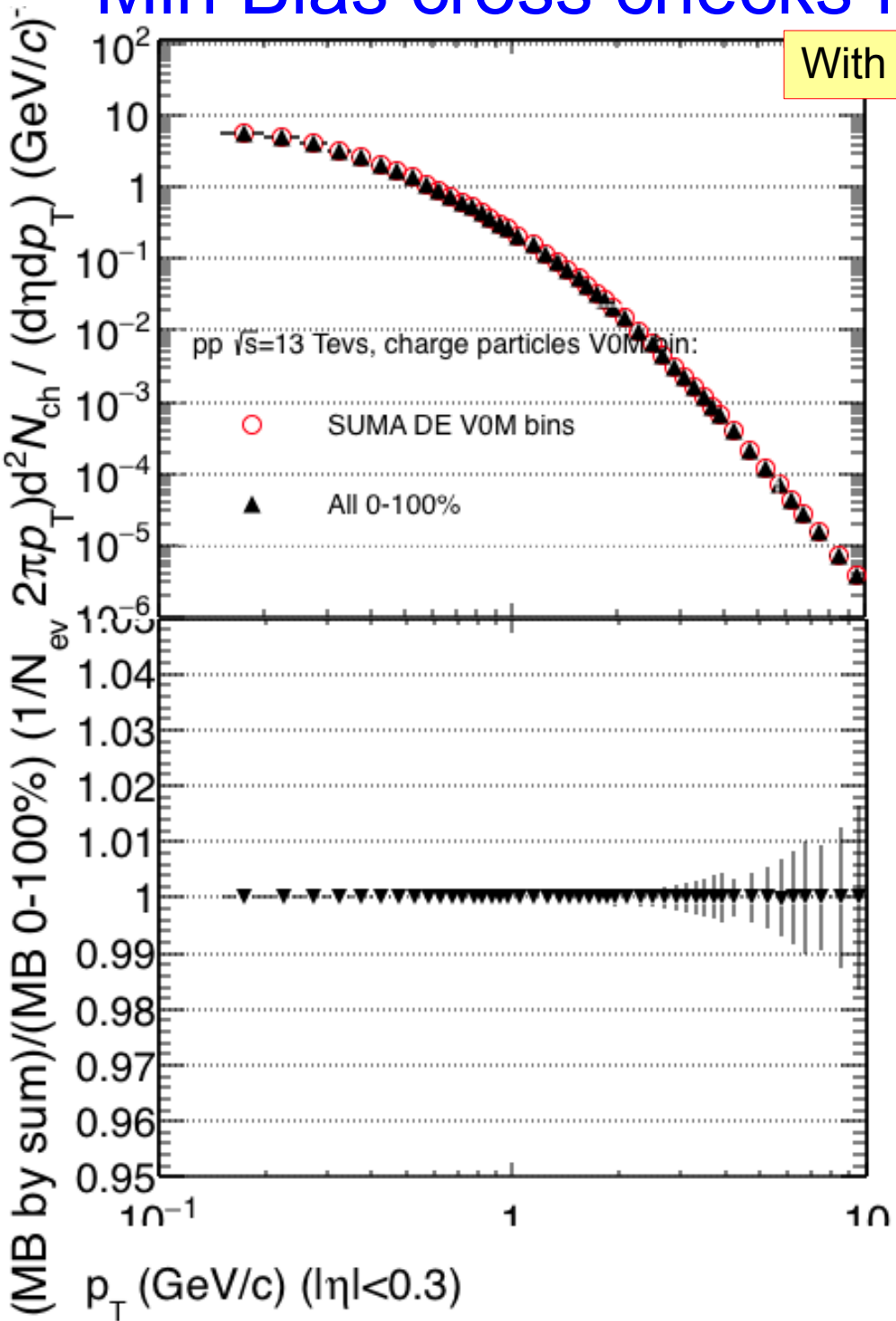
But also the variation will be different for each V0M classes se next slides

Comparing for V0M percentils and N_{ch} for its $\langle dN/d\eta \rangle$

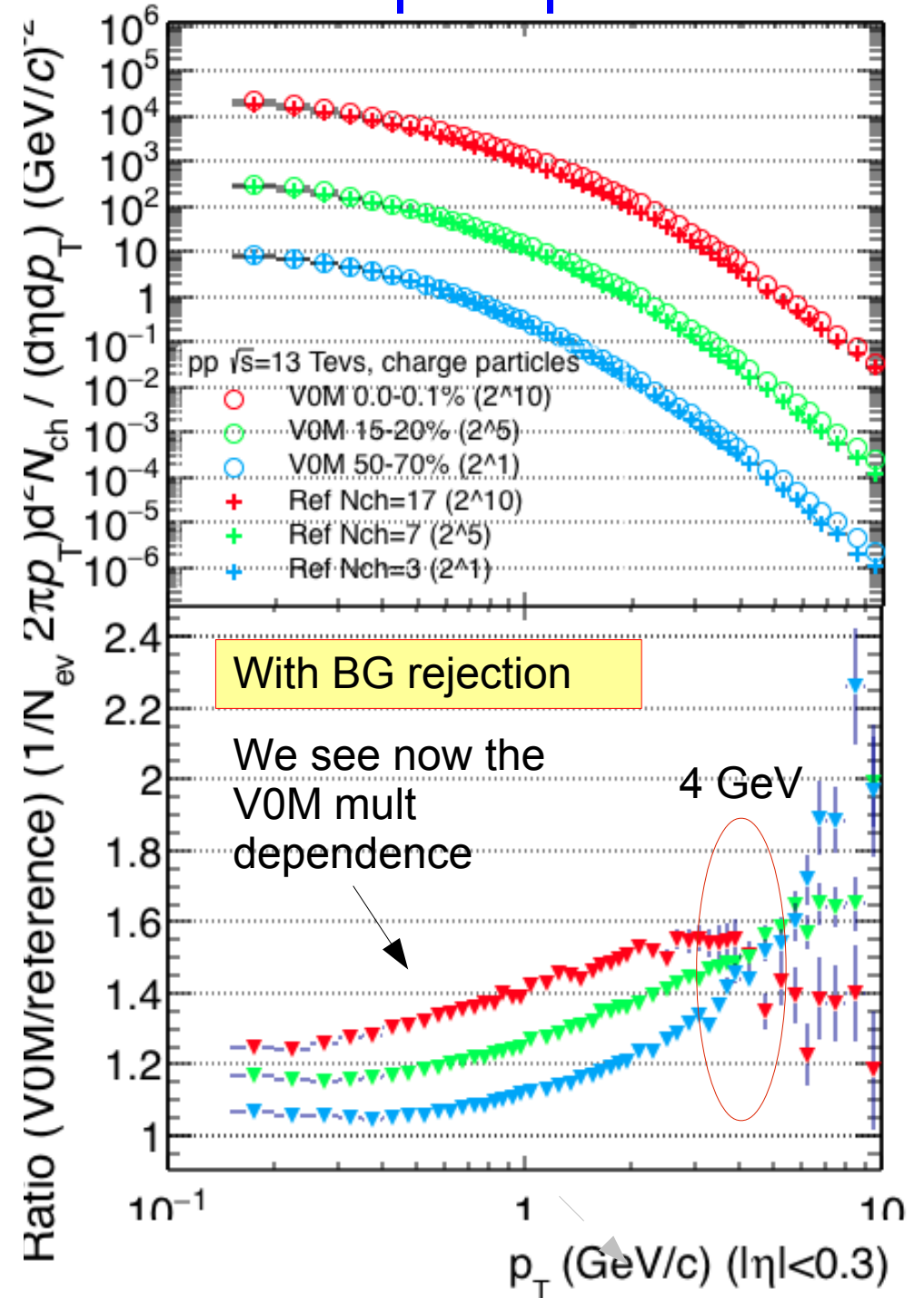
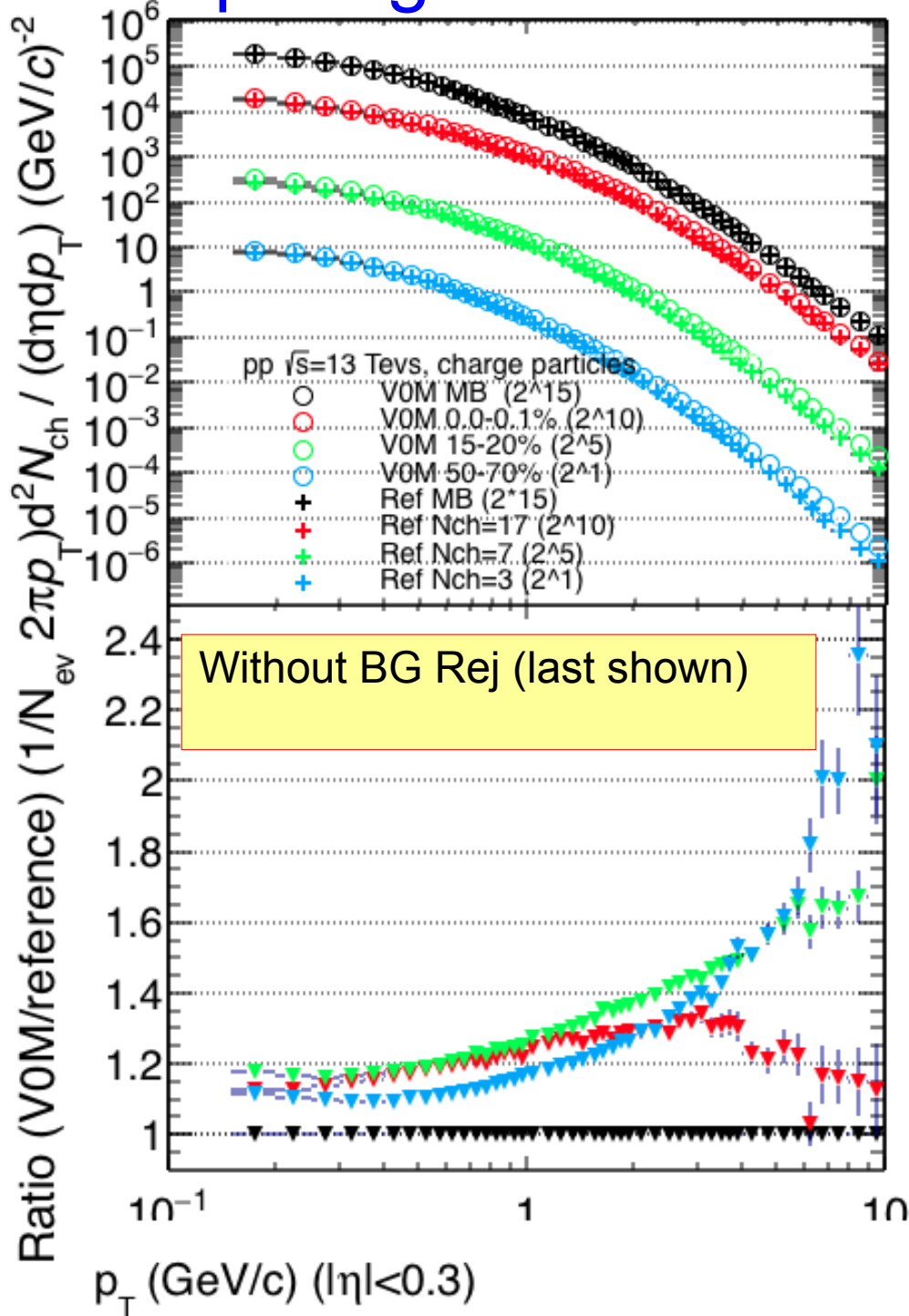


Min Bias cross checks for V0M and Ref $|\eta| < 0.3$

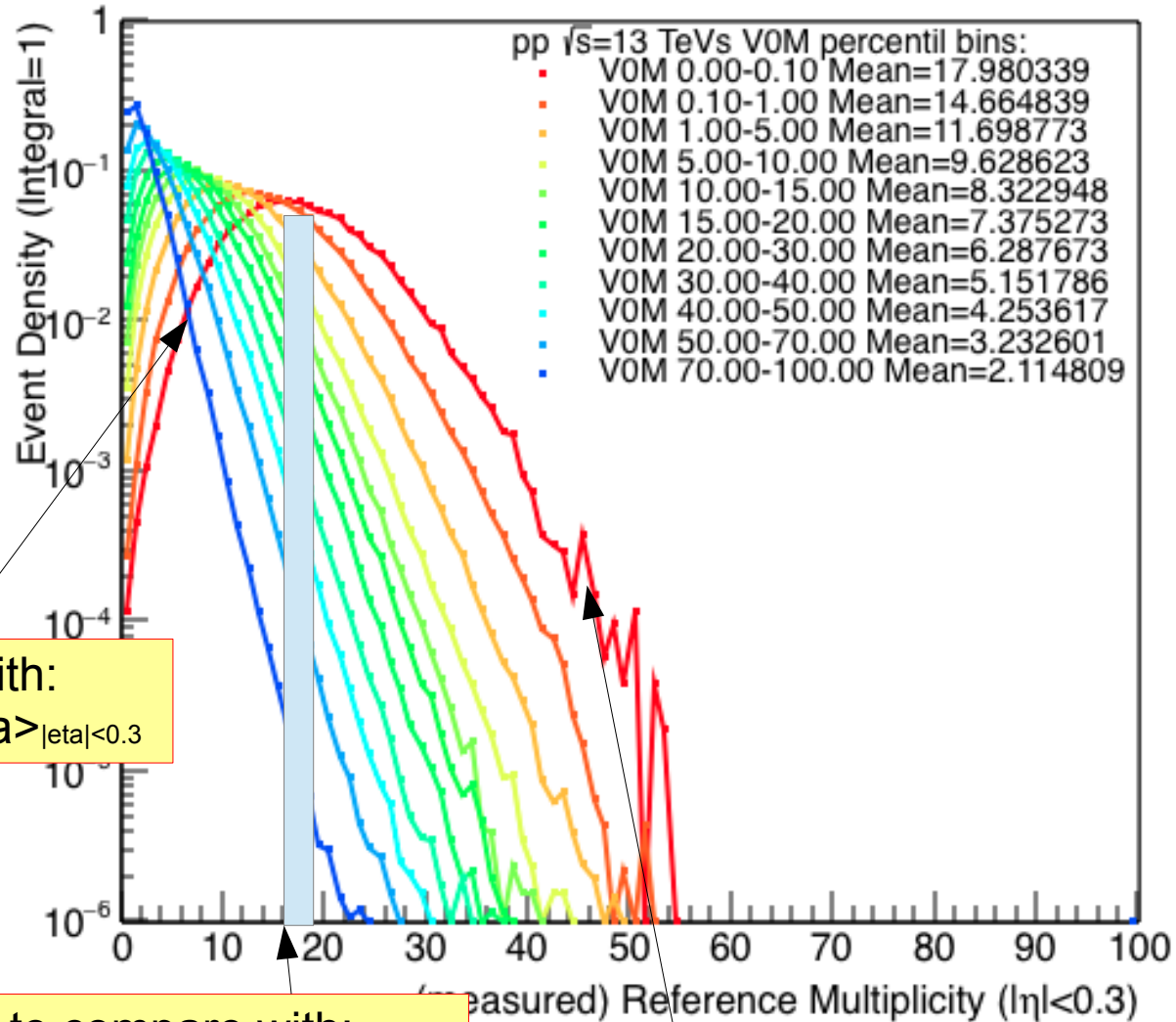
With BG rejection



Comparing estimators V0M and Ref $|\eta| < 0.3$



Who contributes to the greater fraction for V0M?



Ned to compare with:
 $V0M_{Nch} < \langle dN/d\eta \rangle_{|\eta|<0.3}$

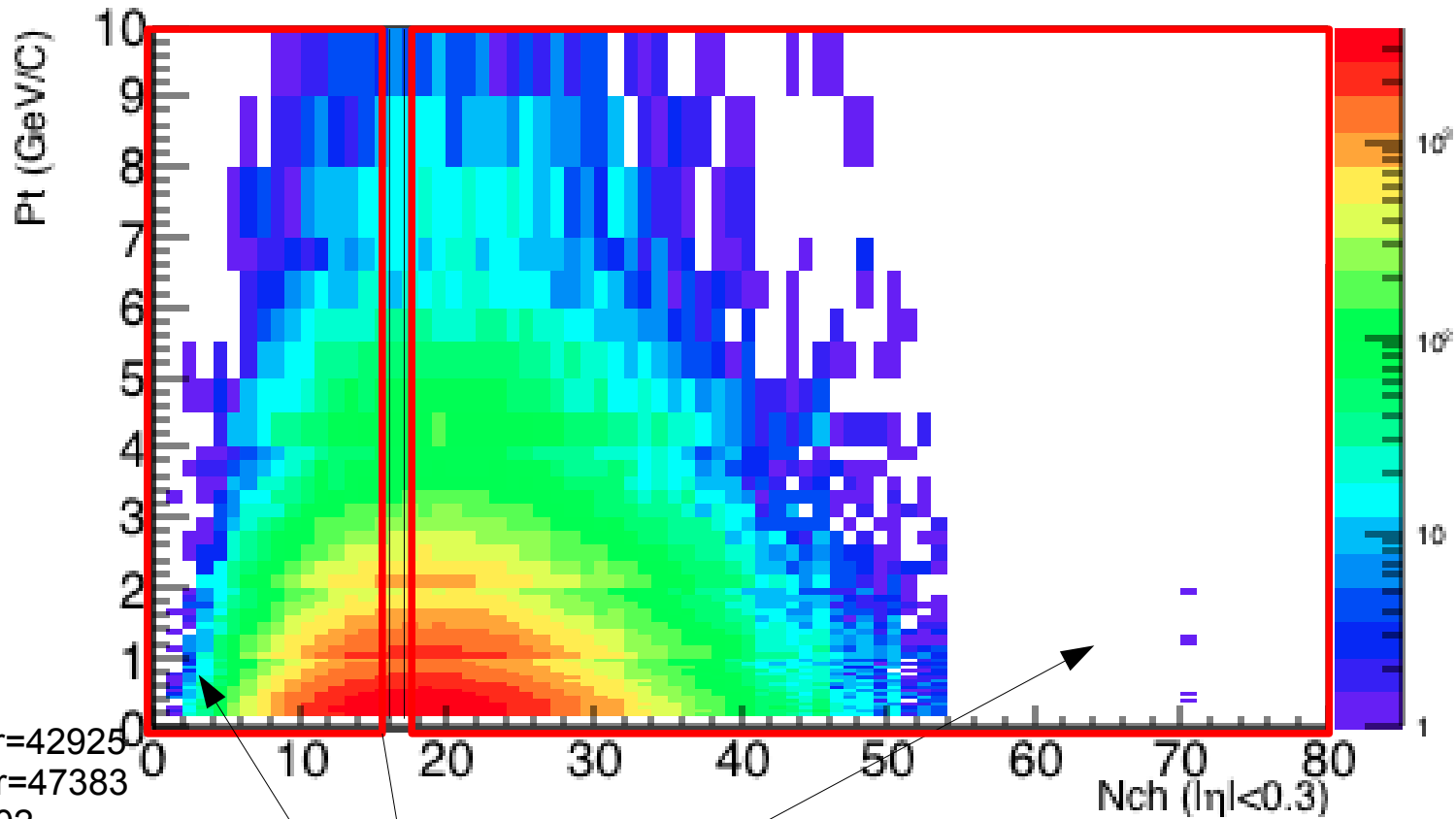
Ned to compare with:
 $V0M_{Nch} = \langle dN/d\eta \rangle_{|\eta|<0.3}$

Ned to compare with:
 $V0M_{Nch} > \langle dN/d\eta \rangle_{|\eta|<0.3}$

Correlation: P_T vs $\langle dN/d\eta \rangle_{|\eta|<0.3}$

This was made for all V0M bins

Correlation Nch vs Pt for $0.000000 < V0M \text{ percentil} < 0.100000$



Nev=95810

Nev para mayor=42925

Nev para menor=47383

Nev para ig=5502

Suma=95810

In order to get pt distributions for:

$Nch \text{ in } V0M > \langle dN/d\eta \rangle_{|\eta|<0.3} = 17$

$Nch \text{ in } V0M \leq \langle dN/d\eta \rangle_{|\eta|<0.3} = 17$

$Nch \text{ in } V0M = \langle dN/d\eta \rangle_{|\eta|<0.3} = 17$

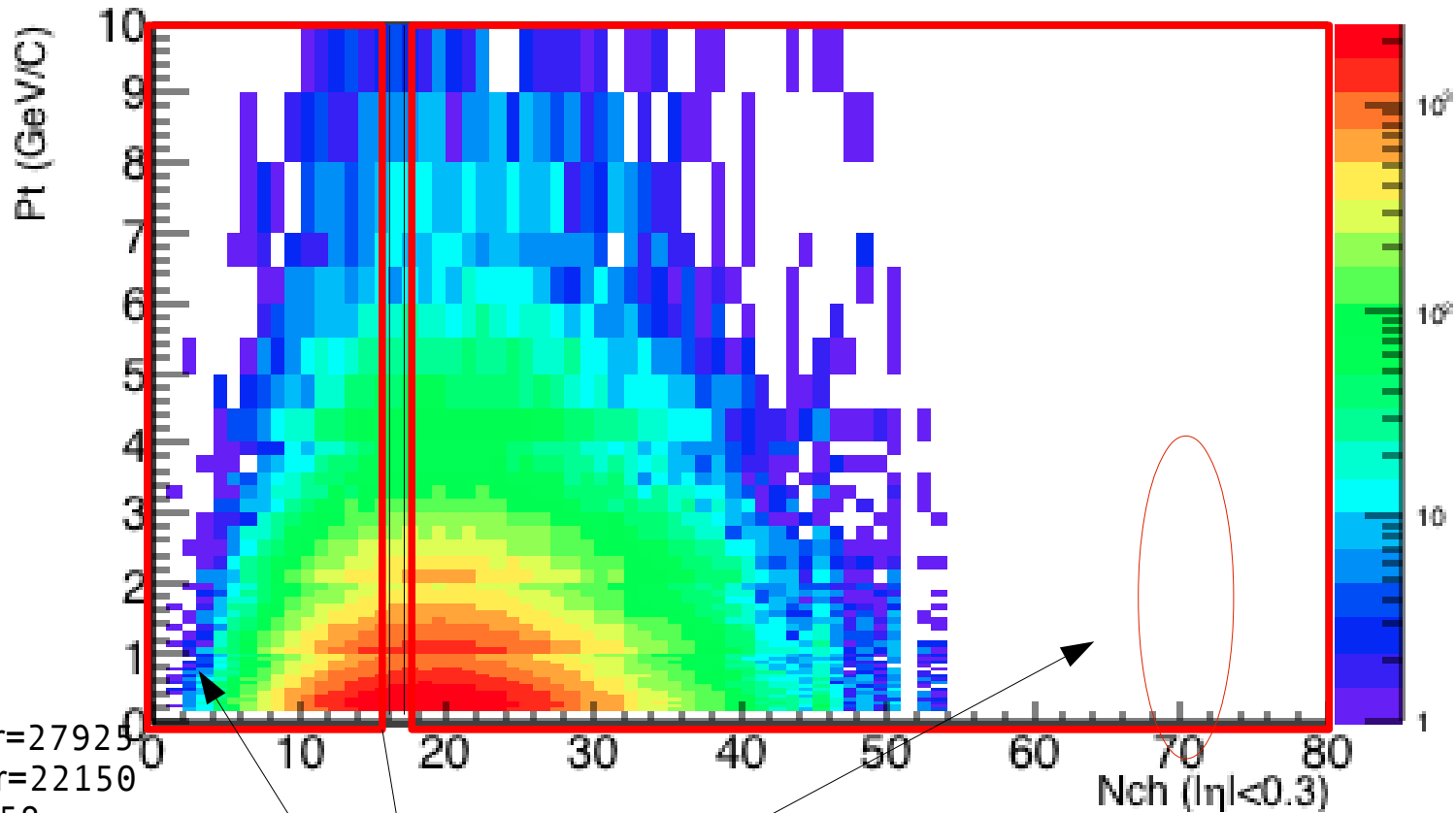
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Correlation: P_T vs $\langle dN/d\eta \rangle_{|\eta|<0.3}$

This was made for all V0M bins

With BG rejection

Correlation Nch vs Pt for $0.000000 < V0M \text{ percentil} < 0.100000$



Nev=53433

Nev para mayor=27925

Nev para menor=22150

Nev para ig=3358

Suma=53433

In order to get pt distributions for:

$Nch \text{ in } V0M > \langle dN/d\eta \rangle_{|\eta|<0.3} = 17$

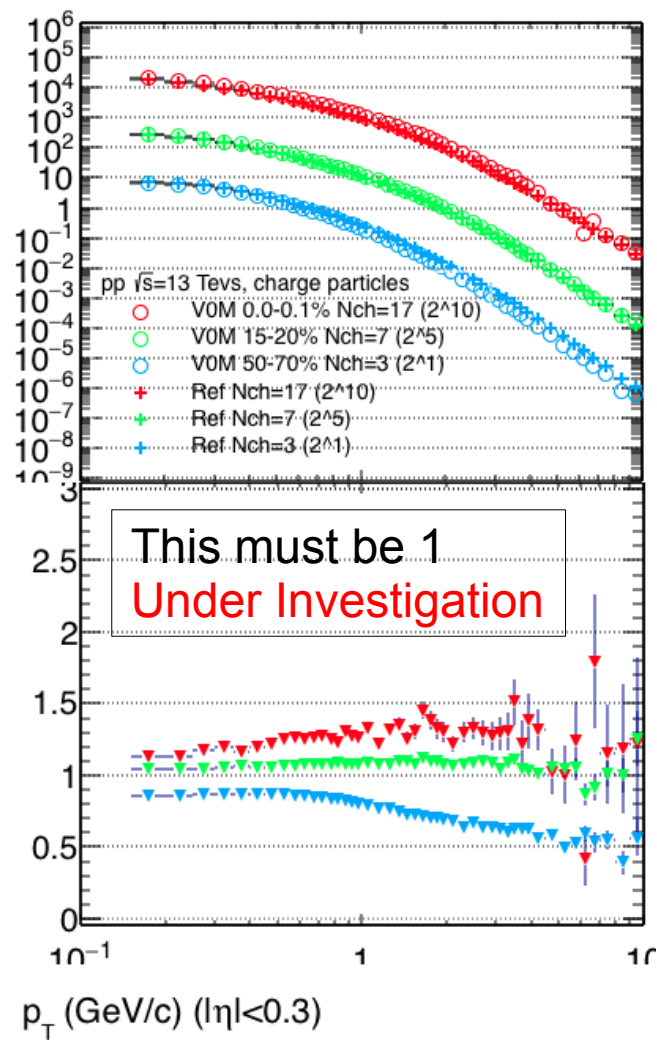
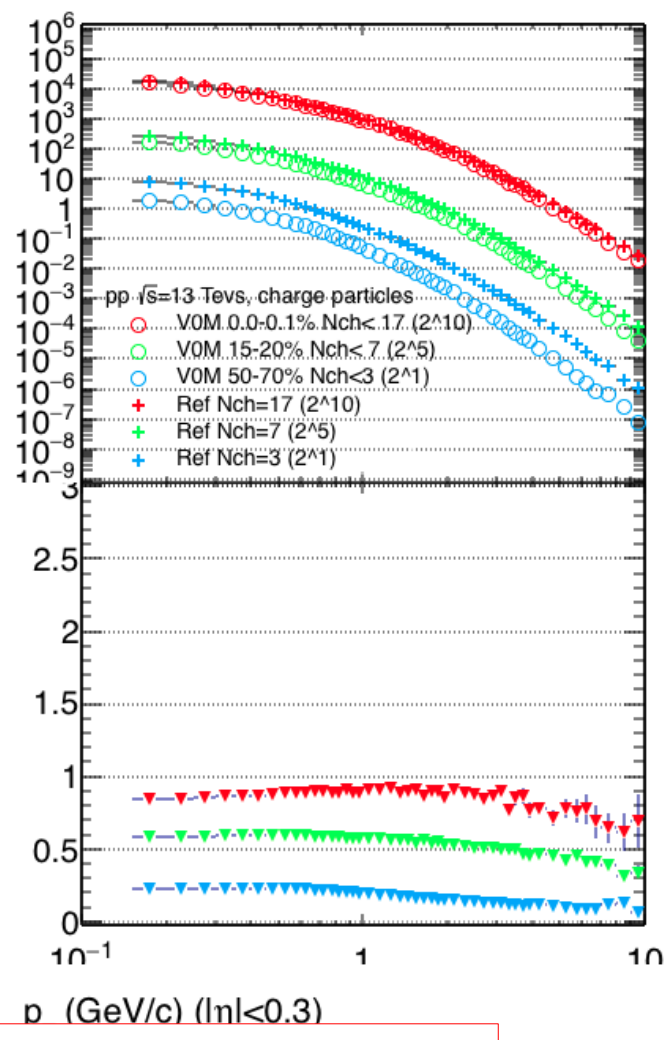
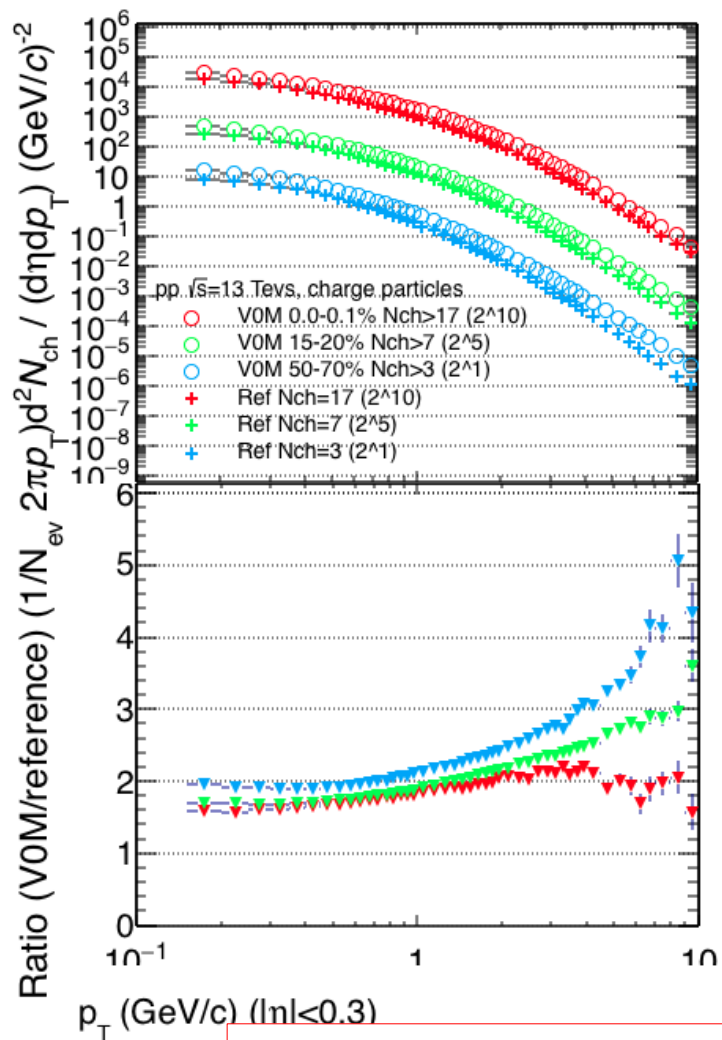
$Nch \text{ in } V0M \leq \langle dN/d\eta \rangle_{|\eta|<0.3} = 17$

$Nch \text{ in } V0M = \langle dN/d\eta \rangle_{|\eta|<0.3} = 17$

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Comparing with V0M mult for Nch: greater, lower and equal to $\langle dN/d\eta \rangle$

With BG rejection

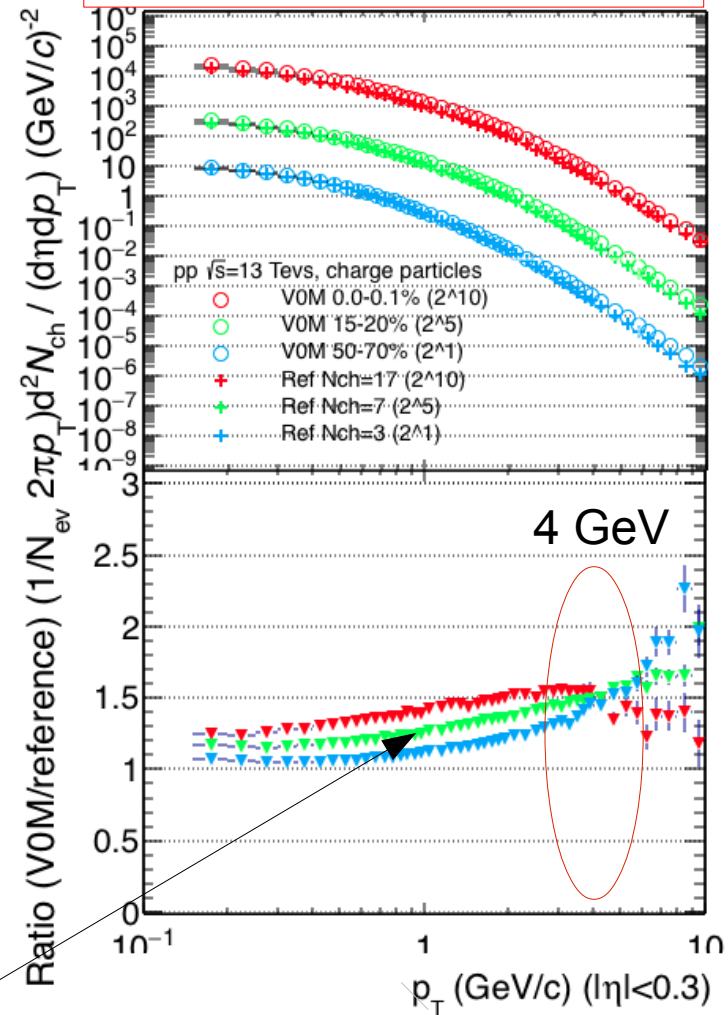
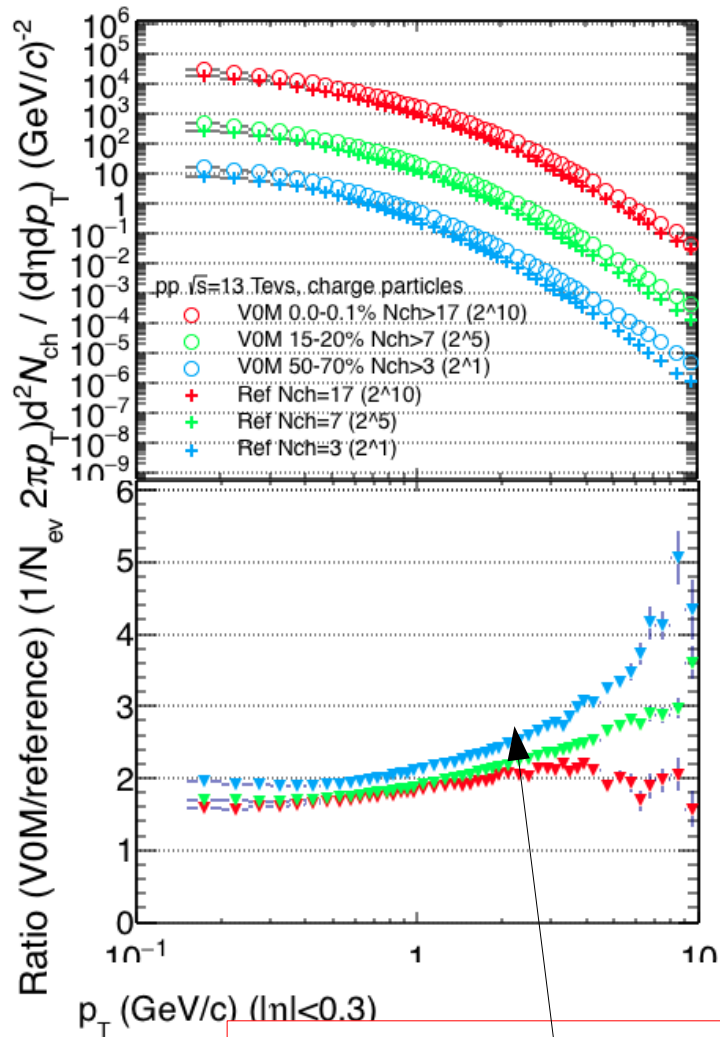


To check the contribution to the ratio,

A crosscheck in number of events has been taken into account

Comparing with V0M mult for Nch: greater,

With BG rejection



To check the contribution to the ratio, we see the contribution comes from $V0M_{N_{ch}} > \langle dN/d\eta \rangle_{|\eta|<0.3}$

Summary

- After the analysis, the contribution to have greater spectra for V0M than for Reference seems due to the spectra for which N_{ch} in V0M is greater than $\langle dN/d\eta \rangle_{|\eta| < 0.3}$
- After the BG rejection, I see at P_T near 4 GeV the same increase in the ratio V0M to REF for each V0M multiplicity class.

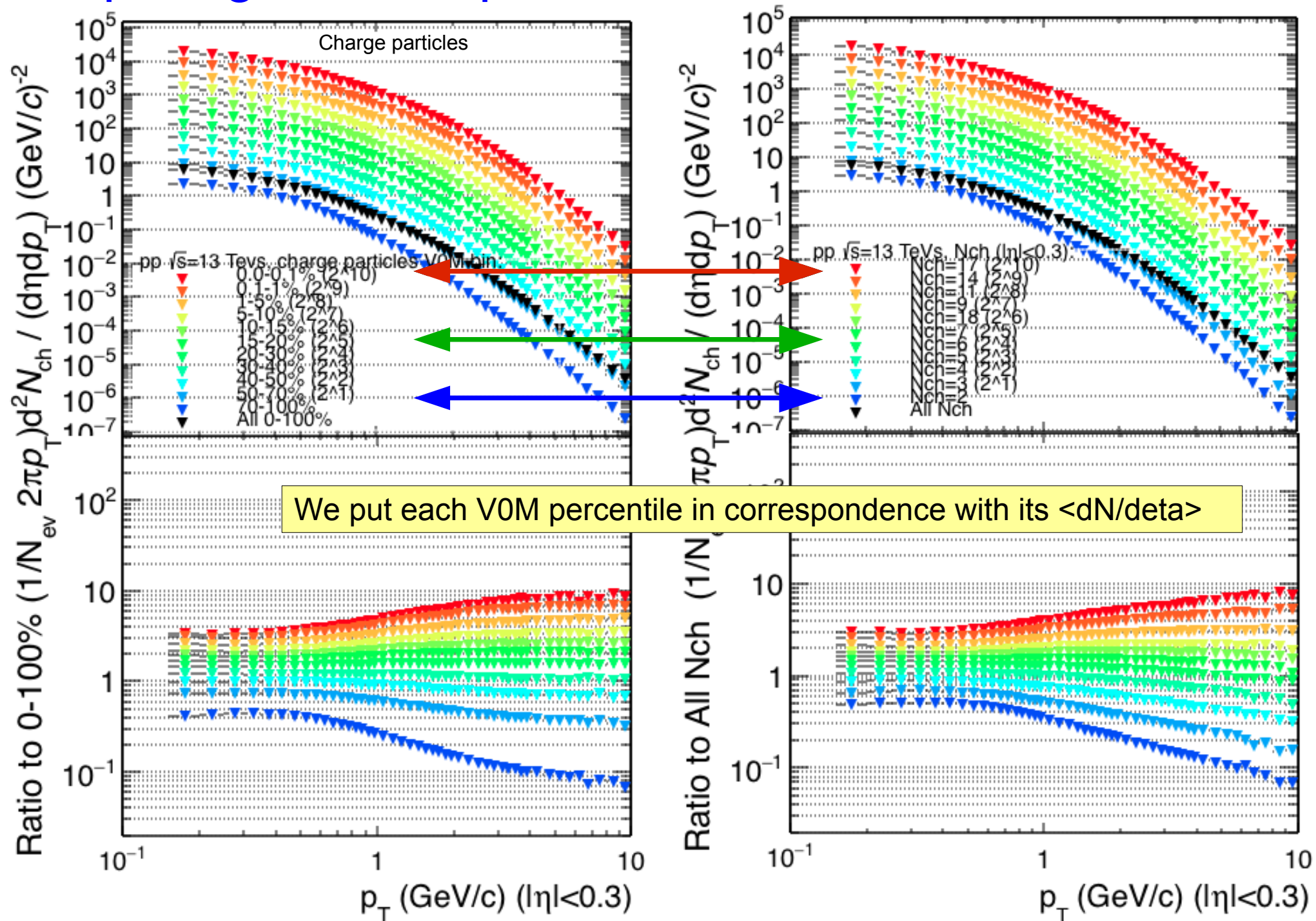
To be done

- Understand what happened with the ratio for V0M = mean
- To check what happened when introduce Multivertex pileup rejection and past-future protection.
- Continue with So analysis

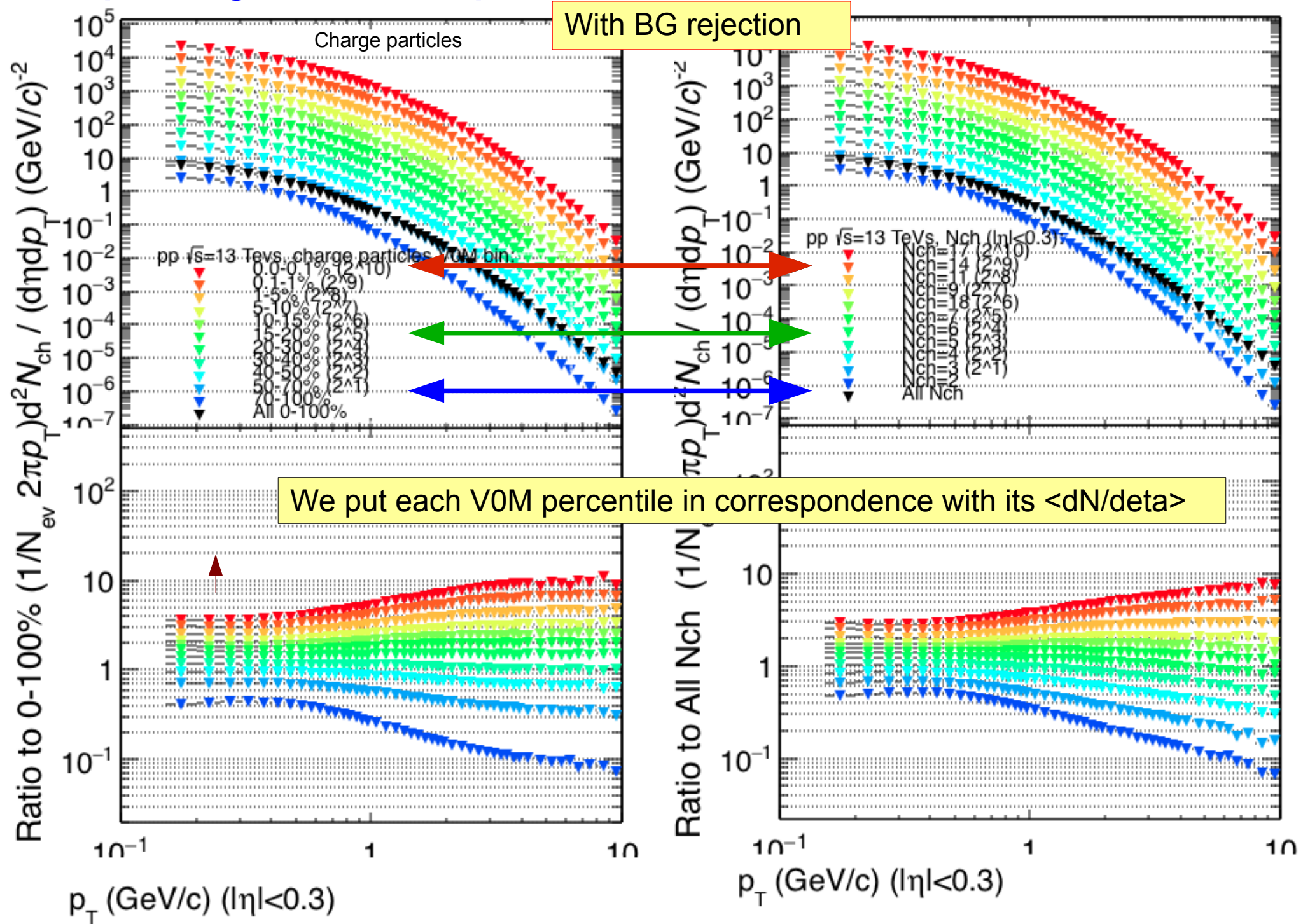
Thank you!.

Back Up

Comparing for V0M percentils and N_{ch} for its $\langle dN/d\eta \rangle$



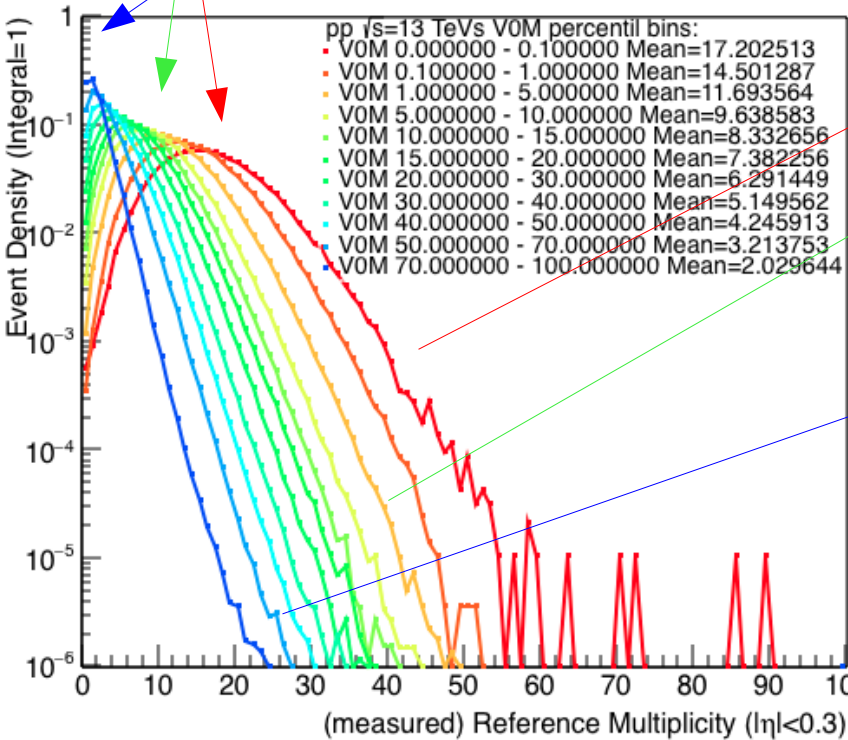
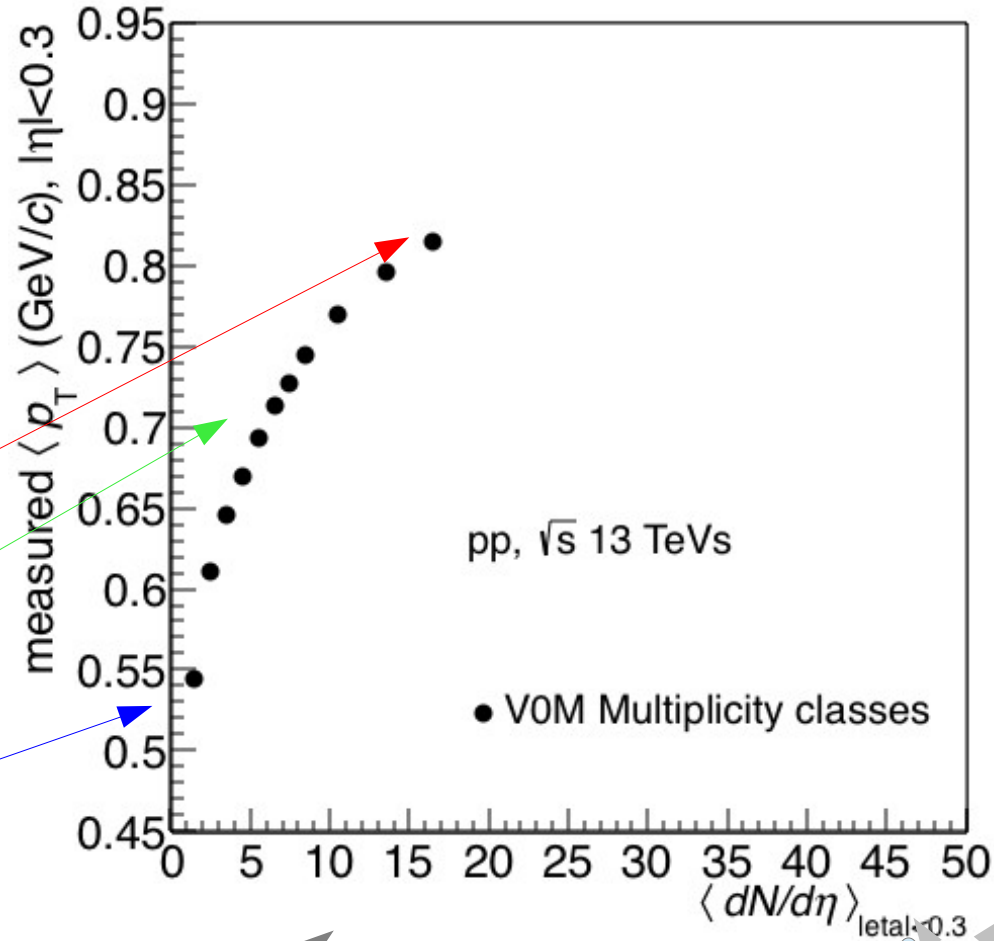
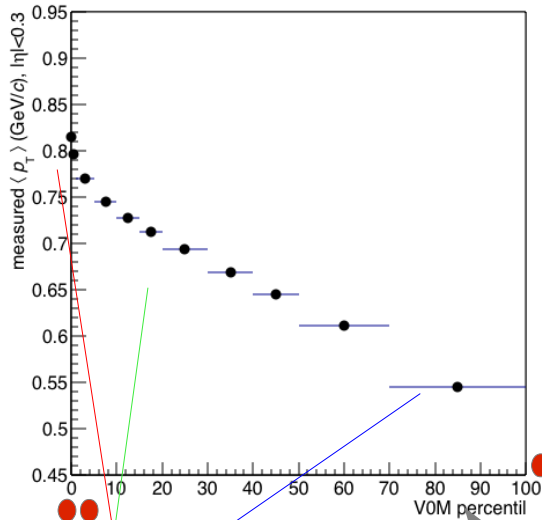
Comparing for V0M percentils and N_{ch} for its $\langle dN/d\eta \rangle$



Mean P_T from V0M percentils to $\langle dN/d\eta \rangle_{|\eta|<0.3}$

$\langle p_T \rangle$ not corrected vs V0M percentil measured, for inel pp @ 13TeV

Without efficiency corrections

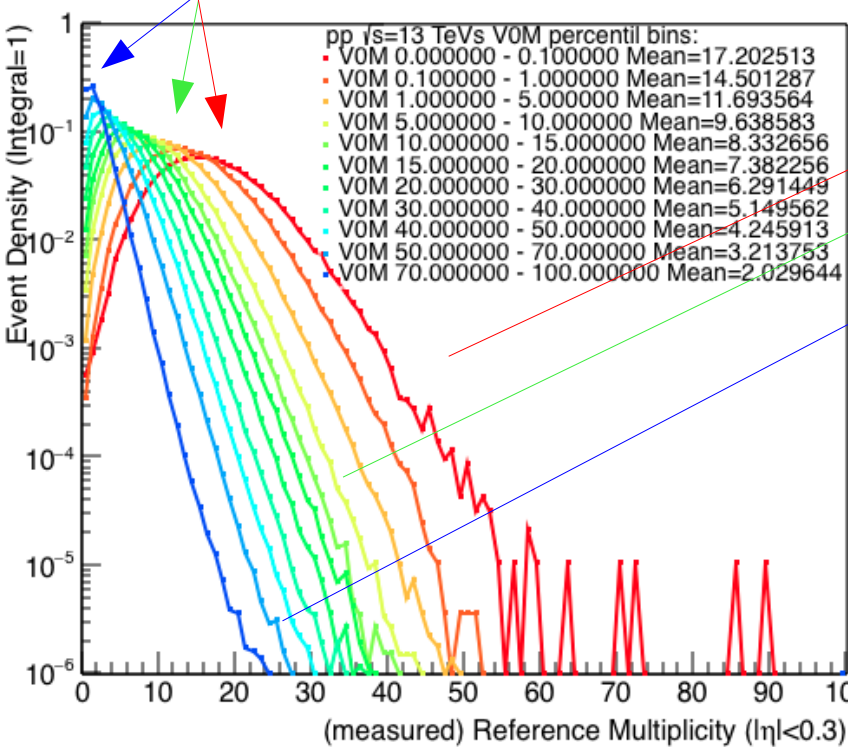
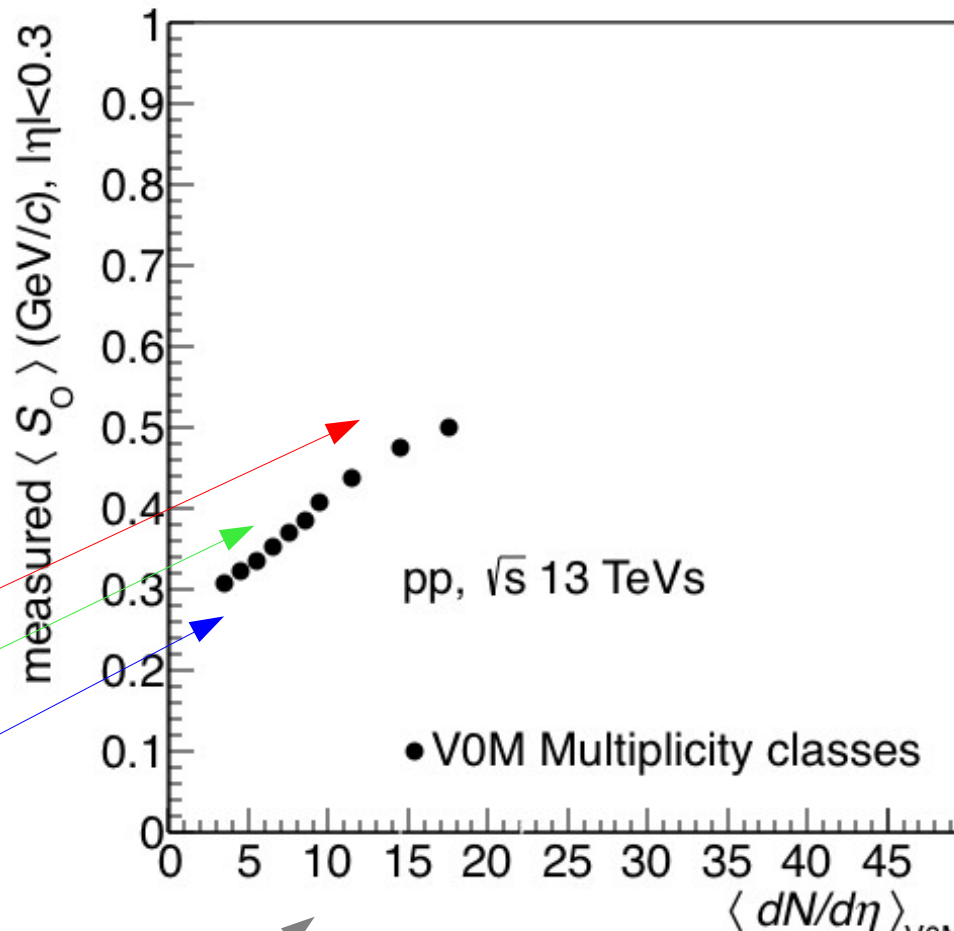
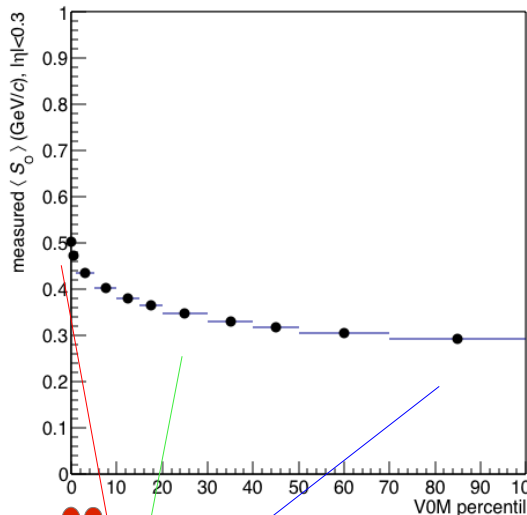


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Mean S_0 from V0M percentils to $\langle dN/d\eta \rangle_{|\eta|<0.3}$

$\langle S_0 \rangle$ not corrected vs V0M percentil measured, for inel pp @ 13TeV

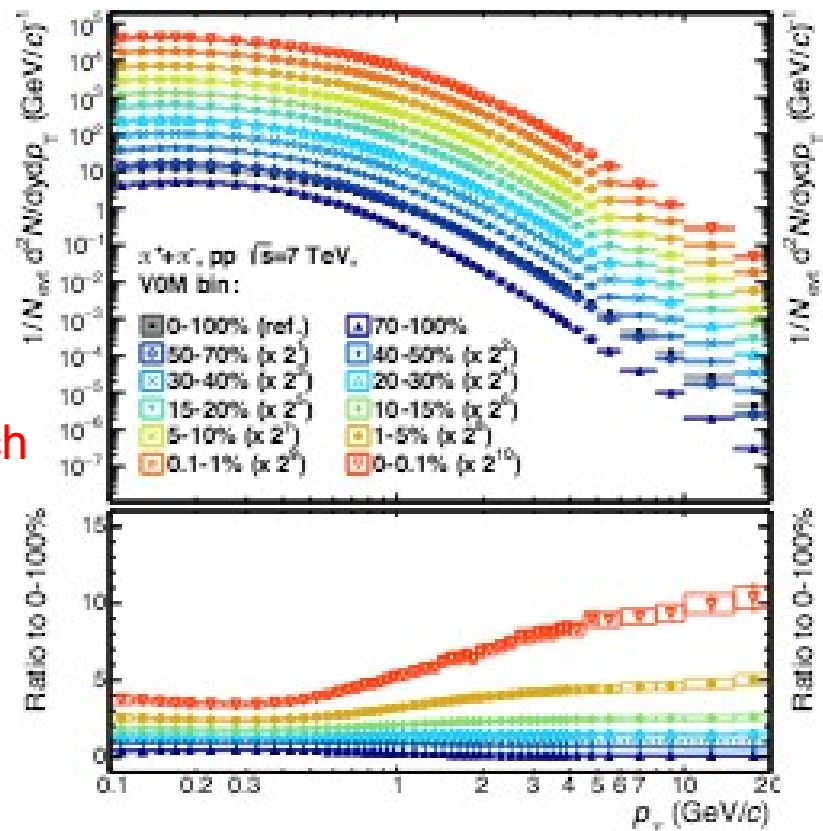
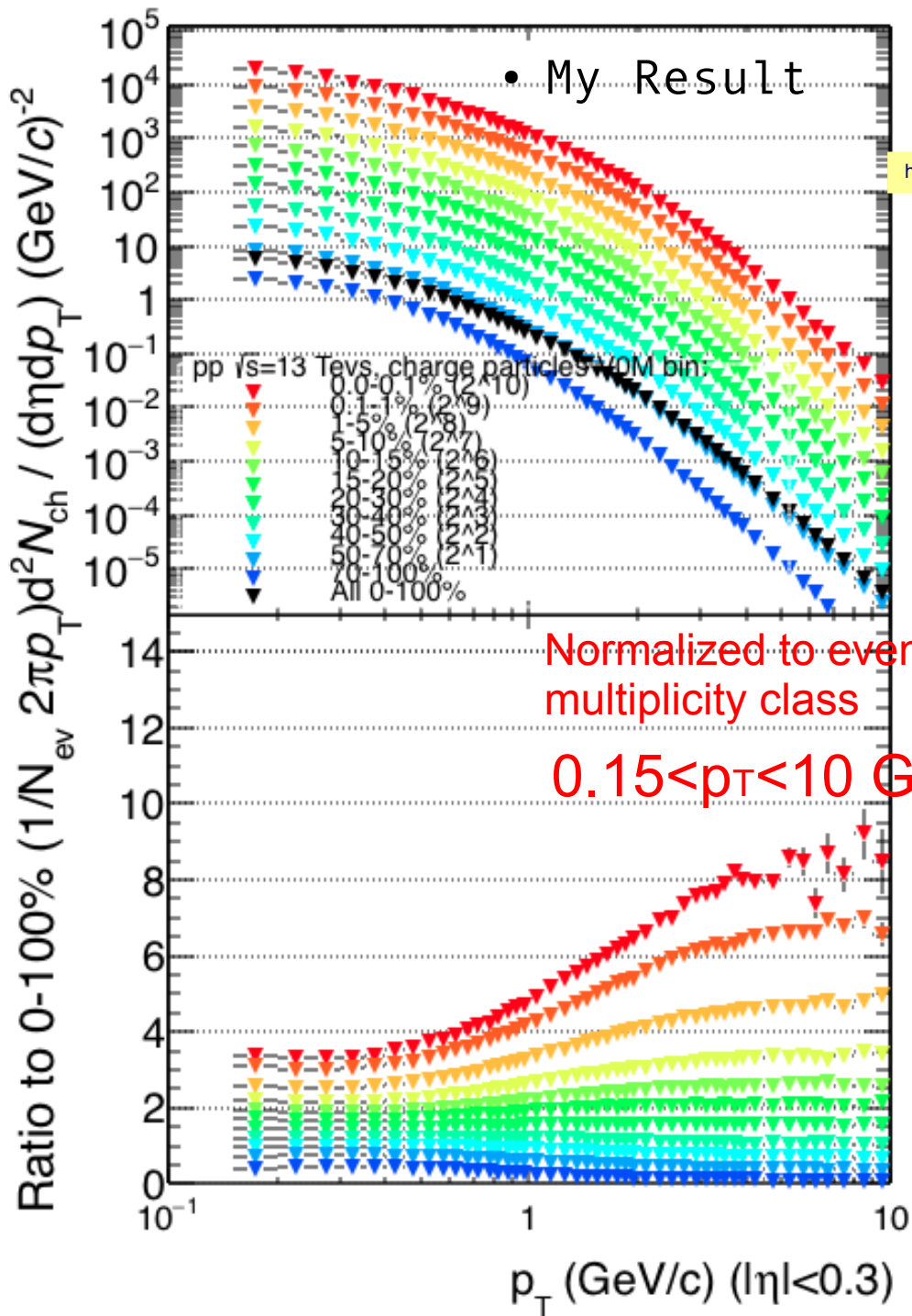
Without efficiency corrections



Invariant Yield for V0M percentils • LHC15f (pass2)

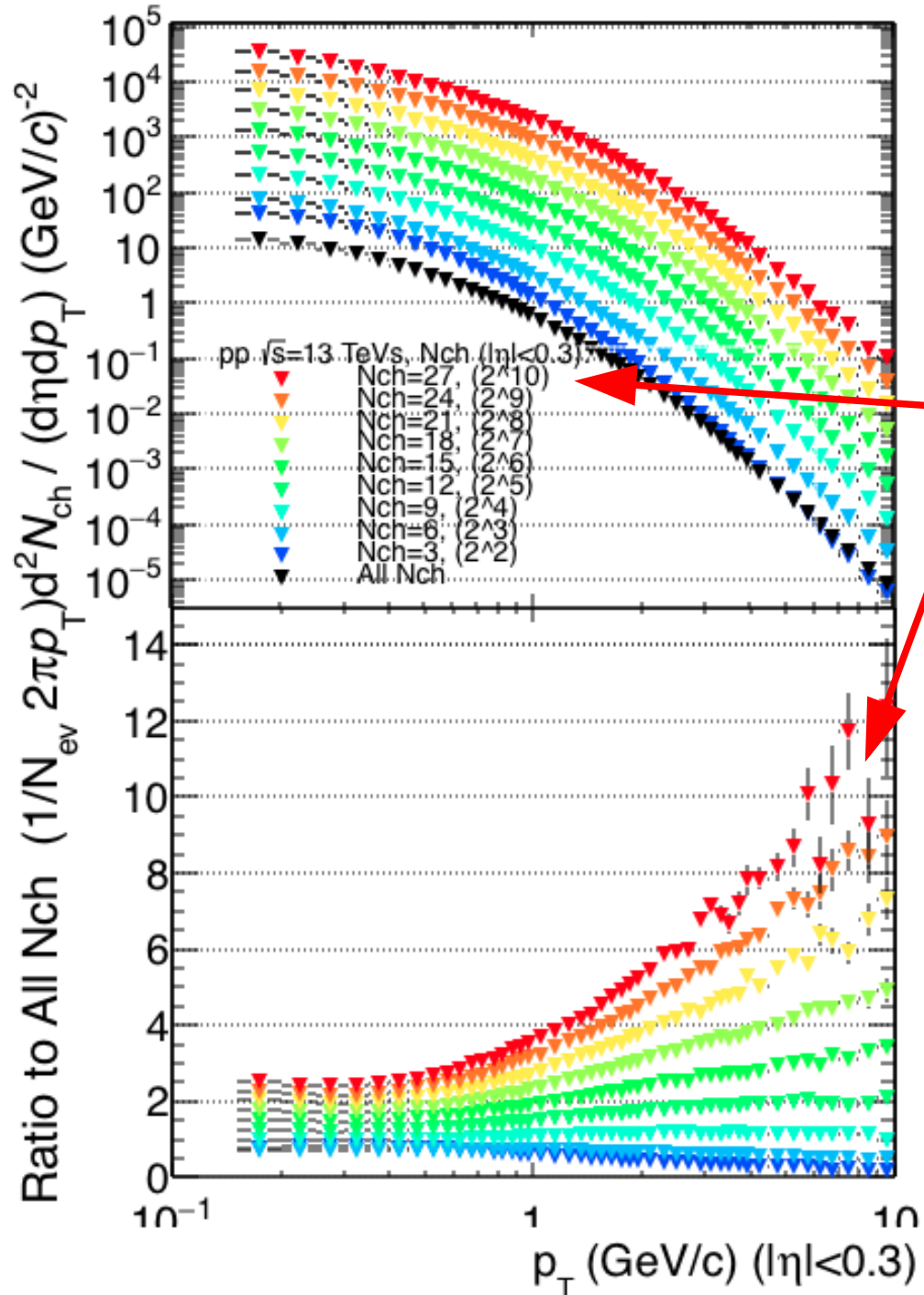
• Vytautas et al Analysis Note

https://aliceinfo.cern.ch/Notes/sites/aliceinfo.cern.ch/Notes/files/notes/analysis/akalweit/2015-Sep-15-analysis_note-4



no $(1/2\pi p_T)$ normalization
 $0.15 < p_T < 20$ GeV/c

Invariant Yield for Reference multiplicity estimator

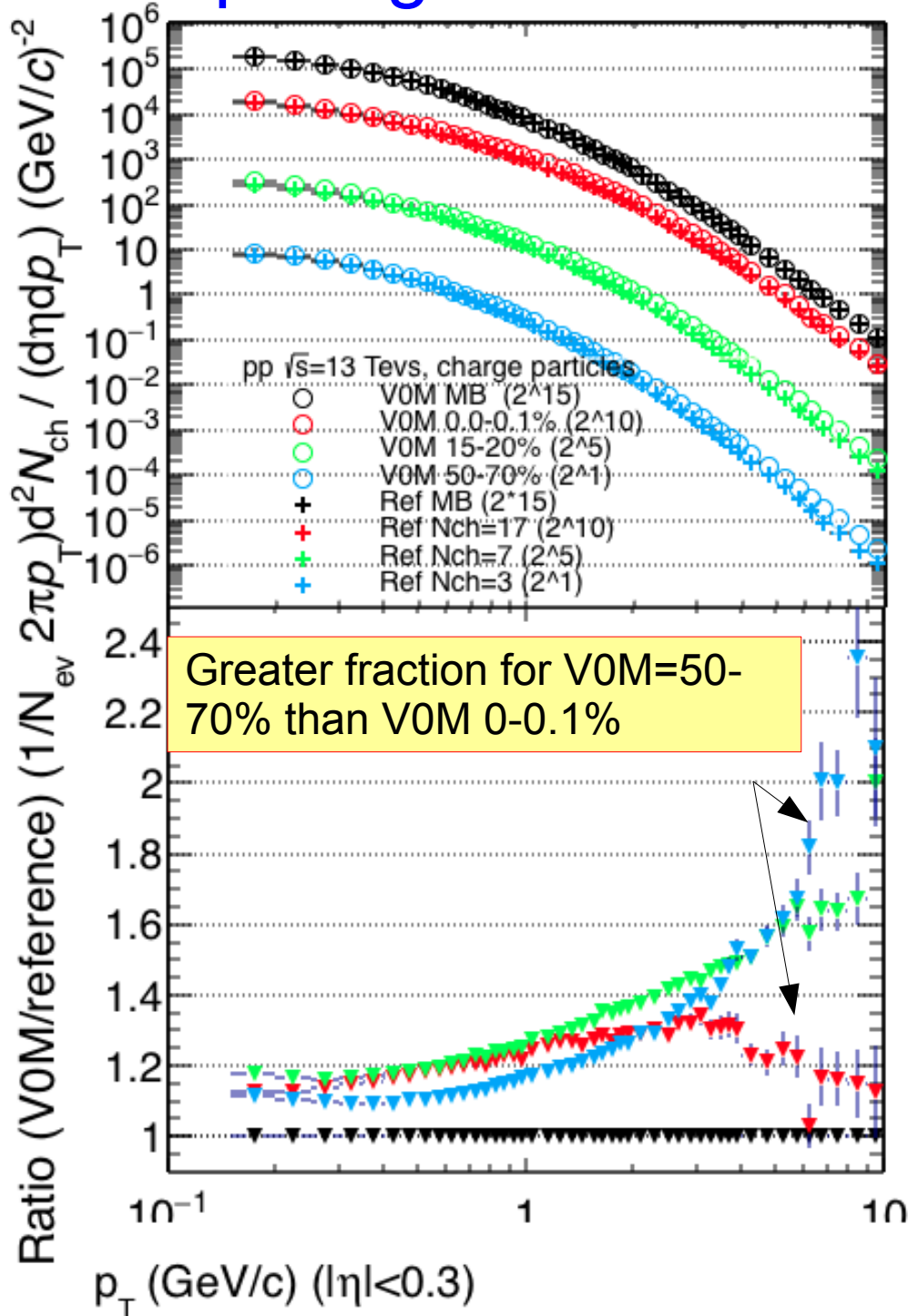


We reach $N_{ch}=27$

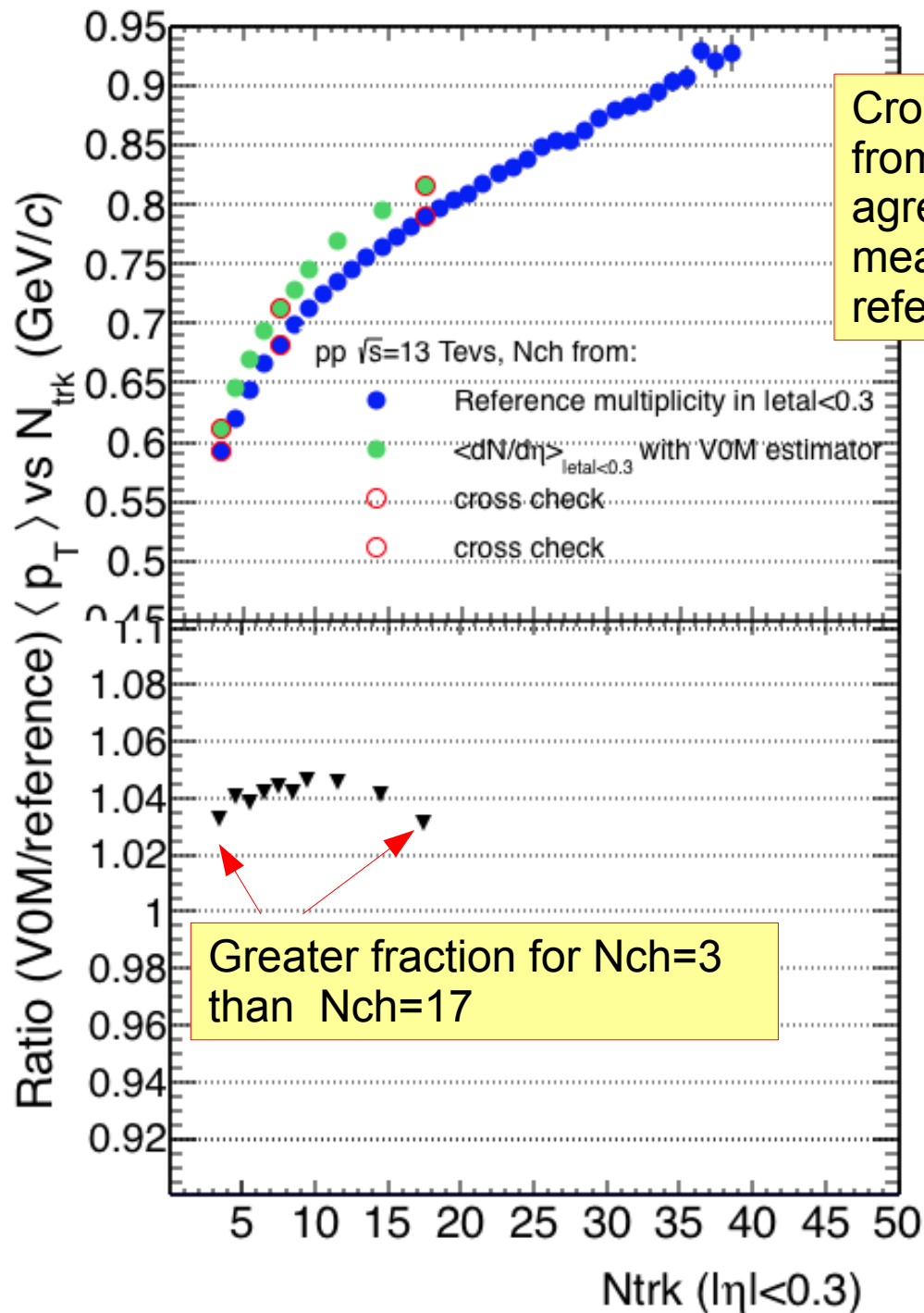
We want to check the spectra behaviour when we take $N_{ch} = \langle dN/d\eta \rangle_{|\eta| < 0.3}$ For each V0M multiplicity class.

See next slide.

Comparing estimators V0M and Ref $|\eta| < 0.3$



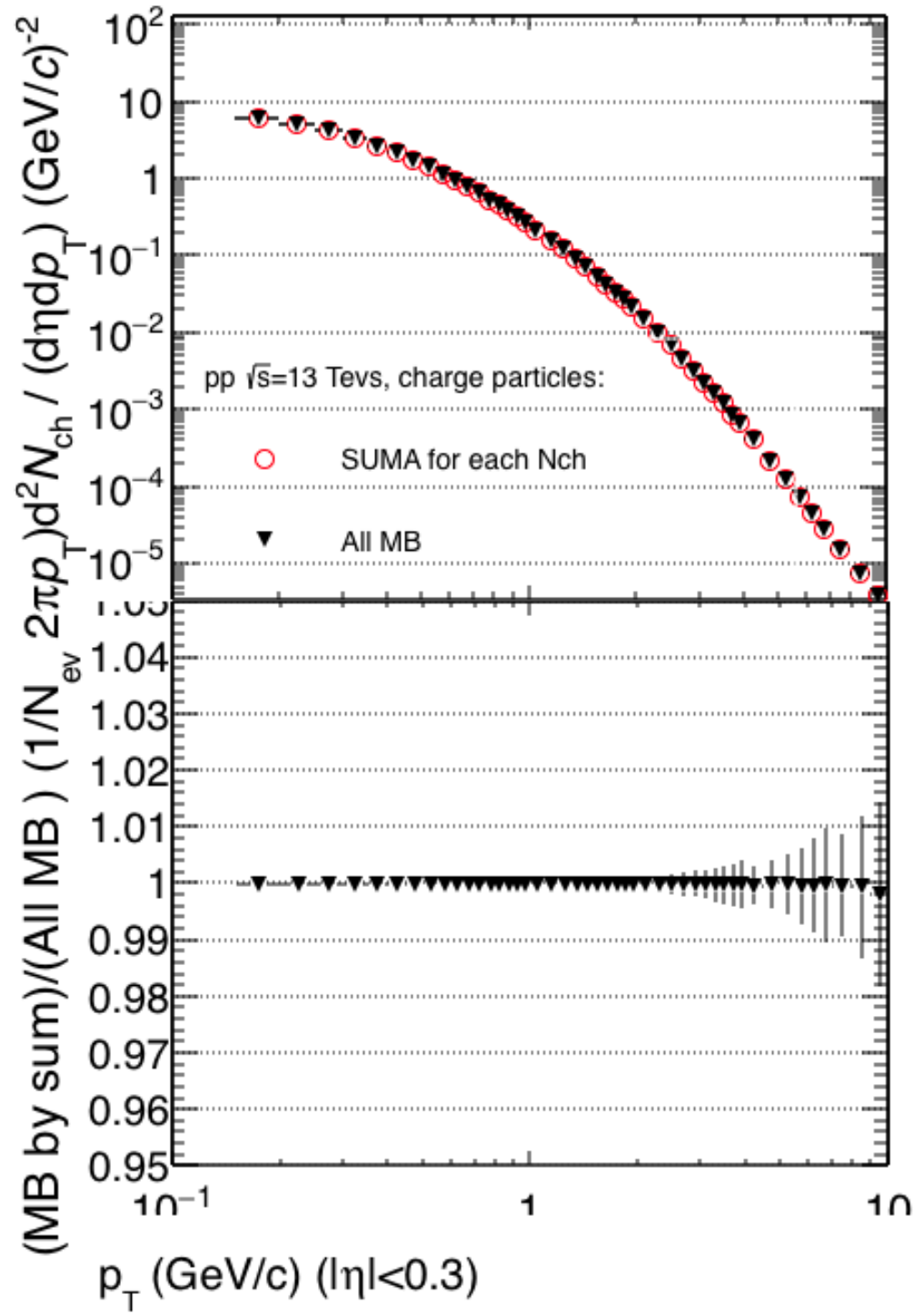
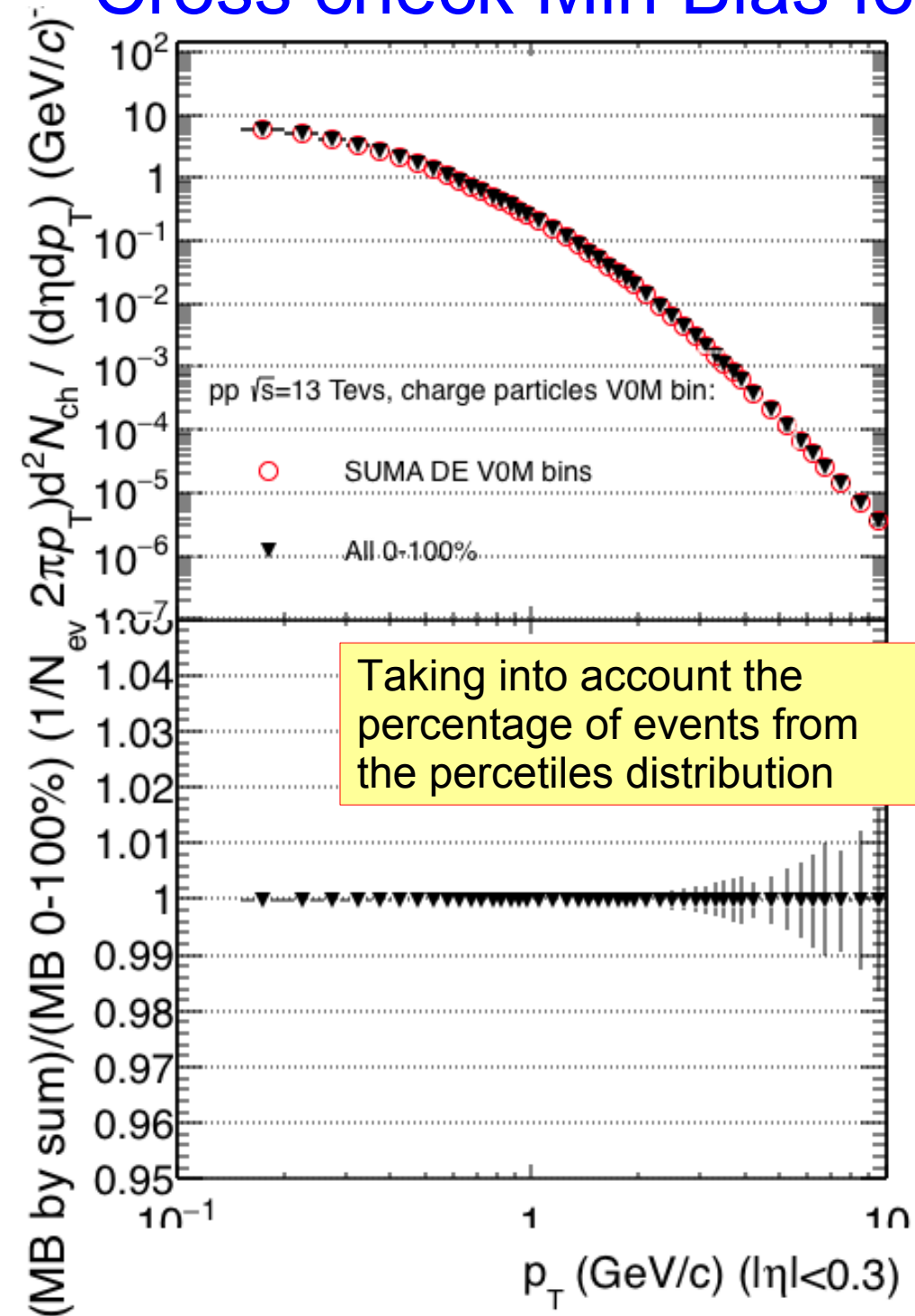
To check the compatibility of my program and the information given by the spectra we make another crosscheck. I take the spectra and calculate $\langle p_T \rangle$



Cross check in $\langle p_T \rangle$ got from the 3 spectra in good agreement with the measurements for VOM and reference estimators

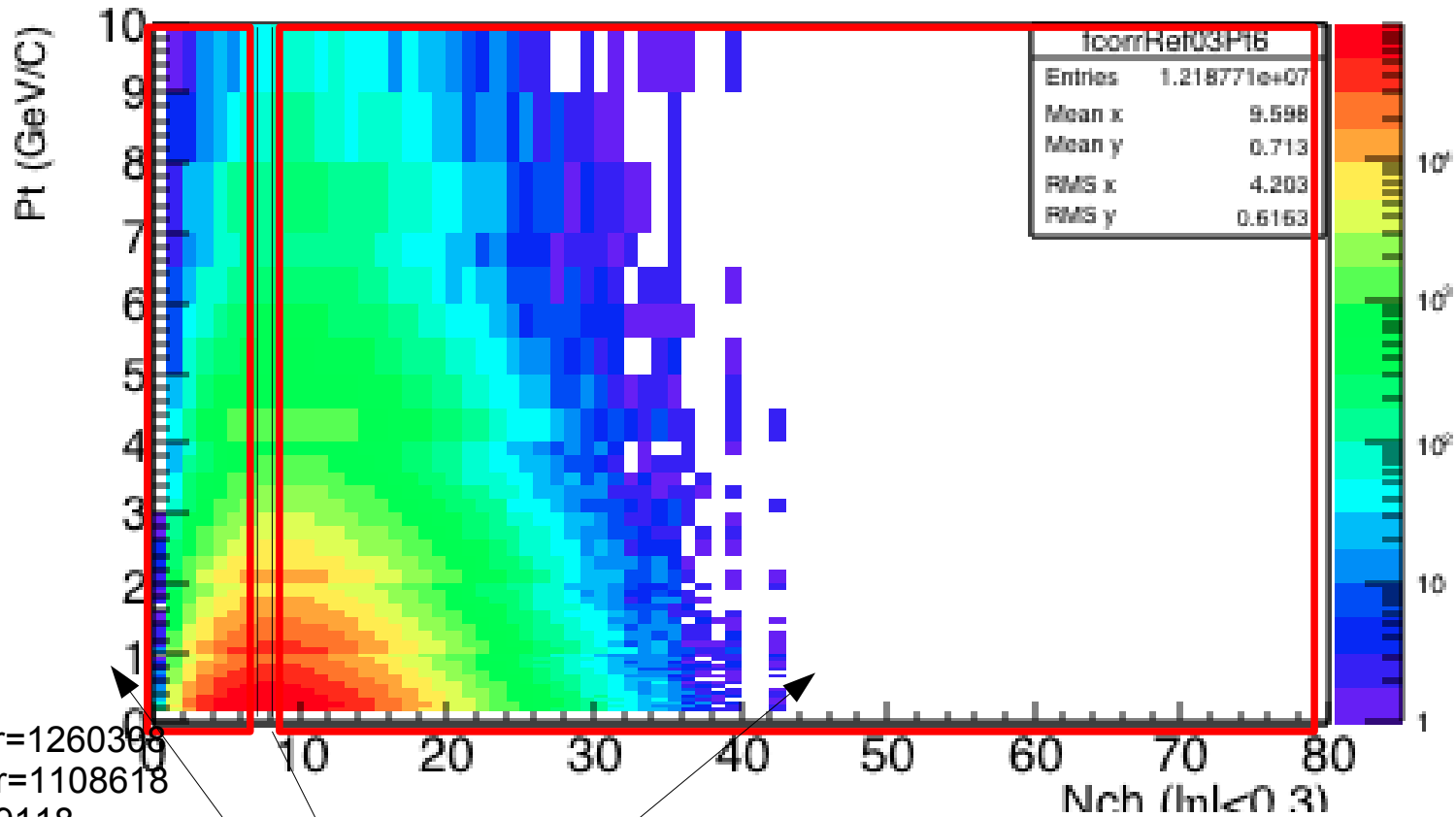
To check the spectra for each VOM multiplicity class is the right one, I made the weighted average in order to get the MB results.
(See next slide)

Cross check Min Bias for V0M and Reference



Correlation pt vs $\langle dN/d\eta \rangle_{|\eta|<0.3}$

Correlation Nch vs Pt for $15.000000 < V0M \text{ percentil} < 20.000000$



Nev=2648044

Nev para mayor=1260398

Nev para menor=1108618

Nev para ig=279118

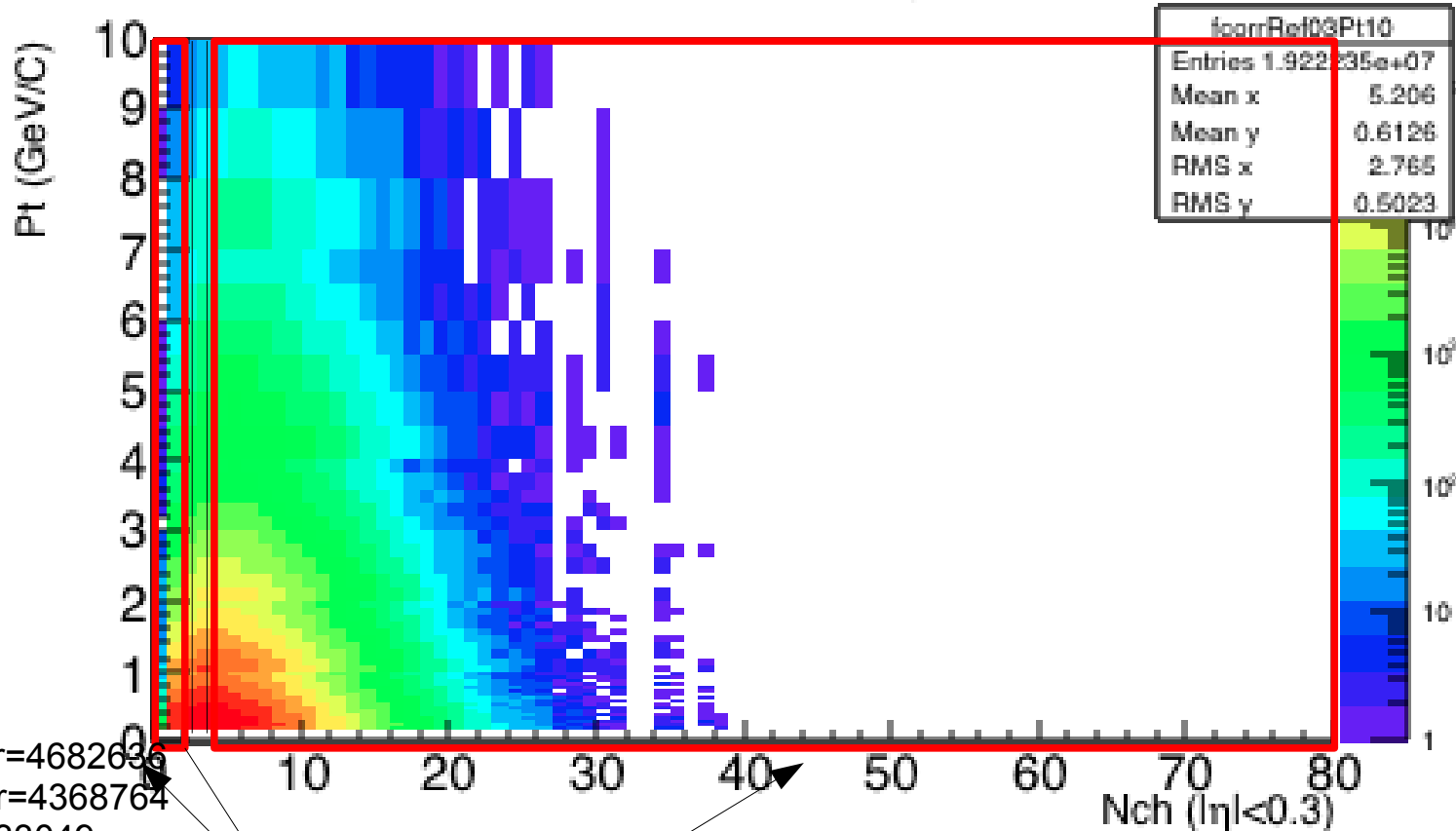
Suma=2648044

In order to get pt distributions for:
 $Nch \text{ in } V0M > \langle dN/d\eta \rangle_{|\eta|<0.3} = 7$
 $Nch \text{ in } V0M < \langle dN/d\eta \rangle_{|\eta|<0.3} = 7$
 $Nch \text{ in } V0M = \langle dN/d\eta \rangle_{|\eta|<0.3} = 7$

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Correlation pt vs $\langle dN/d\eta \rangle_{|\eta|<0.3}$

Correlation Nch vs Pt for $50.000000 < V0M \text{ percentil} < 70.000000$



Nev=11084449

Nev para mayor=4682636

Nev para menor=4368764

Nev para ig=2033049

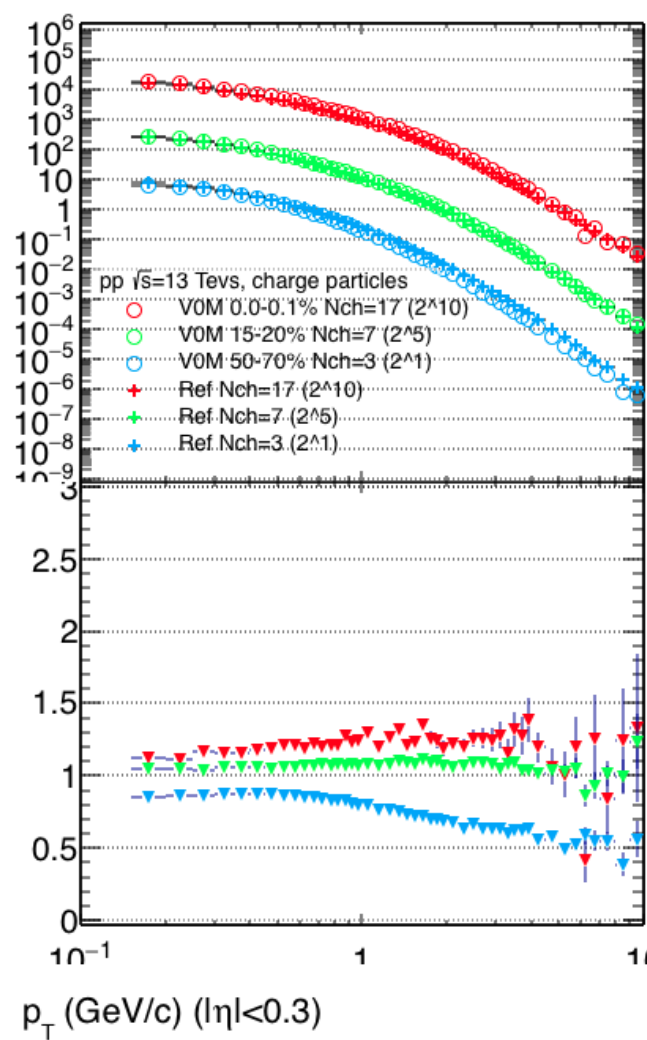
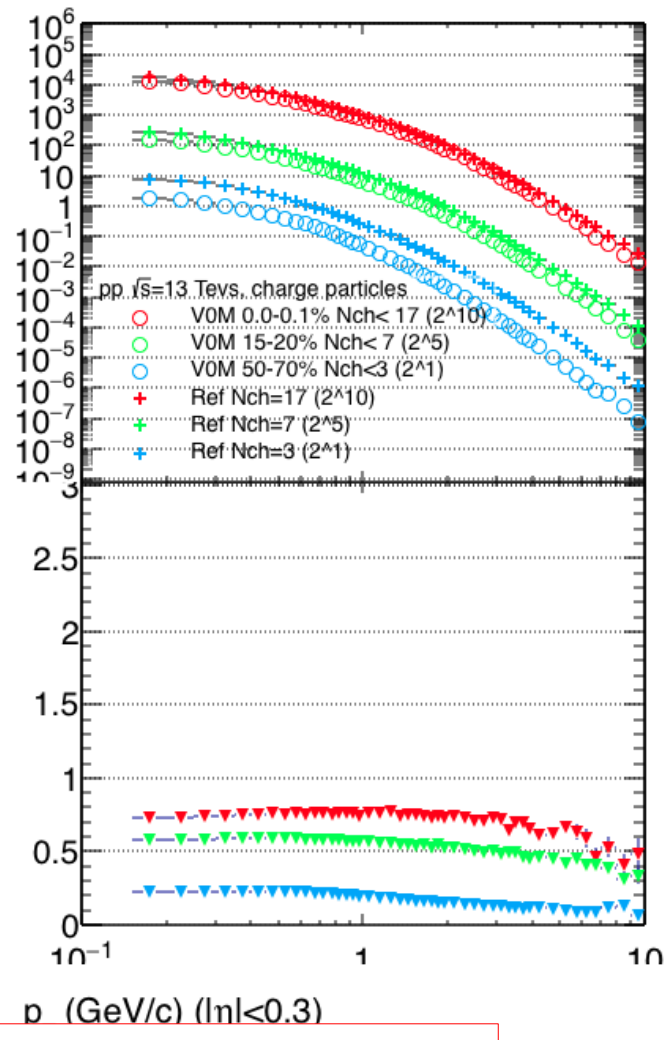
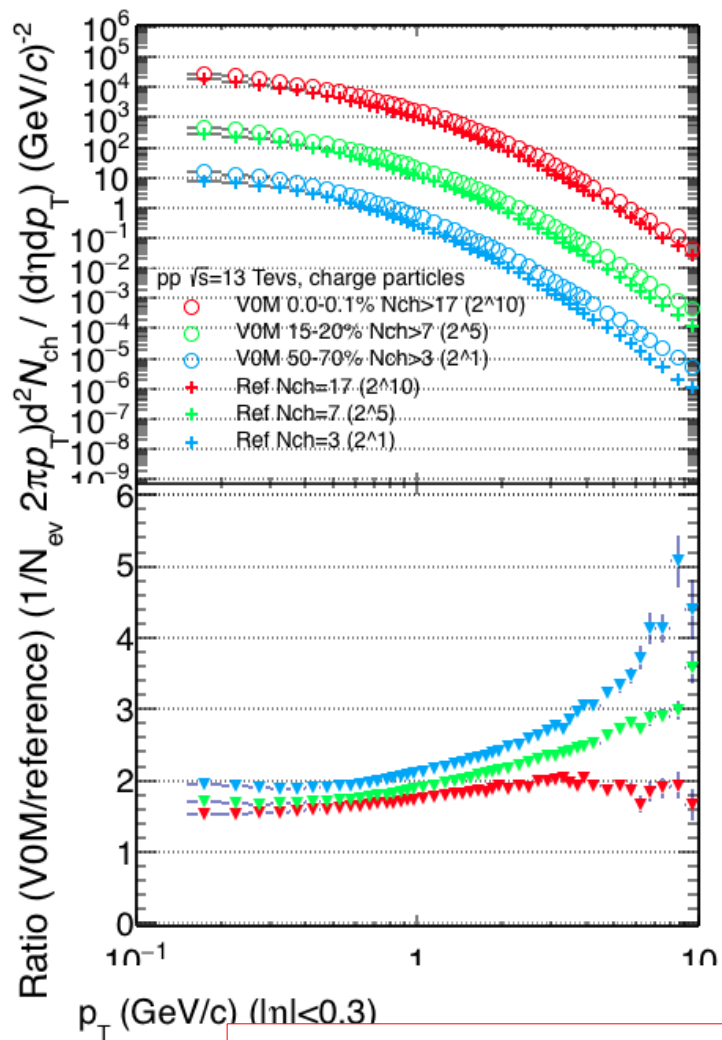
Suma=11084449

In order to get pt distributions for:
 $Nch \text{ in } V0M > \langle dN/d\eta \rangle_{|\eta|<0.3} = 3$
 $Nch \text{ in } V0M < \langle dN/d\eta \rangle_{|\eta|<0.3} = 3$
 $Nch \text{ in } V0M = \langle dN/d\eta \rangle_{|\eta|<0.3} = 3$

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Comparing with V0M mult for Nch:

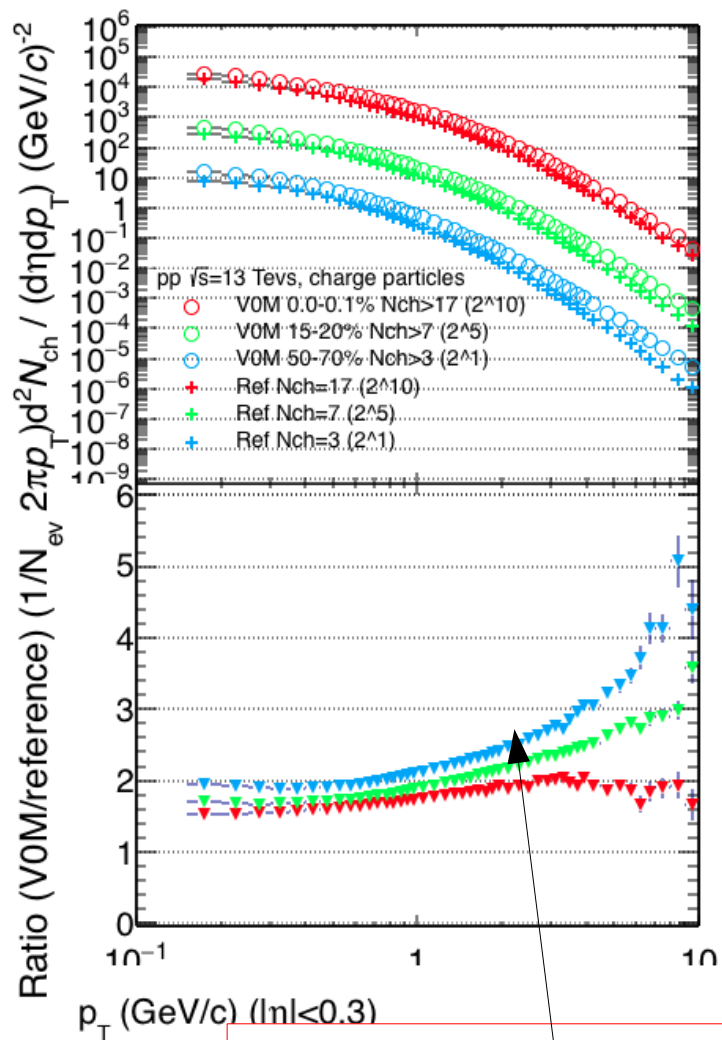
greater, lower and equal to $\langle dN/d\eta \rangle$



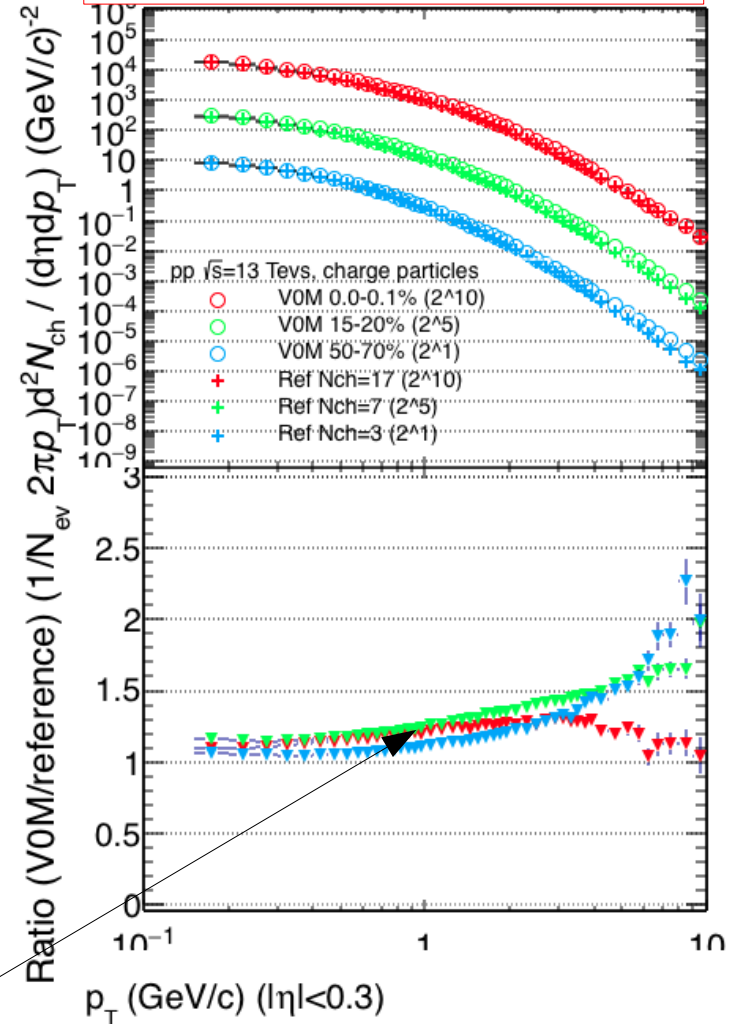
To check the contribution to the ratio,

A crosscheck in number of events has been taken into account

Comparing with V0M mult for Nch: greater,

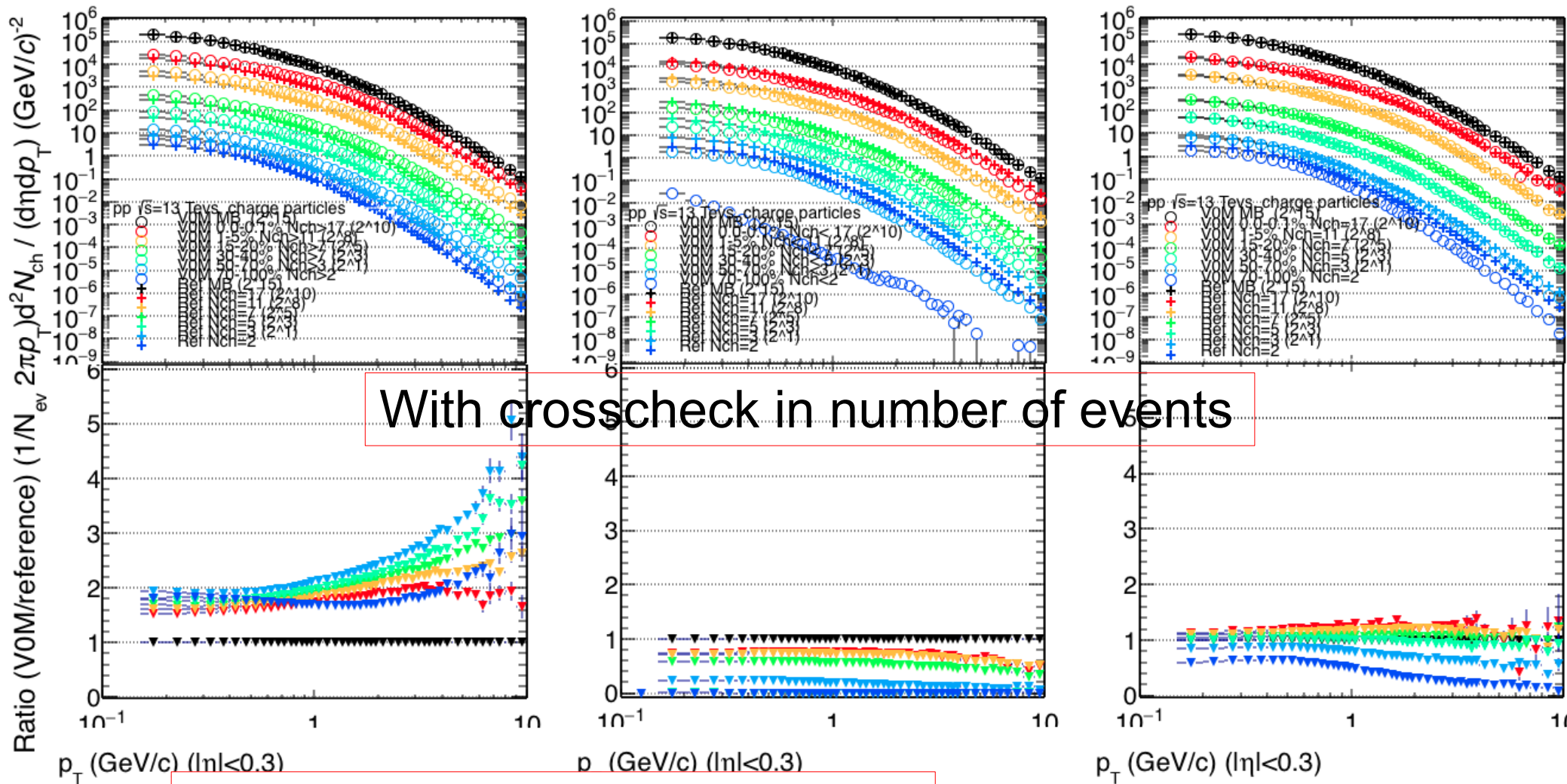


V0MNch vs REF_{|eta|<0.3}



To check the contribution to the ratio, we see the contribution comes from $V0M_{Nch} > \langle dN/d\eta \rangle_{|\eta|<0.3}$

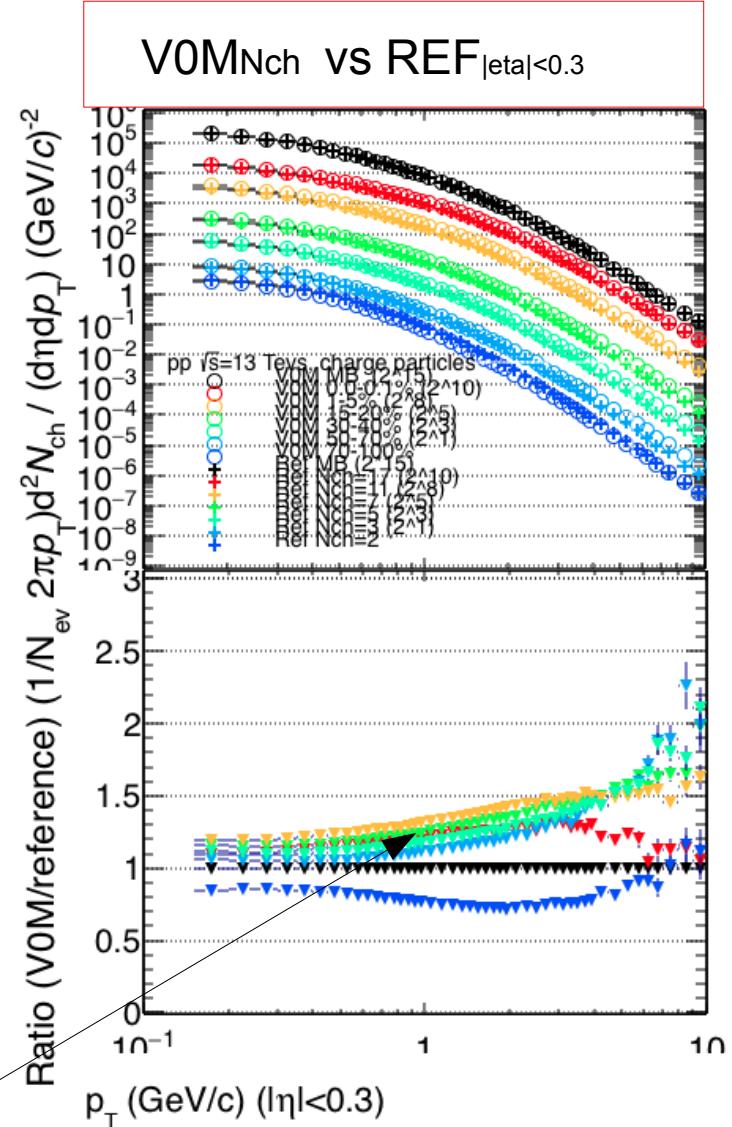
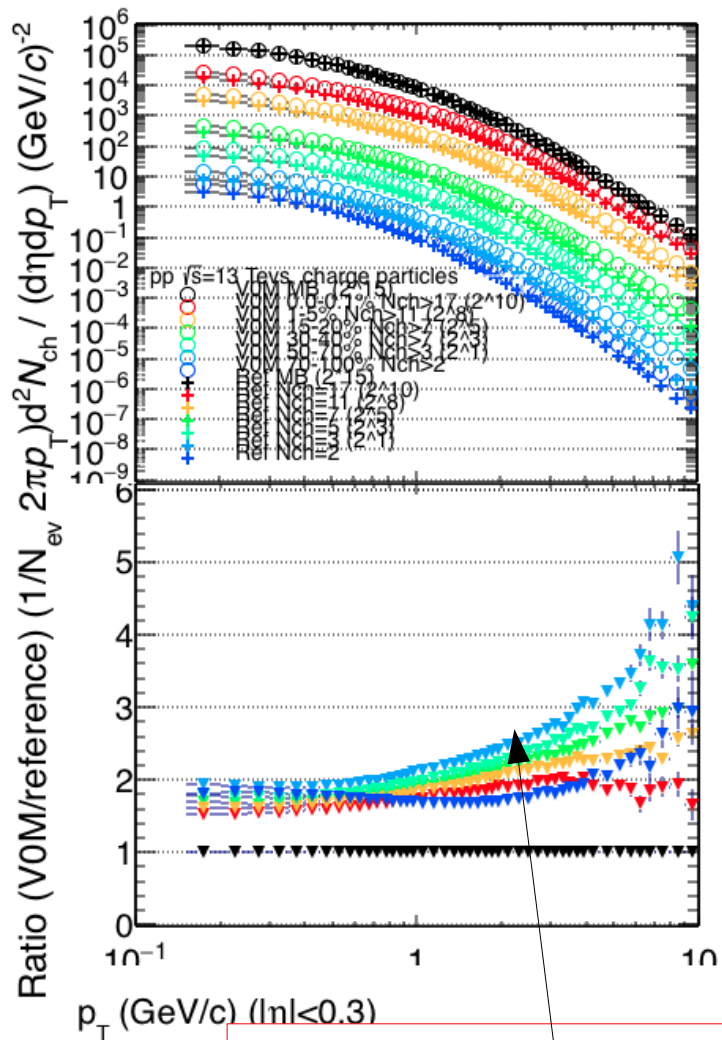
Comparing with V0M mult for Nch: Adding last V0M bin greater, lower and equal to $\langle dN/d\eta \rangle$



With crosscheck in number of events

To check the contribution to the ratio,

Comparing with V0M mult for Nch: greater,



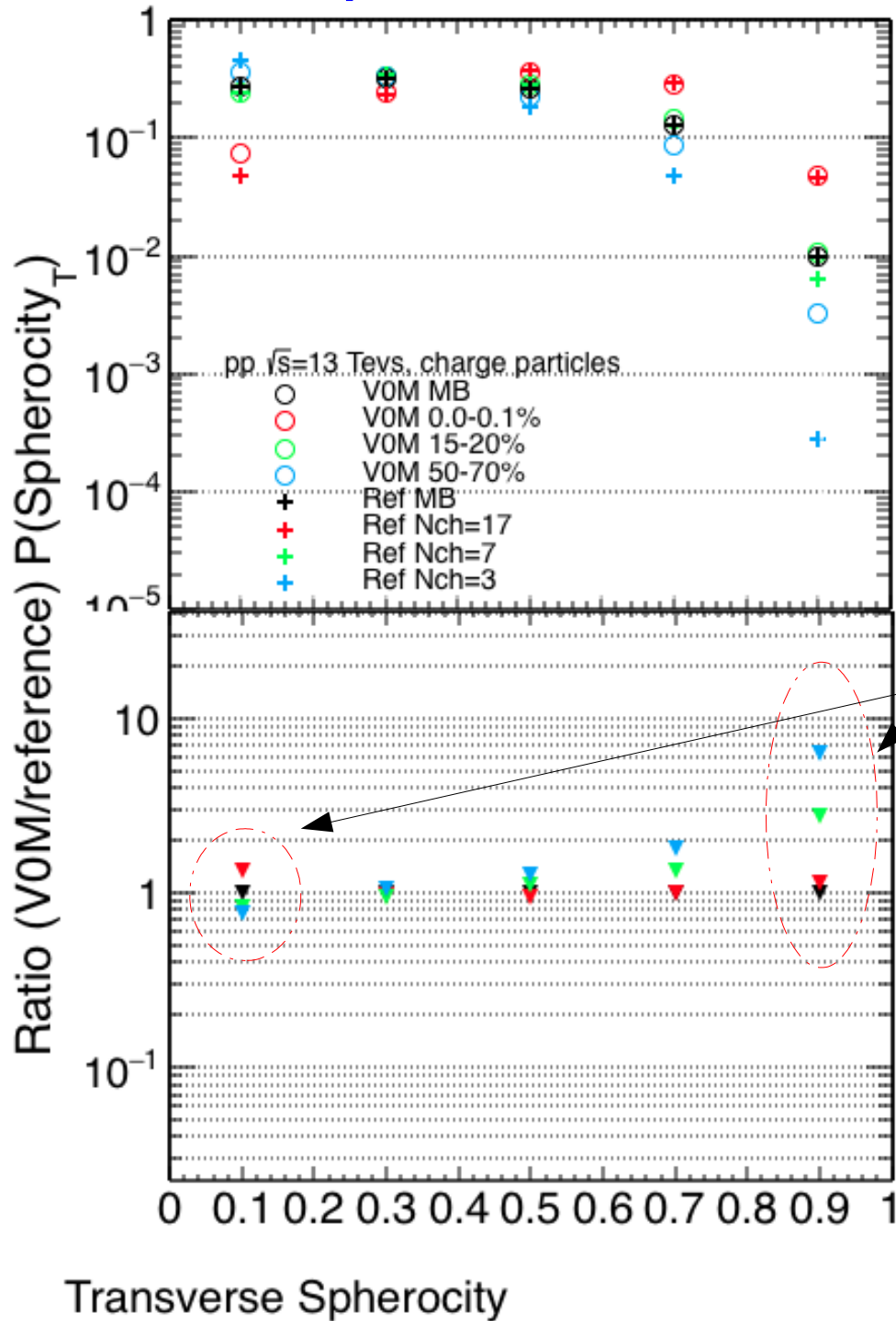
To check the contribution to the ratio, we see the contribution comes from $V0MNch > \langle dN/d\eta \rangle_{|\eta| < 0.3}$

First Conclusion

The results from V0M percentile and the corresponding to $\langle dN/d\eta \rangle_{|\eta| < 0.3}$ shows consistency in all the Crosschecks we made.

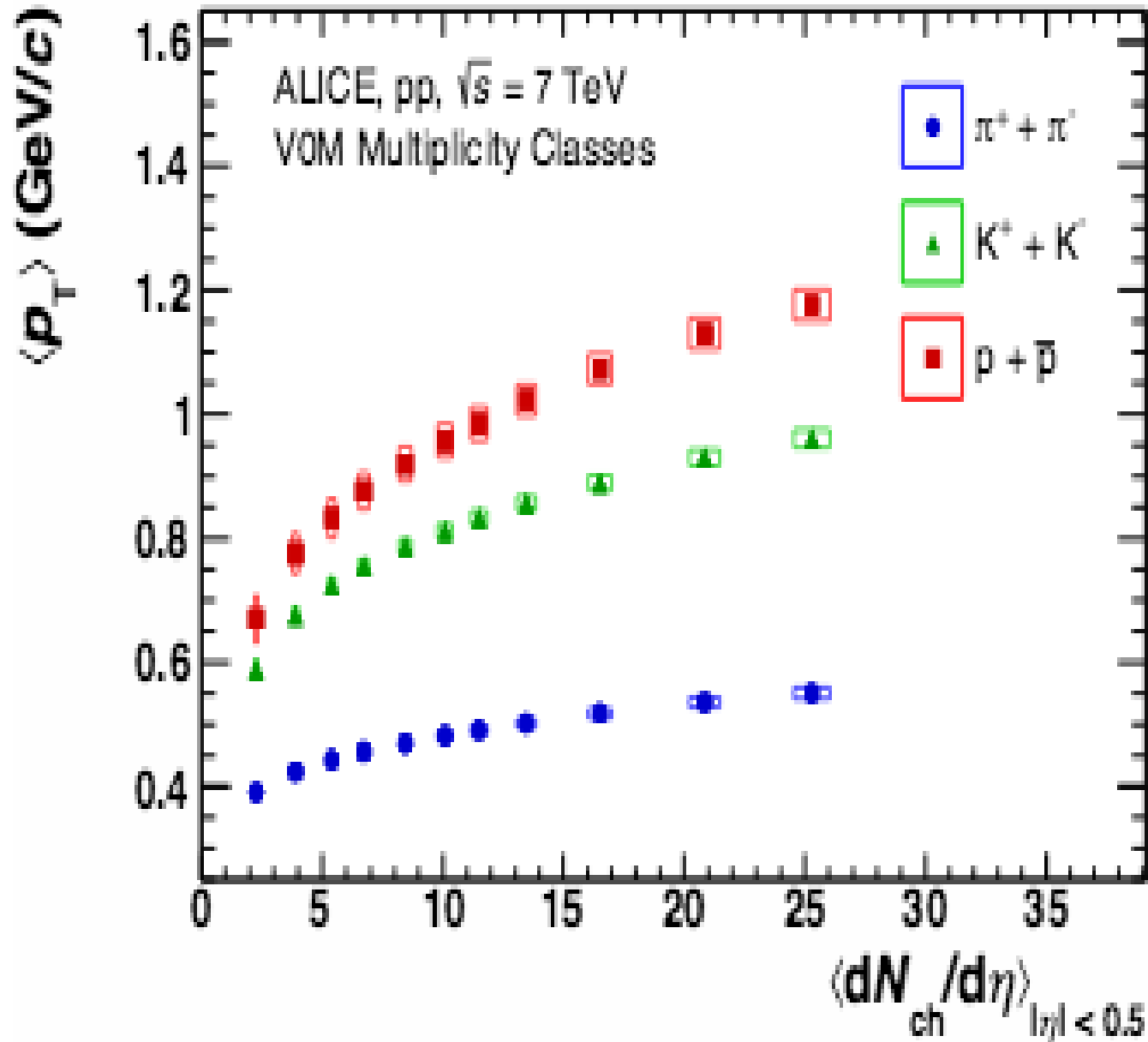
V0M gives greater $\langle p_T \rangle$ for intermediate Multiplicity Than the reference estimator, and start to converge for High N_{ch} .

First Comparison for S_0 with estimators V0M and Ref $|\eta| < 0.3$



Greater difference for isotropic events specially for low N_{ch}

https://aliceinfo.cern.ch/Notes/sites/aliceinfo.cern.ch/Notes/files/notes/analysis/akalweit/2015-Sep-15-analysis_note-AnalysisNote.pdf



Analysis and Event selection

Software: Aliroot:v5-07-20 Aliphysics:vAN-20160204

Event shape classes: (PWGLF/SPECTRA/Sphericity)

Analysis macros: AddTransverseEventShapeTask.C

AliAnaTransverseEventShapeTask.cxx

AliAnaTransverseEventShapeTask.h

Runs: 13 TeV

test pass2

LHC15f test pass2: (7.2 mill of evts)

MC Pythia6 Perugia 2011 LHC15g3c2 1.8 mill.

MC Pythia8 Monash 2011 LHC15g3a2: 2.19 mill,

Pass2

LHC15f pass2: (59 mill of evts) good runs

MC Pythia6 Perugia 2011 LHC15g3c3 50 mill.

MC Pythia8 Monash 2011 LHC15g3a3: 40 mill,

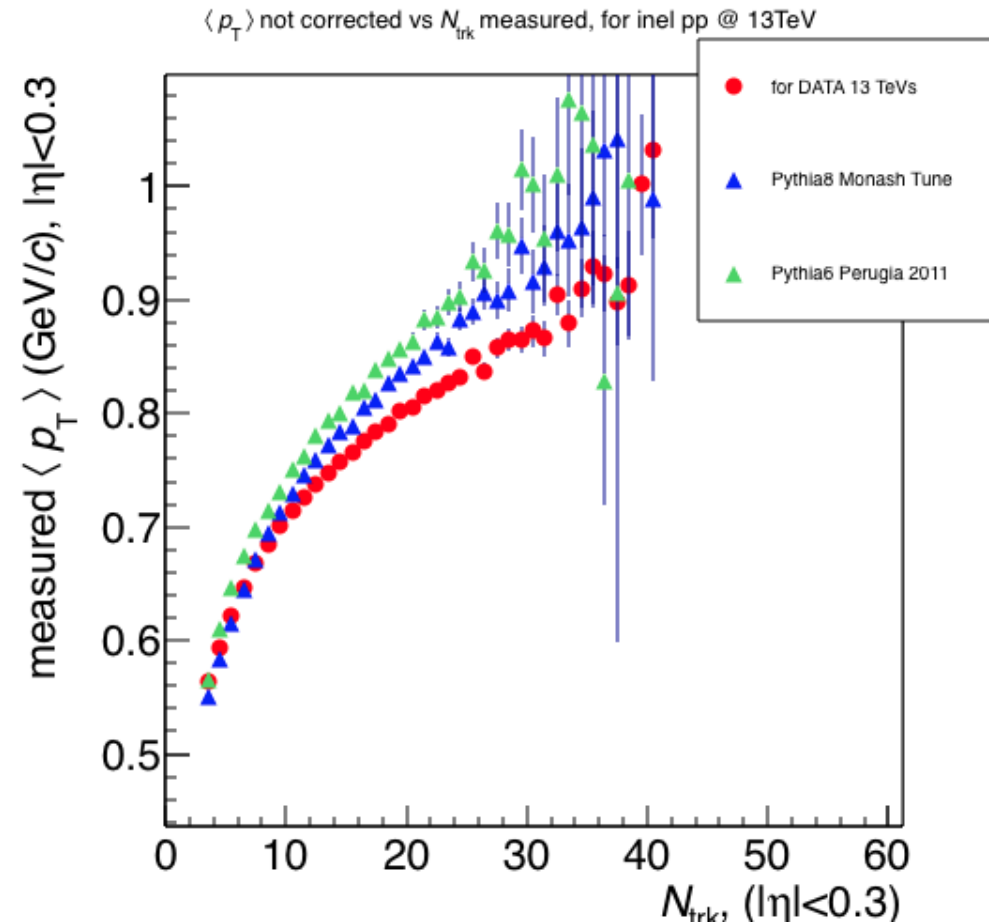
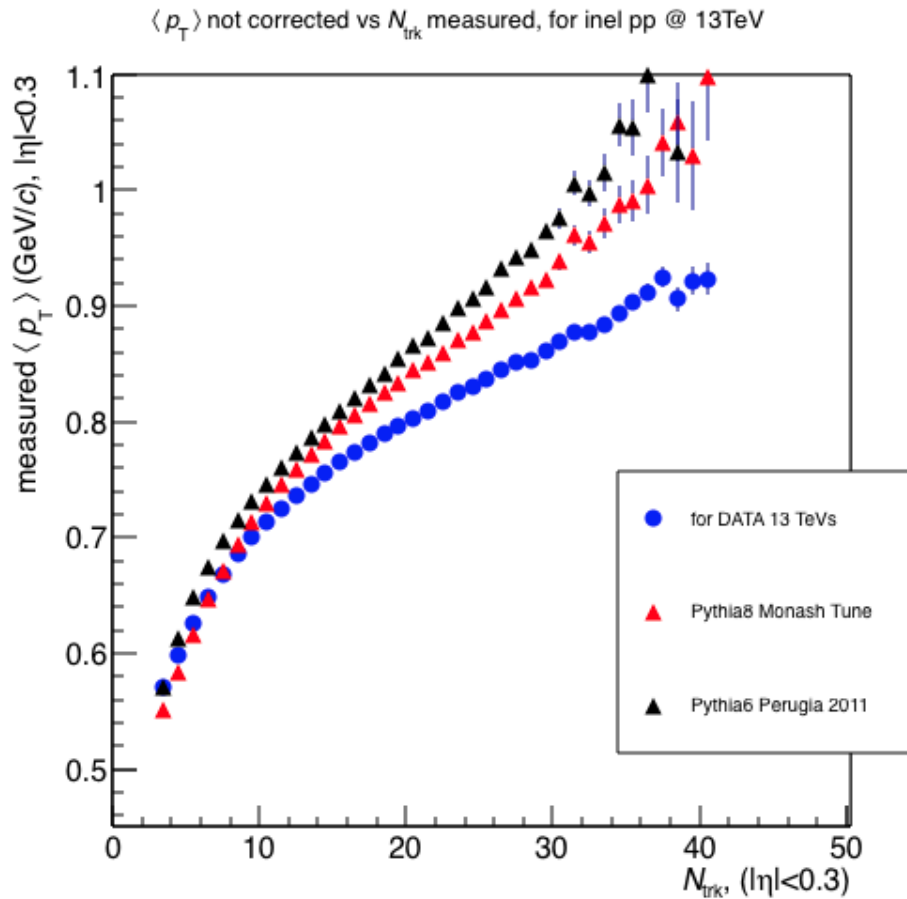
Track selection taken for each analysis:

- So Analysis, Hybrid-track cuts for primary charged particles with $|\eta| < 0.3$ and $0.15 < p_T < 10$ GeV/c.
- $\langle p_T \rangle$ Analysis, Golden-track cuts with $|\eta| < 0.3$ and $0.15 < p_T < 10$ GeV/c.
- Multiplicity, Reference multiplicity selection with $|\eta| < 0.3$

Mean Transverse Momentum

Full Pass2

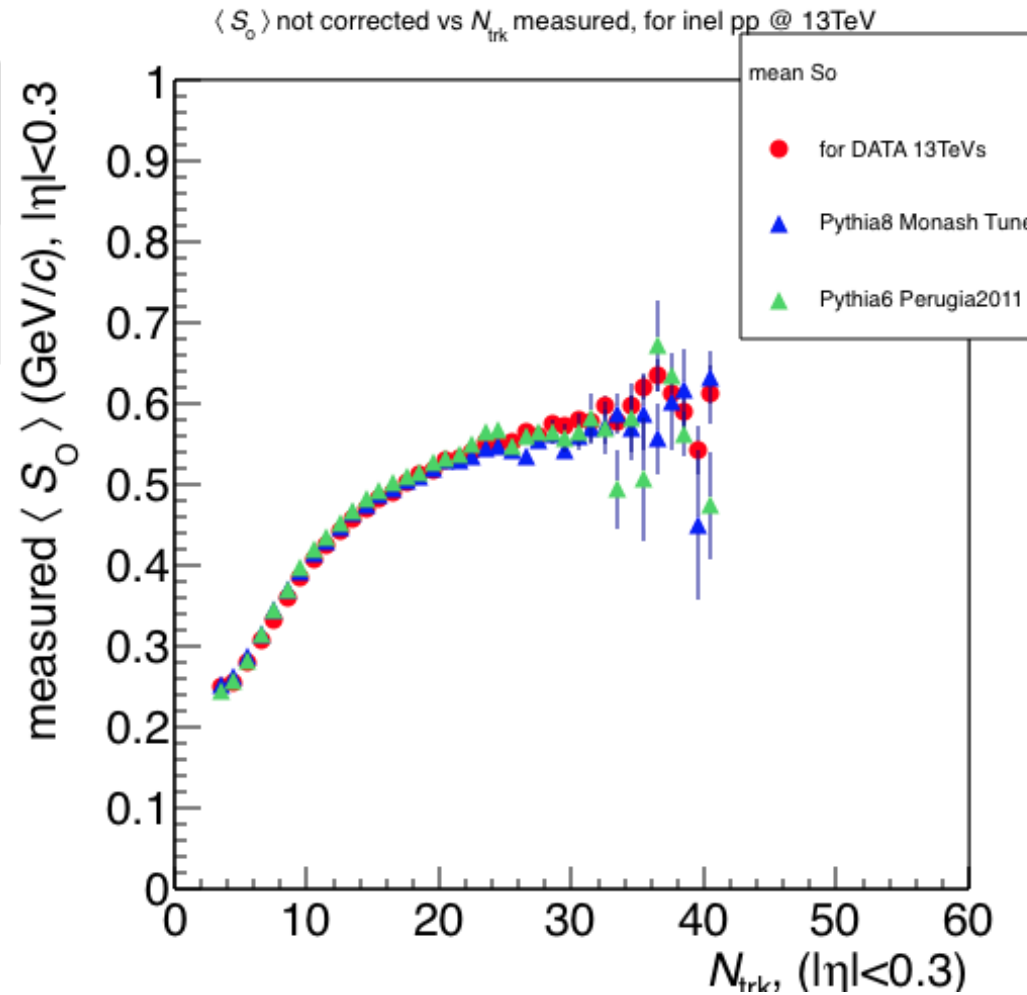
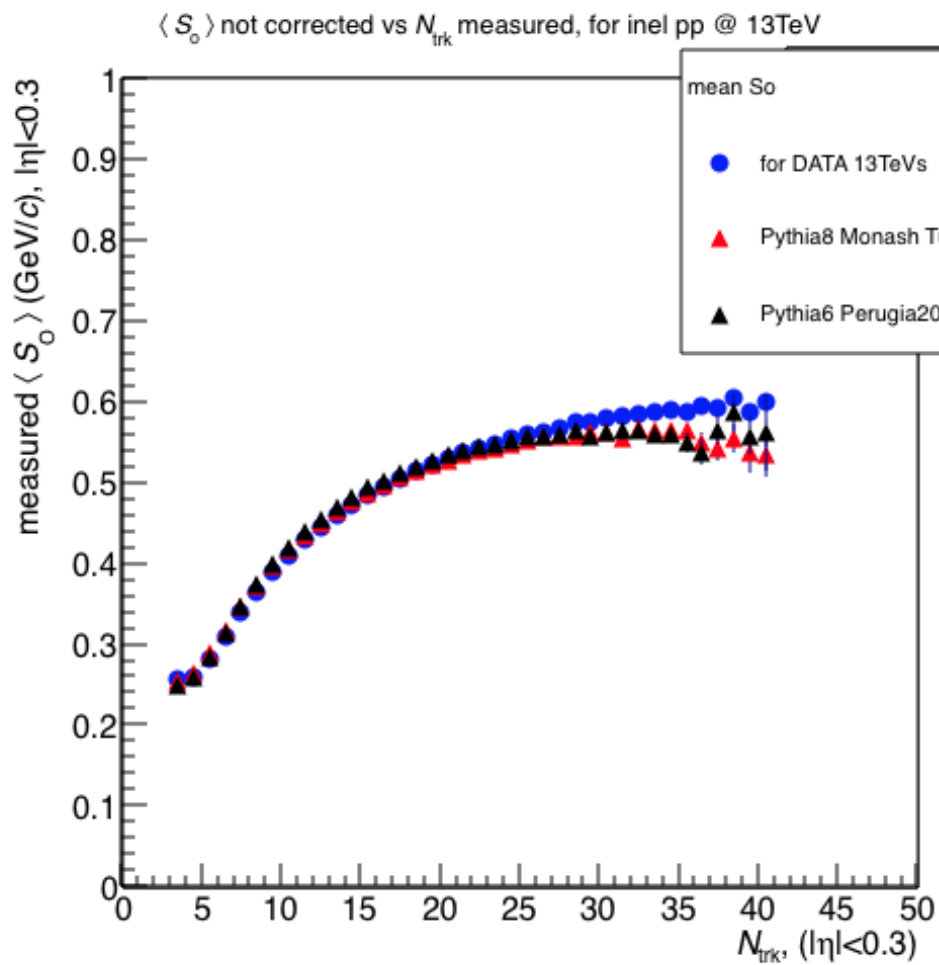
test_pass2



Mean Sphericity

Full Pass2

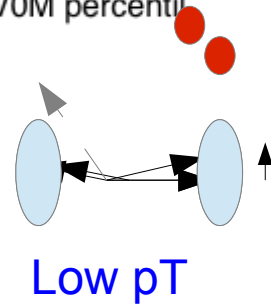
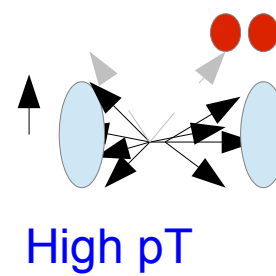
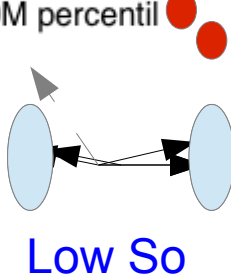
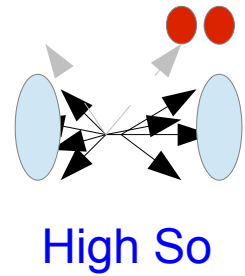
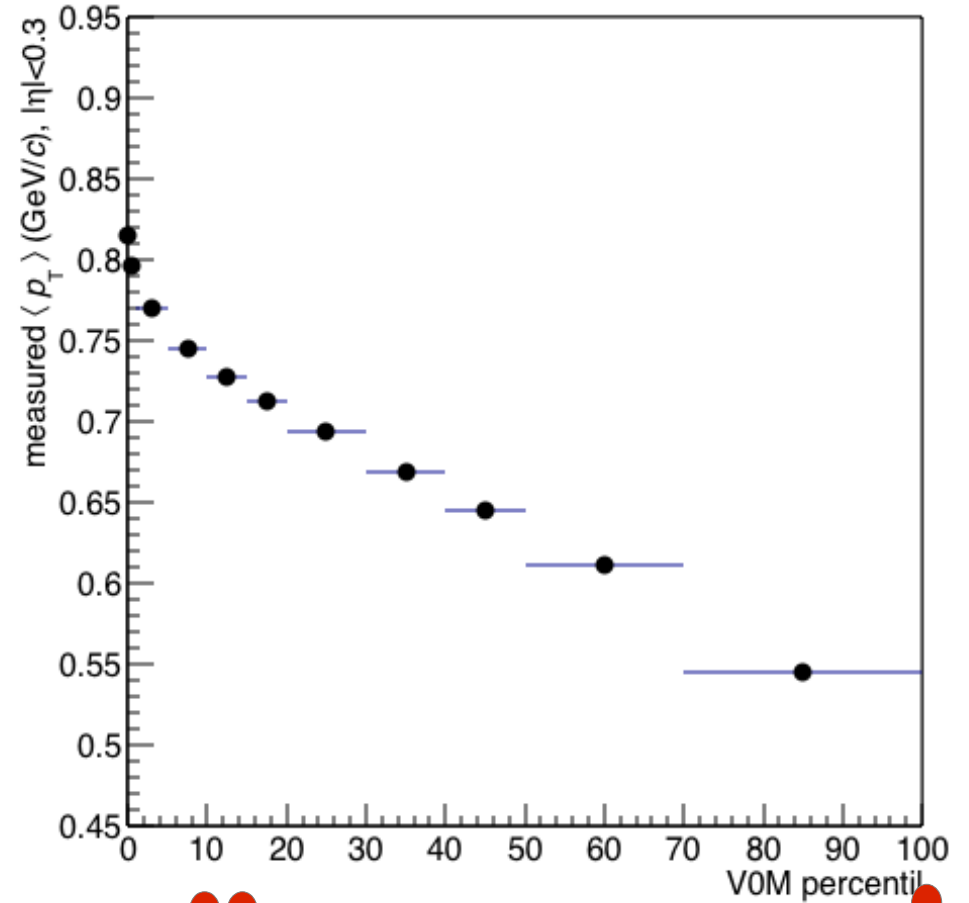
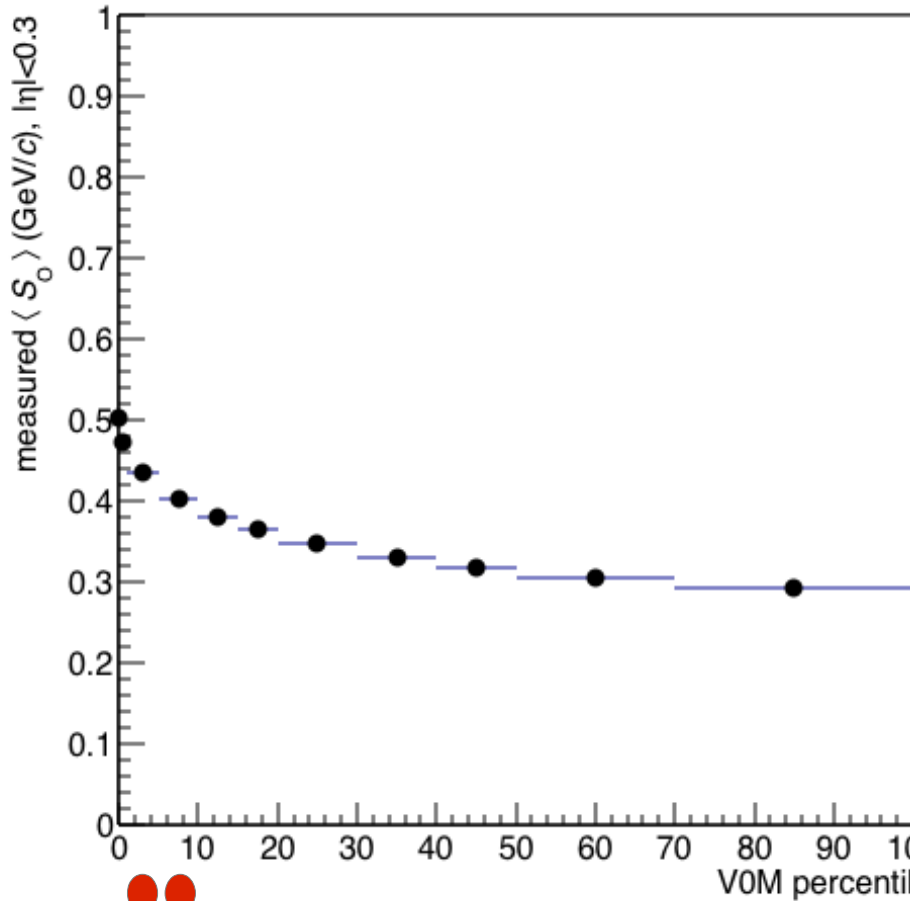
test_pass2



Mean So for V0M percentils • LHC15f (pass2)

$\langle S_0 \rangle$ not corrected vs V0M percentil measured, for inel pp @ 13TeV

$\langle p_T \rangle$ not corrected vs V0M percentil measured, for inel pp @ 13TeV



Hèctor Bello Martinez

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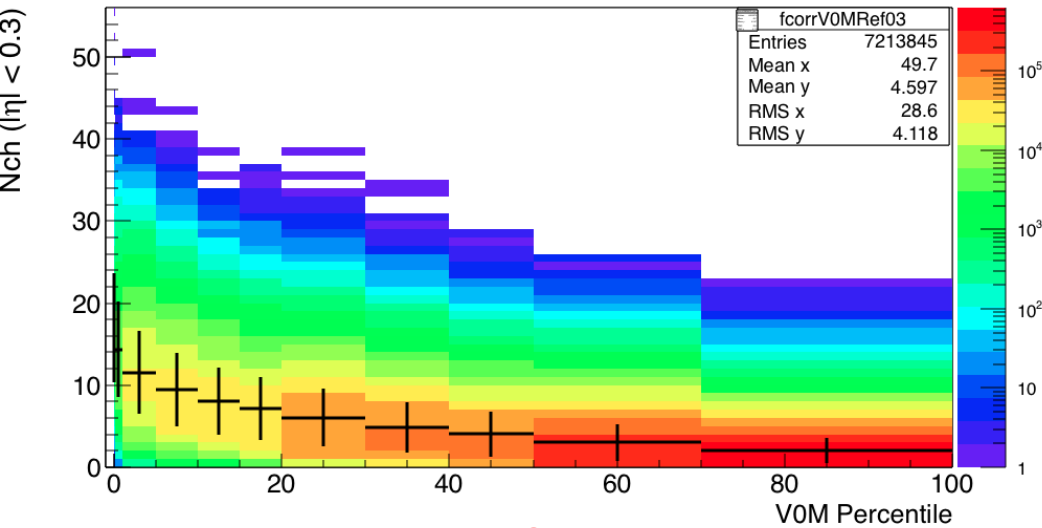
V0MbinsDefault={0.0,0.1,1.0,5.0,10.0,15.0,20.0,30.0,40.0,50.0,70.0,100.0};

Multiplicity correlation (midrapidity vs V0M percentils)

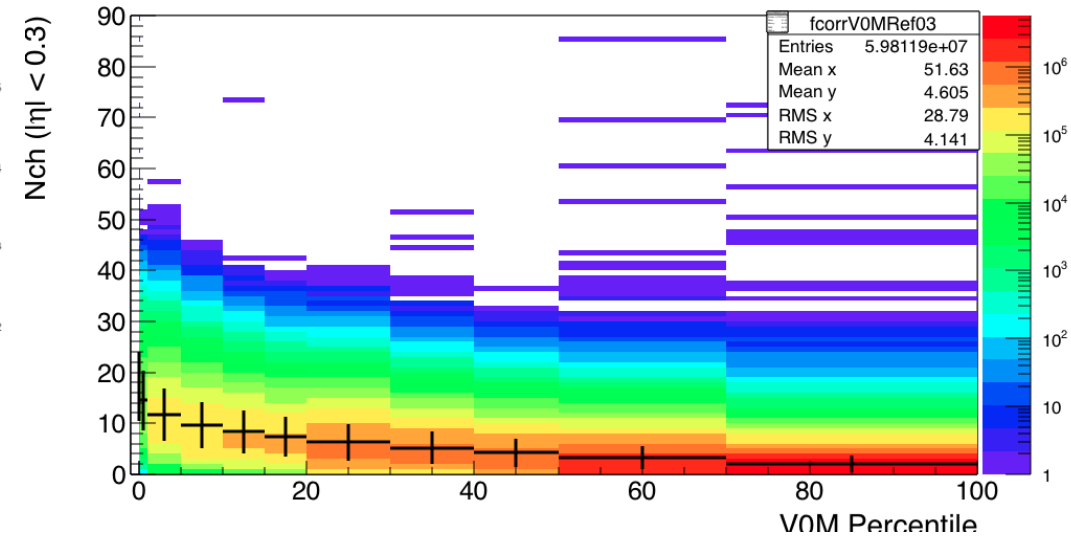
• LHC15f (test pass2)

• LHC15f (pass2)

Multiplicity Correlation (V0M and $|\eta| < 0.3$)



Multiplicity Correlation (V0M and $|\eta| < 0.3$)



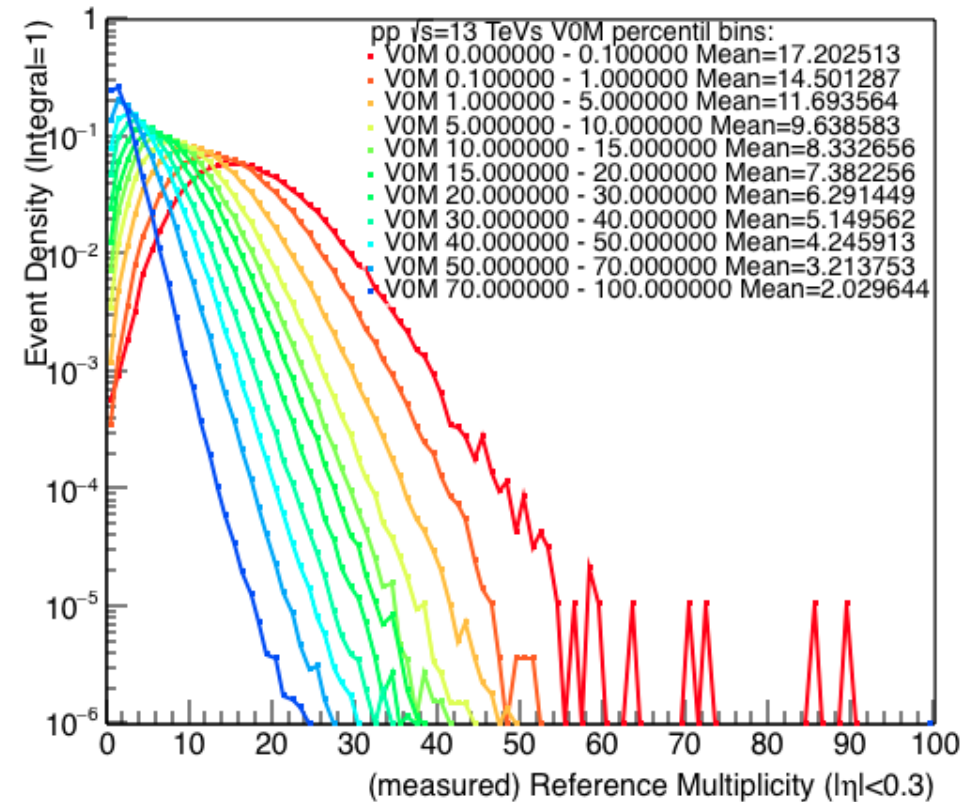
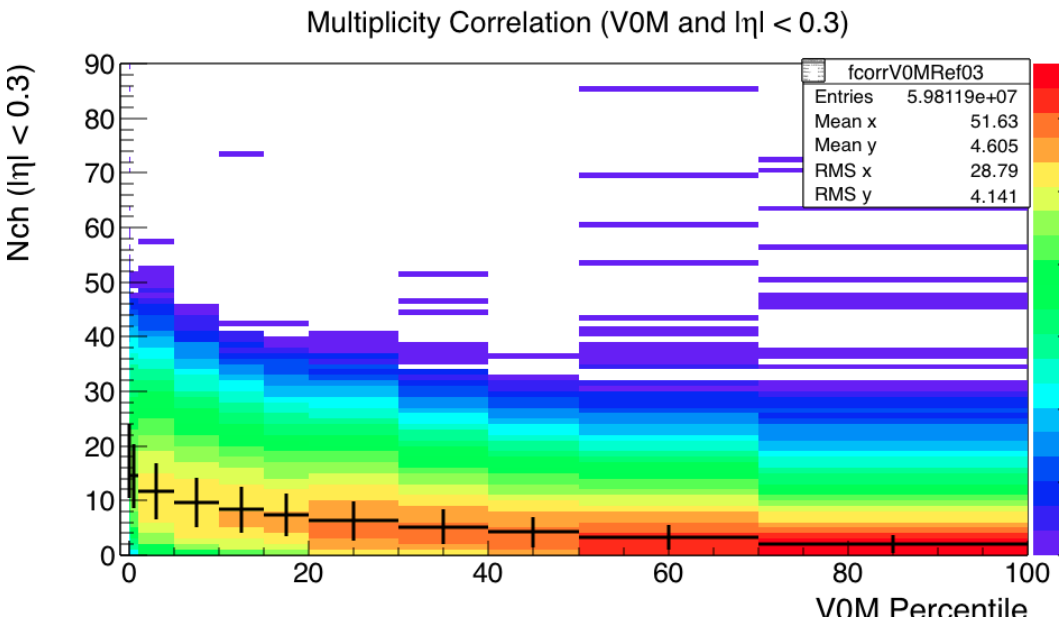
Statistics seem not change too much in the mean value

V0MbinsDefault={0.0,0.1,1.0,5.0,10.0,15.0,20.0,30.0,40.0,50.0,70.0,100.0};

multiplicity in $ \eta < 0.3$	17.20,	14.50,	11.69,	9.63,	8.33,	7.38,	6.29,	5.14,	4.24,	3.21,	2.02	
Proposal for the baseline common multiplicity binning scheme												
<ul style="list-style-type: none"> V0M quantile no need to put fraction of cross-section: that's already there by definition. [0.00, 0.01] [0.01,0.10] [0.10, 1.0] [1.0, 5.0] [5.0, 10.0] [10.0, 15.0] [15.0, 20.0] [20.0, 30.0] [30.0, 40.0] [40.0, 50.0] [50.0, 70.0] [70.0, 100.0] 												
class (percentile)	[0.00, 0.01]	[0.01, 0.1]	[0.1, 1.0]	[1.0, 5.0]	[5.0, 10.0]	[10.0, 15.0]	[15.0, 20.0]	[20.0, 30.0]	[30.0, 40.0]	[40.0, 50.0]	[50.0, 70.0]	[70.0, 100.0]
multiplicity in $ \eta < 0.5$	28.7	24.3	19.9	15.6	12.6	10.7	9.3	7.7	6.1	4.8	3.5	2.3

Multiplicity correlation (midrapidity vs V0M percentils)

- LHC15f (pass2)



V0MbinsDefault={0.0,0.1,1.0,5.0,10.0,15.0,20.0,30.0,40.0,50.0,70.0,100.0};

multiplicity in $ \eta < 0.3$	17.20,	14.50,	11.69,	9.63,	8.33,	7.38,	6.29,	5.14,	4.24,	3.21,	2.02	
Proposal for the baseline common multiplicity binning scheme												
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class (percentile)	[0.00, 0.01]	[0.01, 0.1]	[0.1, 1.0]	[1.0, 5.0]	[5.0, 10.0]	[10.0, 15.0]	[15.0, 20.0]	[20.0, 30.0]	[30.0, 40.0]	[40.0, 50.0]	[50.0, 70.0]	[70.0, 100.0]
multiplicity in $ \eta < 0.5$	28.7	24.3	19.9	15.6	12.6	10.7	9.3	7.7	6.1	4.8	3.5	2.3

Mean values are less than for $|\eta| < 0.5$ Due to small pseudorapidity range

Mean Pt and Mean So for $\langle dN/d\eta \rangle$ • LHC15f (pass2)

