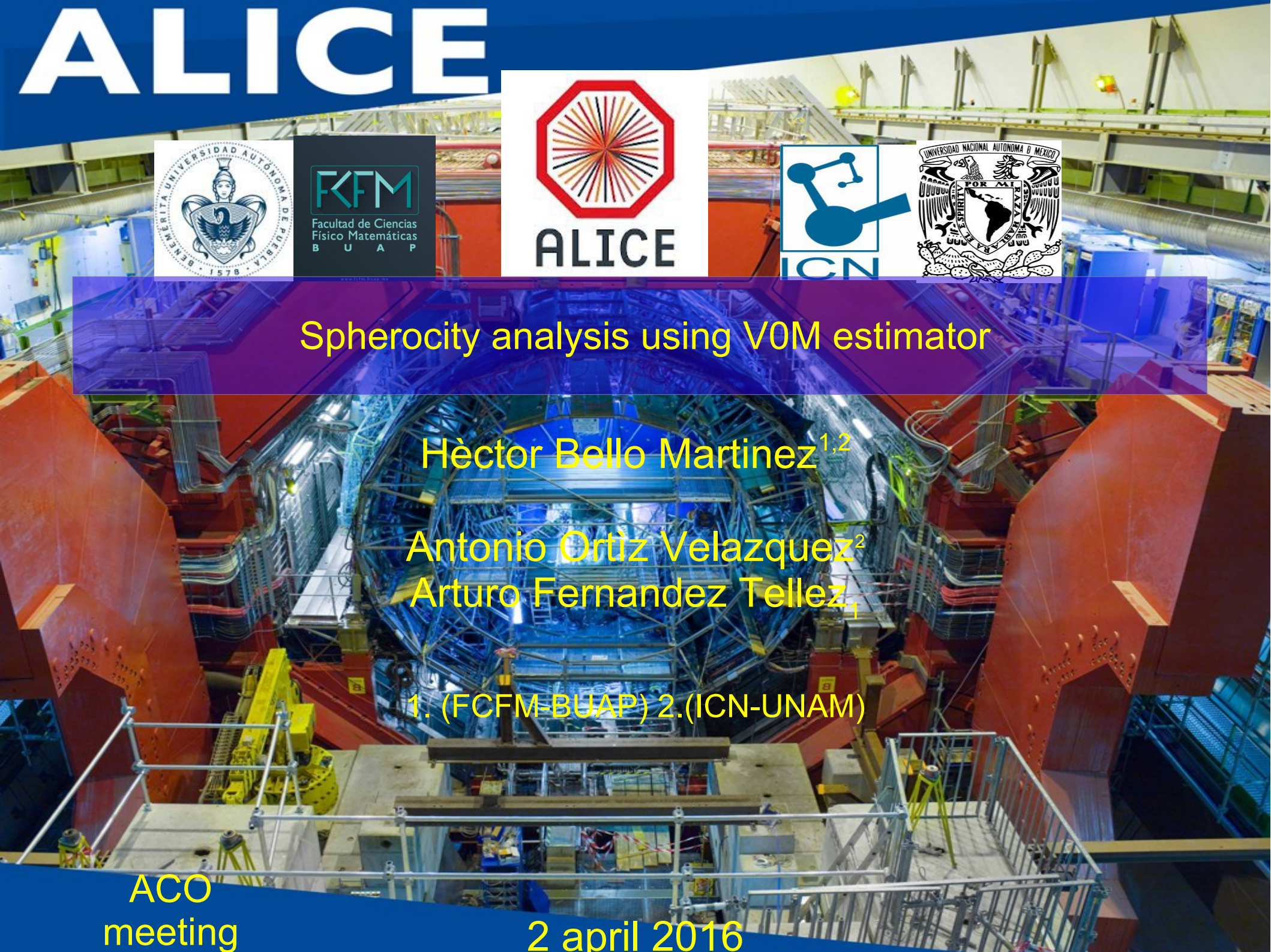


Spherocity analysis using V0M estimator

Hèctor Bello Martinez[1,2]

Antonio Ortìz Velazquez[2]

Arturo Fernandez Tellez[1]

1. (FCFM-BUAP) 2.(ICN-UNAM)

ACO meeting

2 april 2016

Outline

- Comparison between methods V0M and reference |eta|<0.3 for spectra, for Mean P_T
- Correlation pt vs <dN/deta> $_{|eta|<0.3}$
- We compare the V0M-REF ratio for:
  Nch in V0M> <dN/deta>$_{|eta|<0.3}$
  Nch in V0M< <dN/deta>$_{|eta|<0.3}$
  Nch in V0M= <dN/deta>$_{|eta|<0.3}$

- Conclusions.

Analysis and Event selection

Software: Aliroot:`v5-07-20` Aliphysics:`vAN-20160204`
Event shape classes: (PWGLF/SPECTRA/Spherocity)
Analysis macros: `AddTransverseEventShapeTask.C`
`AliAnaTransverseEventShapeTask.cxx`
`AliAnaTransverseEventShapeTask.h`

Trigger: KINT7 (*Thanks to Gyula*)
Standard Physics selection

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 $|\eta|<0.3$

Pass2
LHC15f pass2: (59 mill of evts)
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

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");
```

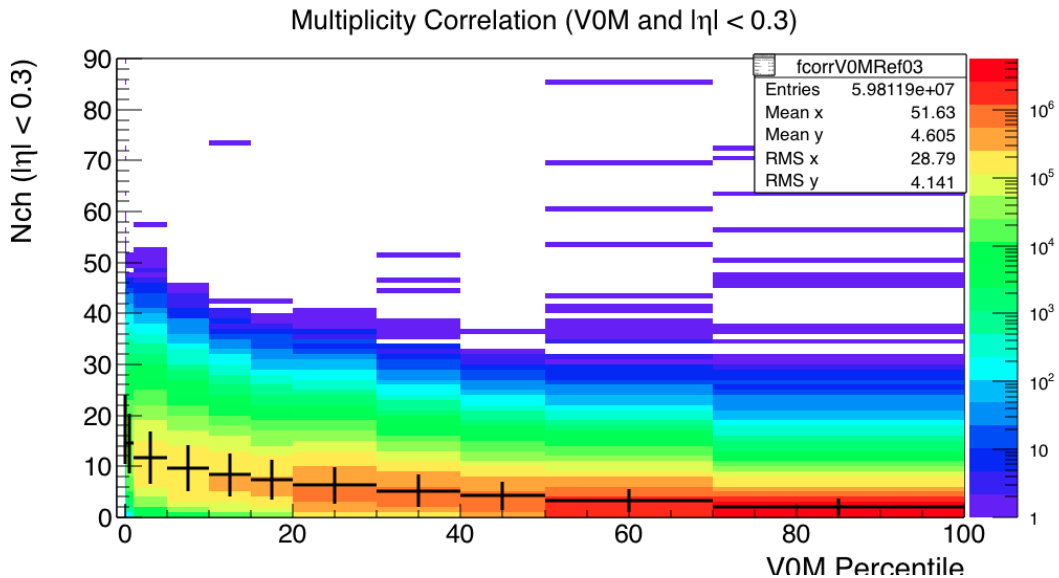
- More:

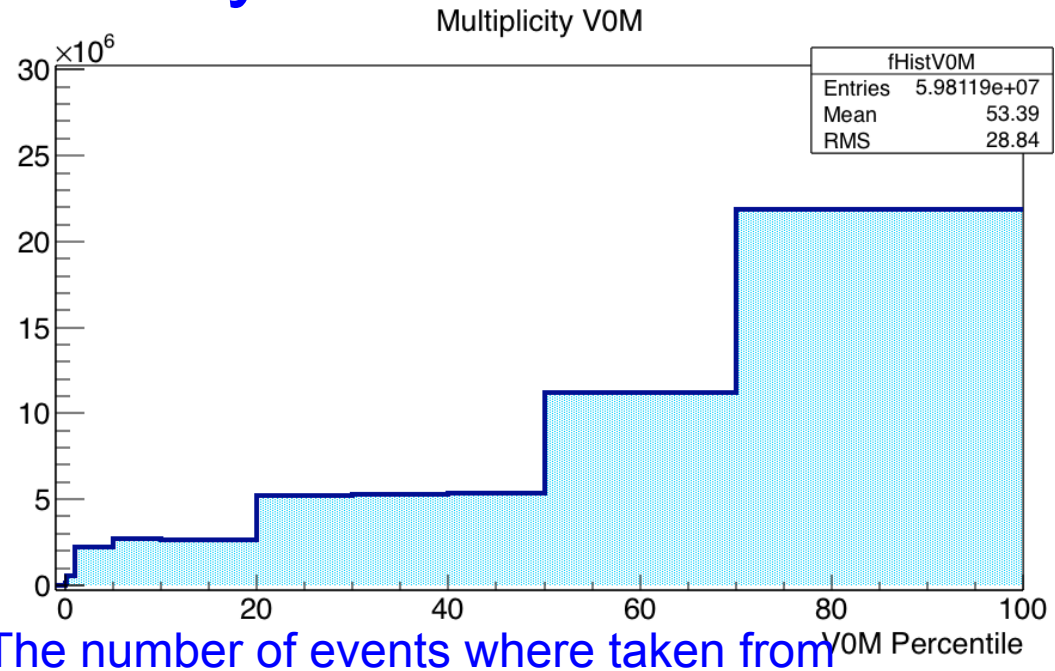
  https://twiki.cern.ch/twiki/bin/viewauth/ALICE/AliceHMTFEstimators

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

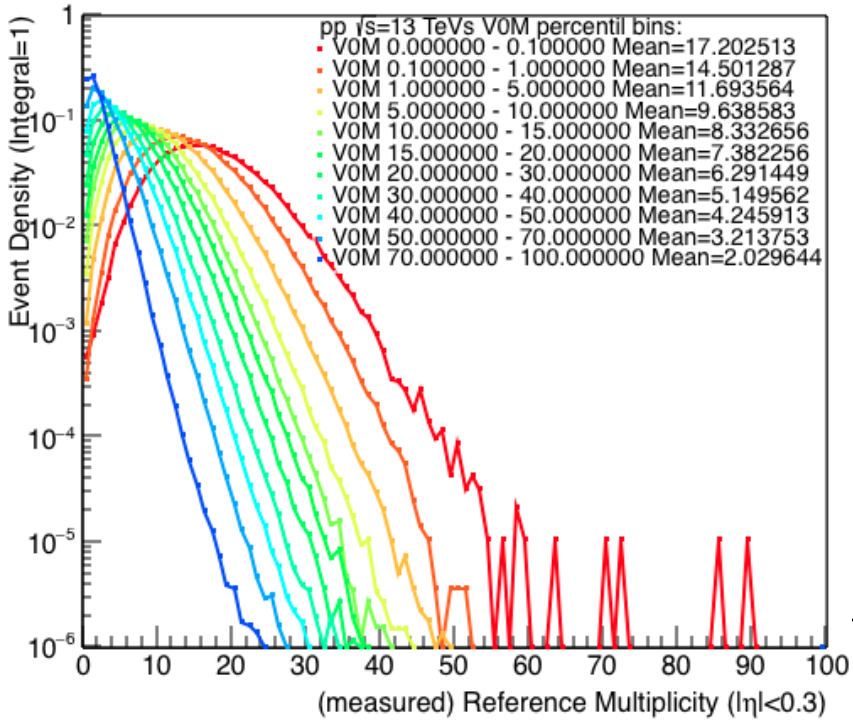
Thanks David for help.
and Vytautas for provide the binning

Some usefull plots for V0M Analysis





I reproduce the proyections in order to ensure the value of <d*N*/deta>

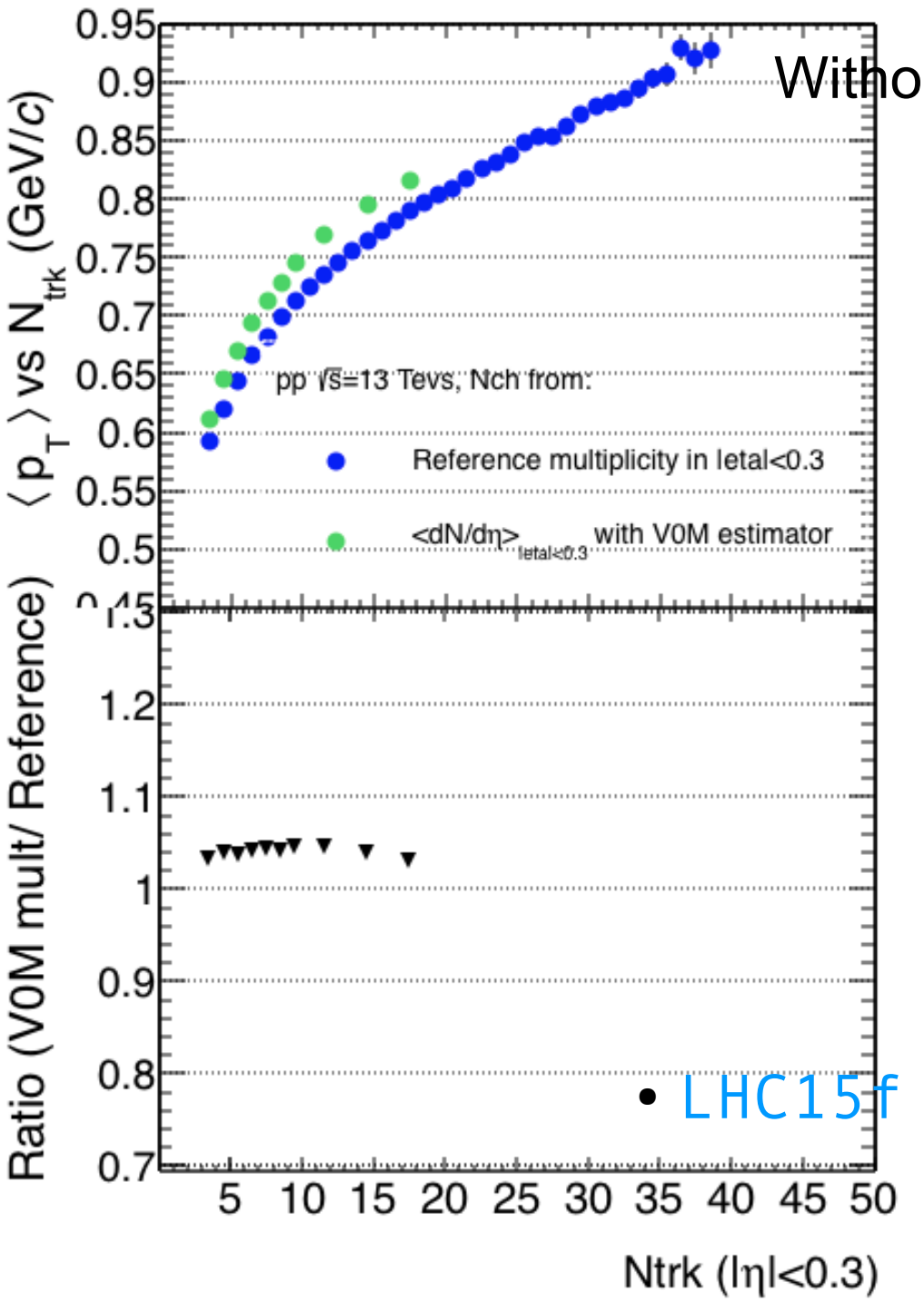


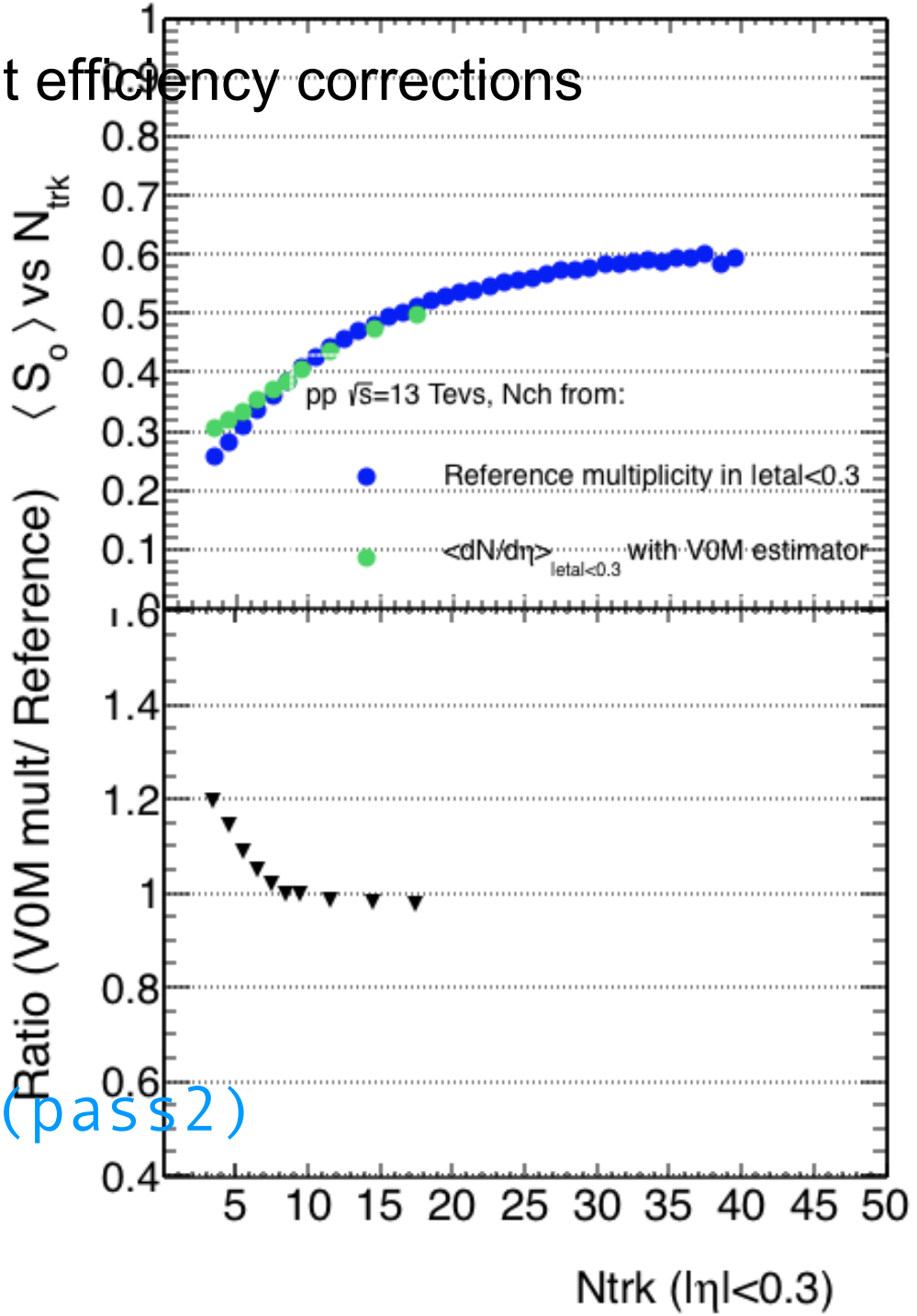
The number of events where taken from each multiplicity class (I was taking from So, this was including some bias)

V0M percentil	<d*N*/deta> |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

Comparing estimators V0M and Ref | eta| <0.3

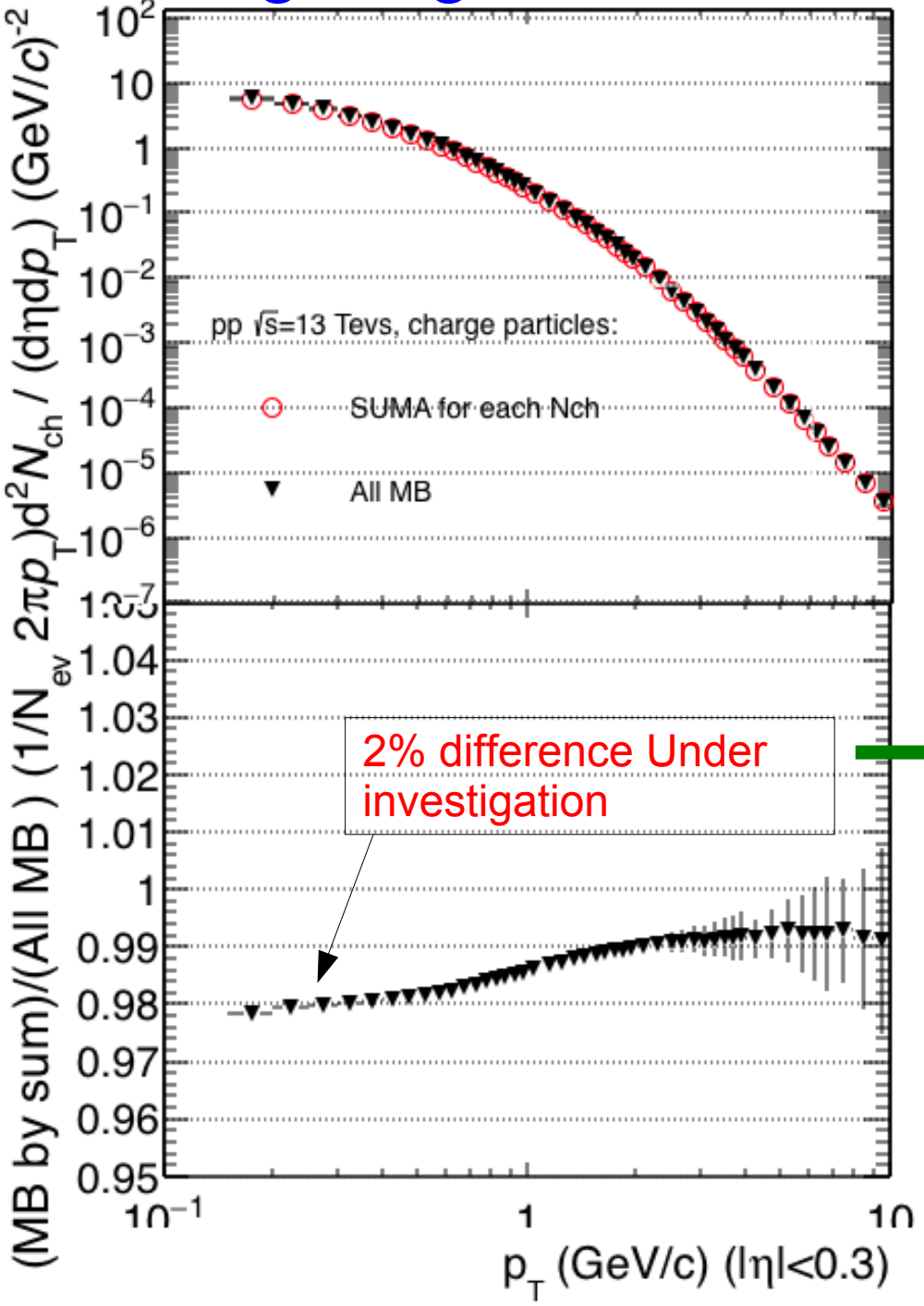
Without efficiency corrections

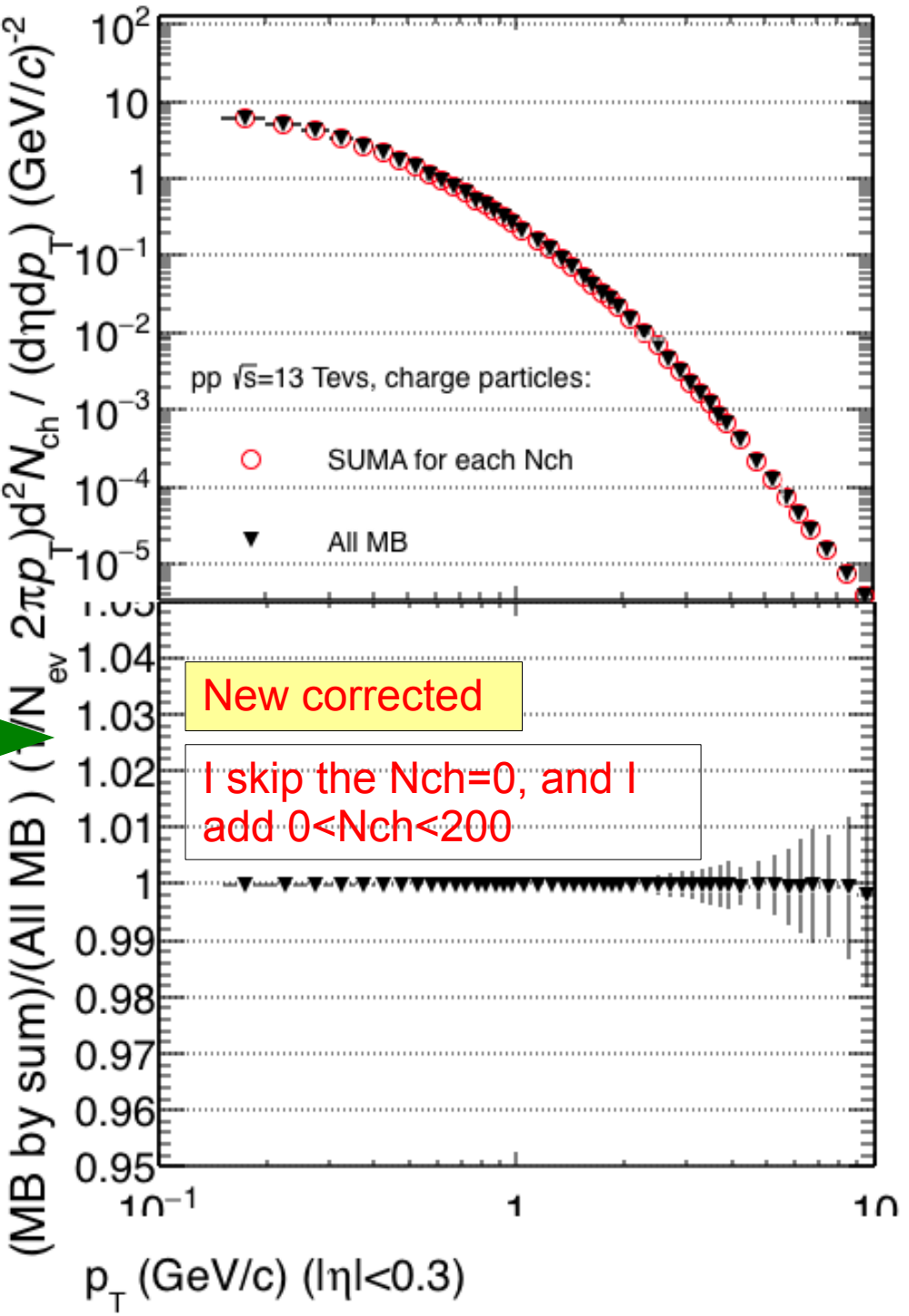




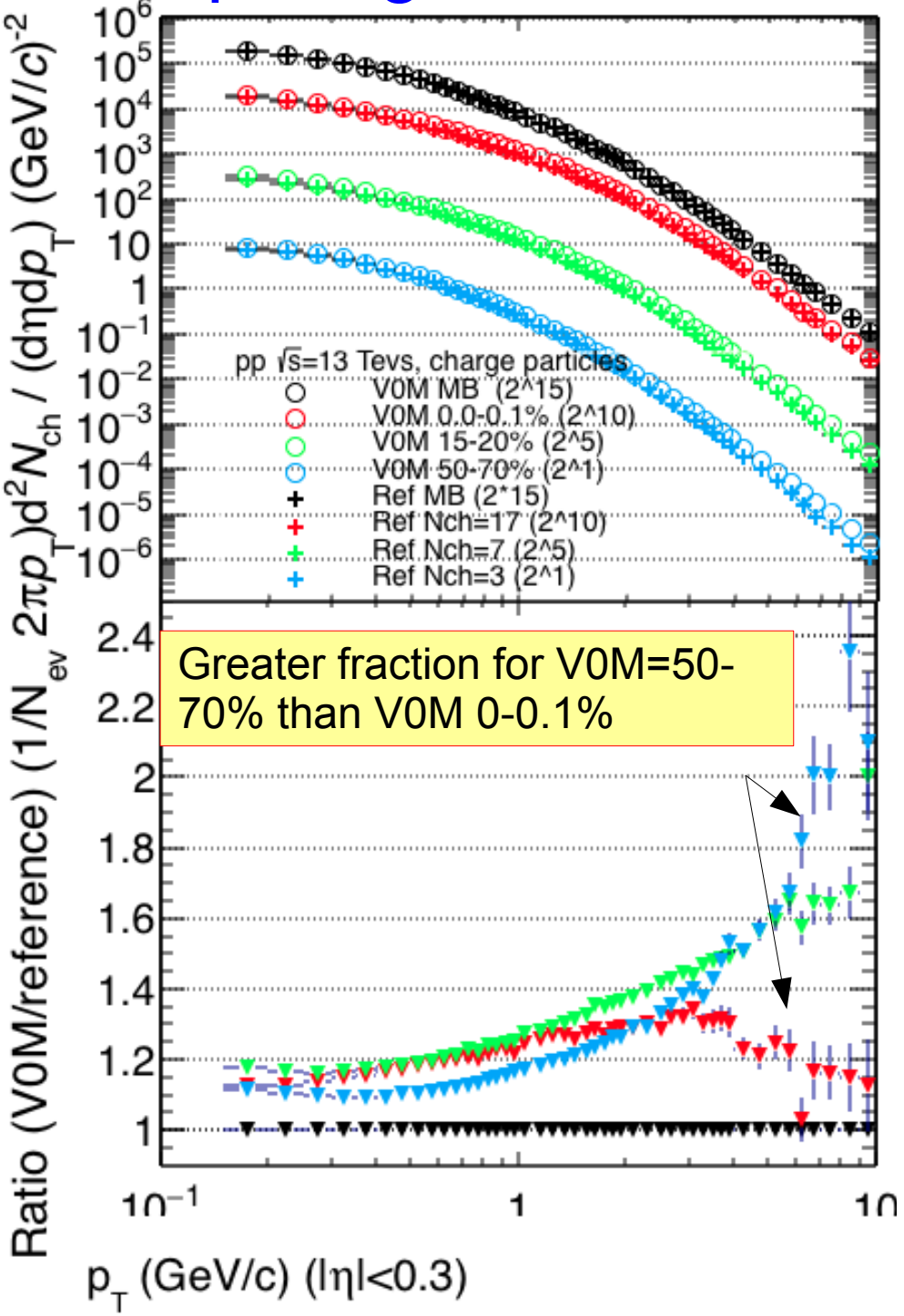
- LHC15f (pass2)

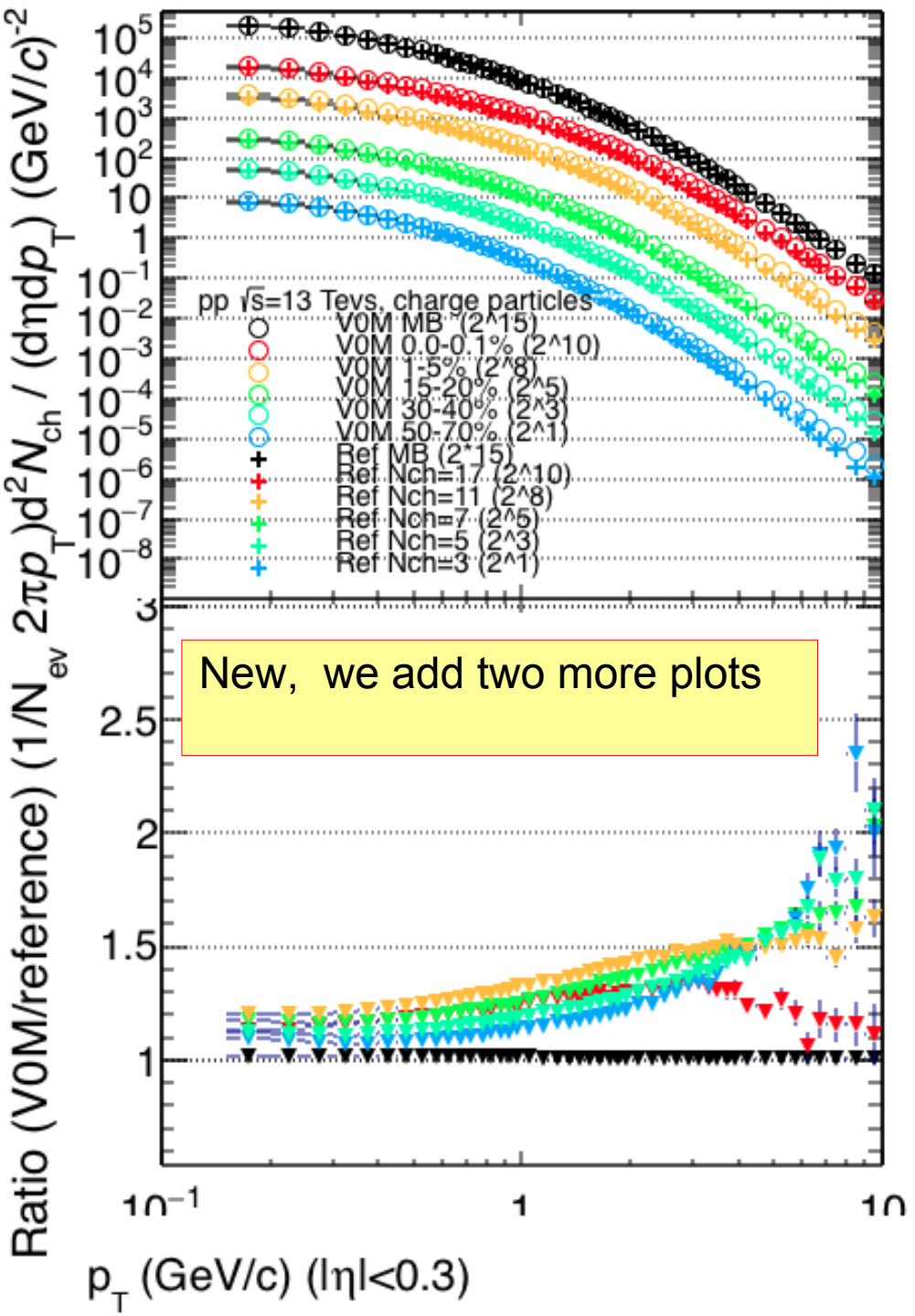
Invetigating Min Bias for Reference



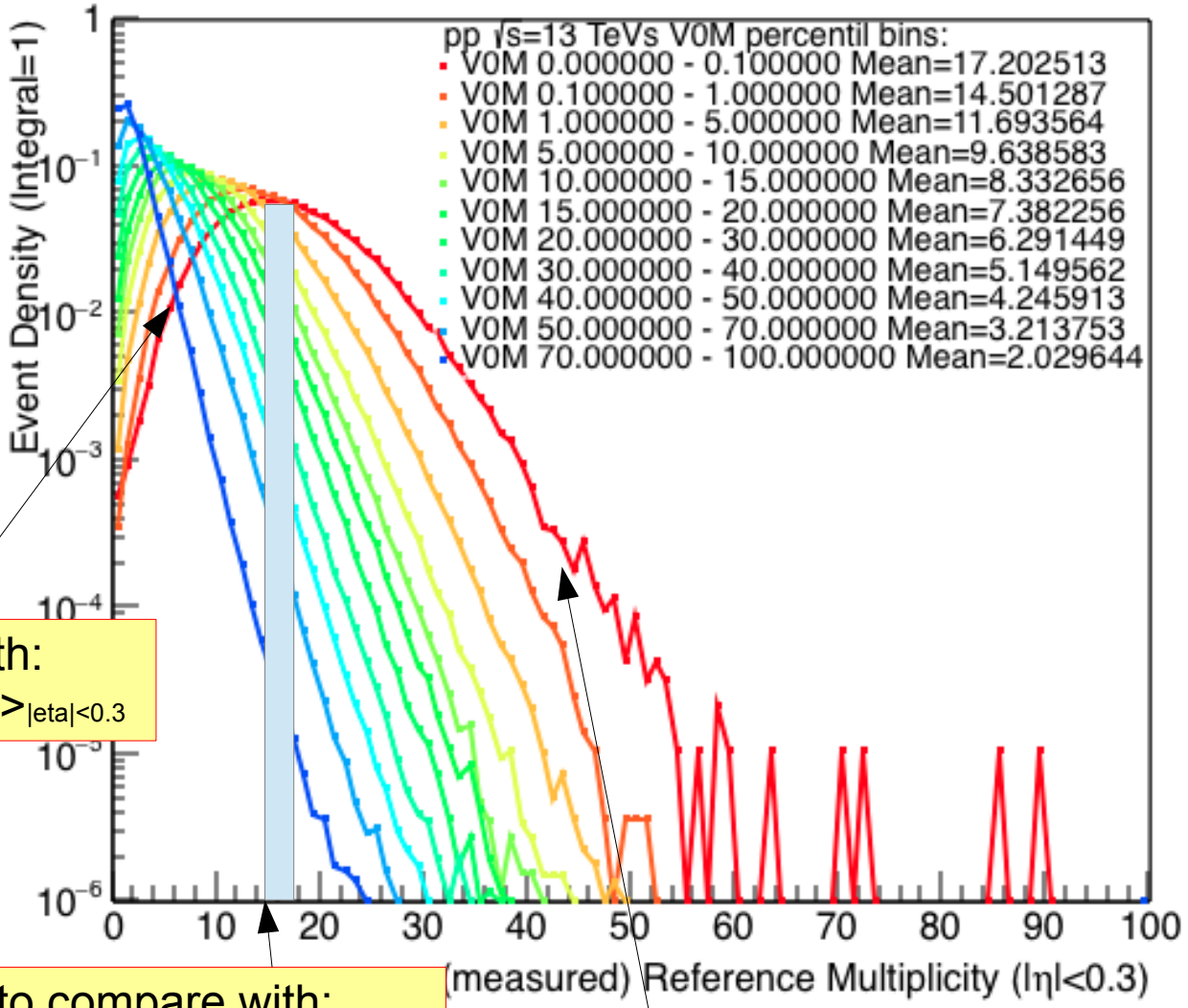


Comparing estimators V0M and Ref I etal <0.3





Who contributes to the greater fraction for V0M?

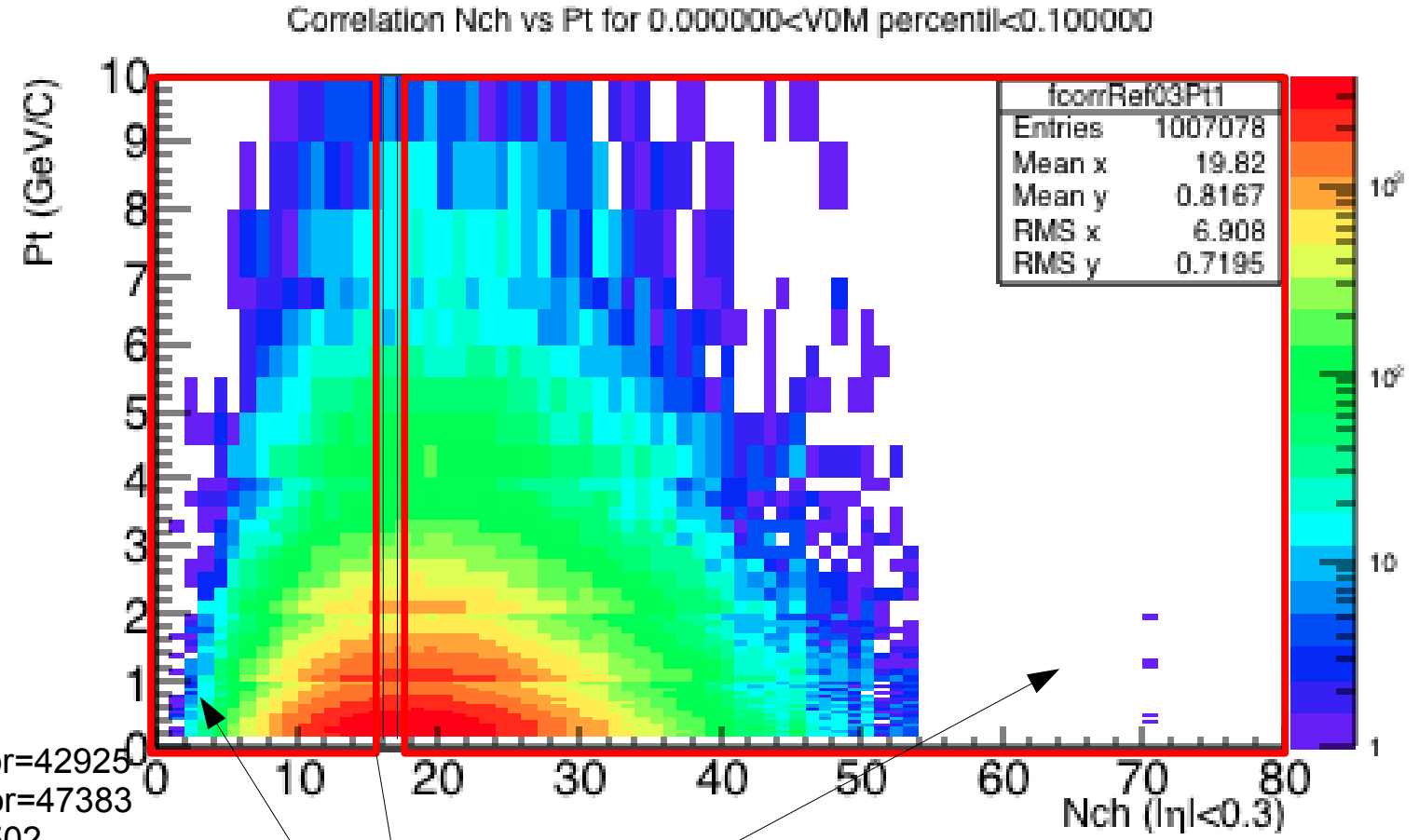


Ned to compare with:
$V0M_{Nch} < \langle dN/d\eta \rangle_{|\eta|<0.3}$

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 <dN/deta> |eta|<0.3



Nev=95810

Nev para mayor=42925
Nev para menor=47383
Nev para ig=5502
Suma=95810

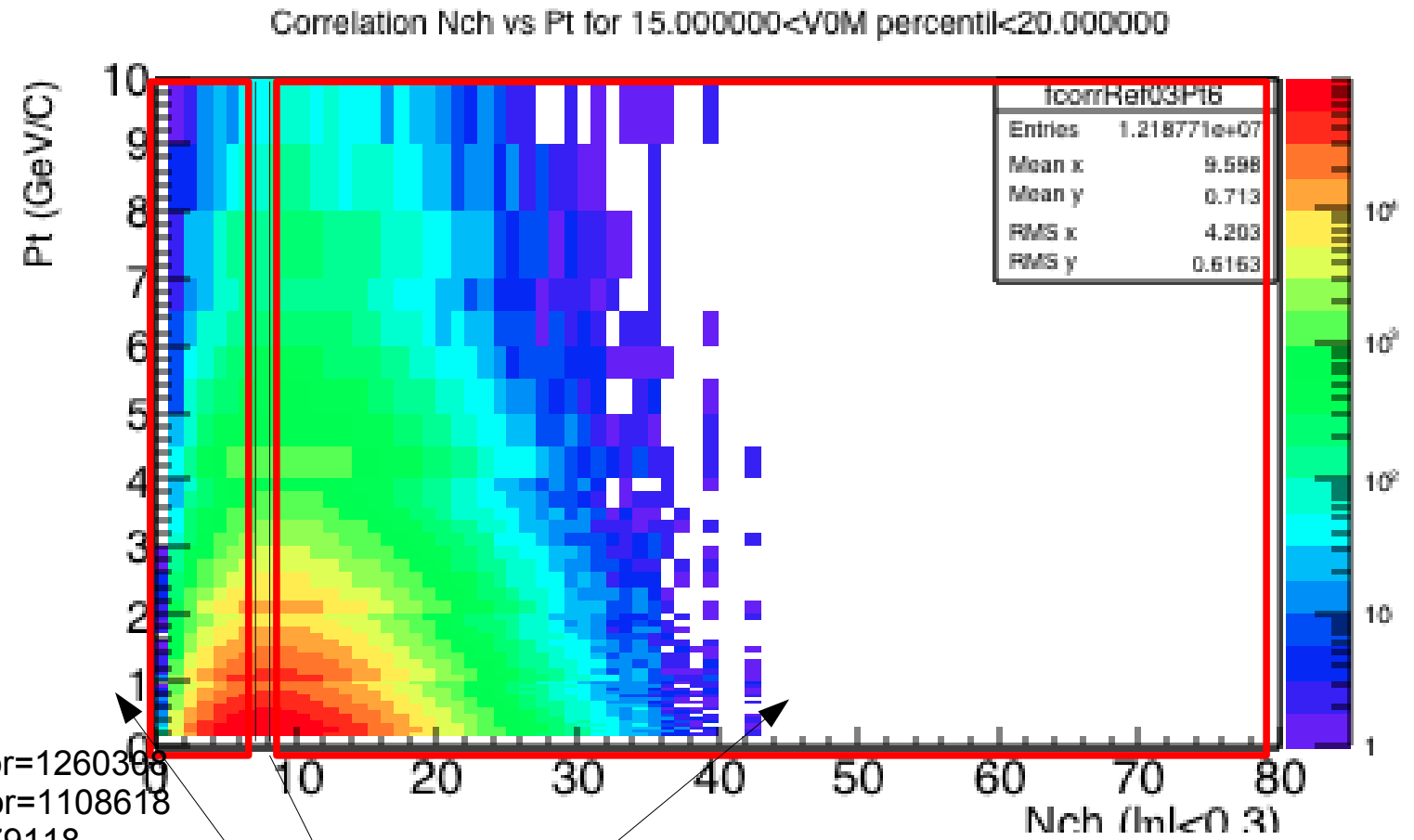
In order to get pt distributions for:

Nch in V0M> <dN/deta>$_{|eta|<0.3}$=17

Nch in V0M< <dN/deta>$_{|eta|<0.3}$=17

Nch in V0M= <dN/deta>$_{|eta|<0.3}$ =17

Correlation pt vs <dN/deta> |eta|<0.3



Nev=2648044

Nev para mayor=1260308
Nev para menor=1108618
Nev para ig=279118
Suma=2648044

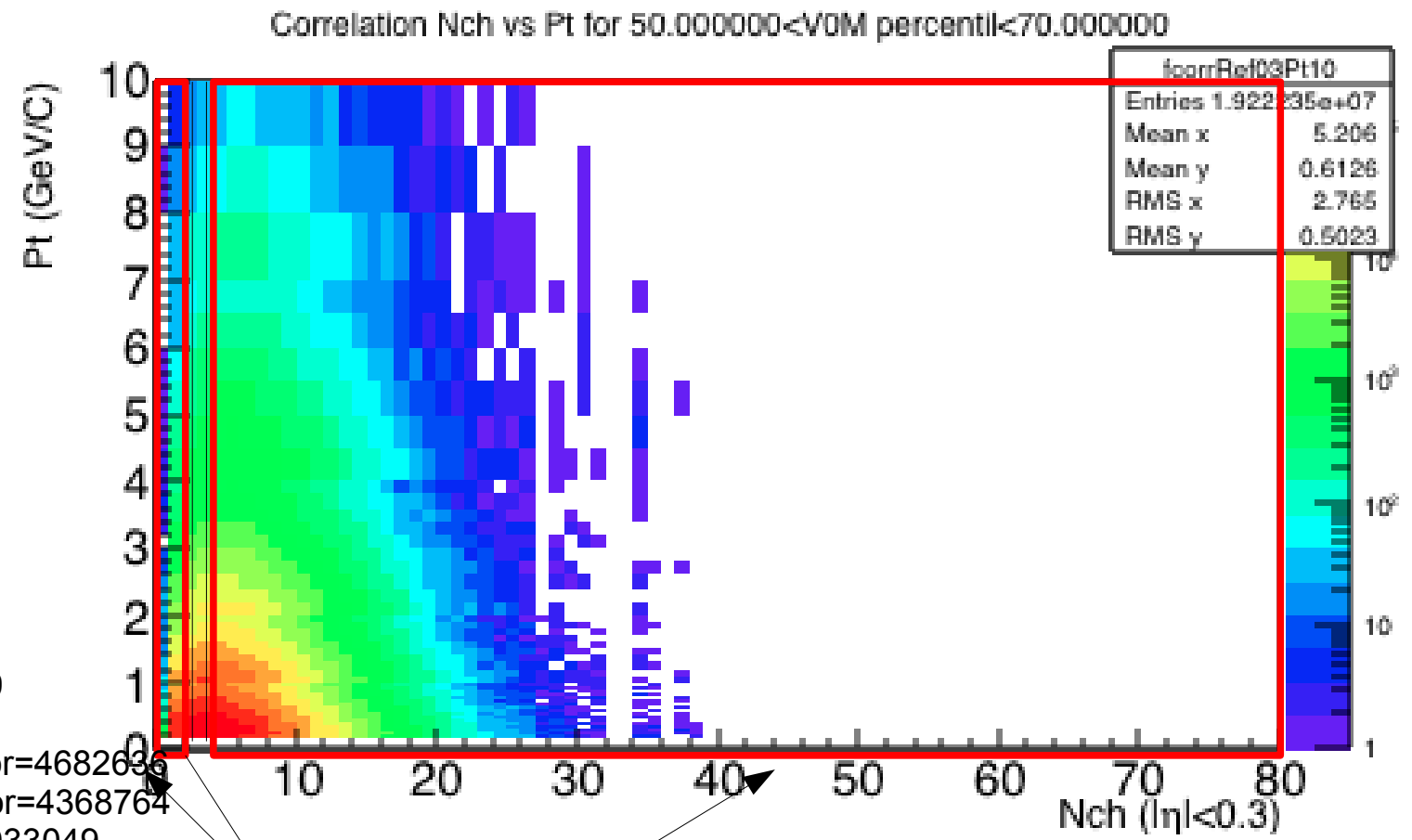
In order to get pt distributions for:

Nch in V0M> <dN/deta>$_{|eta|<0.3}$=7

Nch in V0M< <dN/deta>$_{|eta|<0.3}$=7

Nch in V0M= <dN/deta>$_{|eta|<0.3}$ =7

Correlation pt vs <dN/deta> |eta|<0.3



Nev=11084449

Nev para mayor=4682636
Nev para menor=4368764
Nev para ig=2033049
Suma=11084449

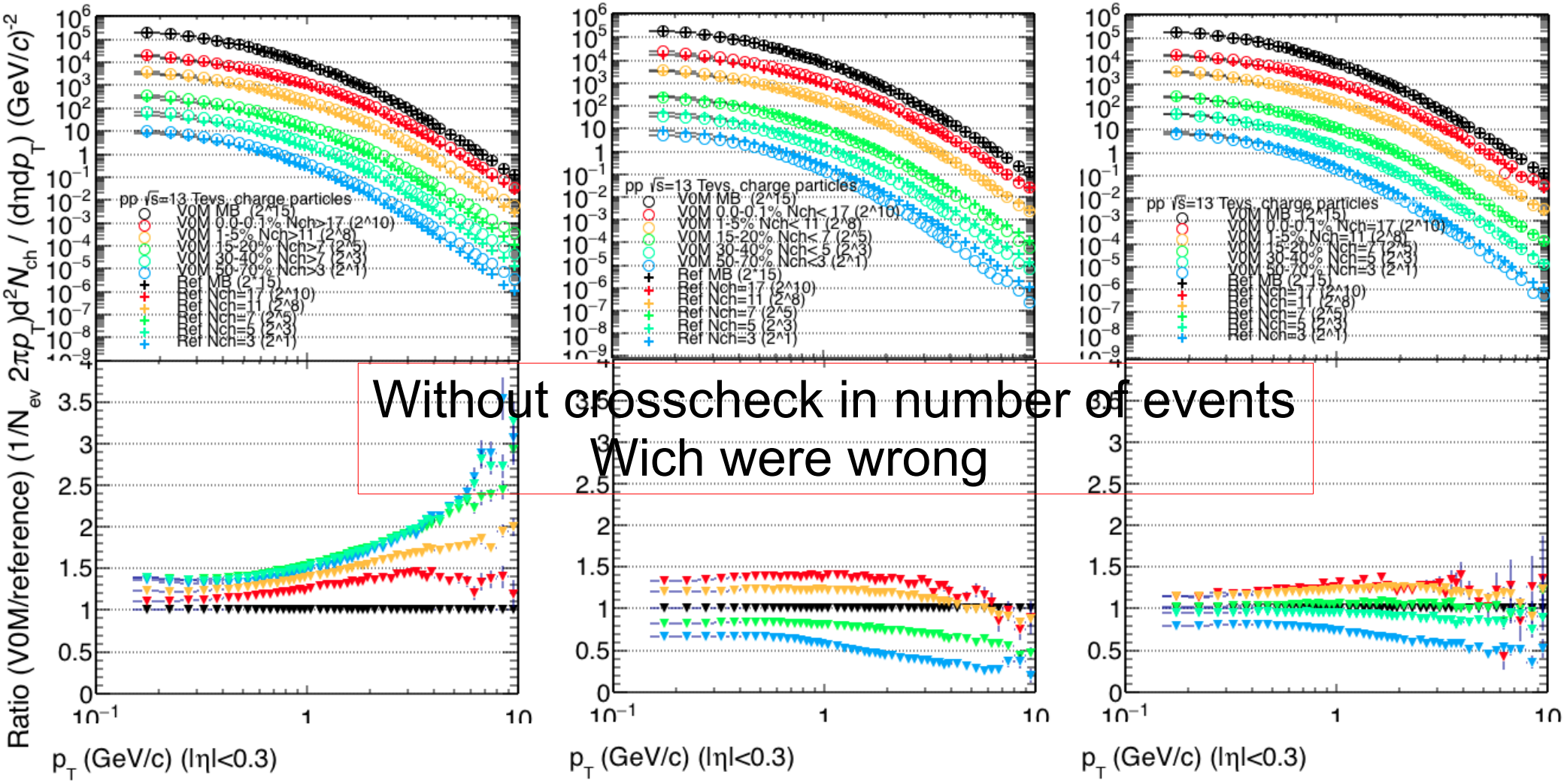
In order to get pt distributions for:

Nch in V0M> <dN/deta>$_{|eta|<0.3}$=3

Nch in V0M< <dN/deta>$_{|eta|<0.3}$=3

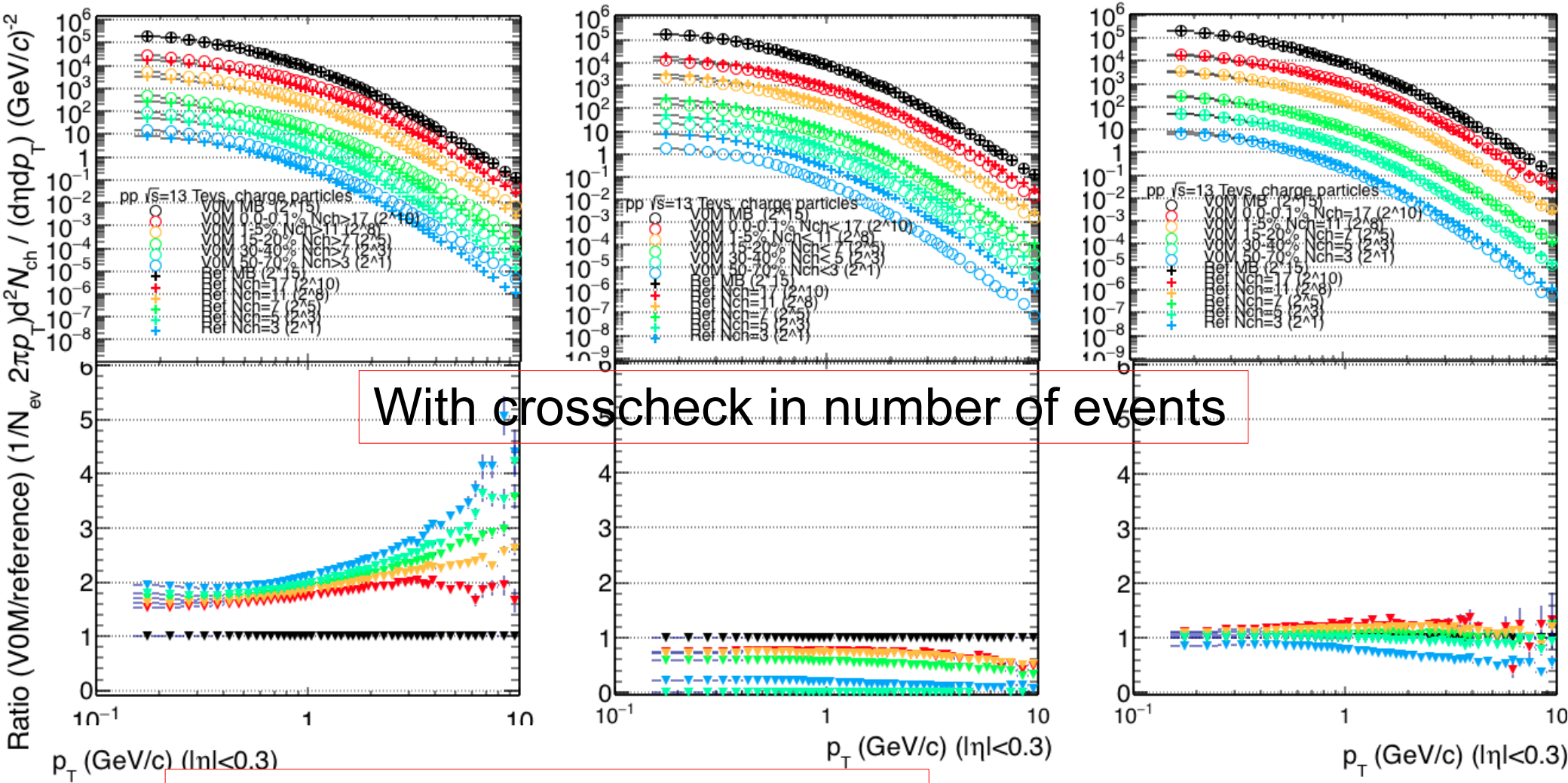
Nch in V0M= <dN/deta>$_{|eta|<0.3}$ =3

Comparing with V0M mult for Nch:
greater, lower and equal to <dN/deta>



Without crosscheck in number of events
Wich were wrong

Comparing with V0M mult for Nch:
greater, lower and equal to <dN/deta>

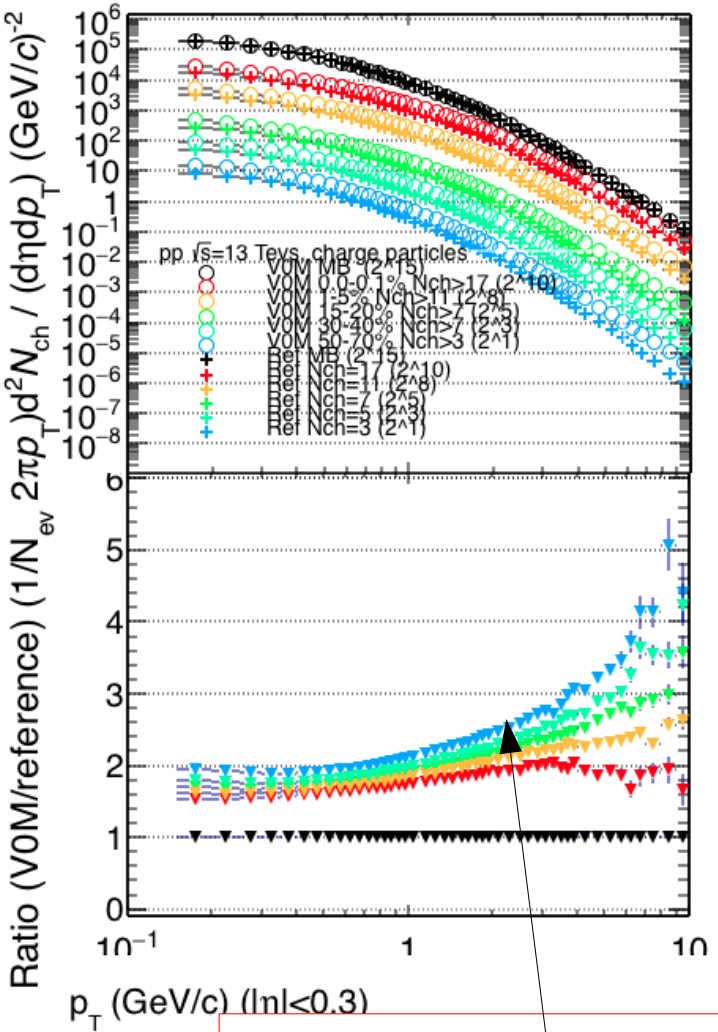


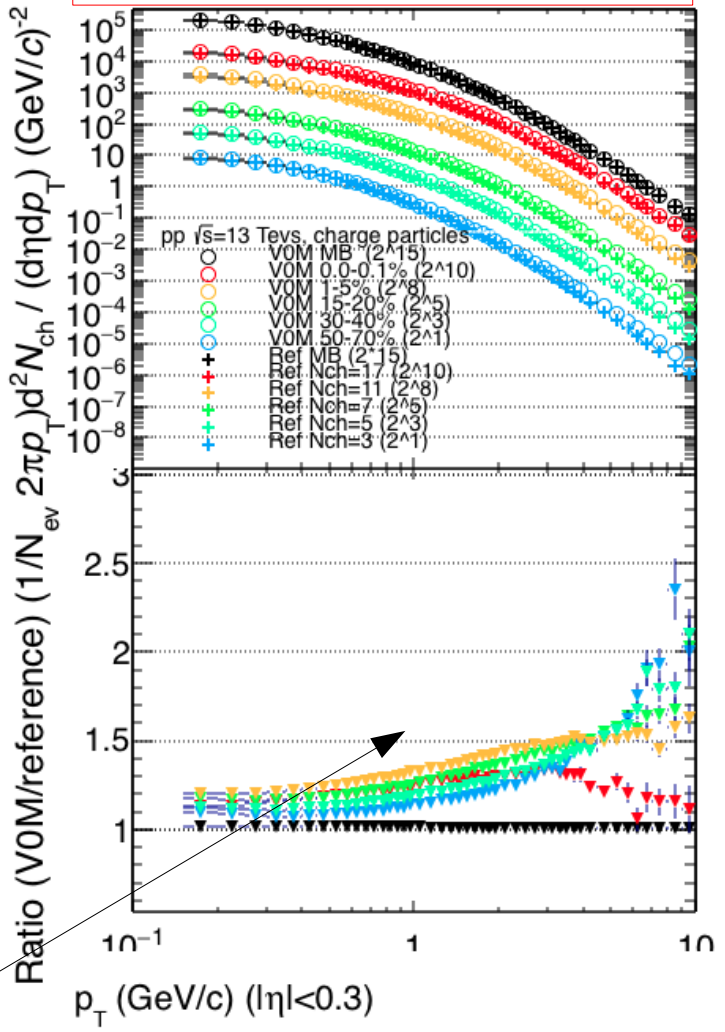
With crosscheck in number of events

To check the contribution to the ratio,

Comparing with V0M mult for Nch: greater,

V0M$_{Nch}$ vs REF$_{|eta|<0.3}$





To check the contribution to the ratio, we see the contribution comes from V0M$_{Nch}$ > <dN/deta>$_{|eta|<0.3}$

Summary

- After the analysis, the contribution to have greater spectra for V0M than for Reference seems due to the spectra for wich Nch in V0M is greater than $\langle dN/d\eta \rangle_{|\eta|<0.3}$

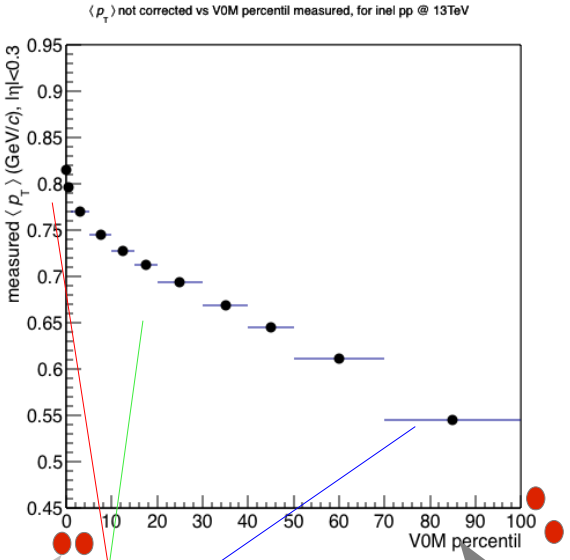
To be done

Continue with So analysis

Thank you!.

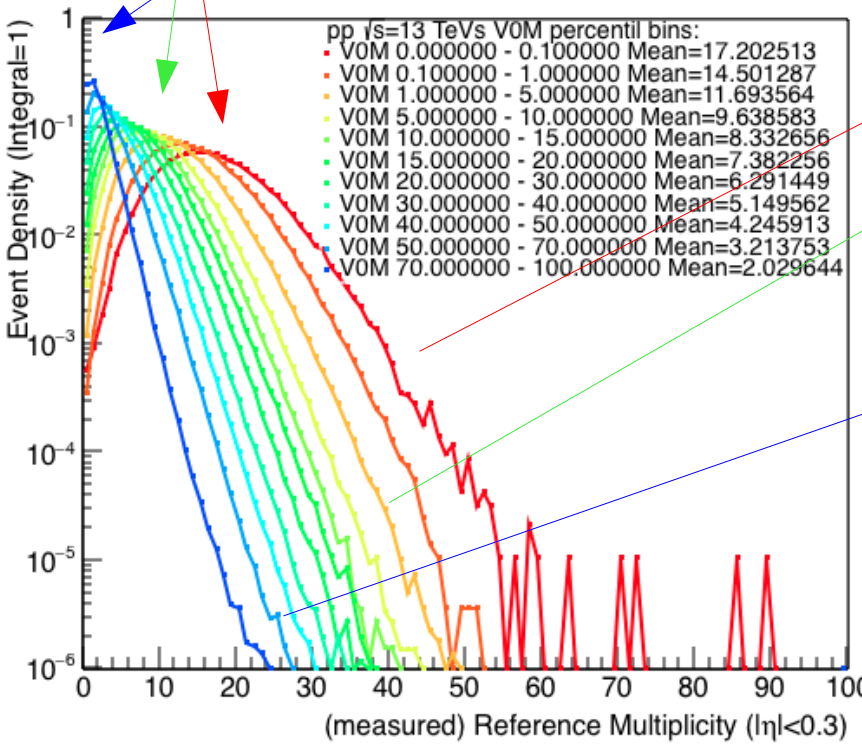
Mean P_T from V0M percentils to <d*N*/deta>$_{|eta|<0.3}$

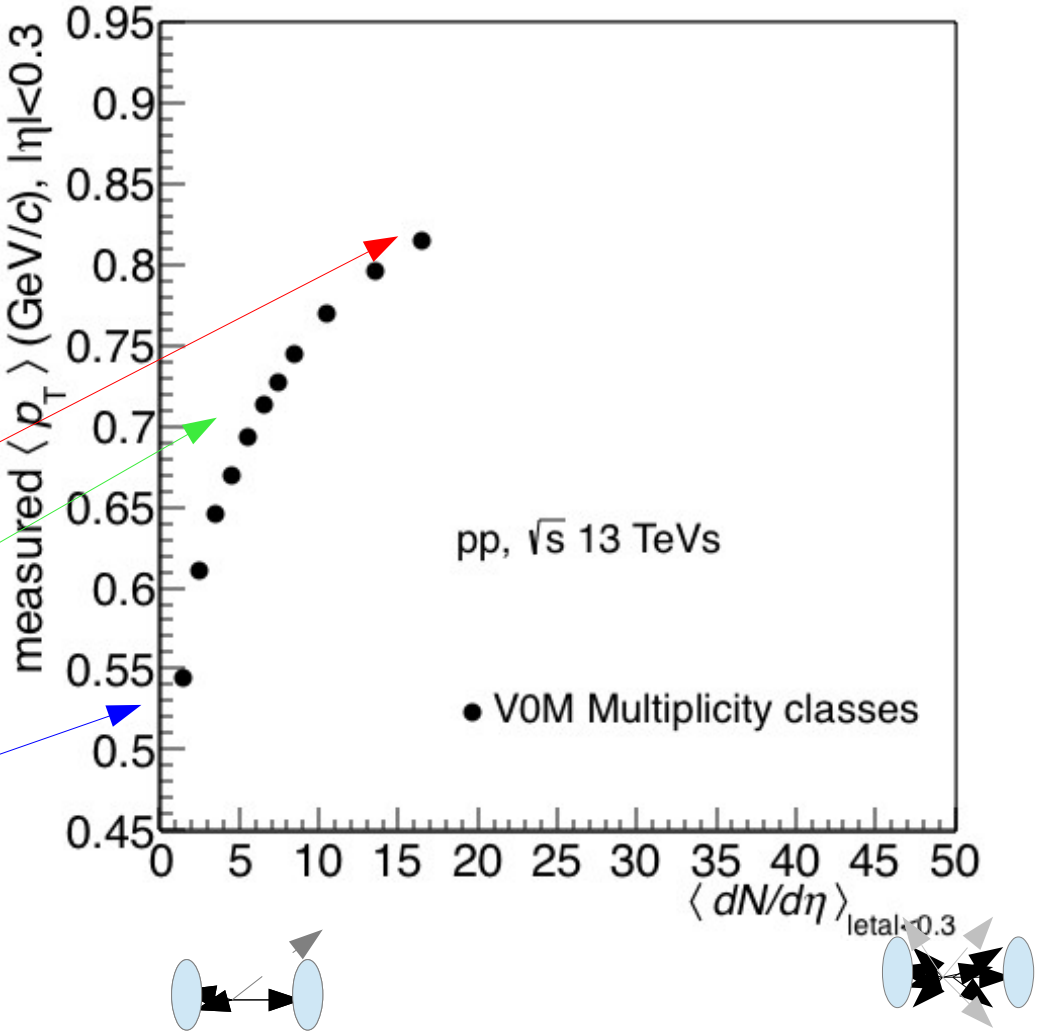
Without efficiency corrections



High P_T

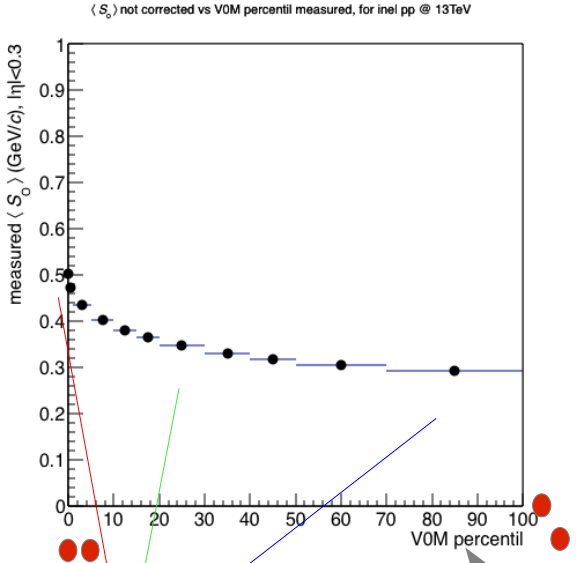
Low P_T





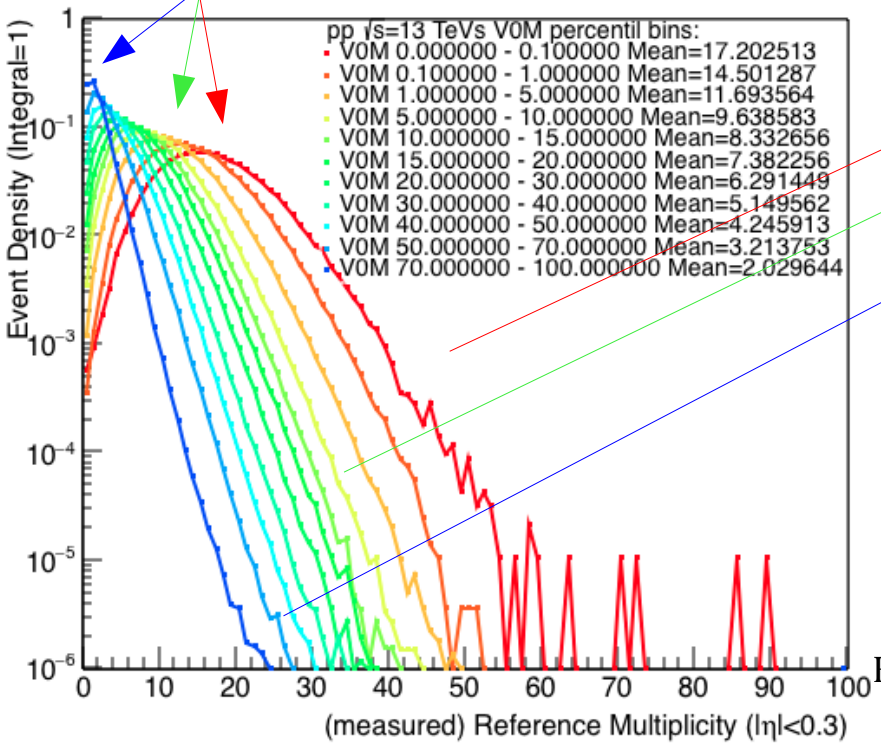
Mean So from V0M percentils to <d*N*/deta>$_{|eta|<0.3}$

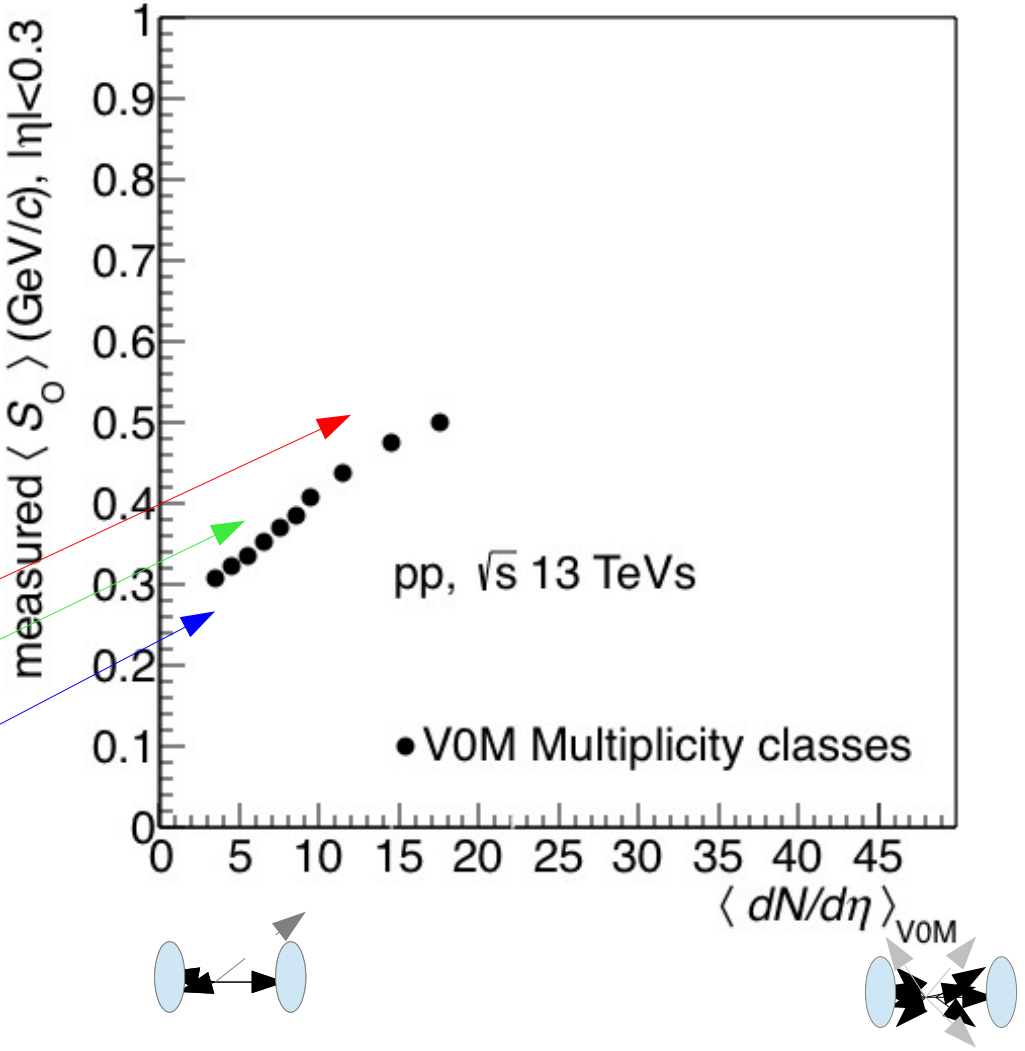
Without efficiency corrections



High So

Low So

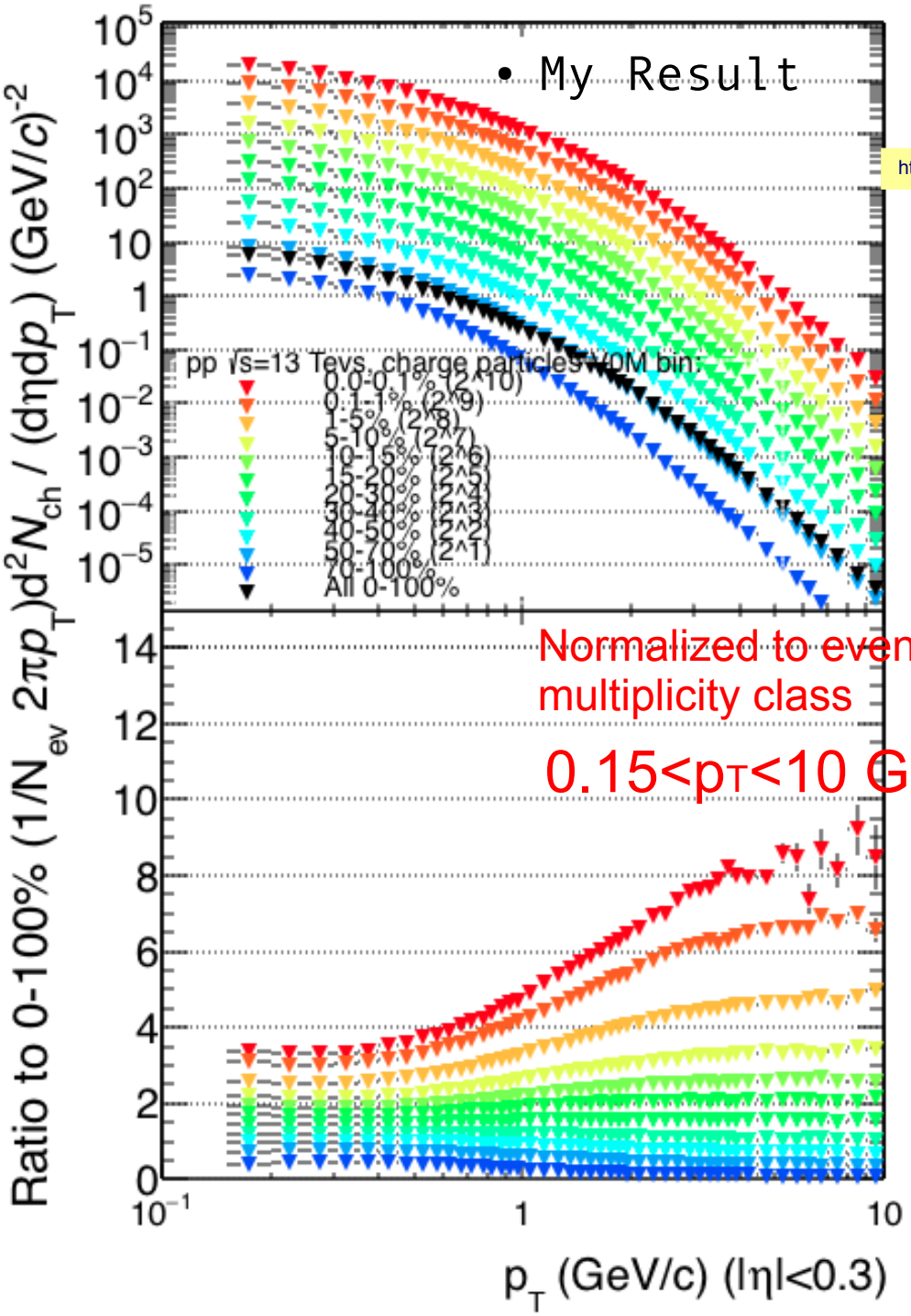




Invariant Yield for V0M percentils

- LHC15f (pass2)

- My Result

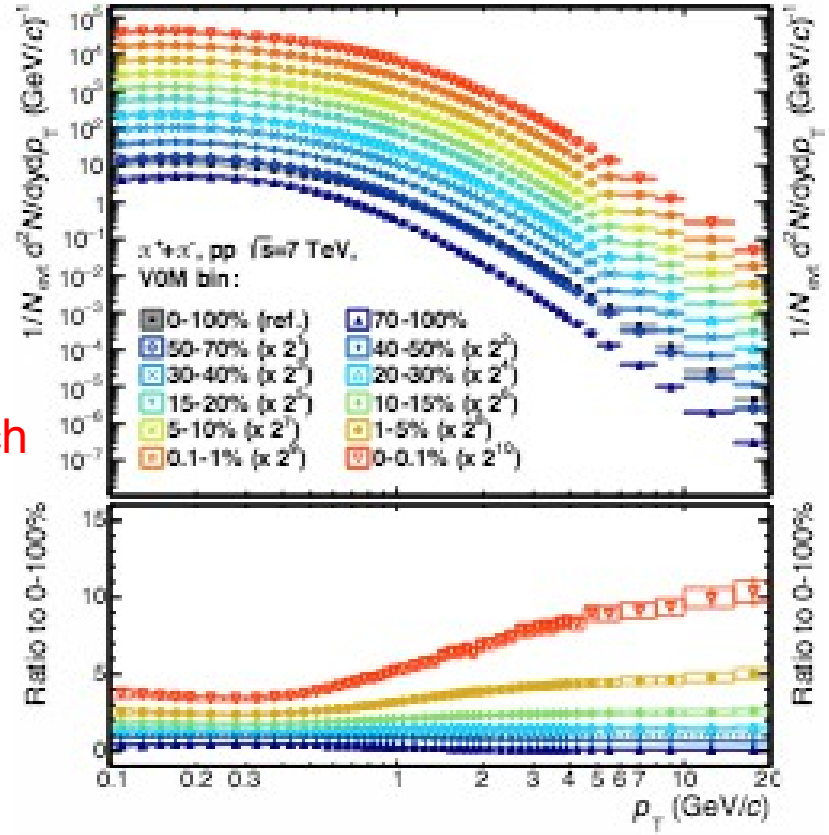


Normalized to events of each multiplicity class

$0.15<p_T<10$ GeV/c

- Vytautas et all Analysis Note

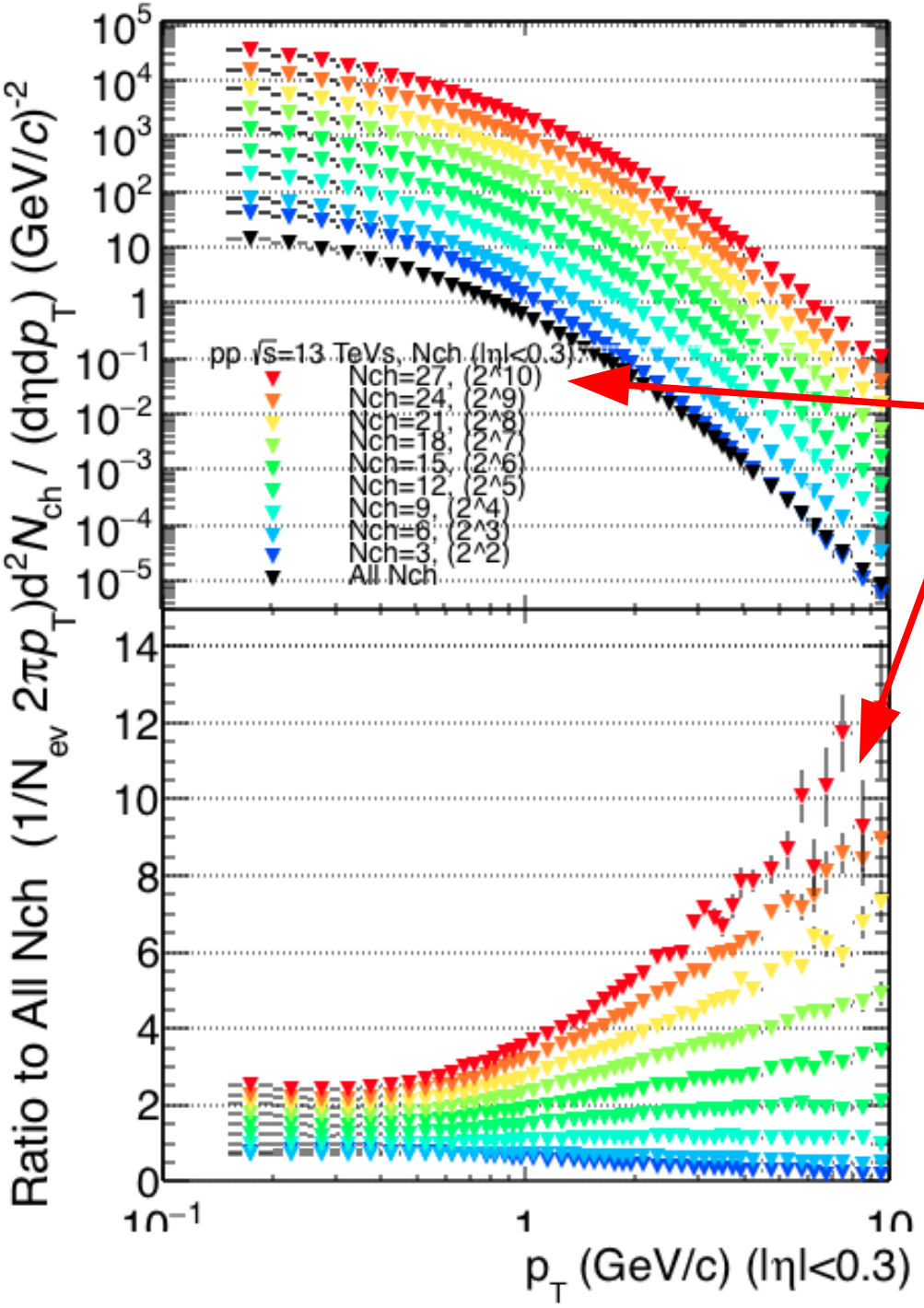
https://aliceinfo.cern.ch/Notes/sites/aliceinfo.cern.ch.Notes/files/notes/analysis/akalweit/2015-Sep-15-analysis_note-A



no (1/2pi*p_T) normalization

$0.15<p_T<20$ GeV/c

Invariant Yield for Reference multiplicity estimator

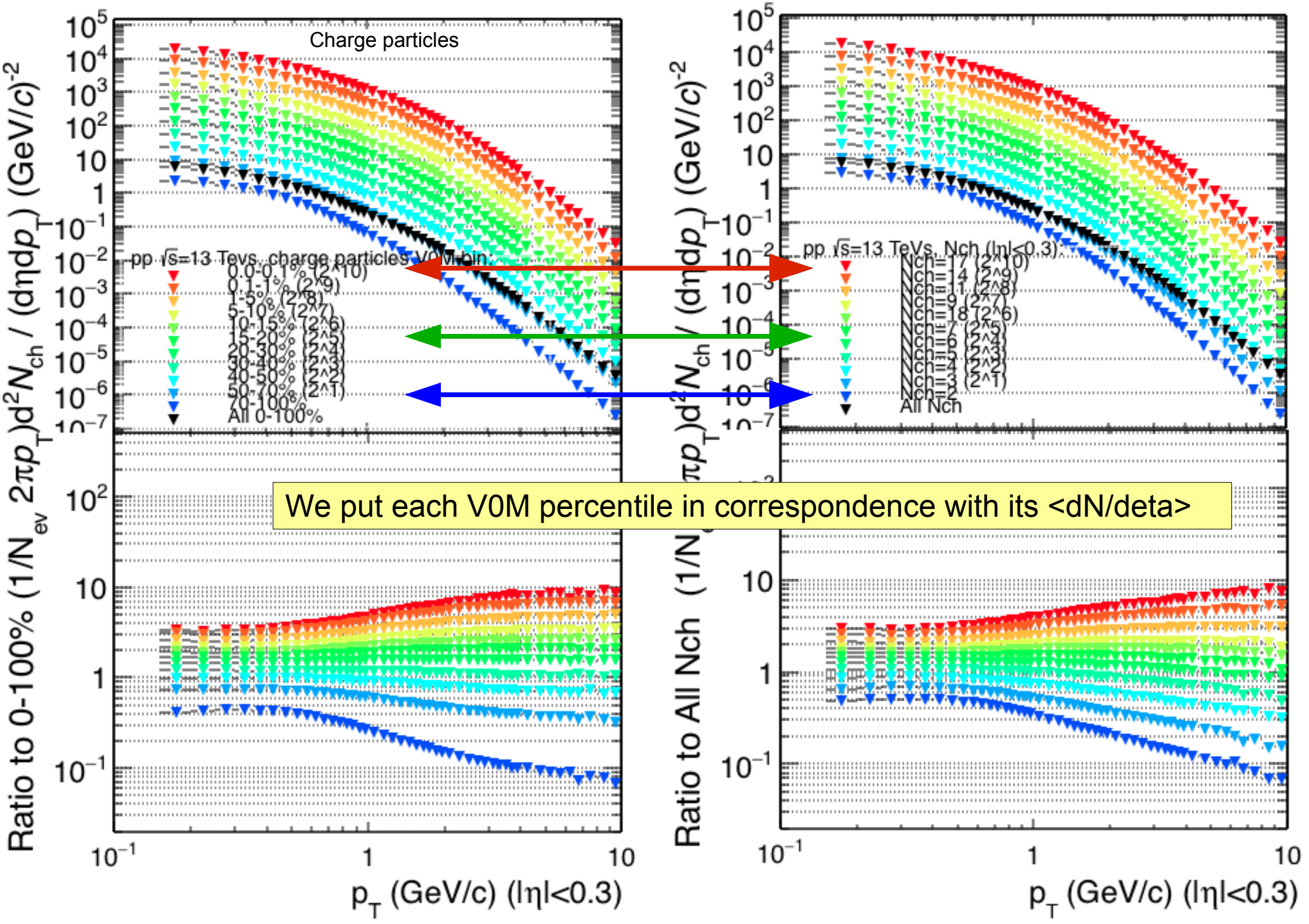


We reach Nch=27

We want to check the spectra behaviour when we take *N*ch= <d*N*/deta>$_{|eta|<0.3}$ For each V0M multiplicity class.

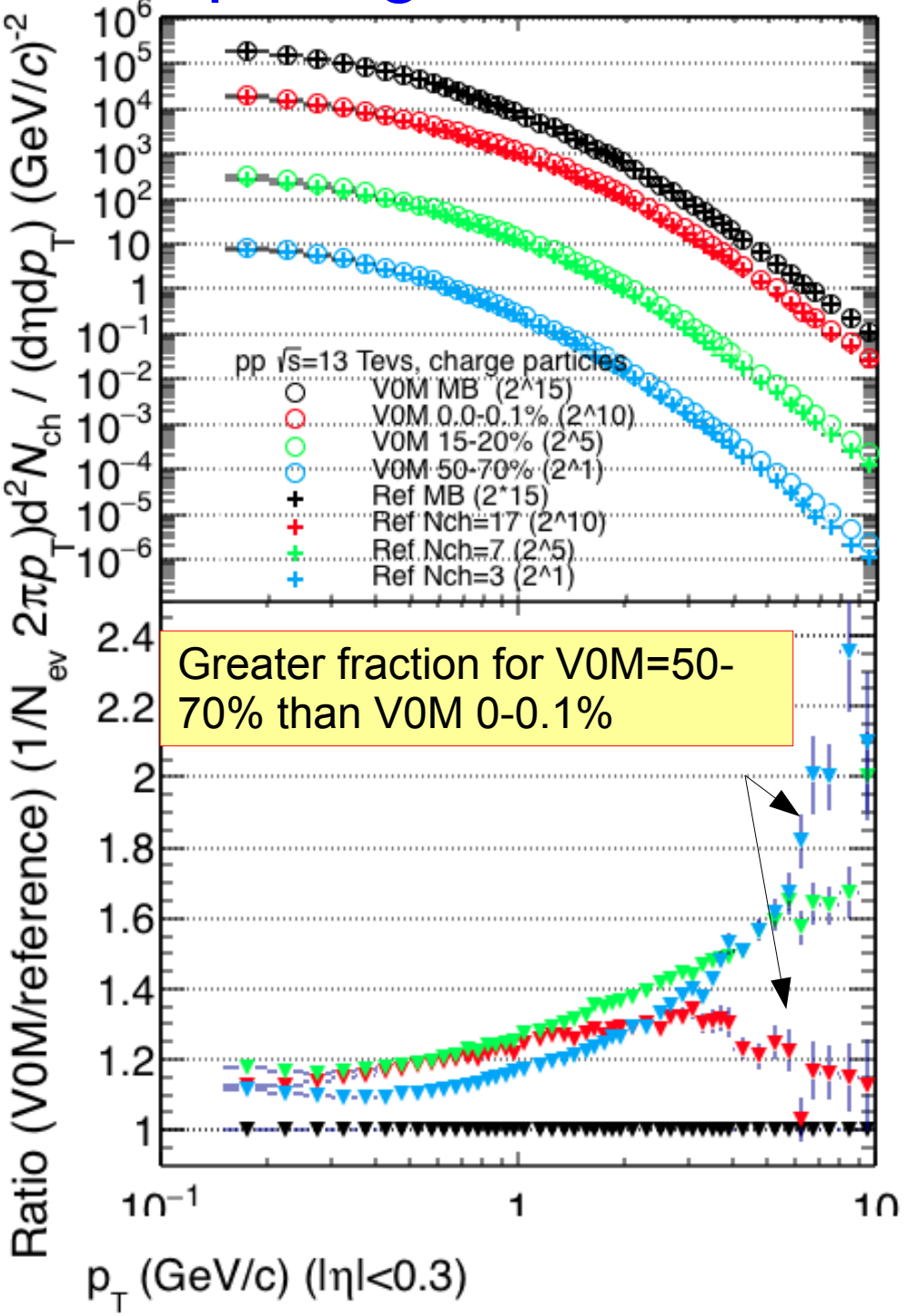
See next slide.

Comparing for V0M percentils and N_{ch} for its <dN/deta>

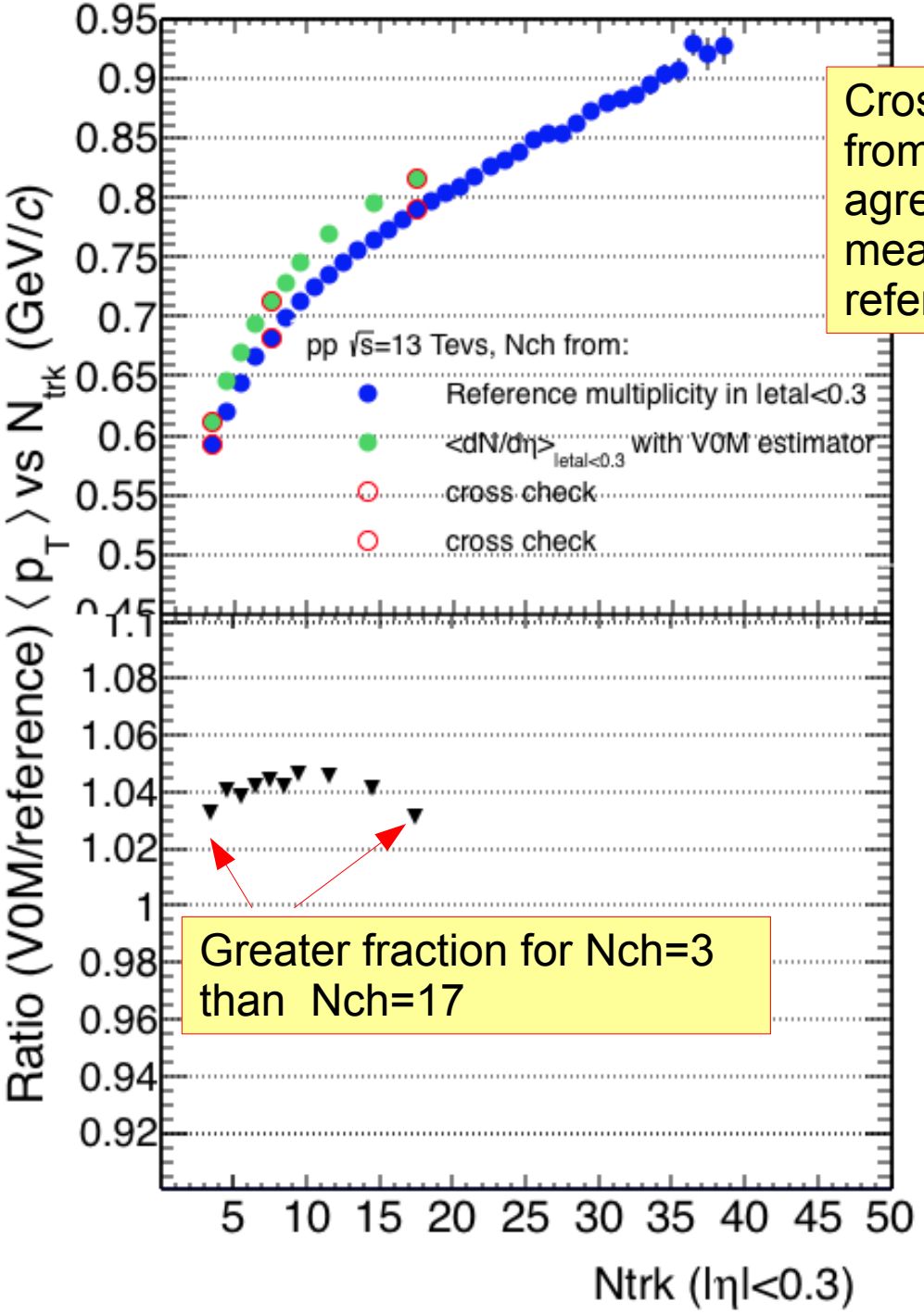


We put each V0M percentile in correspondence with its <dN/deta>

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 <p_T>



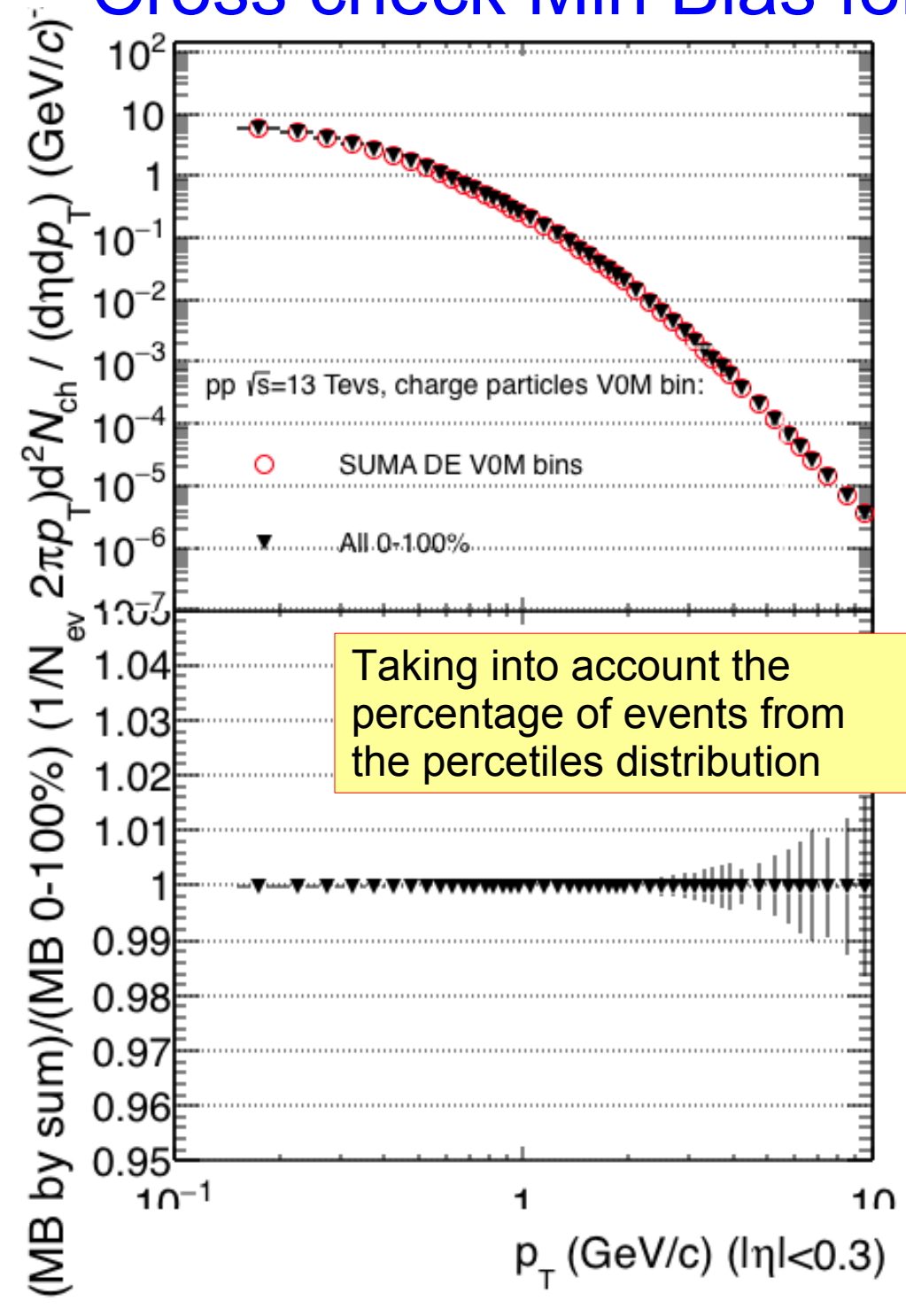
Cross check in <pT> got from the 3 spectra in good agrement with the measurements for V0M and reference estimators

Greater fraction for Nch=3 than Nch=17

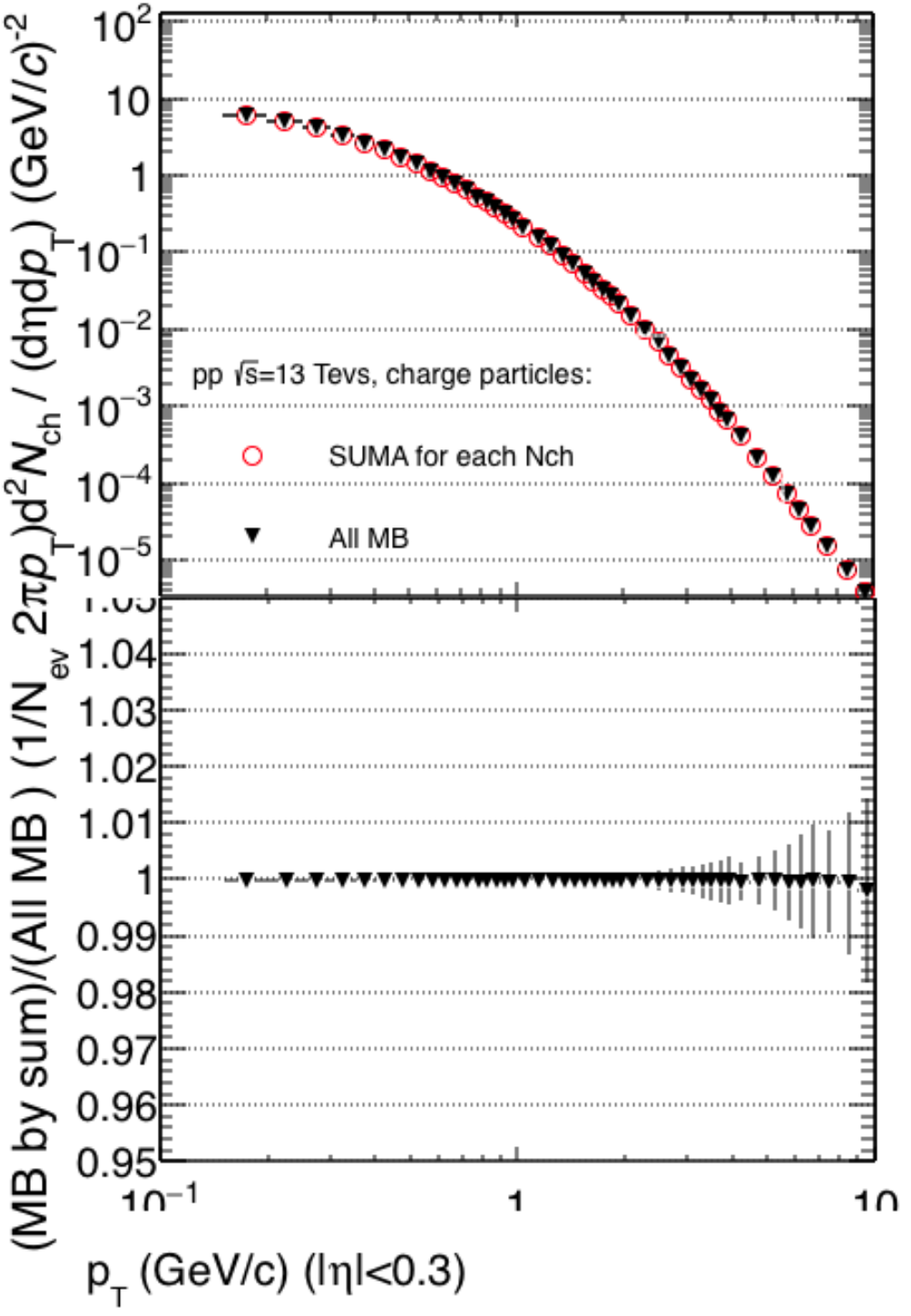
To check the spectra for each V0M multiplicity class is the right one, I made the weighted average in order to get the MB results.

(See next slide)

Cross check Min Bias for V0M and Reference



Taking into account the percentage of events from the percetiles distribution

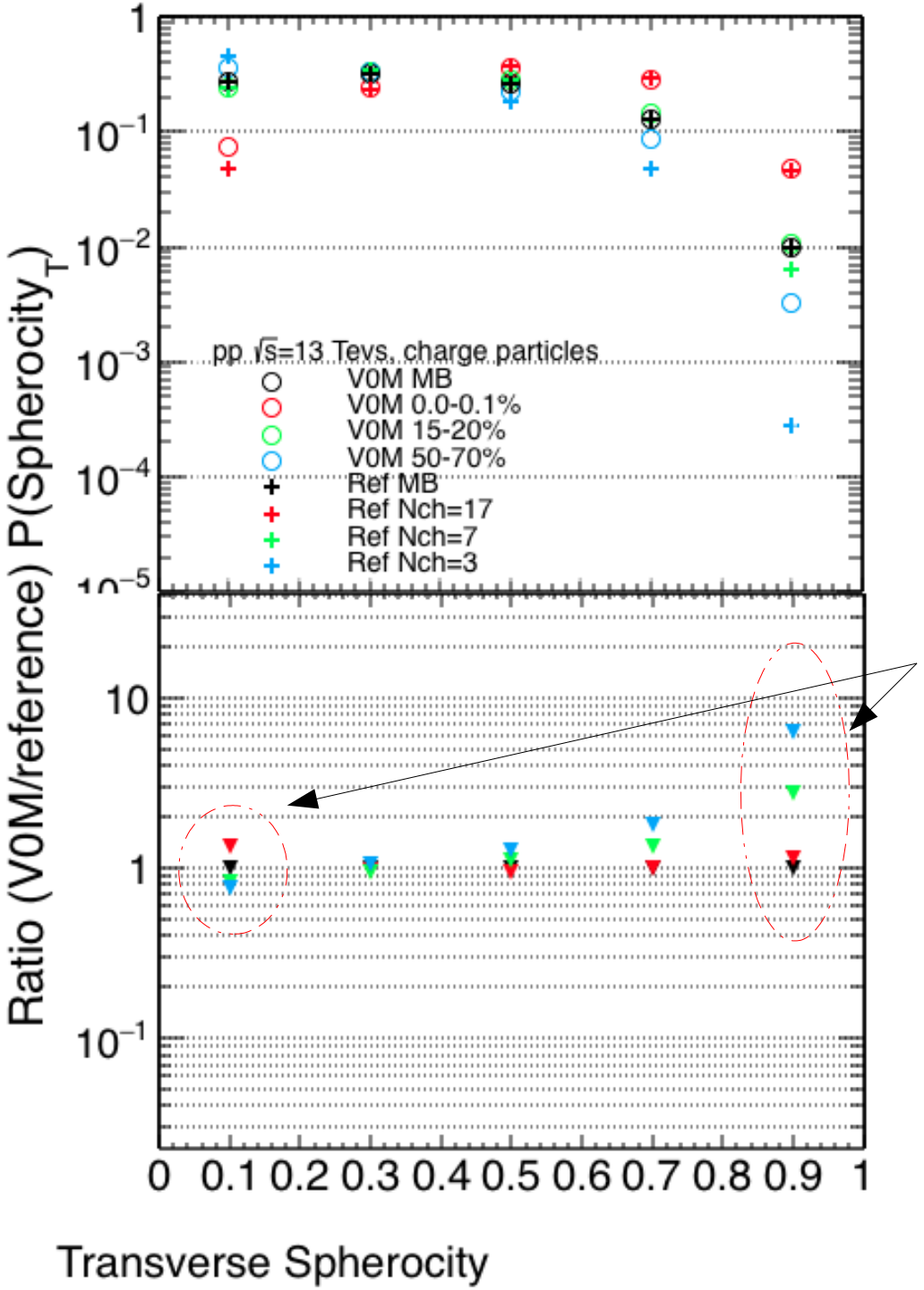


First Conclusion

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 So with estimators V0M and Ref | eta| <0.3

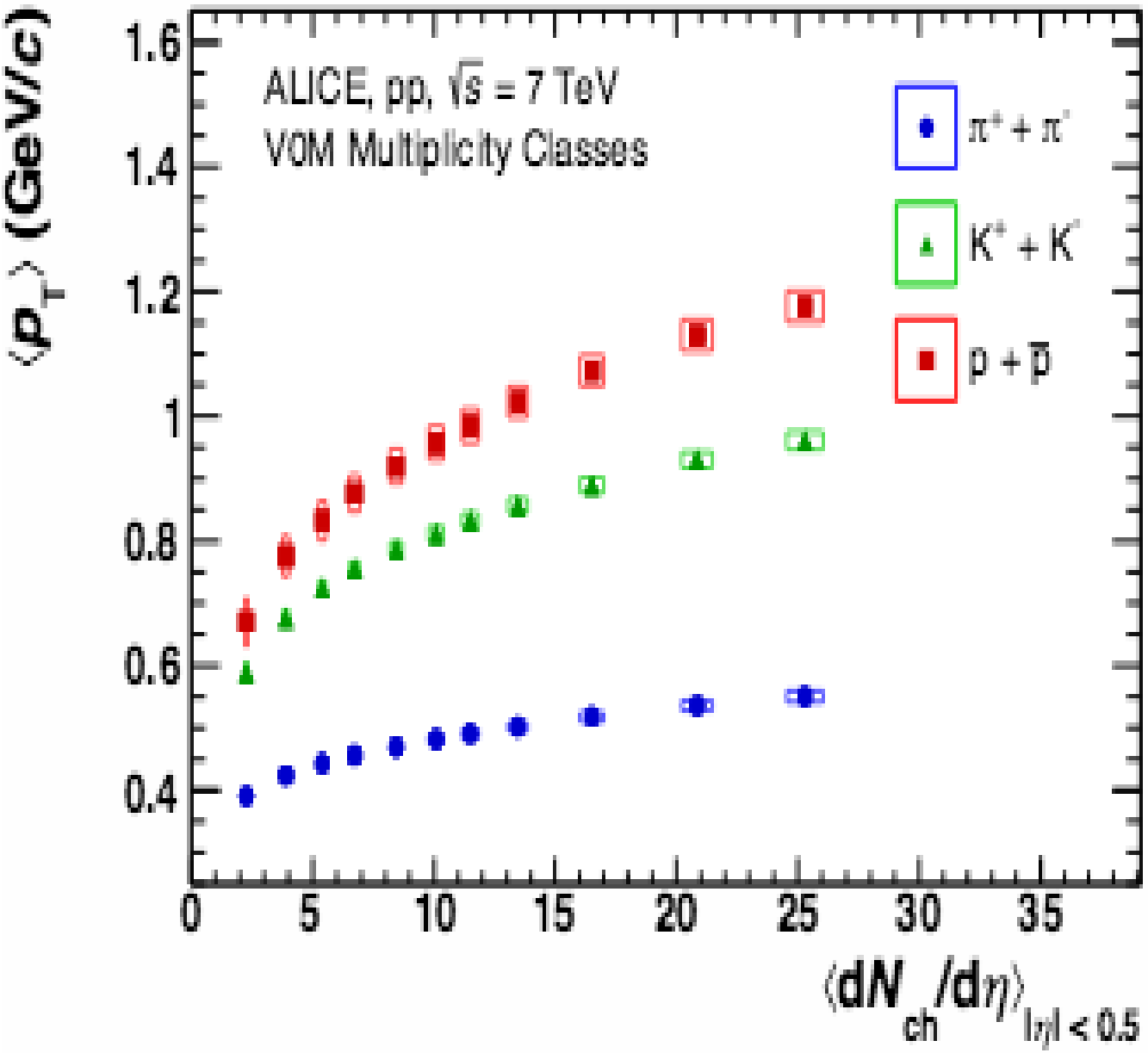


Greater difference for isotropic events specially for low *N*ch

Mean Pt for <dN/deta>

- Vytautas et all Analysis Note

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/Spherocity)
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,

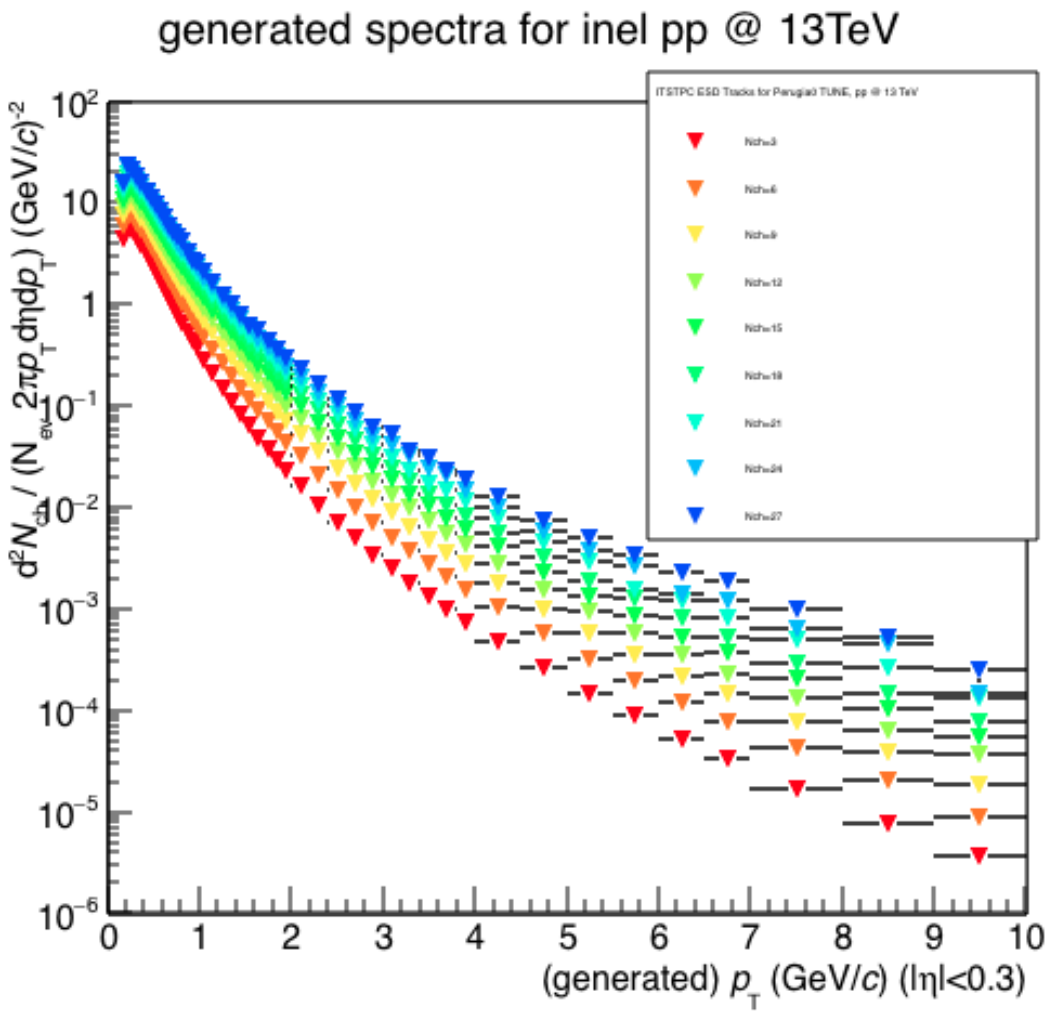
Pass2
LHC15f pass2: (59 mill of evts) good runs
MC Pythia6 Perugia 2011 **LHC15g3c3** 50 mill.
MC Pythia8 Monash 2011 **LHC15g3a3**: 40 mill,

Track selection taken for each analysis:

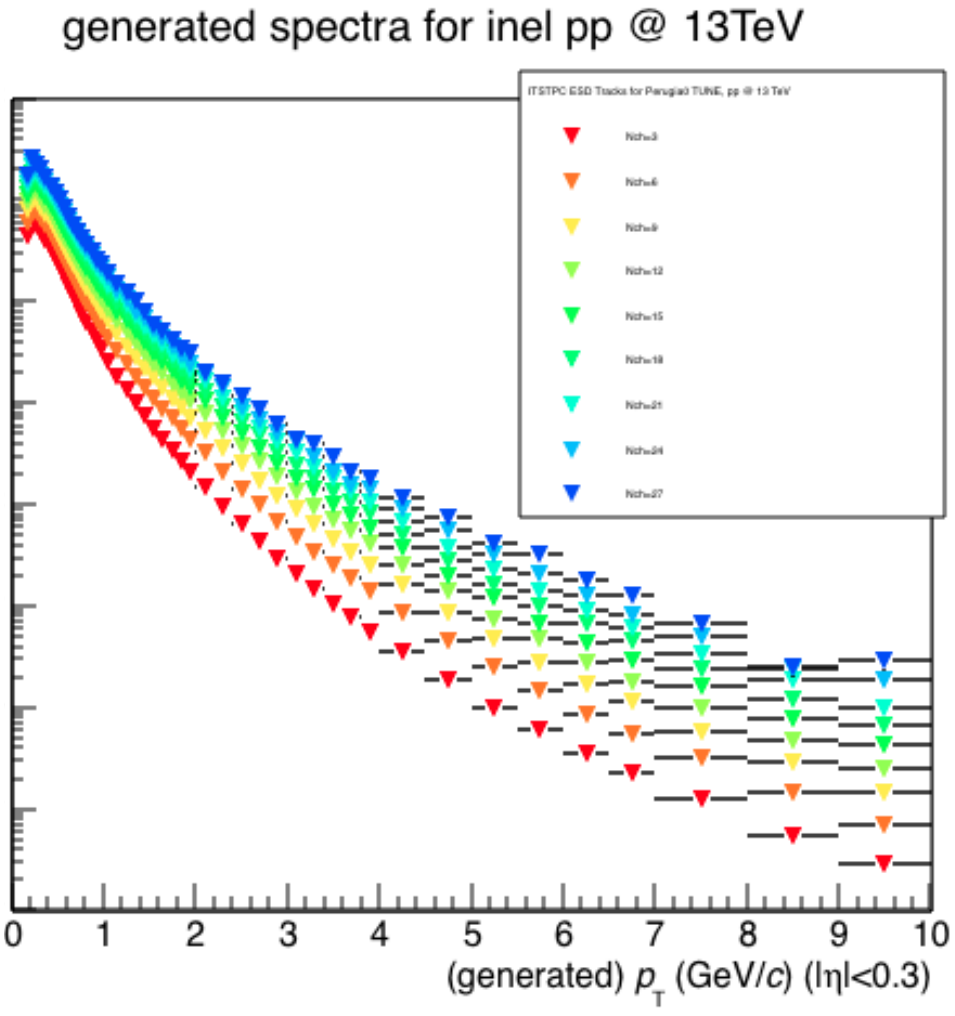
- So Analysis, Hybrid-track cuts for primary charged particles with $|\eta|<0.3$ and $0.15<p_T<10$ GeV/c.
- $<p_T>$ Analysis, Golden-track cuts with $|\eta|<0.3$ and $0.15<p_T<10$ GeV/c.
- Multiplicity, Reference multiplicity selection with $|\eta|<0.3$

Invariant yield spectra for MC full pass2

LHC15g3c3
Pythia6 Perugia 2011

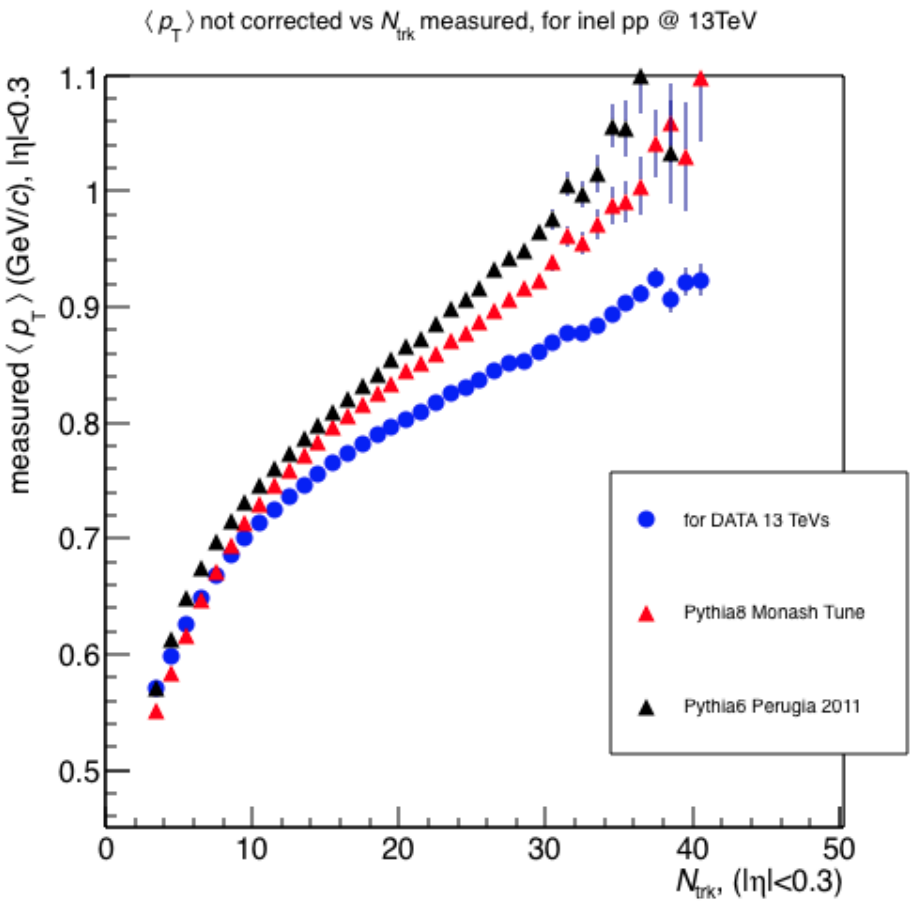


LHC15g3a3
Pythia8 Monash

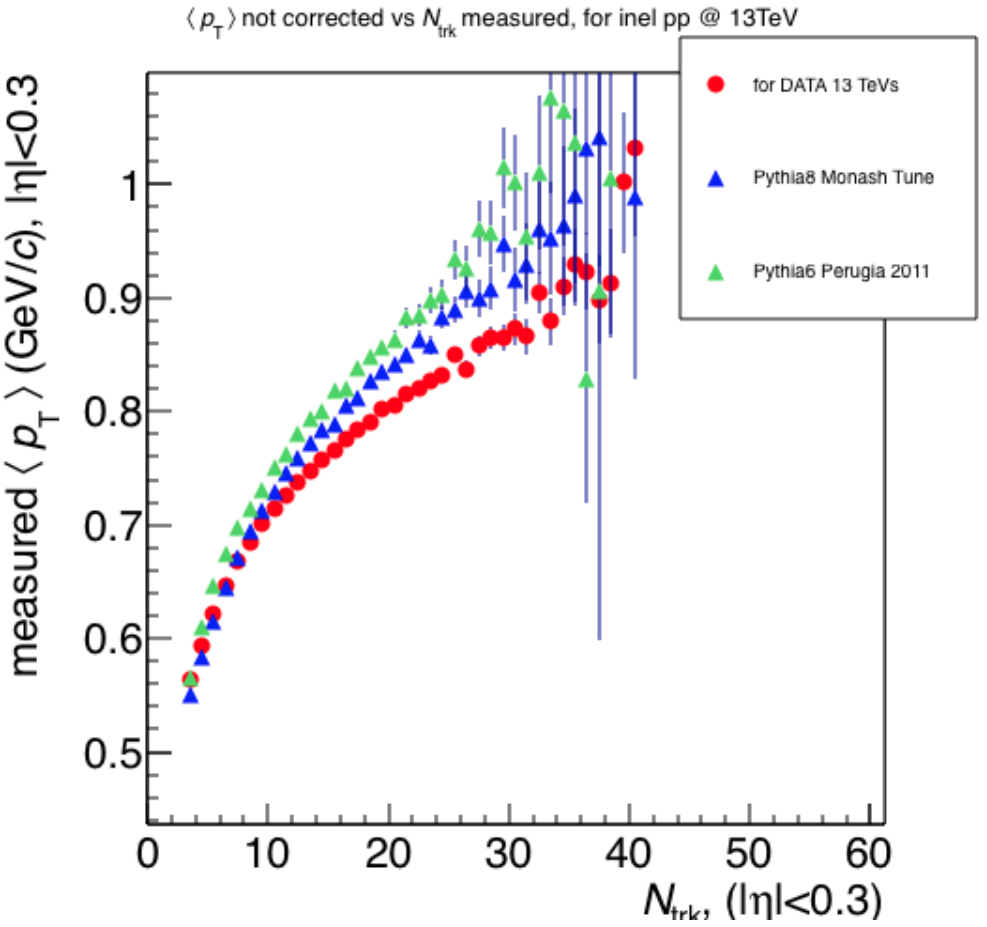


Mean Transverse Momentum

Full Pass2

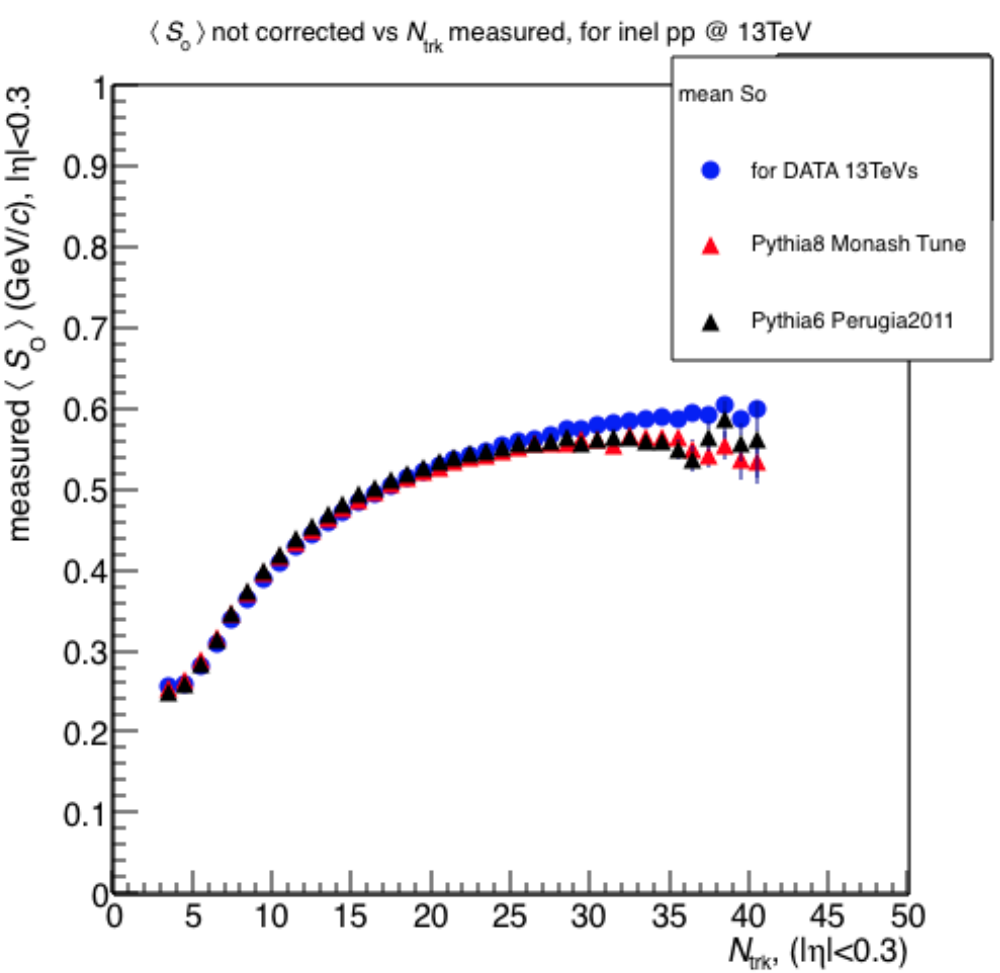


test_pass2

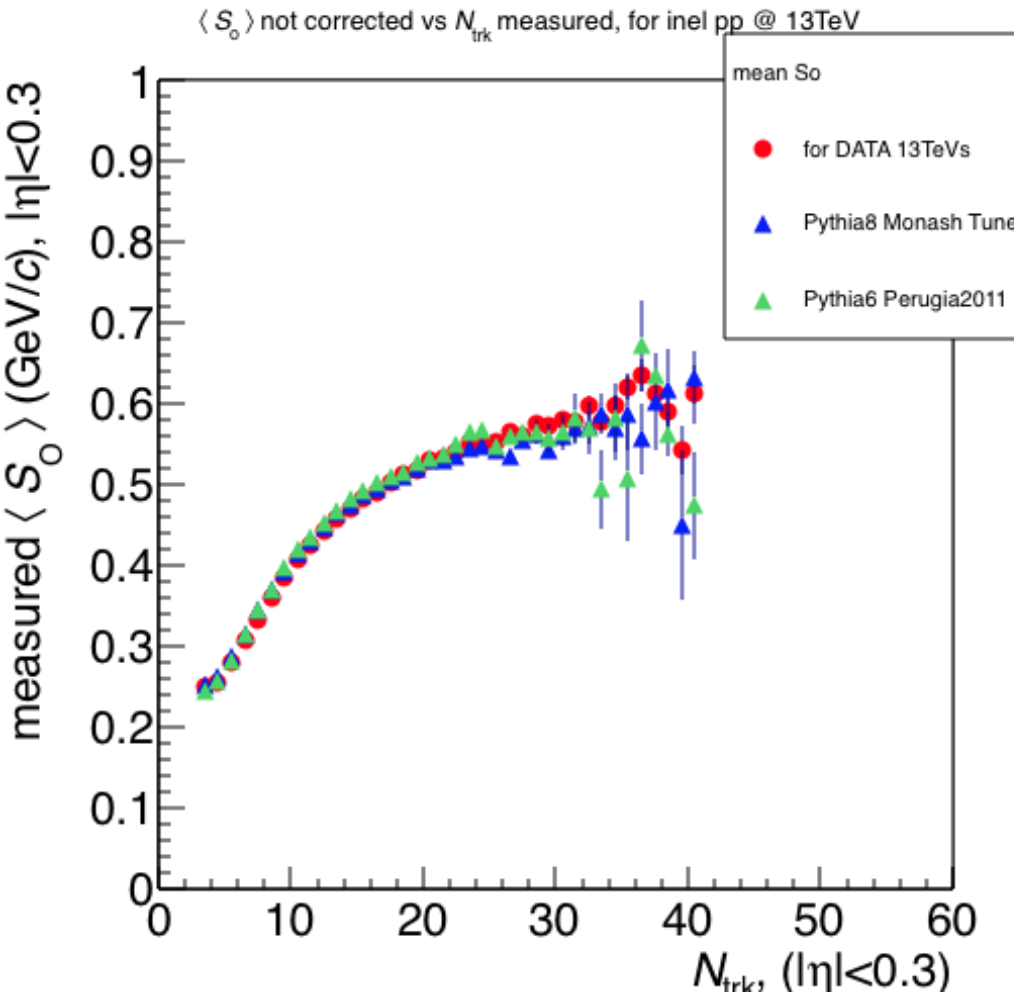


Mean Spherocity

Full Pass2

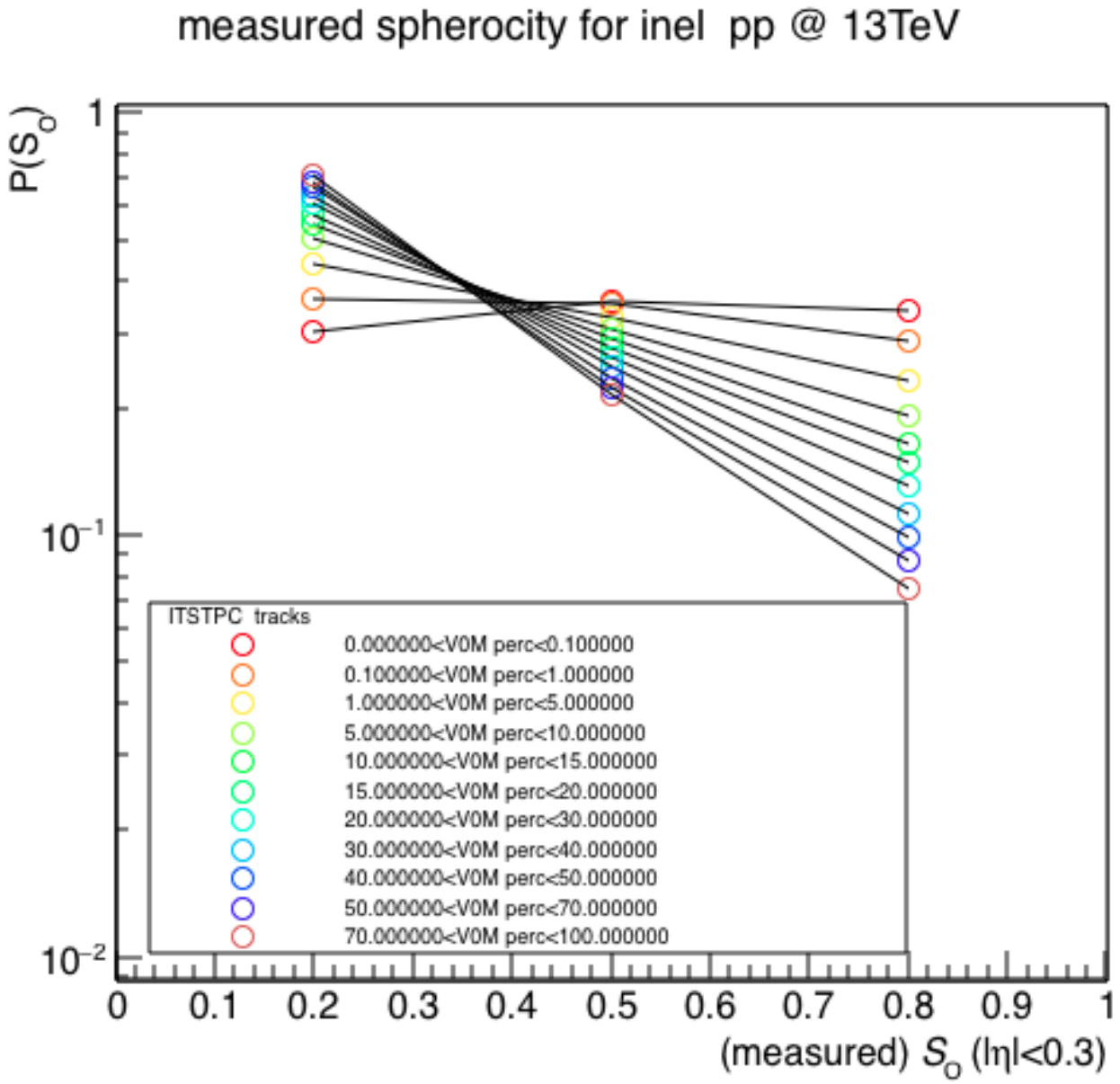


test_pass2



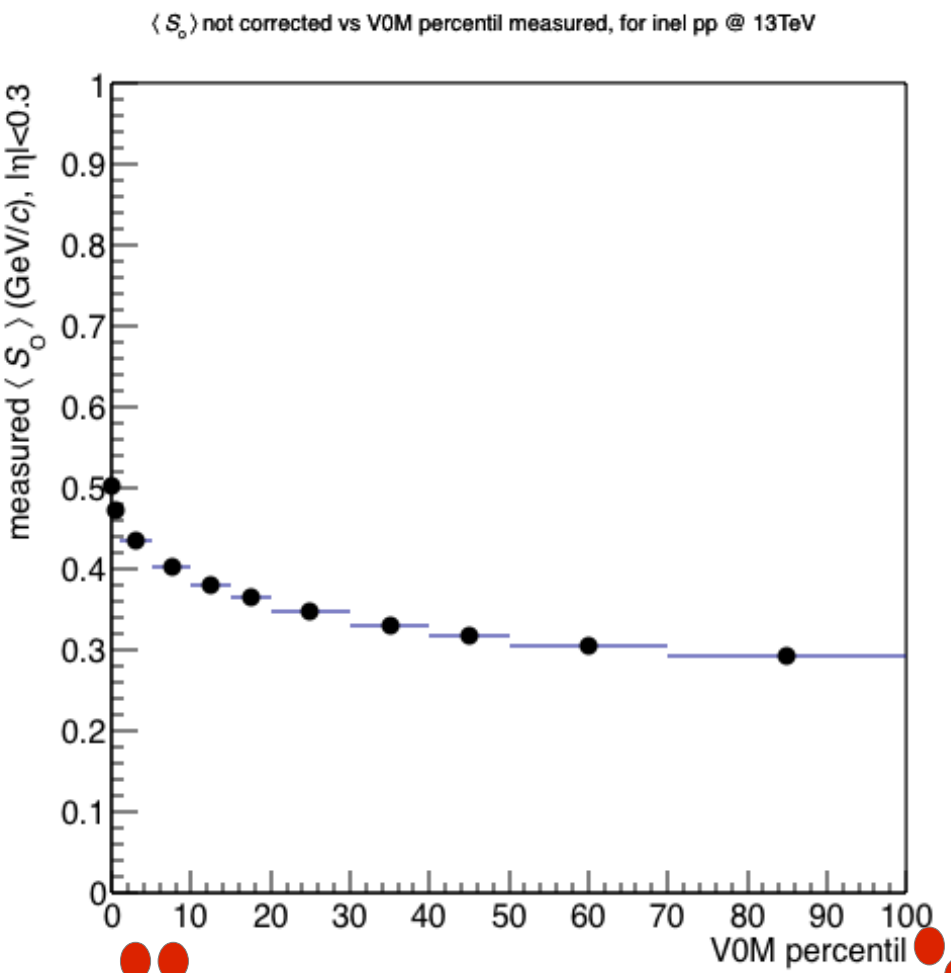
Probability of Spherocity for V0M percentils

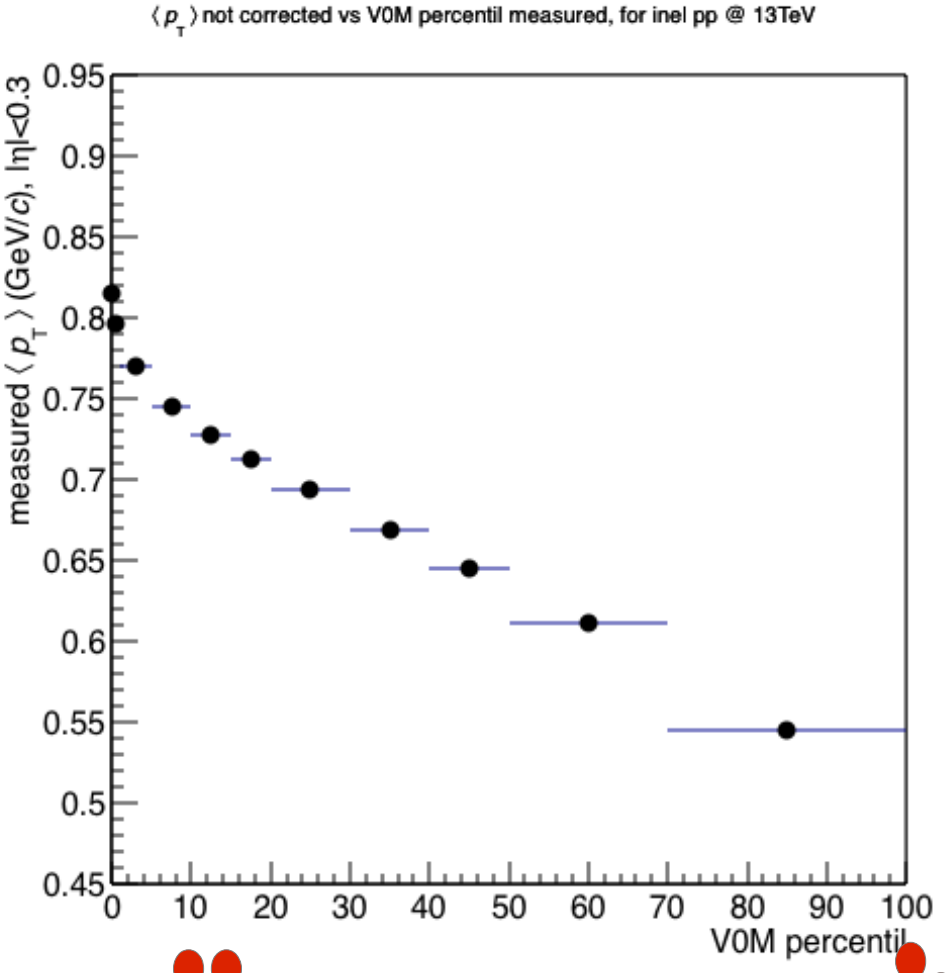
- LHC15f (pass2)



variable bin corrected

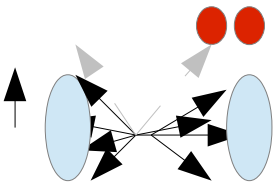
Mean So for V0M percentils • LHC15f (pass2)



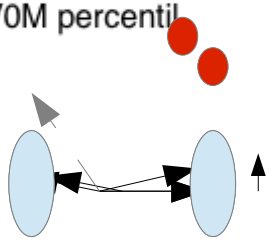


High So

Low So



High pT

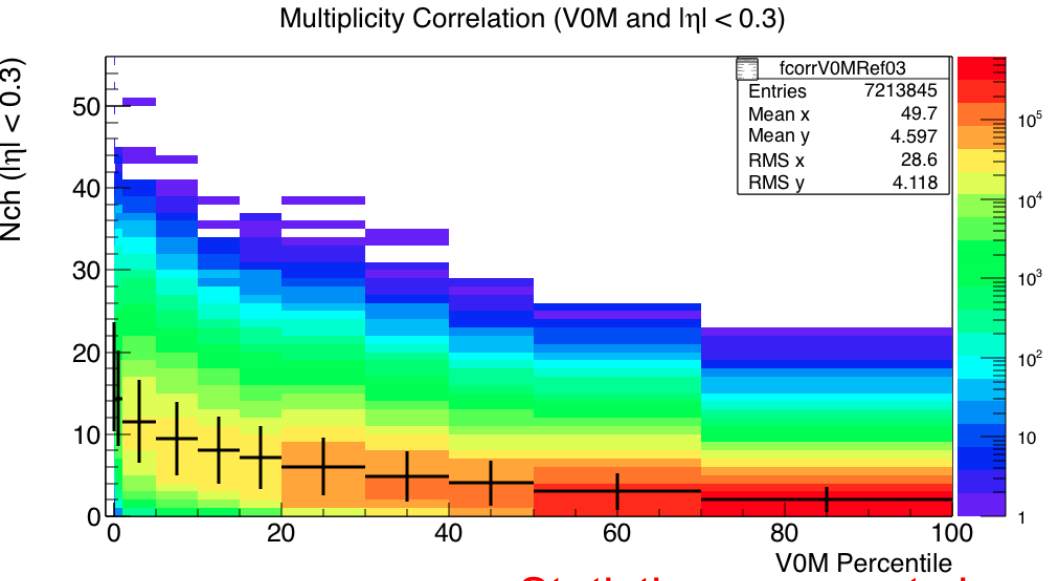


Low pT

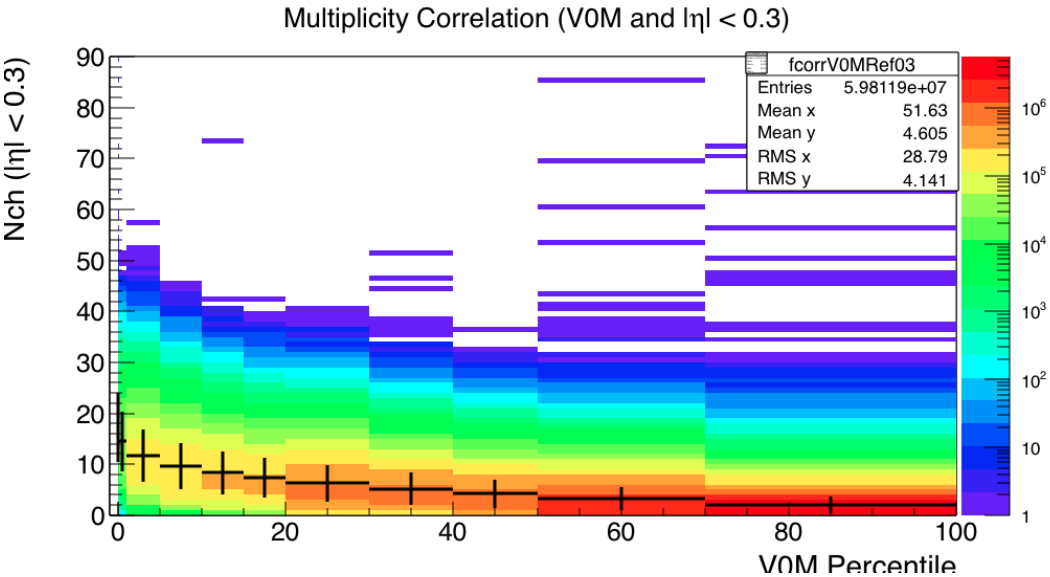
```
V0MbinsDefault={0.0,0.1,1.0,5.0,10.0,15.0,20.0,30.0,40.0,50.0,70.0,100.0};
```

Multiplicity correlation (midrapidity vs V0M percentils)

- LHC15f (test pass2)



- LHC15f (pass2)



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

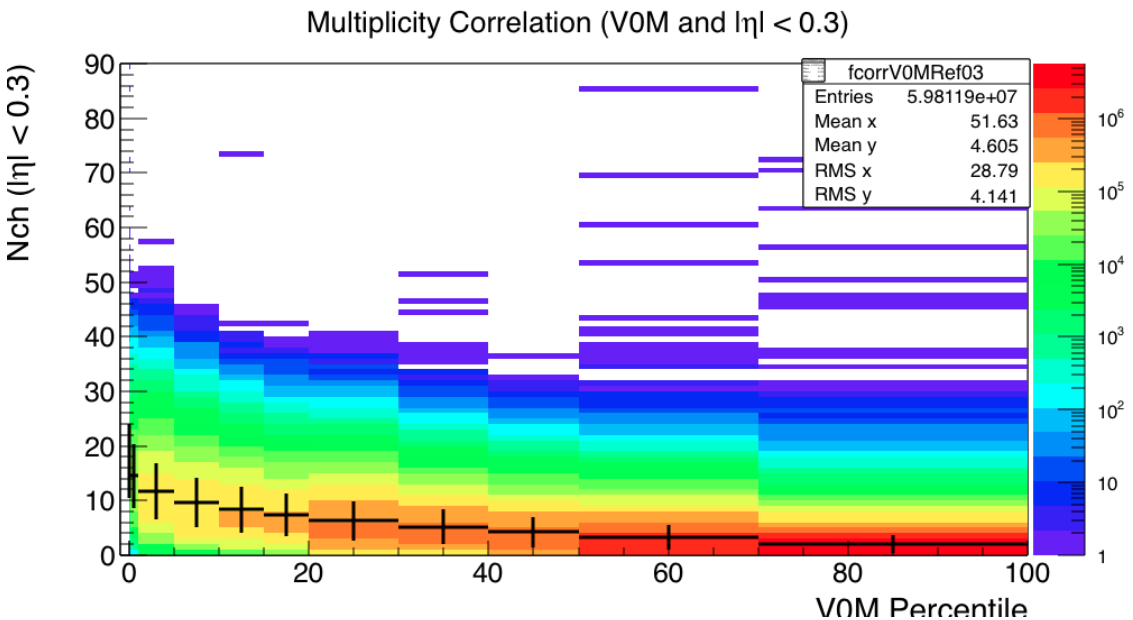
Proposal for the baseline common multiplicity binning scheme

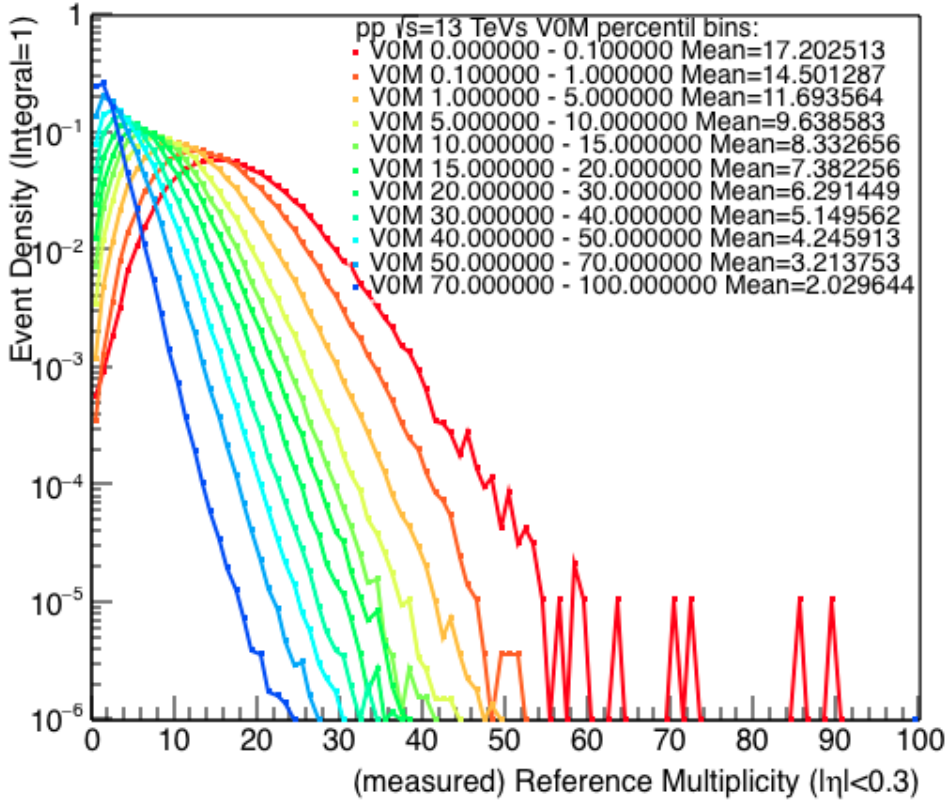
- V0M quantile
- no need to put fraction of cross-section: that's already there by definition.
- [0.00, 0.01] [0.01,0.10] [0.10, 1.0] [1.0, 5.0] [5.0, 10.0] [10.0, 15.0] [15.0, 20.0] [20.0, 30.0] [30.0, 40.0] [40.0, 50.0] [50.0, 70.0] [70.0, 100.0]

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};
```

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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 <dN/deta> • LHC15f (pass2)