ALICE

Properties of the systems created in pp and pA collisions in ALICE at the LHC

5to AVANCE DE TESIS

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AVANCE
De Tesis

02 junio 2016

Outline

Spherocity Analysis with V0M (ESD LHC15f,ESD MCs Monash & Perugia2011)

- -Mean p_T comparison V0M/REF
- -Mean S_o comparison V0M/REF
- -Yields comparison V0M/REF
- -P(S_o) comparison V0M/REF
- -Multiplicity greater,equal and less than $<N_{ch}>$.
- -Spherocity separation jetty, intermediate and isotropic

MC analysis, Jet effects Epos vs Pythia

- -Proton to Pion ratio
- -Blast Wave Analysis for samples inclusive, with and without jets.

Conclusions

Spherocity Analysis with V0M

Analysis and run selection

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

Event shape classes: (PWGLF/SPECTRA/Spherocity)

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

LHC15f pass2: (55 mill of evts) - 54-50
LHC15g3a3 Monash Tune (52 mill of evts)
LHC15g3c3 Perugia 2011 (49 mill of evts)
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, 225579, 225578, 225576, 225322, 225315, 225314, 225313, 225310, 225309, 225307, 225305, 225106, 225052, 225051, 225050, 225043, 225041, 225037, 225035, 225031, 225026

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

Spherocity Analysis with V0M

Event, track and physics selection

Event Selection

Trigger: KINT7 (*Thanks to Gyula*)
Rejection of AliESDEvent::IsIncompleteDAQ (aplied last time)
Vertex selection
SPD Pile-up rejection
Background rejection (aplied last time)
Multivertex Pile-up rejection (new)
low diagonal cut OFO &V0M applied (new)

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

**https://twiki.cern.ch/twiki/bin/view/ALICE/AliceHMTFCodeSnippets#Physics_Selection

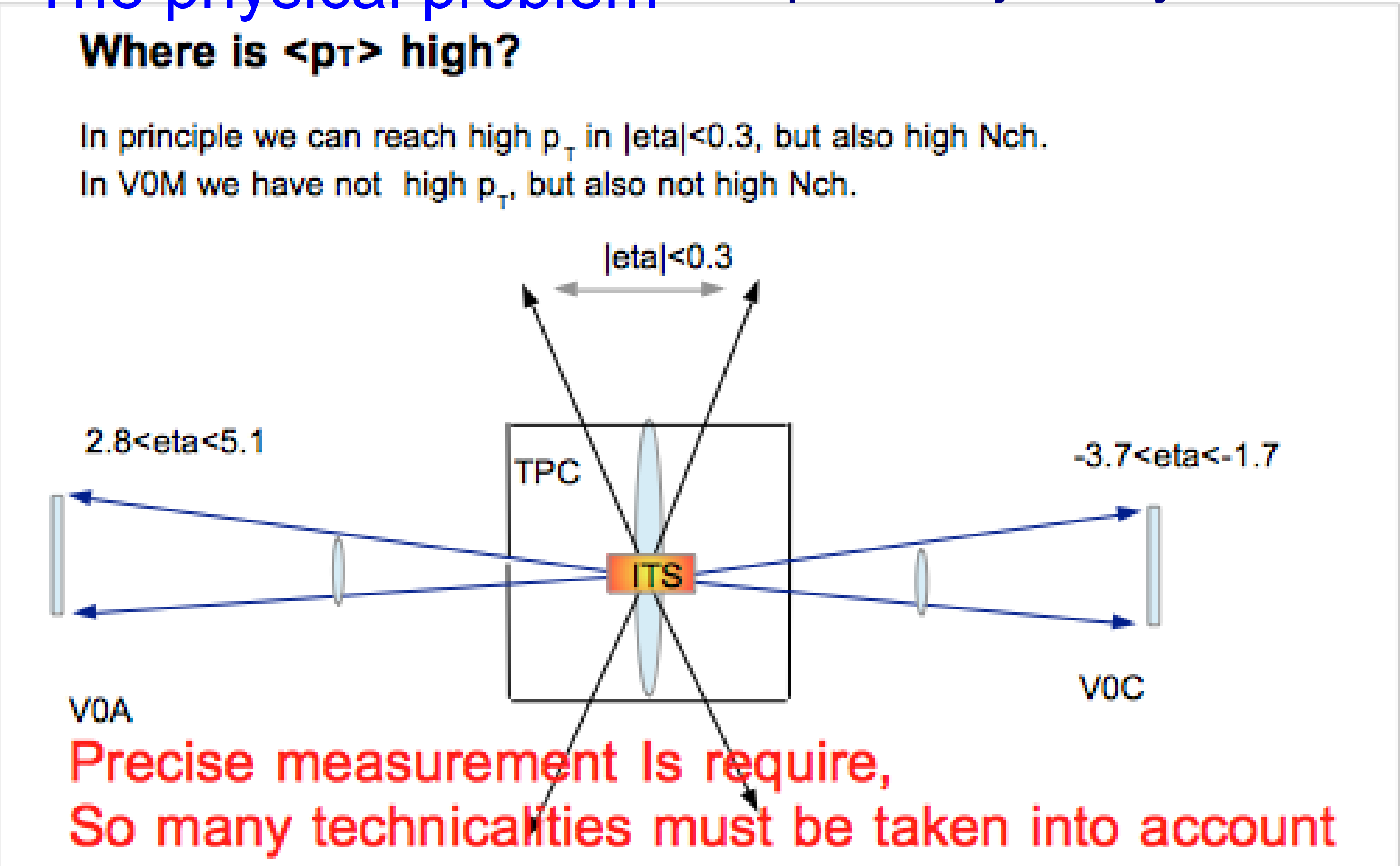
Physics Selection

- 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 $|\eta|<0.3$ (0.8) and $0.15<p_T<10$ GeV/c.
- $\langle p_T \rangle$ Analysis, Golden-track cuts with $|\eta|<0.3$ (0.8) and $0.15<p_T<10$ GeV/c.
- Multiplicity:
  - Reference multiplicity selection with $|\eta|<0.3$ (0.8)
  -V0M percentil selection

The physical problem



Where is <p_T> high?

In principle we can reach high p_T in |eta|<0.3, but also high Nch.

In V0M we have not high p_T, but also not high Nch.

Precise measurement Is require,

So many technicalities must be taken into account

The physical problem

Where is $\langle p_T \rangle$ high?

In principle we can reach high p_T in |eta|<0.3, but also high Nch.
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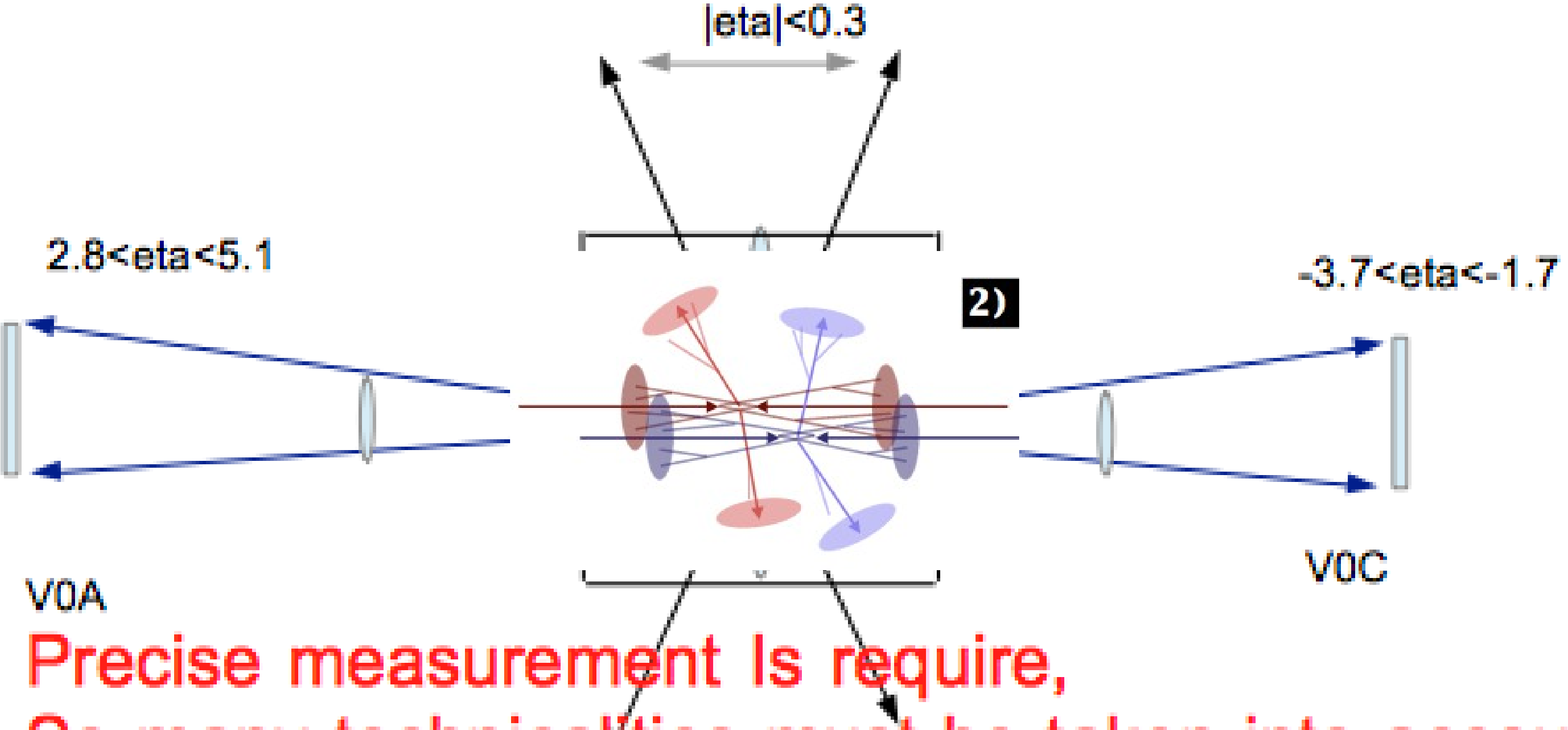


Precise measurement Is require,
So many technicalities must be taken into account

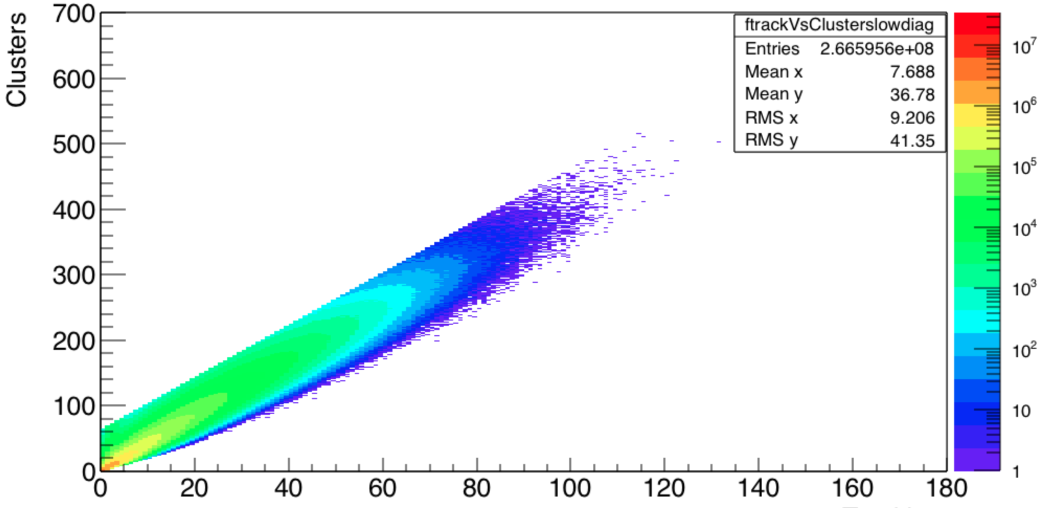
And why?

Is there any physics or any process such as MPI, CR, flow, wich can explain the behaviour?
And wich observables can help to understand this? Multiplicity? Spherocity?

Cuts to clean from PU&BG

Spherocity Analysis with V0M

With low diagonal cut SPD & V0M Off-Online FastOR:

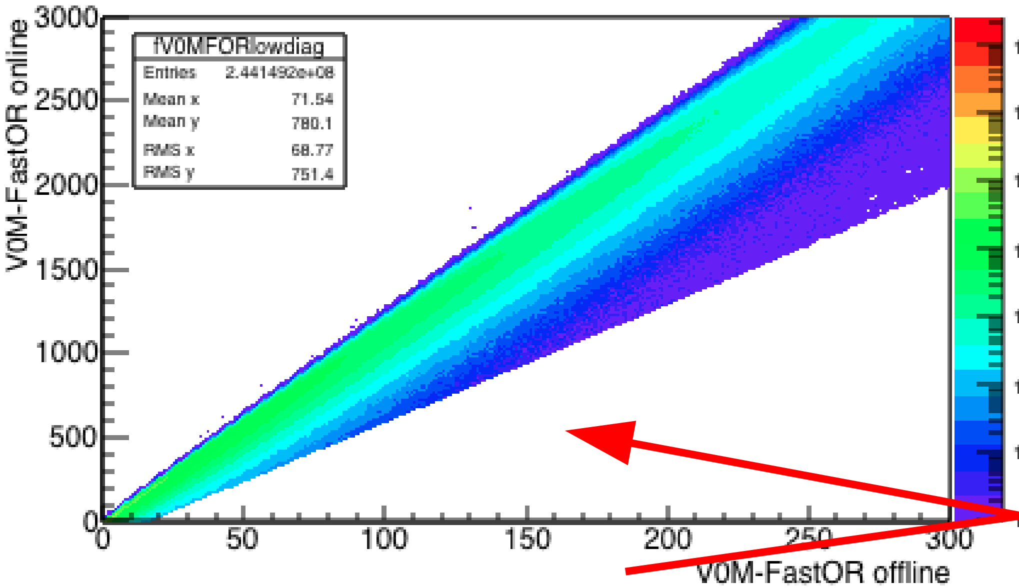


With MV pileup rejection:

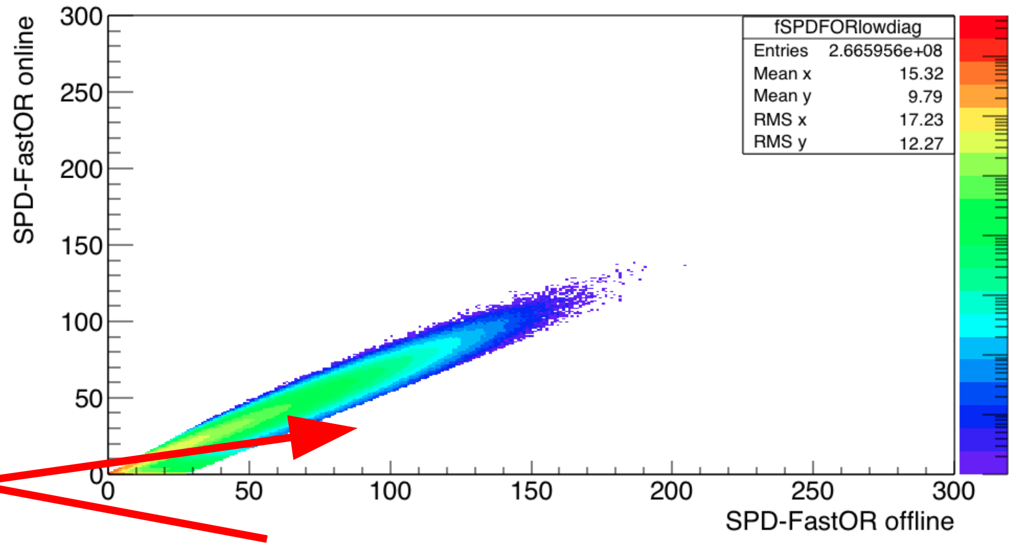
SetMinPlpContribMV=5,
SetMaxPlpChi2MV(5.0),
SetMinWDistMV(15.0), S
SetCheckPlpFromDifferentBCMV=kFALSE

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

V0M-FastOR offline vs V0M online after low diag cut

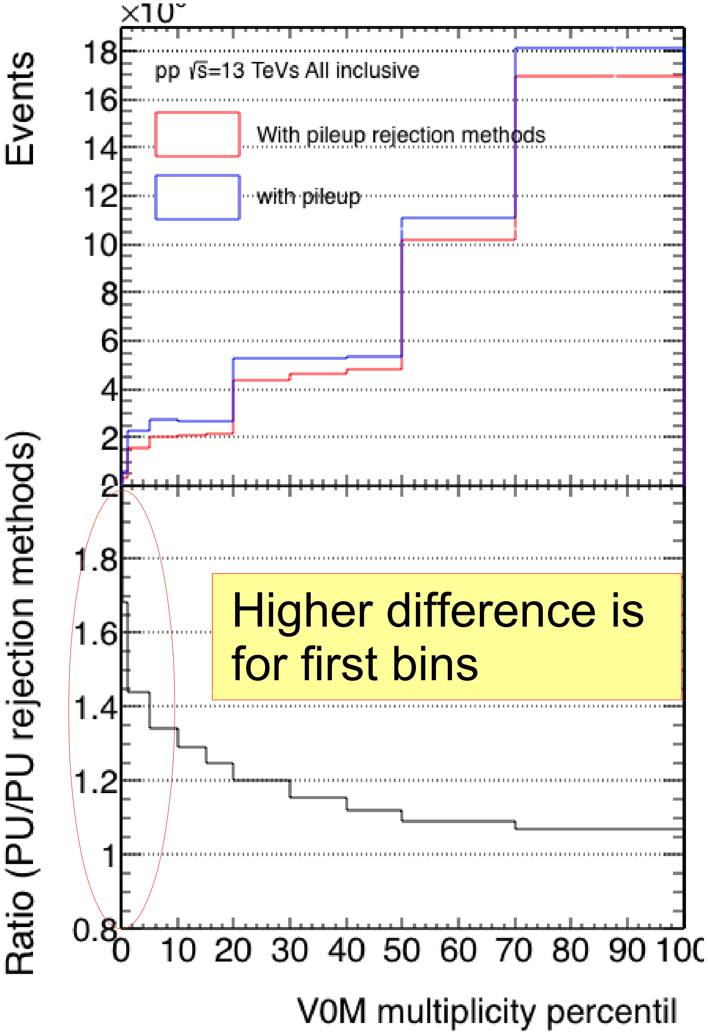


SPD-FastOR offline vs SPD online after low diag cut

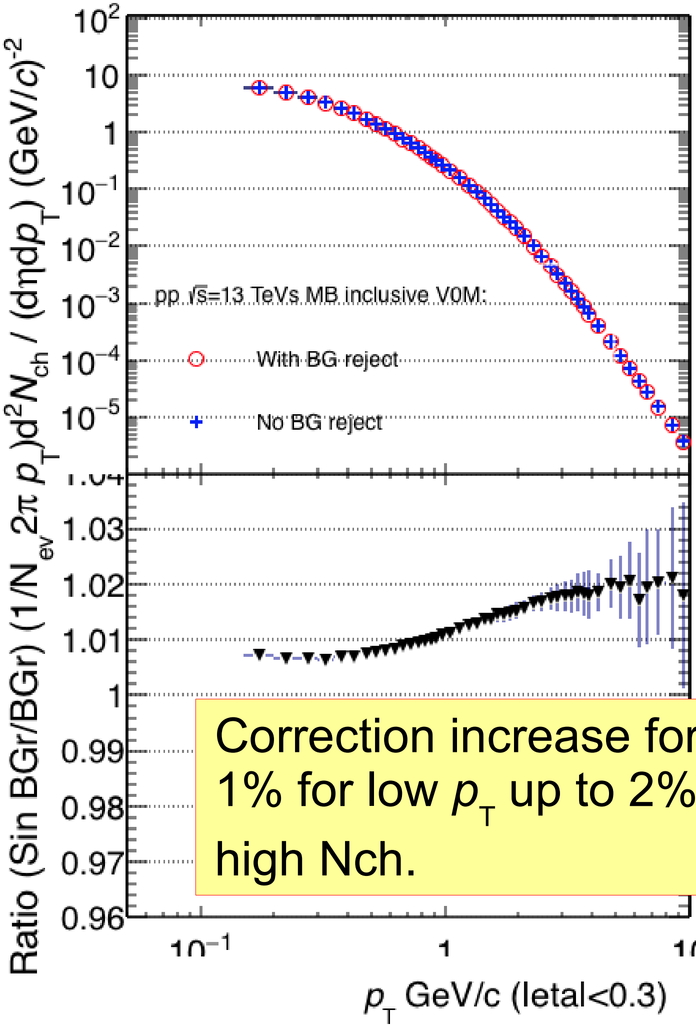


onlineSPD >= -20.589 + 0.73664*offlineSPD && onlineV0M >= -100.+7.*offlineV0M

Events in V0M Multiplicity clases after cleaning



Higher difference is for first bins



Correction increase form 1% for low p_T up to 2% for high Nch.

With BG rejection:

With MV pileup rejection:

With low diagonal cut
SPD & V0M Off-Online FastOR:

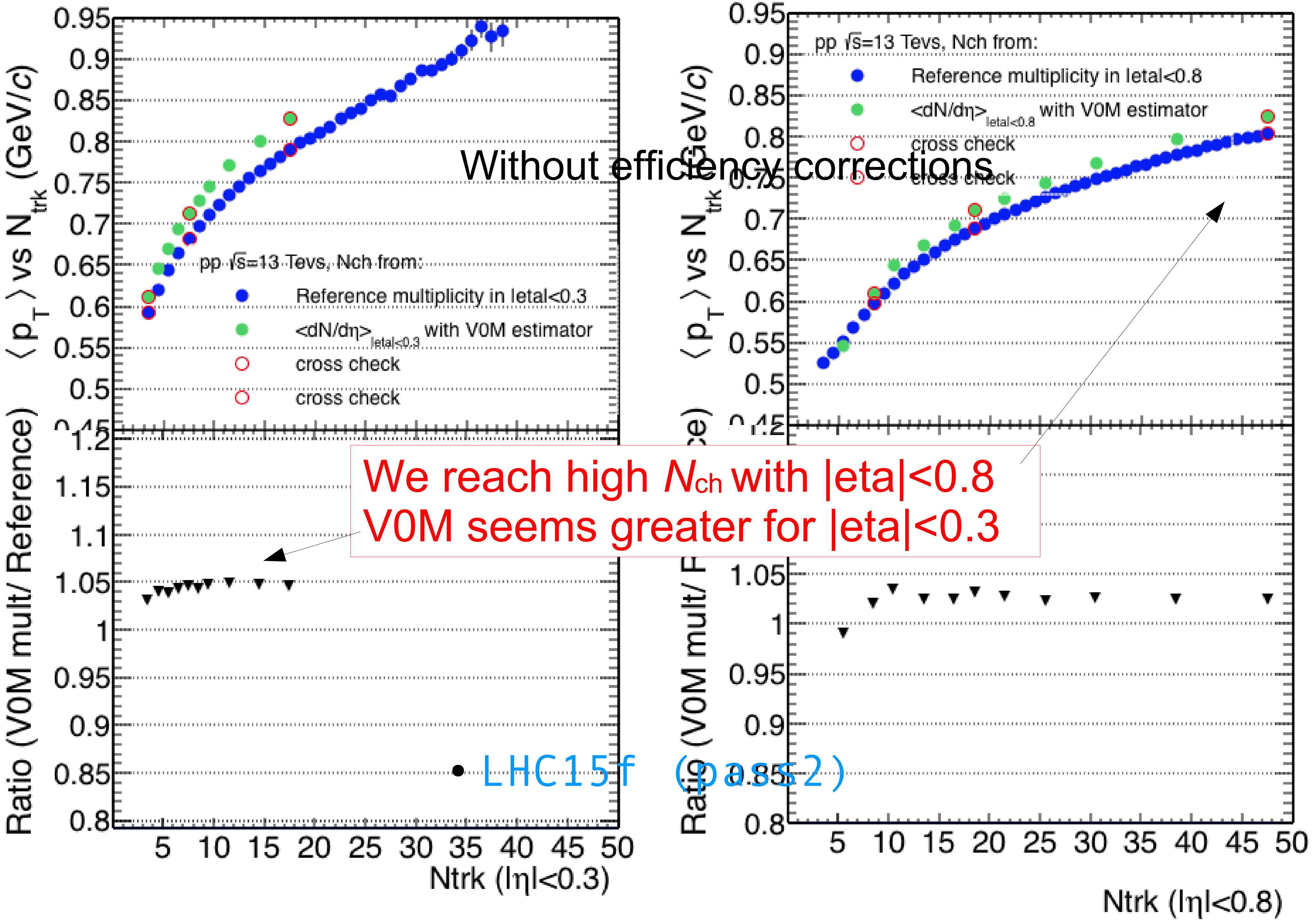
Spherocity Analysis with V0M

ESD DATA

LHC15f pp 13 TeVs

- `LHC15f (pass2)`

$\langle P_T \rangle$ vs Nch for V0M and Ref for: $|\eta| < 0.3$ & $|\eta| < 0.8$

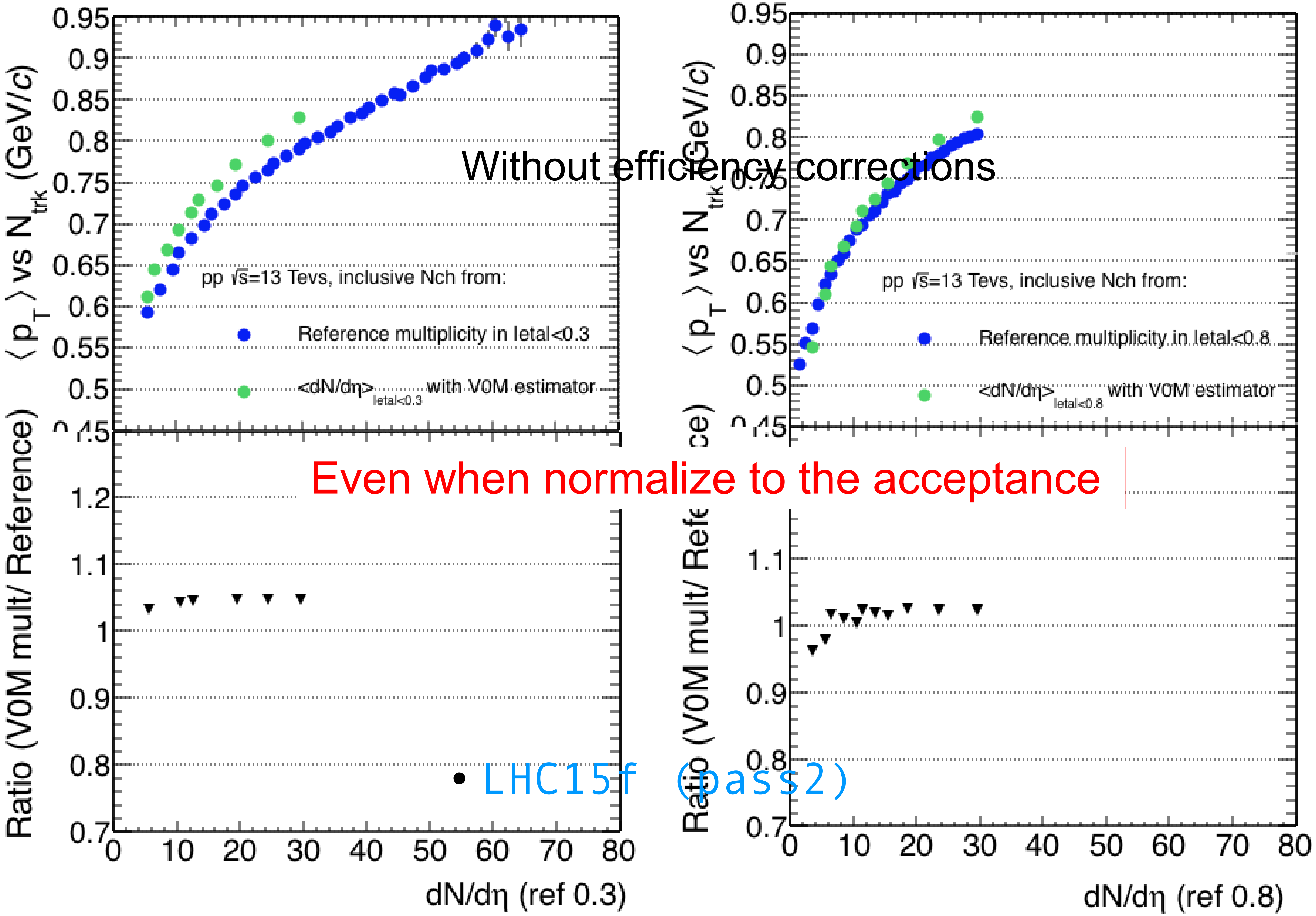


Without efficiency corrections

We reach high N_{ch} with |eta|<0.8
V0M seems greater for |eta|<0.3

- LHC15f (pass2)

<P_T> vs dN/dη for V0M and Ref for:| η | <0.3 & | η | <0.8

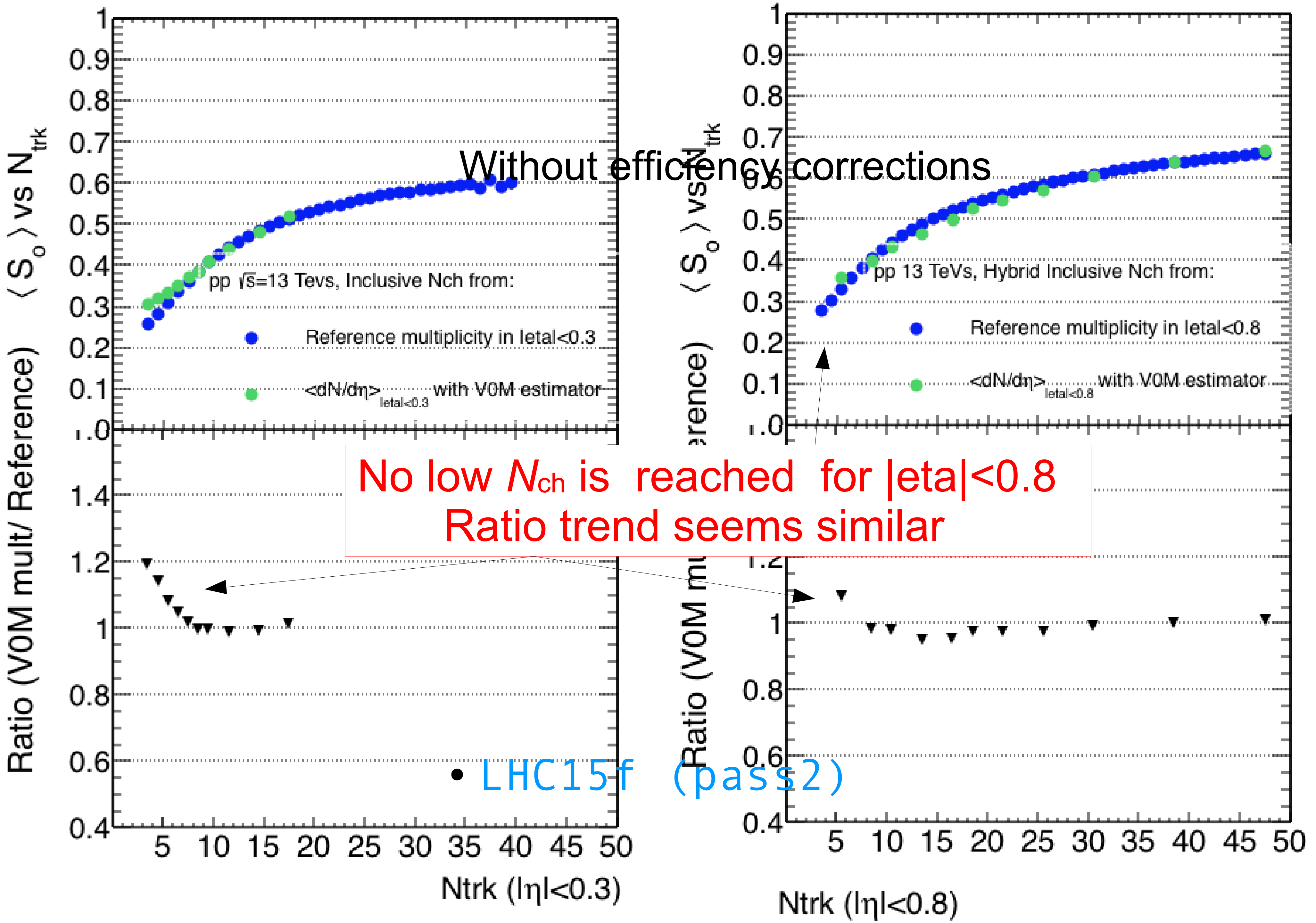


Without efficiency corrections

Even when normalize to the acceptance

- LHC15f (pass2)

$<S_O>$ for V0M and Ref for: | η | <0.3 & | η | <0.8

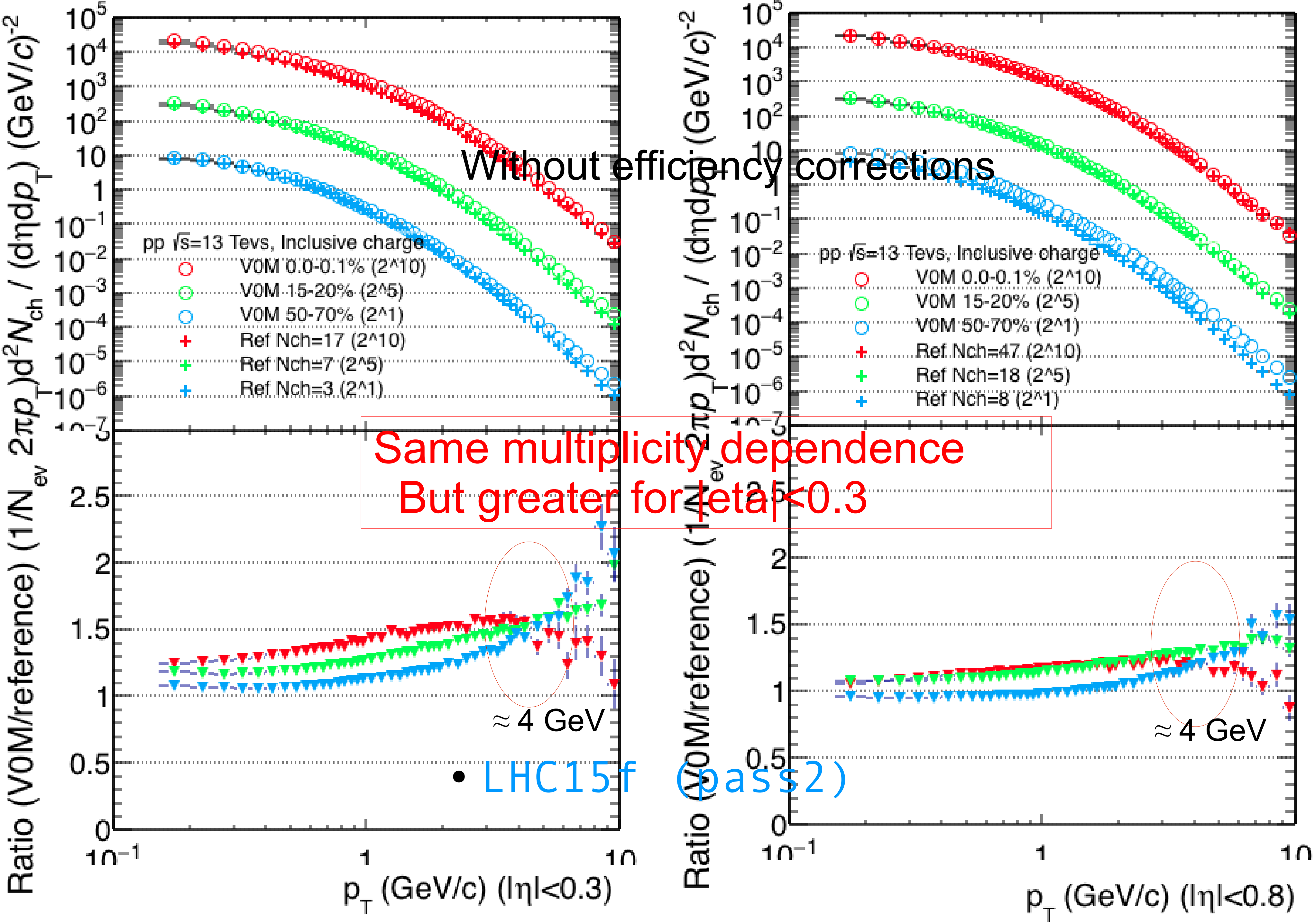


Without efficiency corrections

No low N_{ch} is reached for |eta|<0.8
Ratio trend seems similar

- LHC15f (pass2)

Invariant Yield for V0M and Ref for: $|\eta| < 0.3$ & $|\eta| < 0.8$



Without efficiency corrections

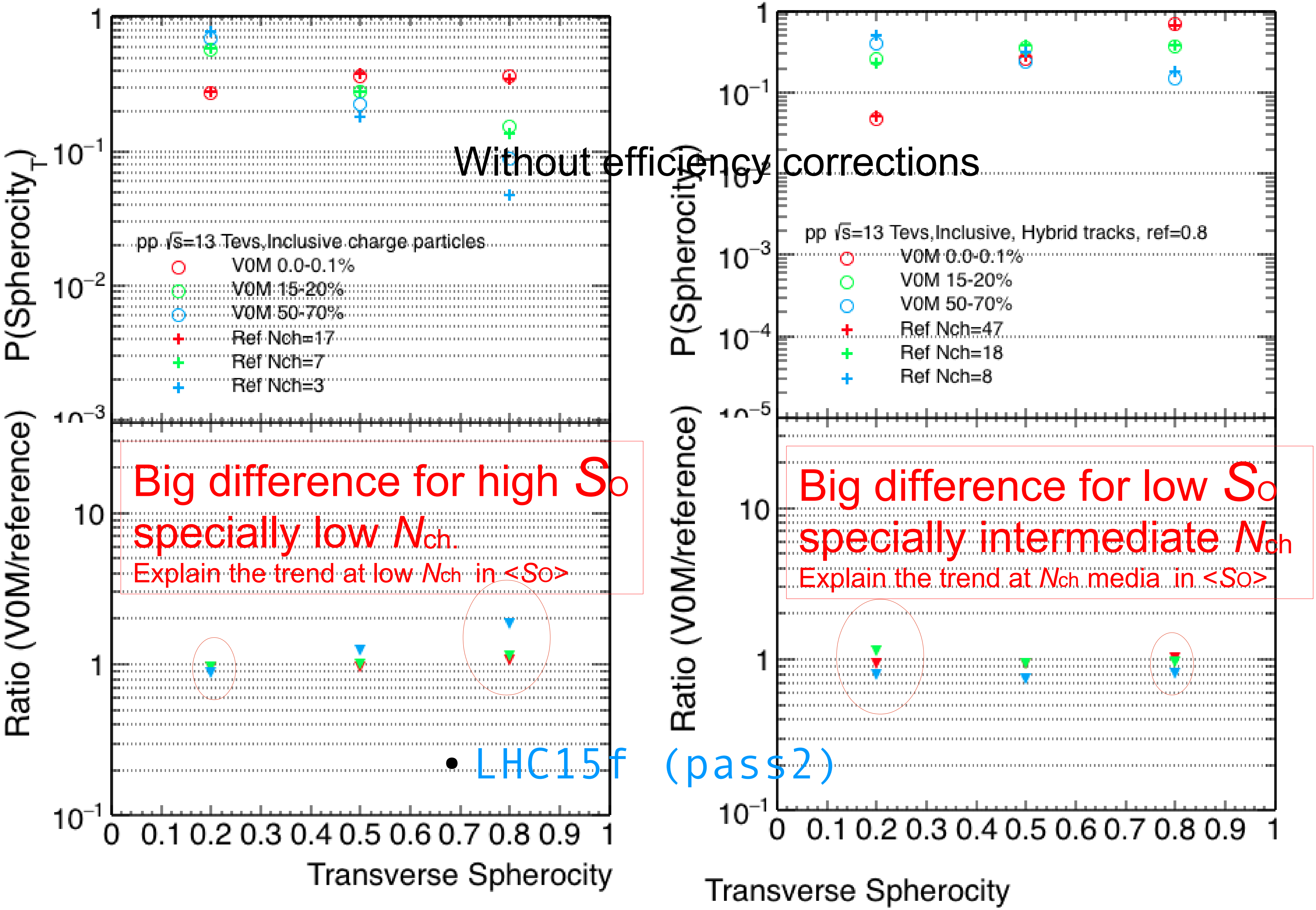
Same multiplicity dependence
But greater for |eta|<0.3

≈ 4 GeV

≈ 4 GeV

- LHC15f (pass2)

Probability of S_O for V0M and Ref for: $|\eta|<0.3$ & $|\eta|<0.8$



Without efficiency corrections

Big difference for high S_O specially low N_{ch}.

Explain the trend at low N_{ch} in $<S_O>$

Big difference for low S_O specially intermediate N_{ch}

Explain the trend at N_{ch} media in $<S_O>$

- LHC15f (pass2)

Spherocity Analysis with V0M

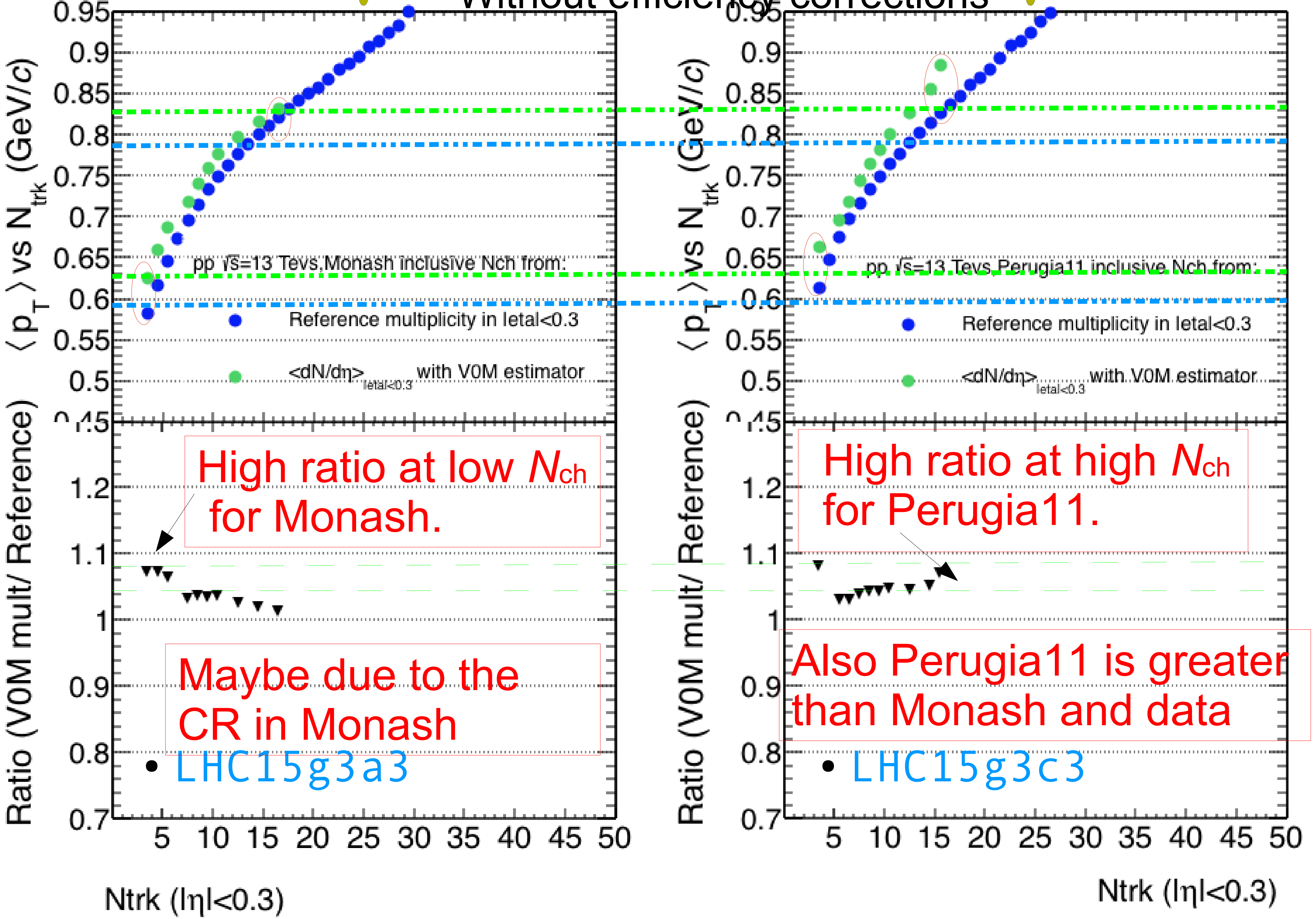
ESD MC

LHC15g3a3 (Monash) and LHC15g3c3 (Perugia11)

- `LHC15g3a3`
- `LHC15g3c3`

<P_{T}> vs Nch for V0M and Ref for: $|\eta|$ <0.3

Without efficiency corrections



High ratio at low N_{ch} for Monash.

Maybe due to the CR in Monash

- LHC15g3a3

High ratio at high N_{ch} for Perugia11.

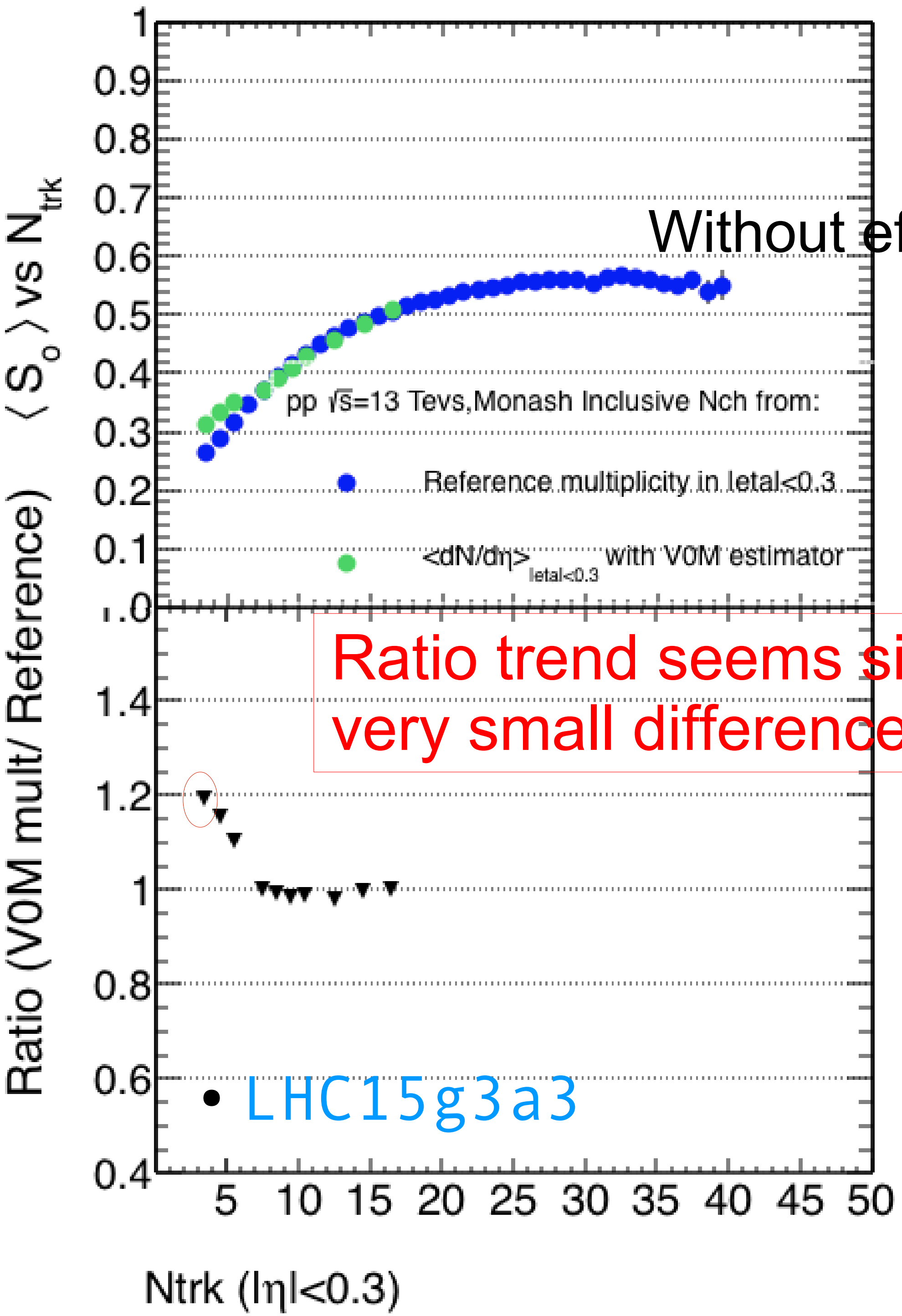
Also Perugia11 is greater than Monash and data

- LHC15g3c3

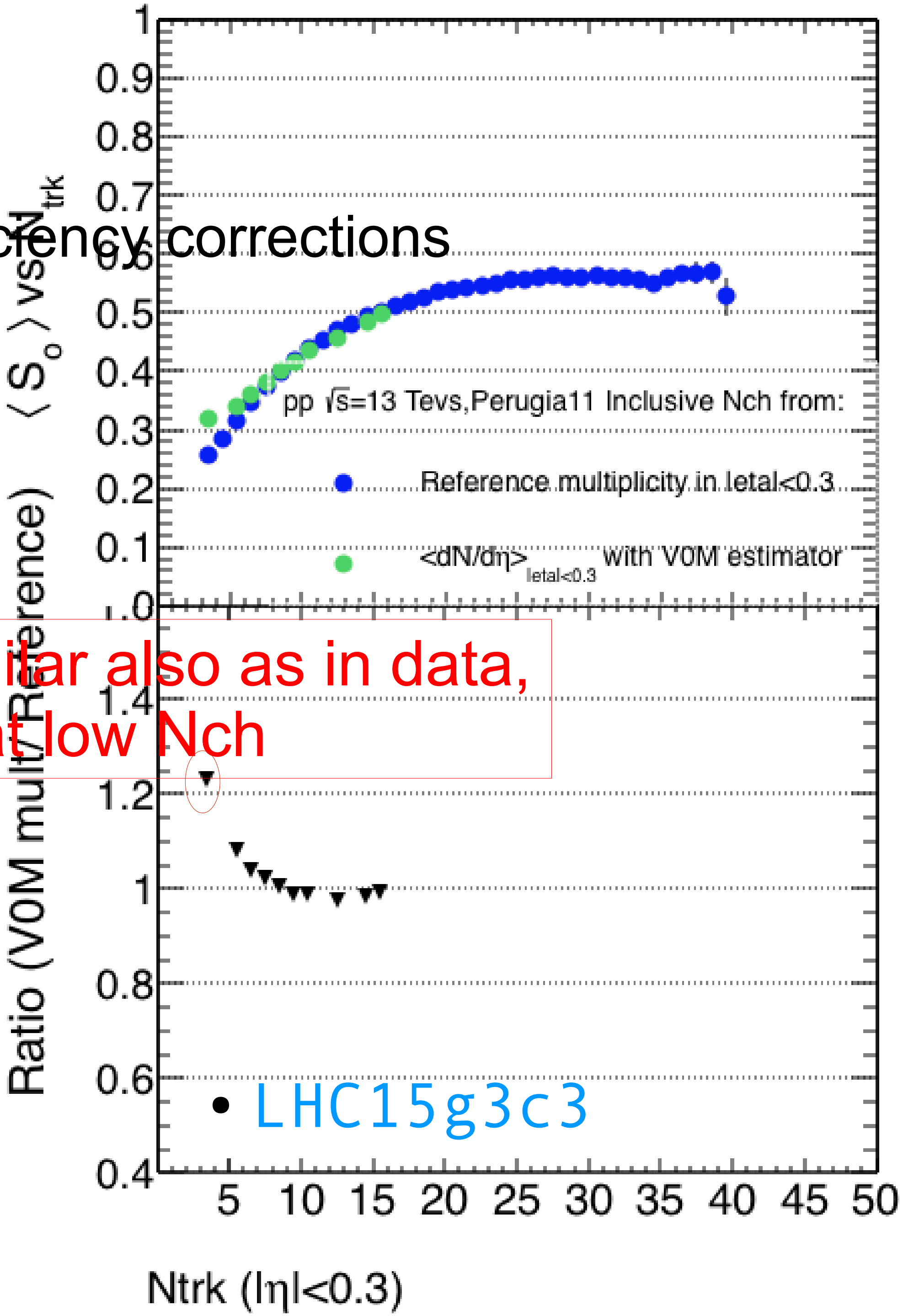
<S_O> vs Nch for V0M and Ref for: | η | <0.3

Without efficiency corrections

Ratio trend seems similar also as in data, very small difference at low Nch

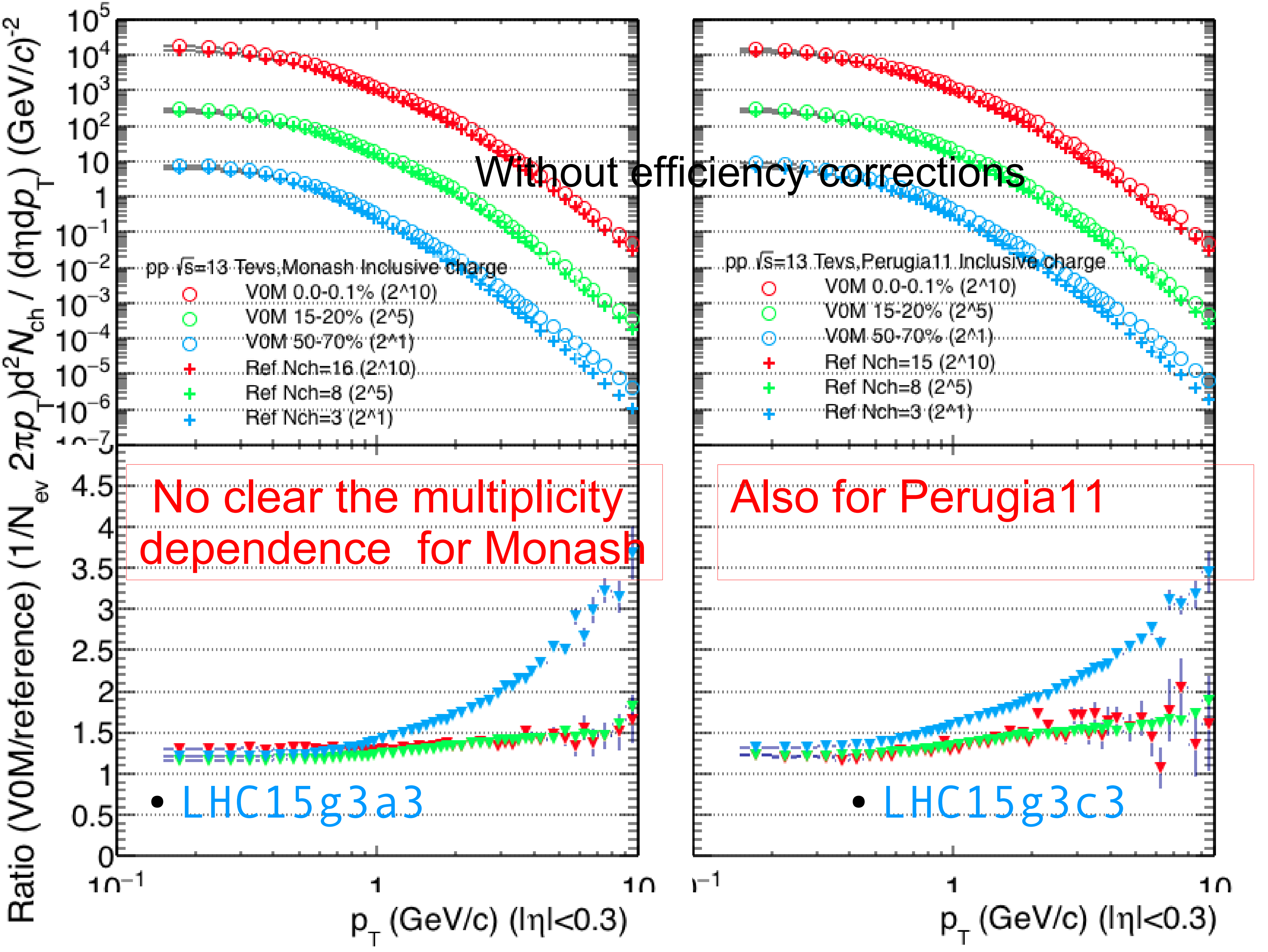


- LHC15g3a3



- LHC15g3c3

Invariant Yield for V0M and Ref for:| η | <0.3



Without efficiency corrections

No clear the multiplicity dependence for Monash

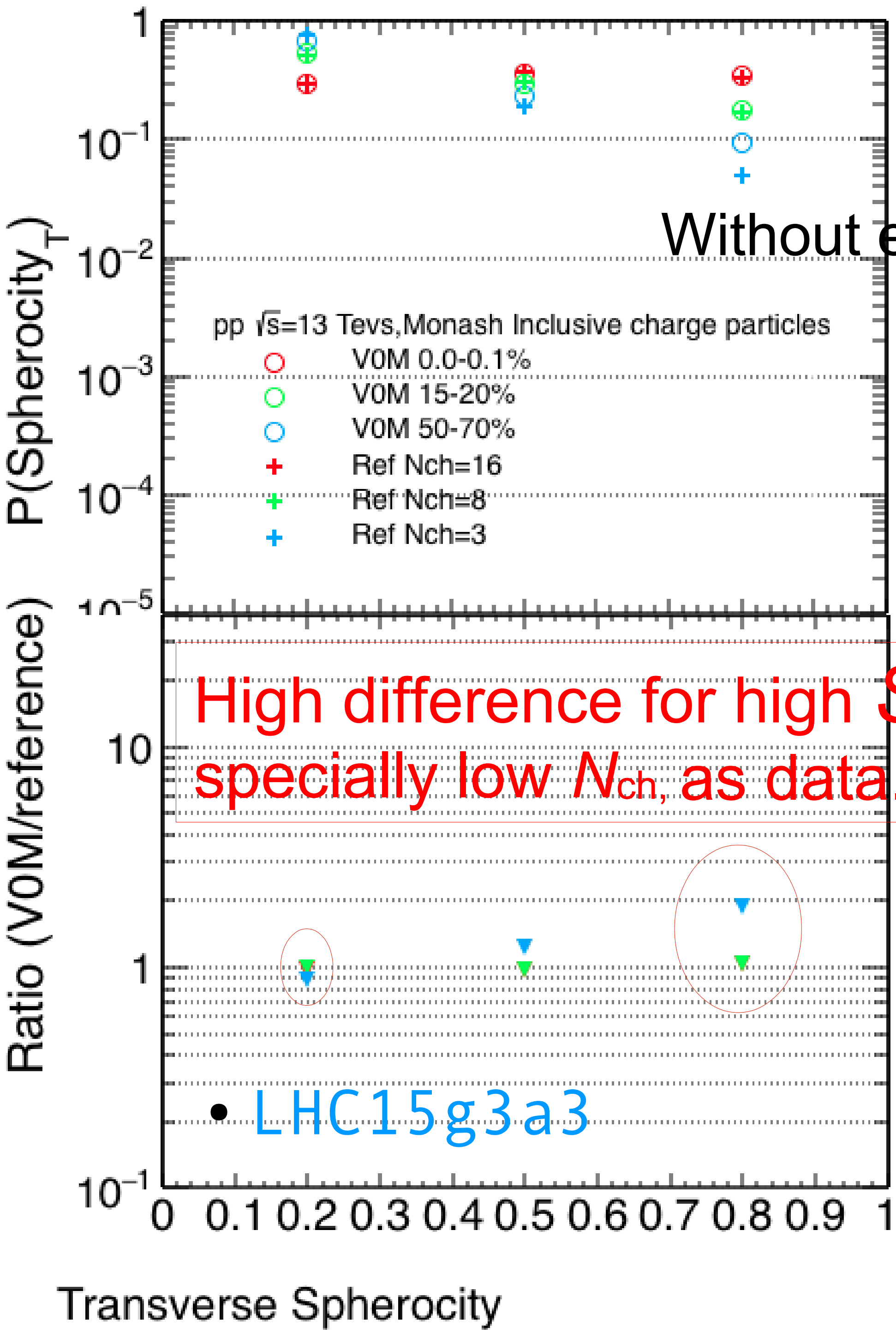
Also for Perugia11

- LHC15g3a3

- LHC15g3c3

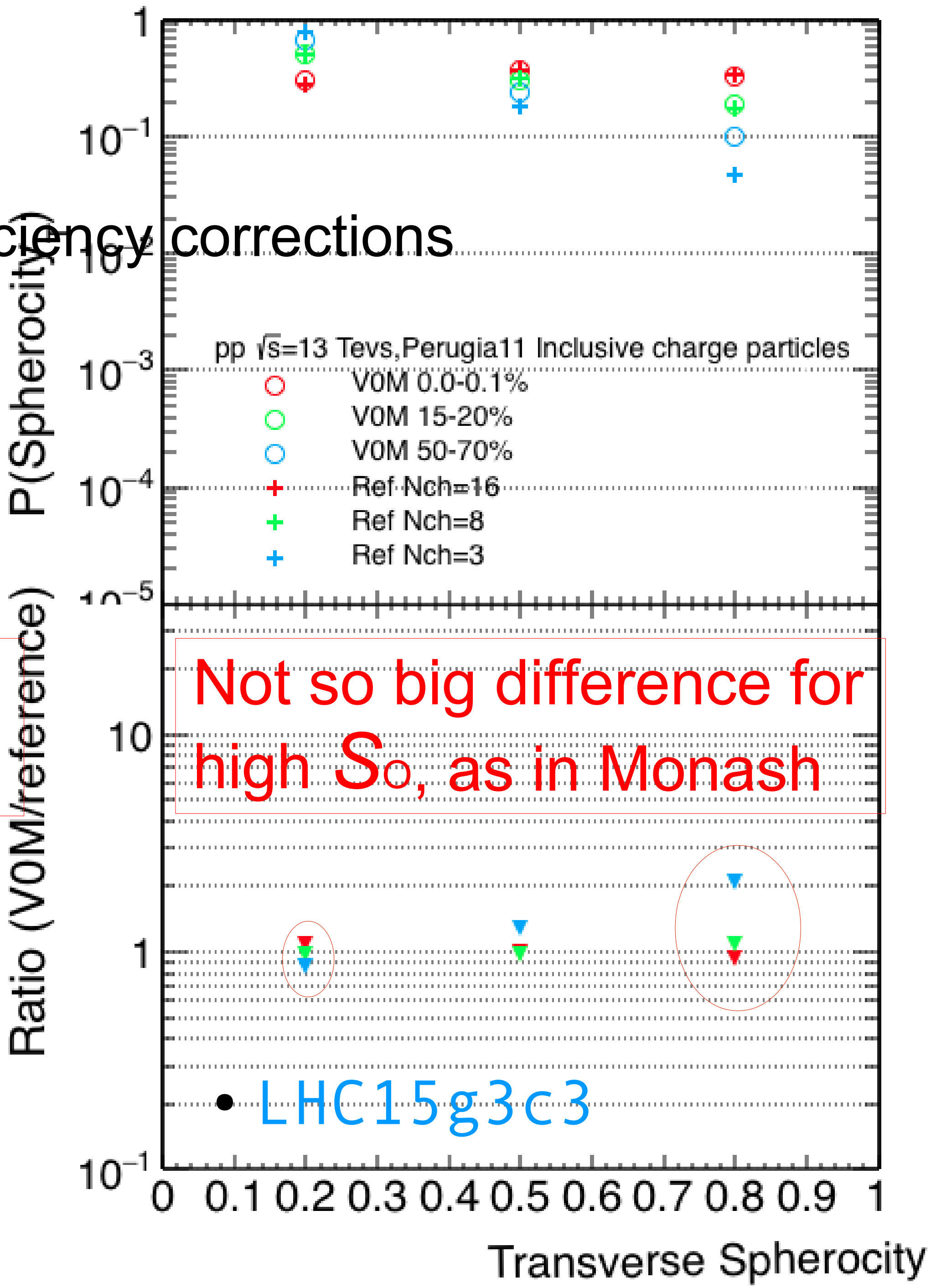
Probability of S_{o} for V0M and Ref for: $|\eta| < 0.3$

Without efficiency corrections



High difference for high S_{o} specially low N_{ch}, as data.

- LHC15g3a3



Not so big difference for high S_{o}, as in Monash

- LHC15g3c3

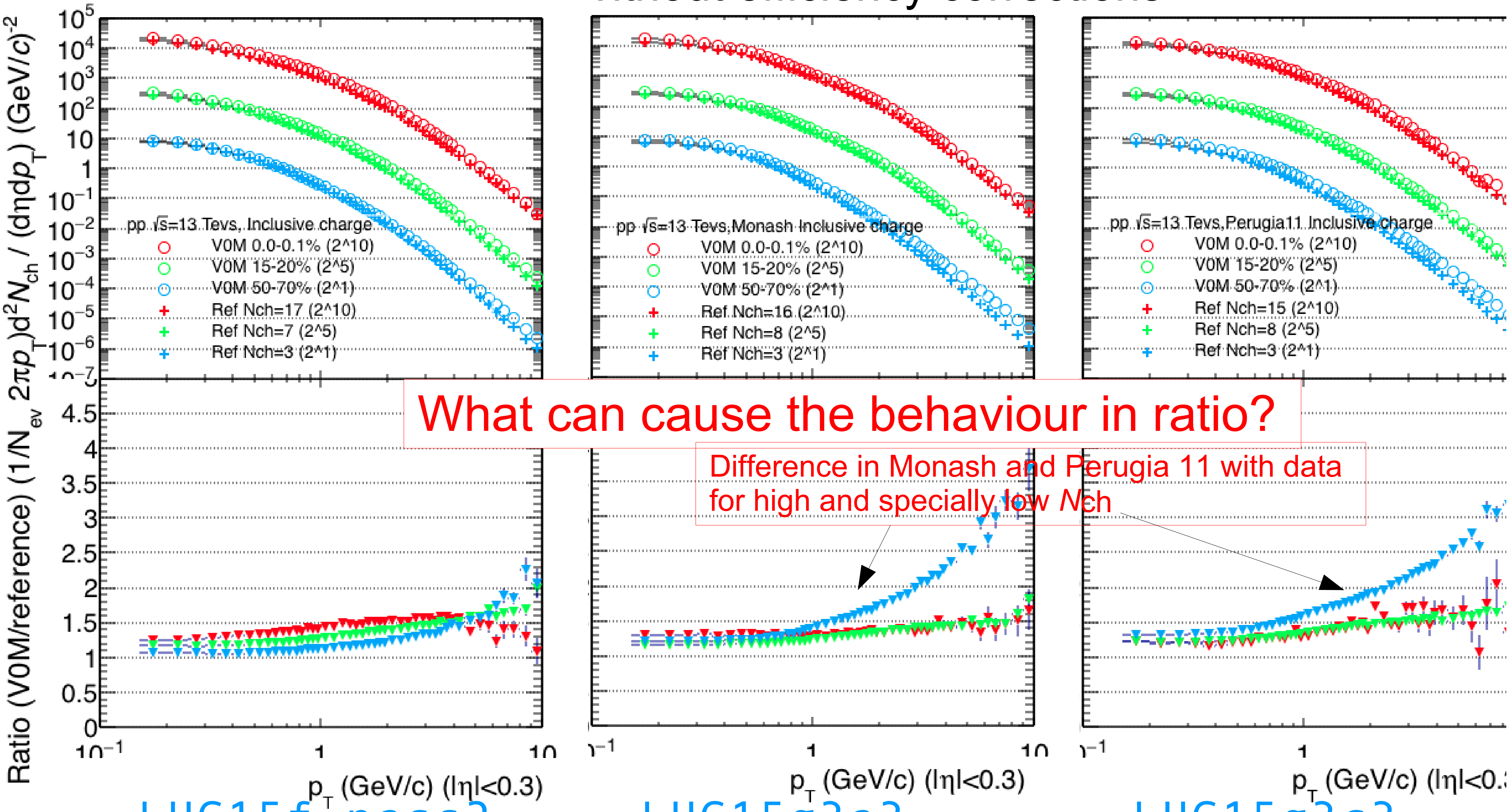
V0M/REF spectra ratio behaviour

Data and MC: Pythia Monash and Pythia Perugia11

- `LHC15f pass2`
- `LHC15g3a3`
- `LHC15g3c3`

Invariant Yield for V0M and Ref for: $|\eta| < 0.3$

Without efficiency corrections



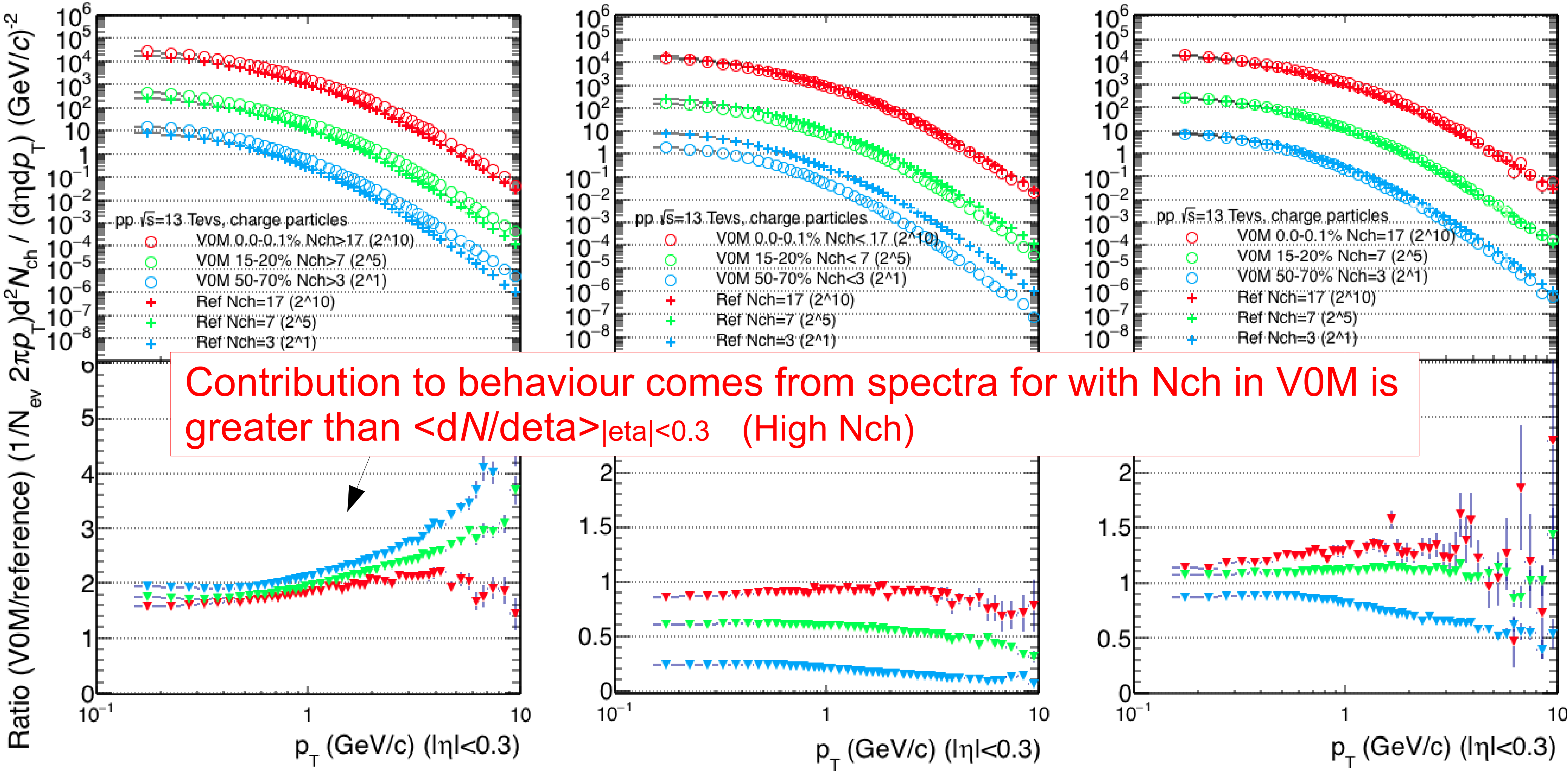
What can cause the behaviour in ratio?

Difference in Monash and Perugia 11 with data for high and specially low *N*ch

- LHC15f pass2
- LHC15g3a3
- LHC15g3c3

Hèctor Bello Martinez

For DATA comparison with V0M mult for Nch: greater, lower and equal to <N_{ch}>

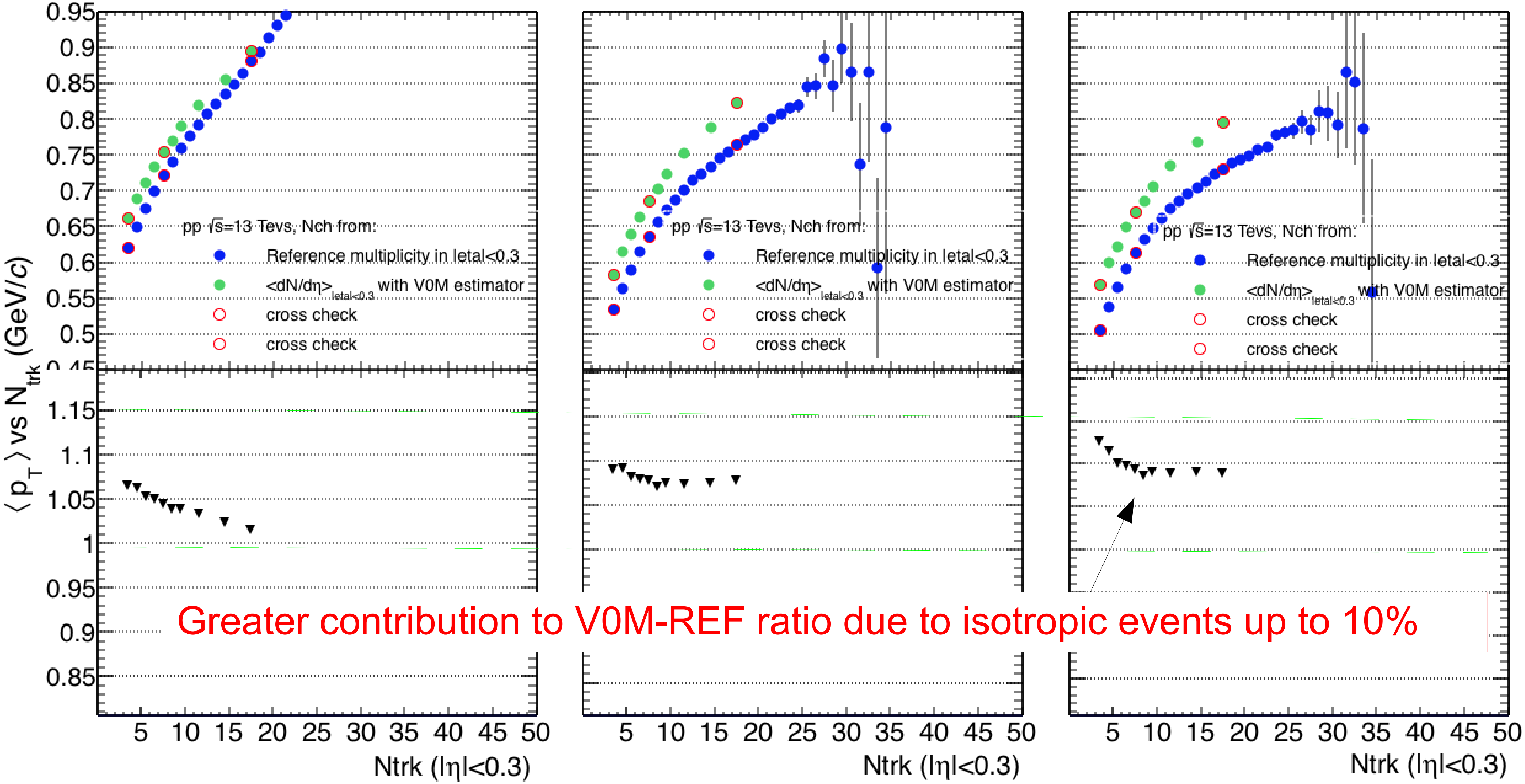


Contribution to behaviour comes from spectra for with Nch in V0M is greater than <dN/deta>$_{|eta|<0.3}$ (High Nch)

A crosscheck in number of events has been taken into account

For DATA comparing estimators V0M and Ref $|\eta|<0.3$ using spherocity bins

Without efficiency corrections



Greater contribution to V0M-REF ratio due to isotropic events up to 10%

0<So<0.4

0.4<So<0.6

0.6<So<1

Summary for:

For data:

- The contribution to greater spectra for V0M seems due to the spectra for wich Nch in V0M is greater than $\langle dN/deta \rangle_{|eta|<0.3}$
- The contribution to greater $\langle P_T \rangle$ for V0M comes from isotropic events (0.6<So<1) >10%
- The contribution to greater V0M-REF ratio seems due to isotropic events (0.6<So<1) as seen in the $\langle P_T \rangle$

  (under check REF events normalization)

For MC:

- High ratio at low N_{ch} for Monash.
- V0M-REF Ratio for $\langle S_O \rangle$ trend seems similar also as in data.
- Spectra V0M/REF ratio has not multiplicity dependence for Monash at extreme multiplicites

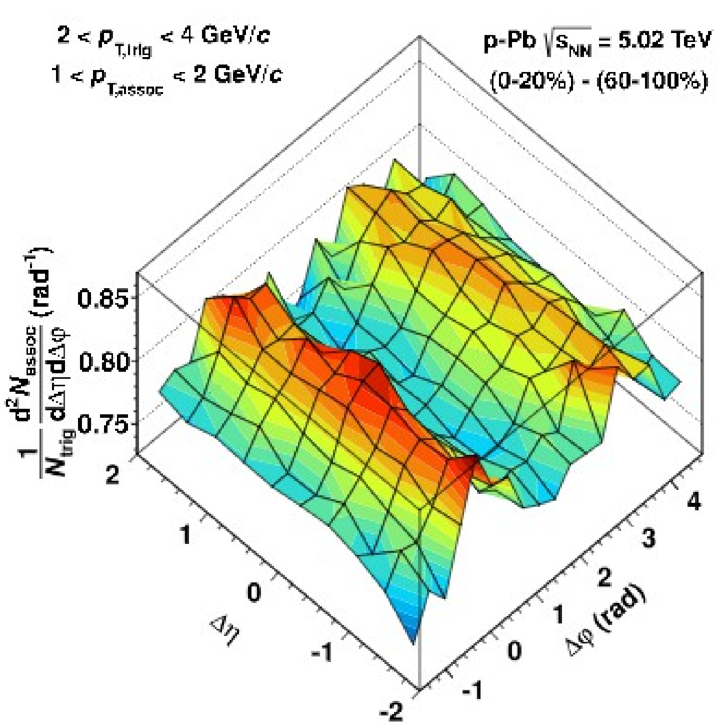
  To be done:
- Get V0M-REF ratio for Perugia11
- Check in data normalization for REF in So bins.

MC analysis, Jet effects Epos vs Pythia

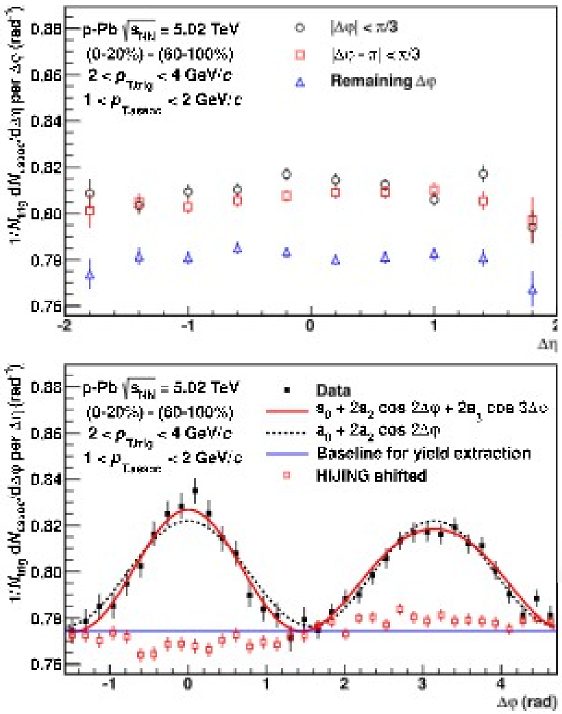
Introducción

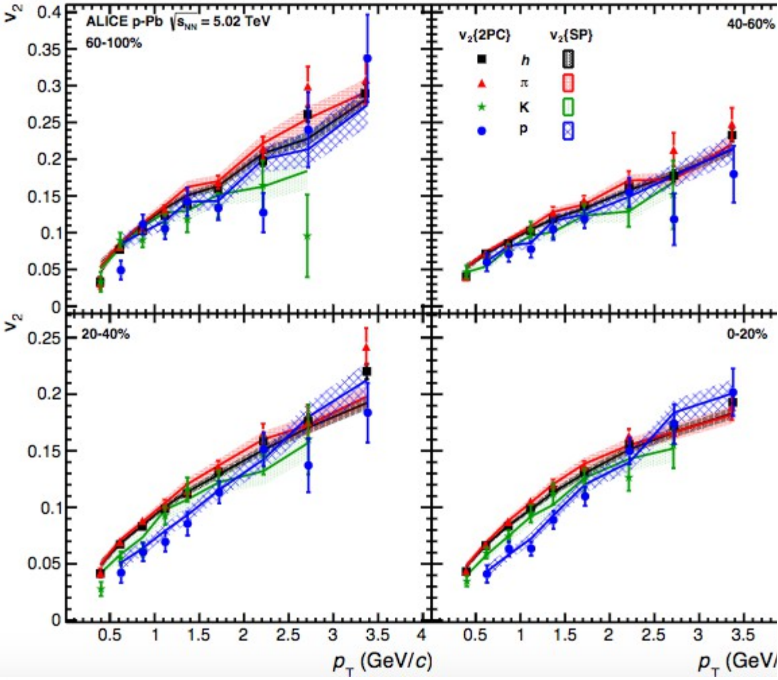
Los sistemas pequeños como los formados en colisiones pp y pPb han atraido la atención de la comunidad de iones pesados porque:

- Evidencias de tipo s-QGP han sido encontradas (flujo y correlaciones azimutales de largo alcance) en eventos de alta multiplicidad,
- El orígen de estos efectos permanece bajo discusión.
- Más estudios diferentes son necesarios.



Phys.Lett. B719 (2013) 29-41





Phys. Lett. B 726 (2013) 164-177

Introducción

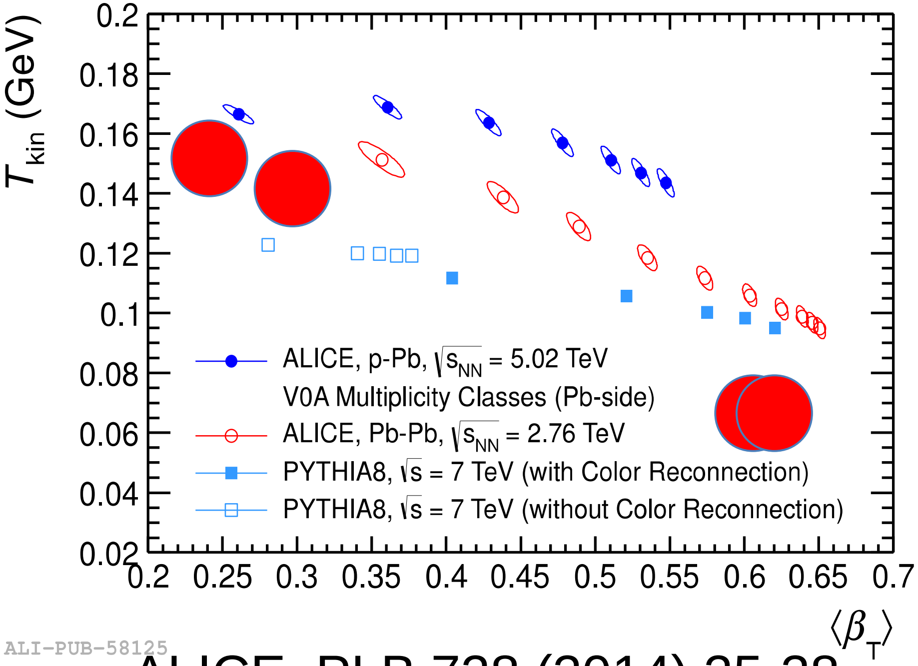
Blast-Wave, inspirado en hidrodinámica

$$\frac{1}{p_{\mathrm{T}}}\frac{\mathrm{d}N}{\mathrm{d}p_{\mathrm{T}}} \propto \int_0^R r\,\mathrm{d}r\,m_{\mathrm{T}} I_0\left(\frac{p_{\mathrm{T}}\sinh\rho}{T_{\mathrm{kin}}}\right) K_1\left(\frac{m_{\mathrm{T}}\cosh\rho}{T_{\mathrm{kin}}}\right)$$

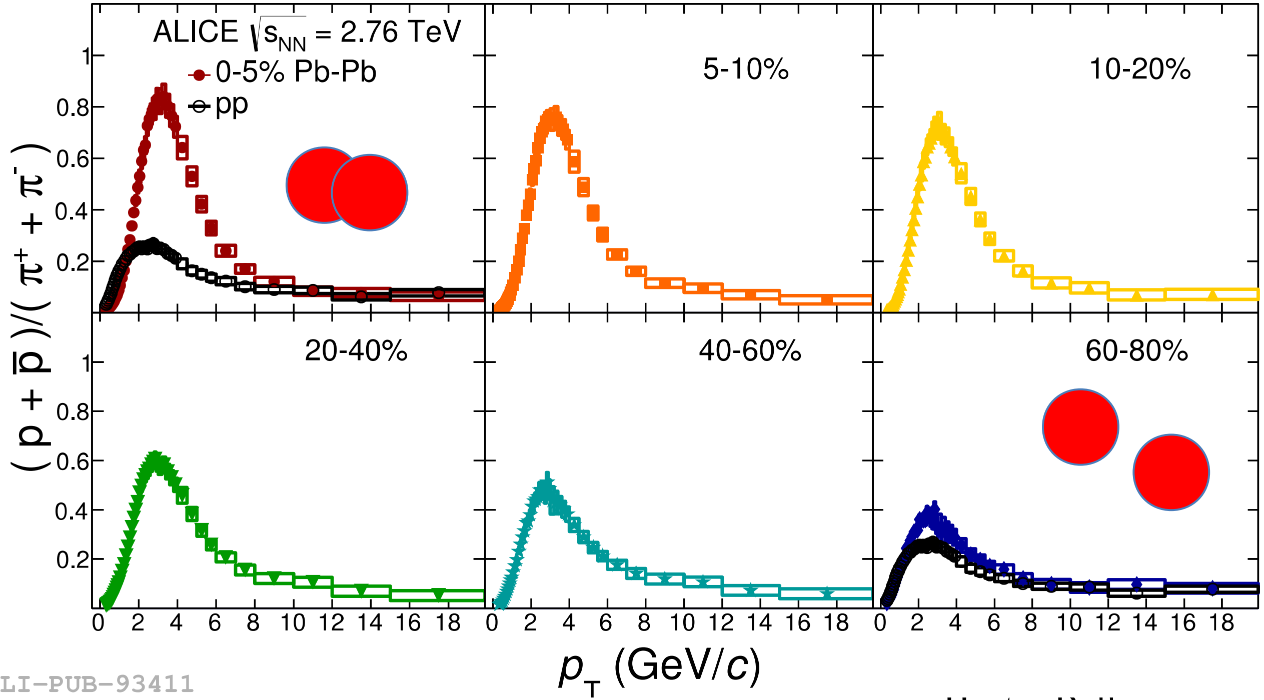
$$\rho = \tanh^{-1}\beta_{\mathrm{T}} = \tanh^{-1}\left(\left(\frac{r}{R}\right)^n \beta_{\mathrm{S}}\right)$$

Describe el espectro de p_{T} para partículas identificadas en

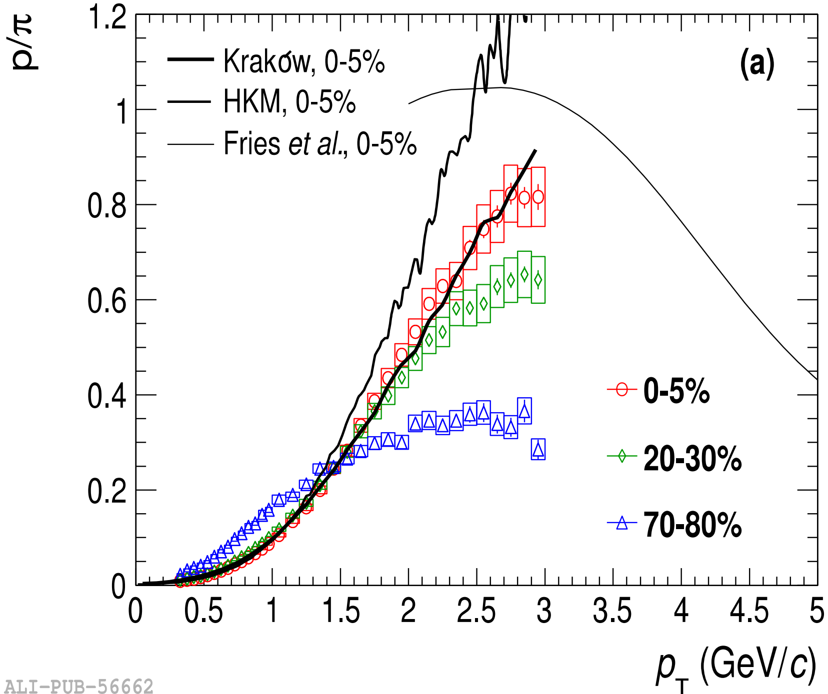
- Datos p-Pb y Pb-Pb



ALICE, PLB 728 (2014) 25-38



ALICE, arXiv:1506.07287



ALICE, PRC 88 (2013) 044910

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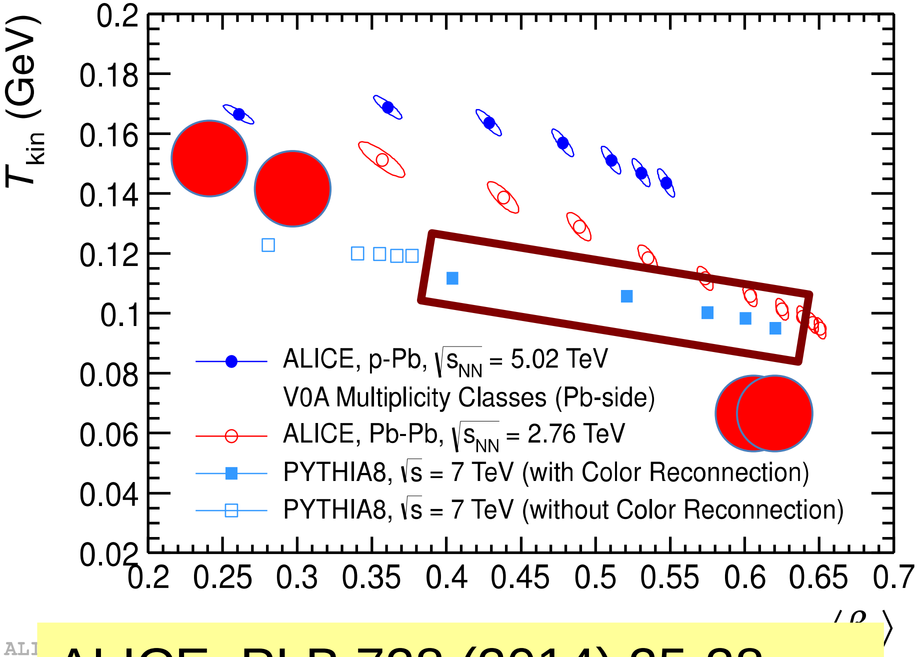


ALICE, PLB 728 (2014) 25-38

Describe el espectro de p_{T} para partículas identificadas en:

- Datos p Pb y Pb Pb
- Distribuciones generadas con Pythia (no asume evolución hidrodinámica)
- Se ha discutido como la reconexión por color produce patrones de tipo flujo radial debido a cuerdas con “boost”.

Antonio. Ortíz, G. Paic, E. Cuautle, P. Christiansen and I. Maldonado. PRL 111

Introducción

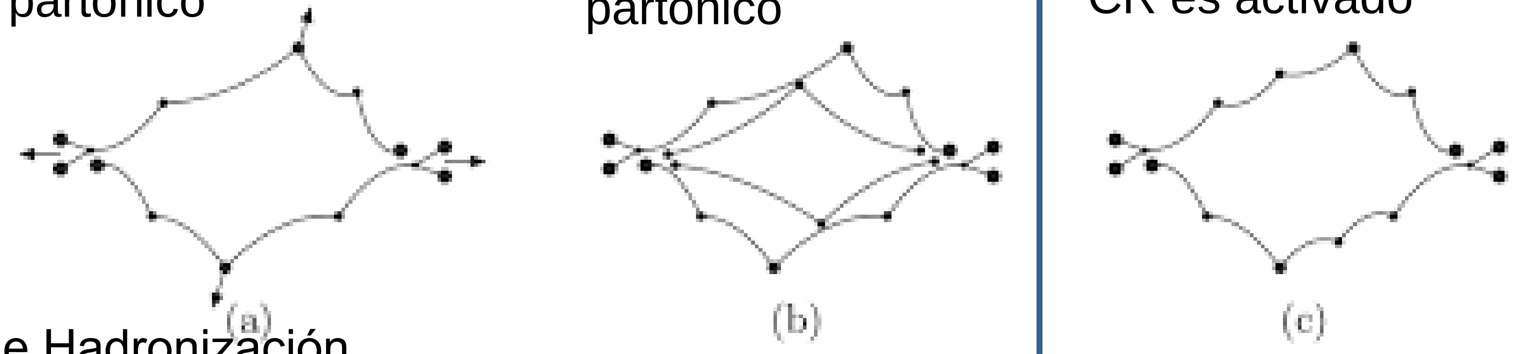
Reconexión por Color (PYTHIA8)

- Figure taken from: G. Gustafson, Acta Phys. Polon. B40, 1981 (2009)

1er sistema partónico

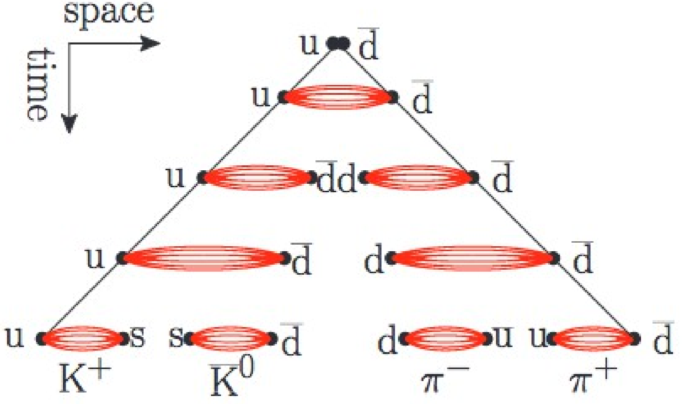
+2º sistema partónico

CR es activado

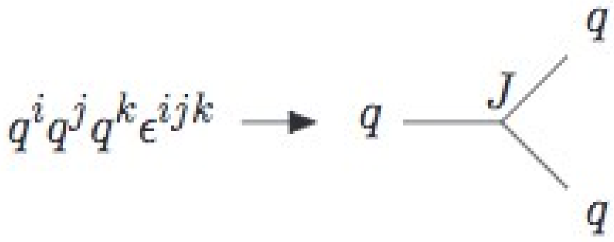


Modelo de Hadronización.

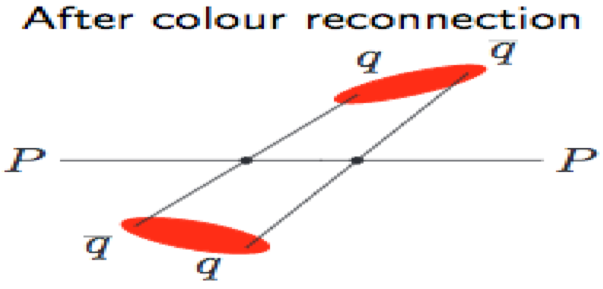
Modelo de fragmentación de cuerda



Reglas de QCD nos dicen que reconexiones se permiten (tensor de color épsilon)



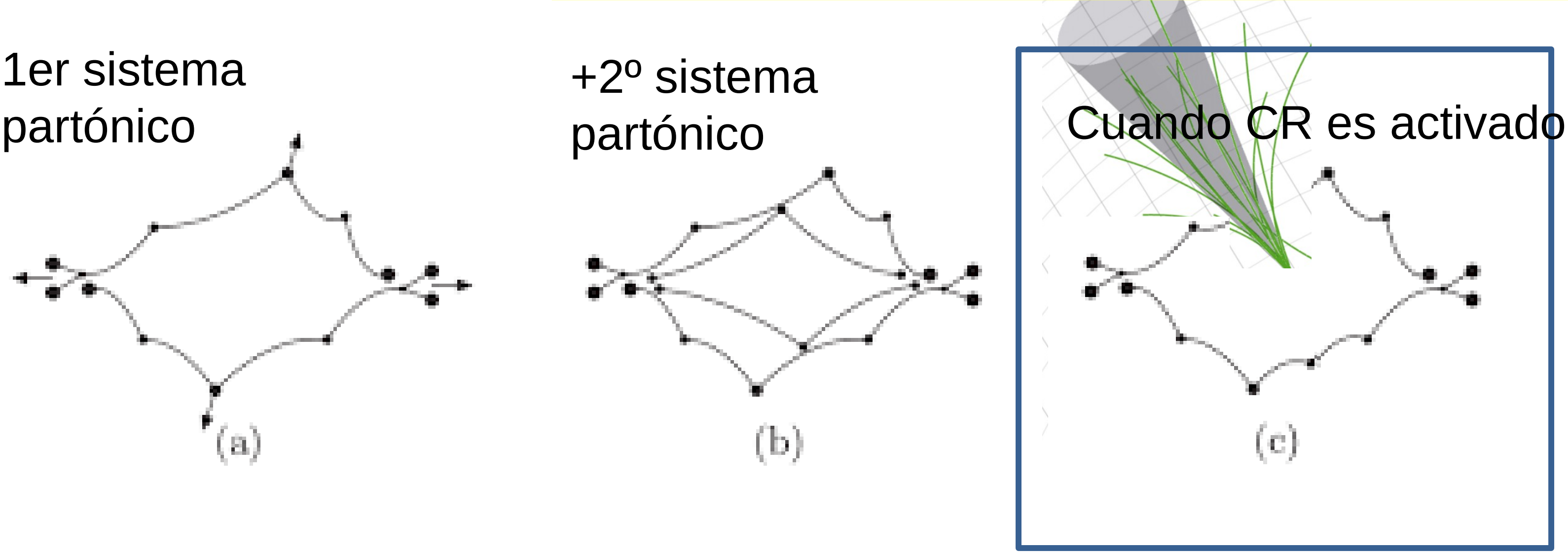
La longitud mínima de la cuerda nos dice la configuración .



From: Jesper Roy Christiansen MPI@LHC 2014

Introducción

Reconexión por Color (PYTHIA8)



- Figure taken from: G. Gustafson, Acta Phys. Polon. B40, 1981 (2009)

Este fue el enfoque en: PRL 111 (2013) 042001

- Cuanto más *N*MPI mayor es el efecto tipo flujo.

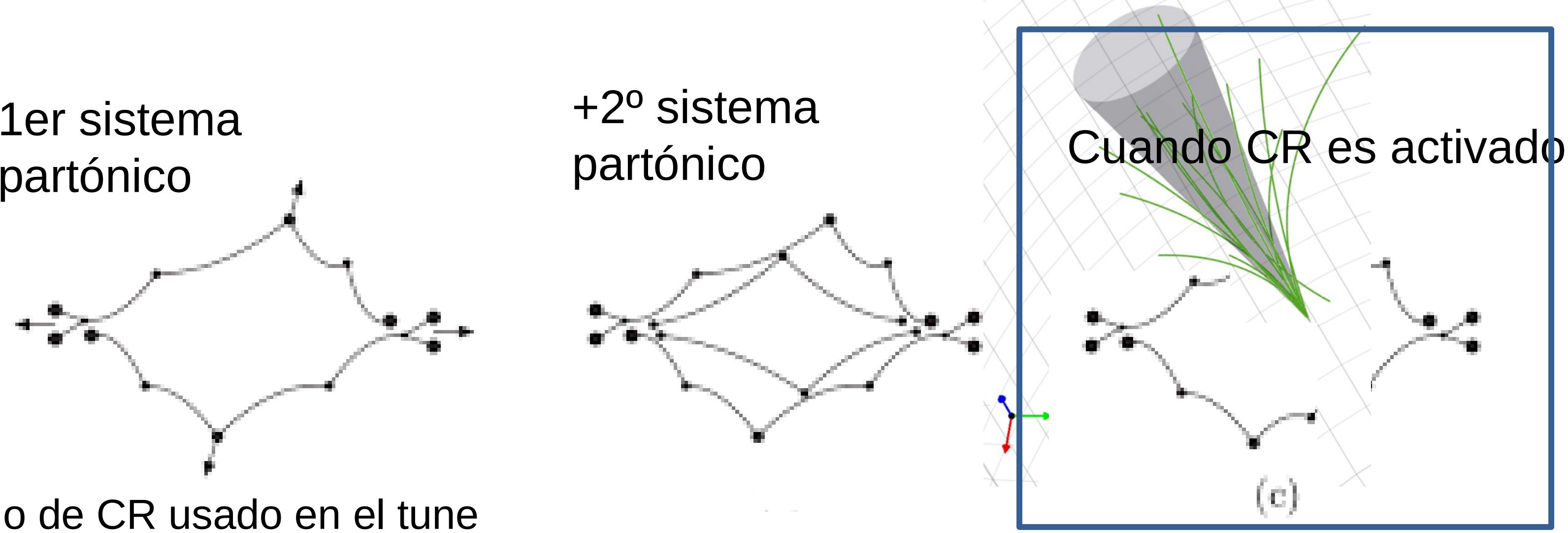
Debido al gran número de MPI, un jet de alto *p*T en el evento es esperado (con alta probabilidad):

- ¿Podemos cuantificar los efectos de jets a alto *p*T?

Introducción

Reconexión por Color (PYTHIA8)

- Figure taken from: G. Gustafson, Acta Phys. Polon. B40, 1981 (2009)
  Effects of CR on hadron flavor observables, C. Bierlich and J. R. Christiansen, PRD 92 (2015) 9, 094010



1er sistema partónico

+2º sistema partónico

Cuando CR es activado

En el modelo de CR usado en el tune Monash2013 un sistema MPI con una escala de p_T de interacción dura (normalmente $2 \rightarrow 2$) Puede juntarse con uno de escala mas dura con una probabilidad que es:

$$P(p_\mathrm{T}) = \frac{(RRxp_{T0})^2}{(RRxp_{T0})^2 + p_\mathrm{T}^2}$$

Rango de Reconexión (*RR*): 0-10
Tune Monash 2013: *RR*x*p*T0: 3

http://home.thep.lu.se/~torbjorn/pythia82html/Welcome.html

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Reconexión por Color (PYTHIA8)

- Figure taken from: G. Gustafson, Acta Phys. Polon. B40, 1981 (2009)
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Estudiaremos las propiedades de los eventos pp generados con Pythia como función de:

multiplicidad ($z = dN/d\eta/\langle dN/d\eta \rangle$)

& su contenido de jets

En el modelo de CR usado en el tune Monash2013 un sistema MPI con una escala de p_T de interacción dura (normalmente $2 \rightarrow 2$) Puede juntarse con uno de escala mas dura con una probabilidad que es:

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Rango de Reconexión (*RR*): 0-10
Tune Monash 2013: *RR*xp_{T0}: 3

http://home.thep.lu.se/~torbjorn/pythia82html/Welcome.html

Introducción
Hidrodinámica (EPOS 3)

Modelo con:

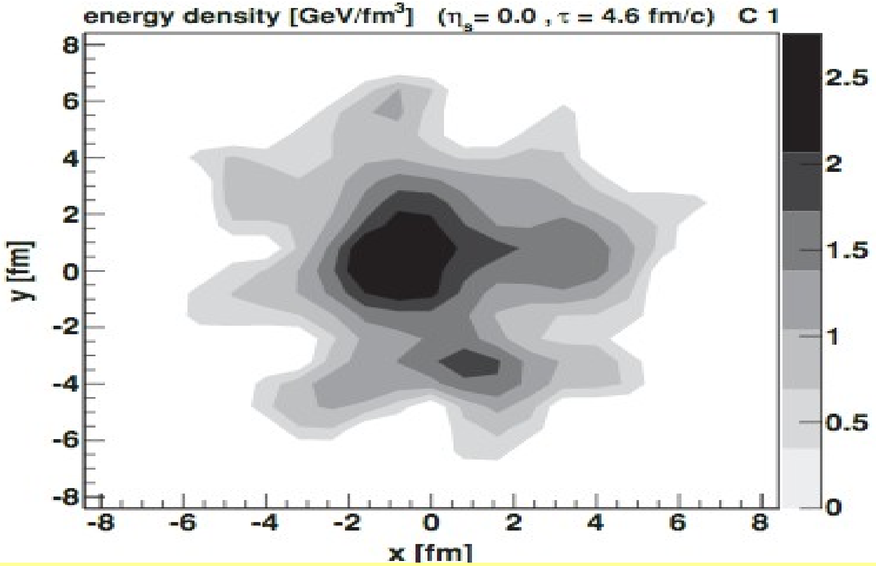
Energía conservada en dispersión multiple
Partón, escaleras partónicas (Gribov–Regge Theory)
Off-shell, remanentes
Saturación

Separación "Core-corona"

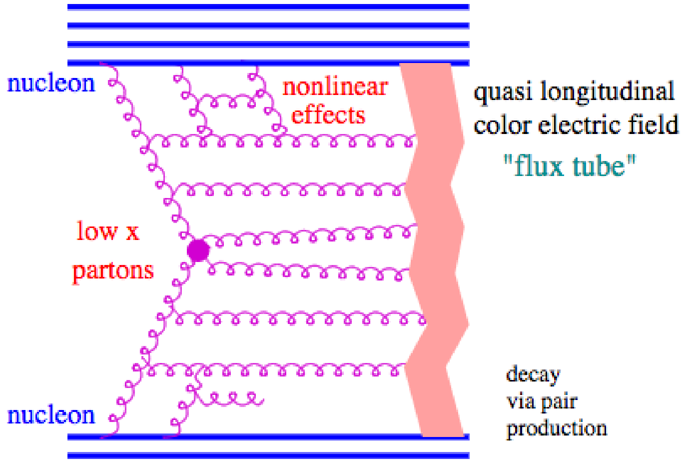
Core->alta densidad de cuerdas
Corona->baja densidad de cuerdas

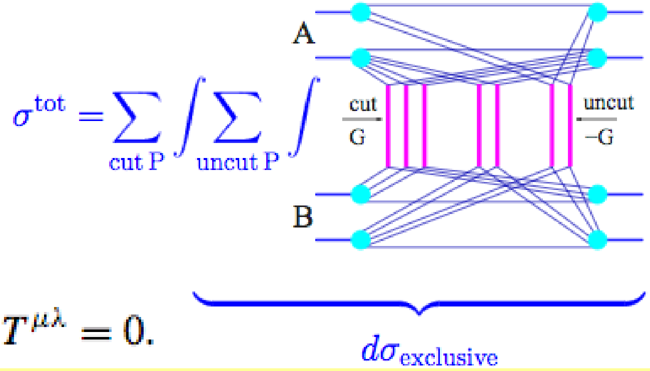
Con "Core"=Hidrodinámica
No "Core"=solo modelo de cuerda.

$$\partial_{;\nu} T^{\mu\nu} = \partial_\nu T^{\mu\nu} + \Gamma^{\mu}_{\nu\lambda} T^{\nu\lambda} + \Gamma^{\nu}_{\nu\lambda} T^{\mu\lambda} = 0.$$



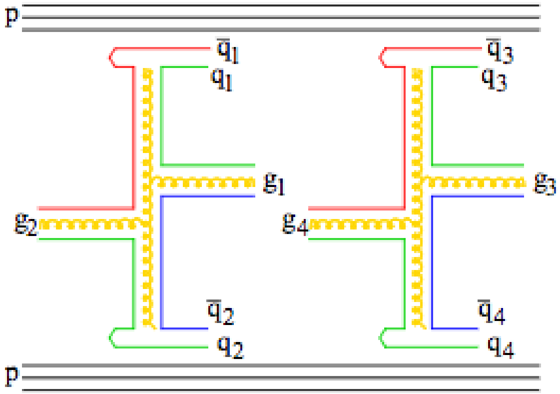
K. Werner et al., PRC 82 (2010) 044904





K. Werner et al., PRC89 (2014) 6, 064903

Tubos de flujo de color, para intercambio de doble Pomerón



K.Werner et al, PRC 92 (2015) 034906

Introducción
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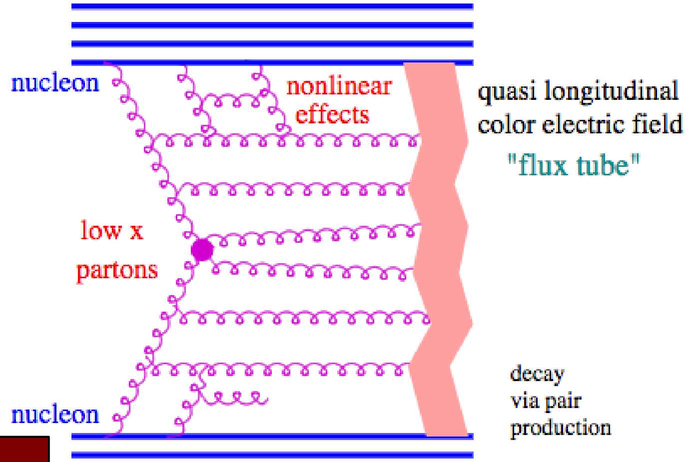
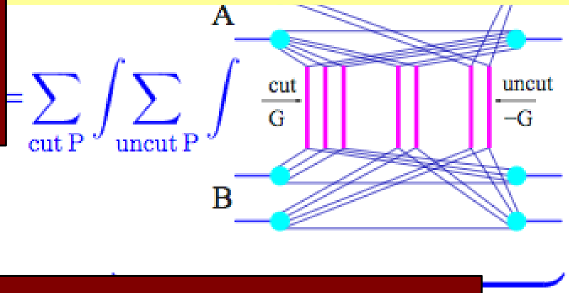
Off-shell, remanentes



., PRC89 (2014) 6, 064903

Estudiaremos las propiedades de los eventos pp generados con EPOS como función de:

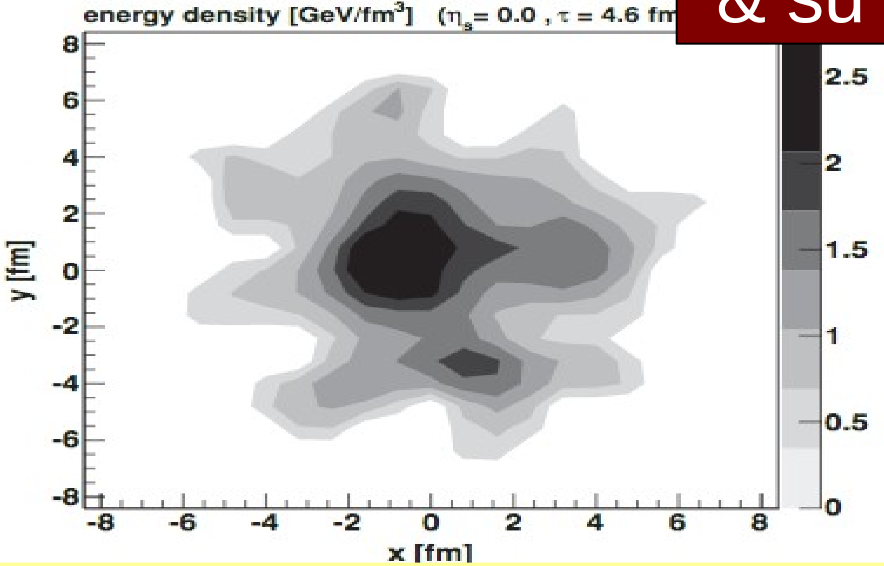


Corona->baja densidad de cuerdas

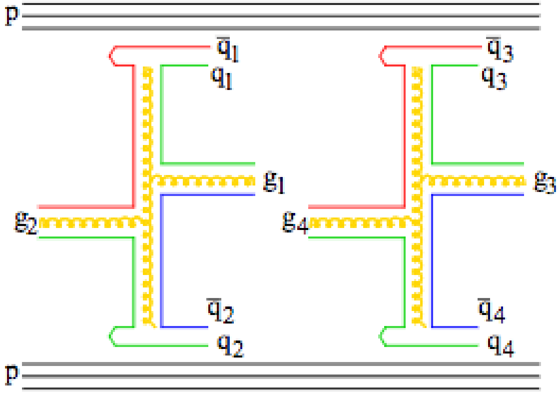
multiplicidad ($z = dN/d\eta/<dN/d\eta>$)

Con "Core"=Hydrodinamica
No "Core"=solo modelo de cu

& su contenido de jets



Tubos de flujo de color, para intercambio de doble Pomerón



K. Werner et al., PRC 82 (2010) 044904

K.Werner et al, PRC 92 (2015) 034906

Herramientas

Generador **Pythia 8.212**

- Monash 2013,
- 900M events

P. Skands, EPJC74 (2014) 8, 3024

Generador **EPOS 3.117,**

- 1000M events

K. Werner et al., PRC89 (2014) 6, 064903
K. Werner et al., PRC 82 (2010) 044904
H.J. Drescher et al., PR 350 (2001) 93-289

Jet Finder: **FastJet 3.1.3**,

- Algorítmo Anti-*k*T
- R=0.4
- *p*Tmin = 5 GeV

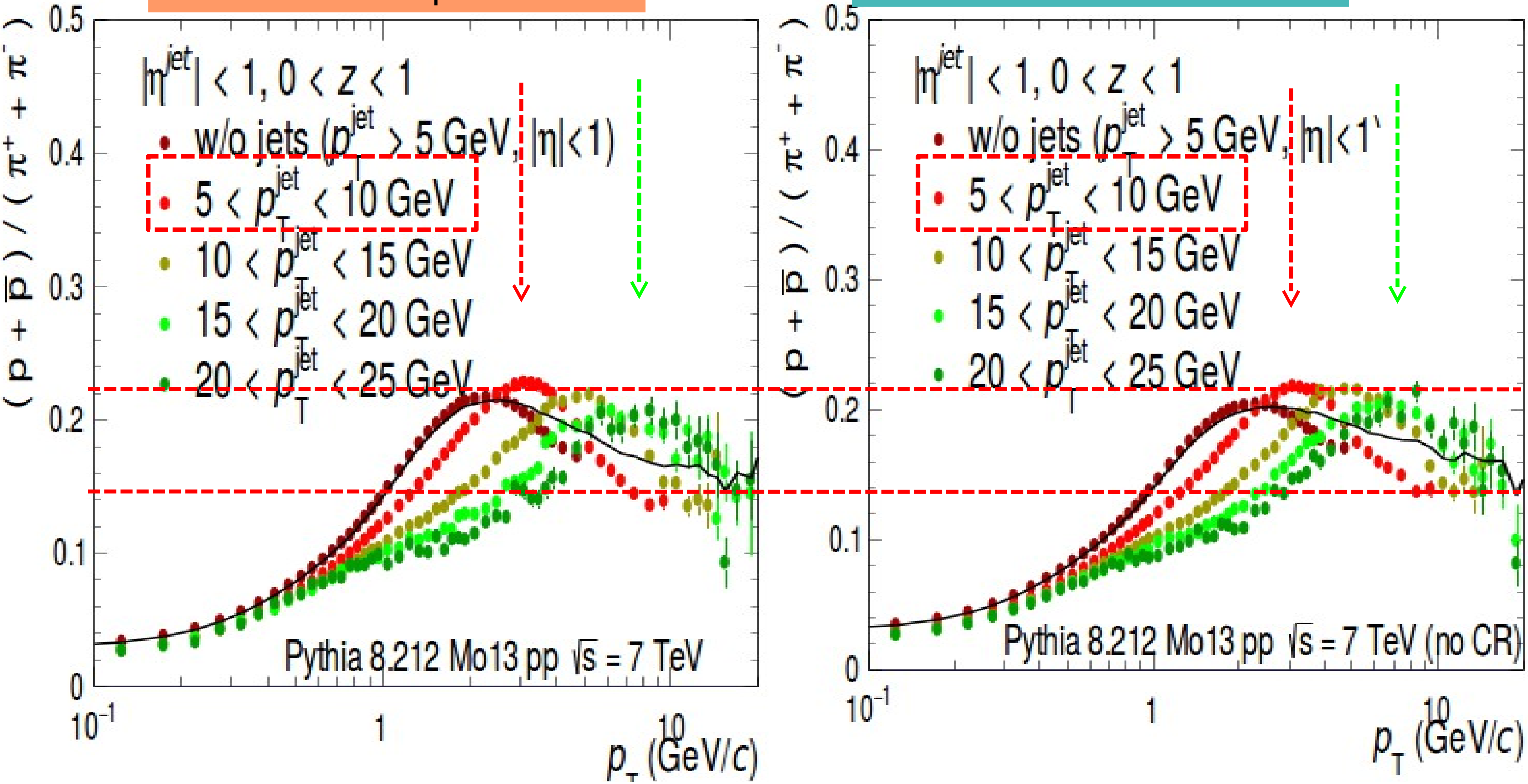
M. Cacciari et al., EPJC72(2012)1896

Partículas estables y primarias (bajo la definición de Pythia) son consideradas para la reconstrucción de jets

p/π vs. p_T (baja multiplicidad)

con Reconexión por Color

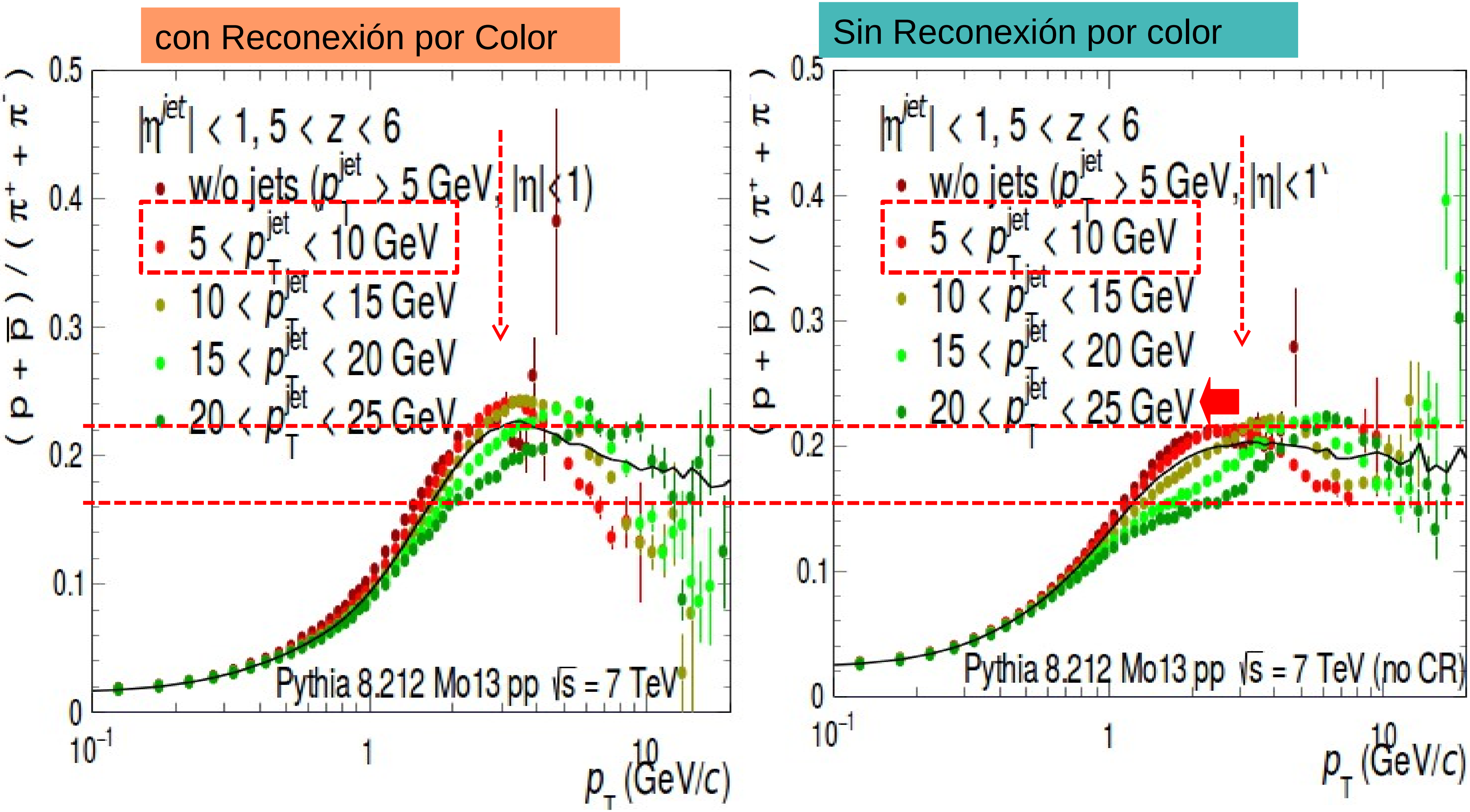
Sin Reconexión por color



- Efectos de reconexión por color se observan para $p_{Tjet} < 10$ GeV.
- La posición del pico es desplazada a alto p_T cuando incrementa p_{Tjet}. El desplazamiento es acompañado por un incremento en < β_T (En el Blast-Wave).

In procedding: Héctor Bello et al, arXiv:1603.05213

p/π vs. p_T (alta multiplicidad)



con Reconexión por Color

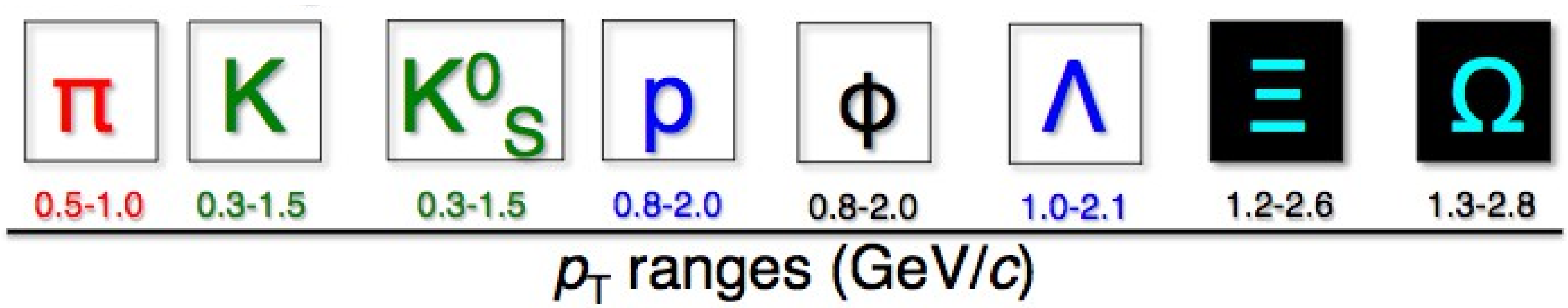
Sin Reconexión por color

- Mayor realce con respecto al caso sin CR
- Con CR, los efectos de jets (posición del pico) son pequeños que en el caso de baja Nch (Dominados por eventos subyacentes).

In procedding: Héctor Bello et al, arXiv:1603.05213

Estudio de la producción de hadrones inclusivos de sabores ligeros

Resultados del análisis de Blast-Wave son presentados, para esto un fit simultaneo de la función BW al espectro de *p*T es desarrollado para extraer <β_T>. Los rangos de los ajustes son:



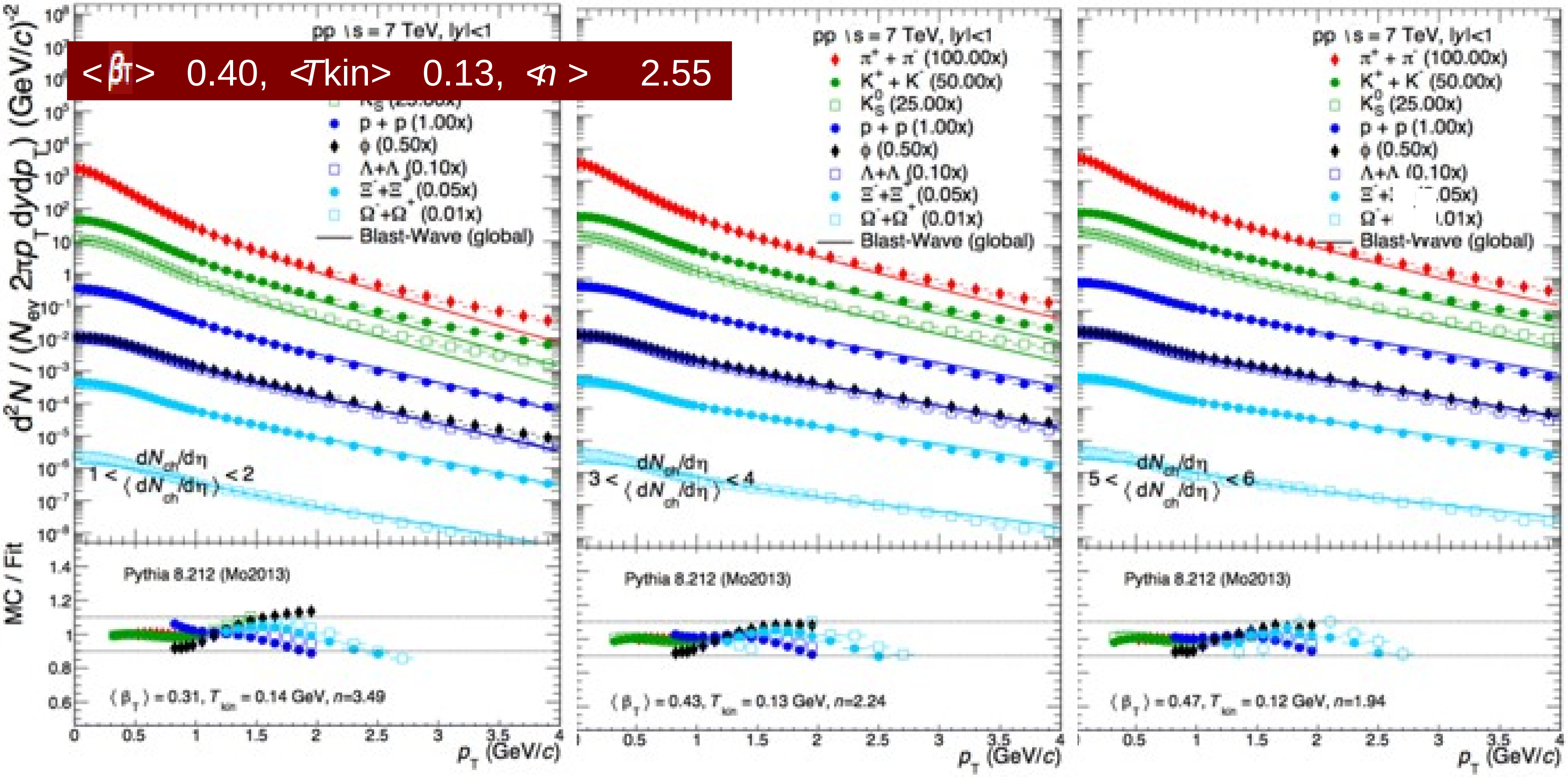
π	K	K^0_S	p	ϕ	Λ	Ξ	Ω
0.5-1.0	0.3-1.5	0.3-1.5	0.8-2.0	0.8-2.0	1.0-2.1	1.2-2.6	1.3-2.8

p_T ranges (GeV/c)

(mismo rango de p_T que en: G. Paic, E. Cuautle and Antonio. Ortíz. NPA 941 (2015) 78-86, donde el espectro de p_T en eventos de alta multiplicidad fueron descritos por el modelo BW en 10%)

Análisis p_T vs N_{ch}

PYTHIA 8



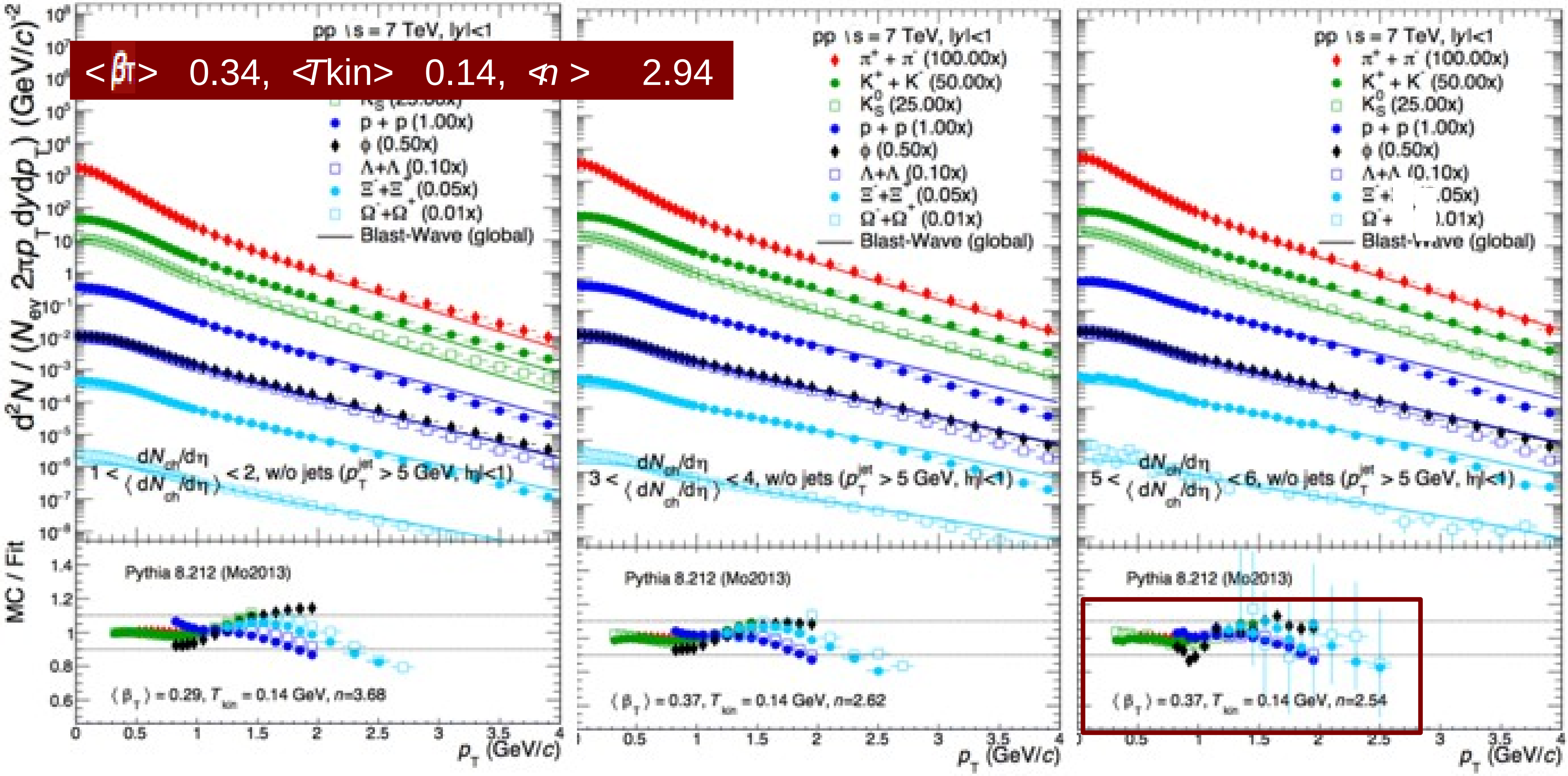
$\langle\beta_T\rangle$ 0.40, $\langle T_{kin}\rangle$ 0.13, $\langle n\rangle$ 2.55

$\langle N_{ch}\rangle_{|\eta|<1}$	$\langle N_{ch}\rangle_{|\eta|<1}$	$\langle N_{ch}\rangle_{|\eta|<1}$
16.73	38.52	60.08

In procedding: Héctor Bello et al, arXiv:1603.05213

Sin Jets

PYTHIA 8



$<\beta_T>$ 0.34, $<T$kin> 0.14, $<n>$ 2.94

<Nch>|η |<1
16.23

<Nch>|η |<1
38.02

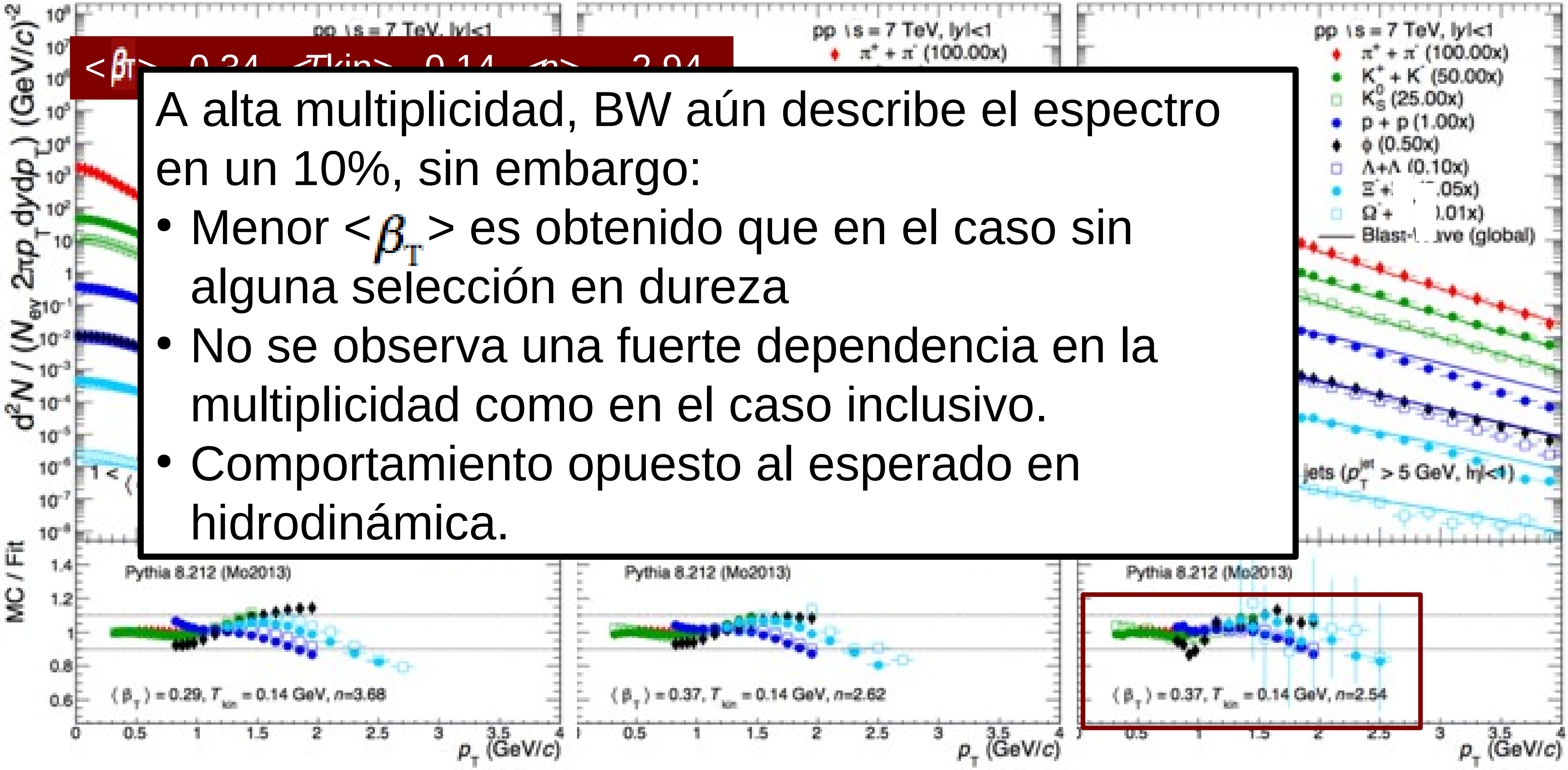
<Nch>|η |<1
59.58

La calidad del ajuste es ligeramente mala & se alcanza un menor $<\beta_T>$

In procedding: Héctor Bello et al, arXiv:1603.05213

Sin Jets

PYTHIA 8



<β_T> 0.34 <Tkin> 0.14 <n> 2.94

A alta multiplicidad, BW aún describe el espectro en un 10%, sin embargo:

- Menor <β_T> es obtenido que en el caso sin alguna selección en dureza
- No se observa una fuerte dependencia en la multiplicidad como en el caso inclusivo.
- Comportamiento opuesto al esperado en hidrodinámica.

<*N*ch>|η|<1 16.23

<*N*ch>|η|<1 38.02

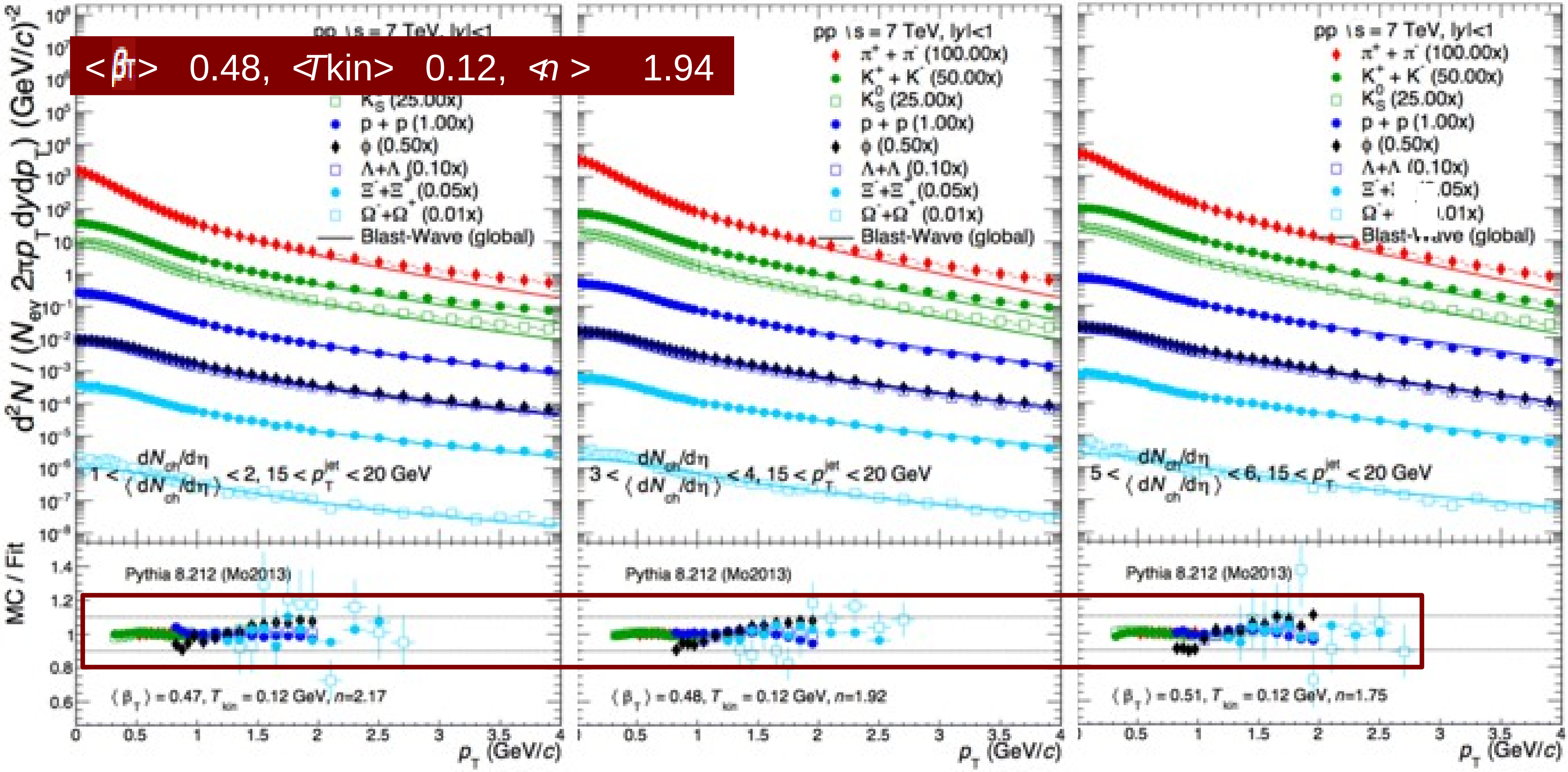
<*N*ch>|η|<1 59.58

La calidad del ajuste es ligeramente mala & se alcanza un menor <β_T>

In procedding: Héctor Bello et al, arXiv:1603.05213

15 < *p*TJet < 20 GeV

PYTHIA 8



$\langle\beta_T\rangle$ 0.48, $\langle T_{kin}\rangle$ 0.12, $\langle n\rangle$ 1.94

$\langle N_{ch}\rangle_{|\eta|<1}$ 18.22

$\langle N_{ch}\rangle_{|\eta|<1}$ 39.18

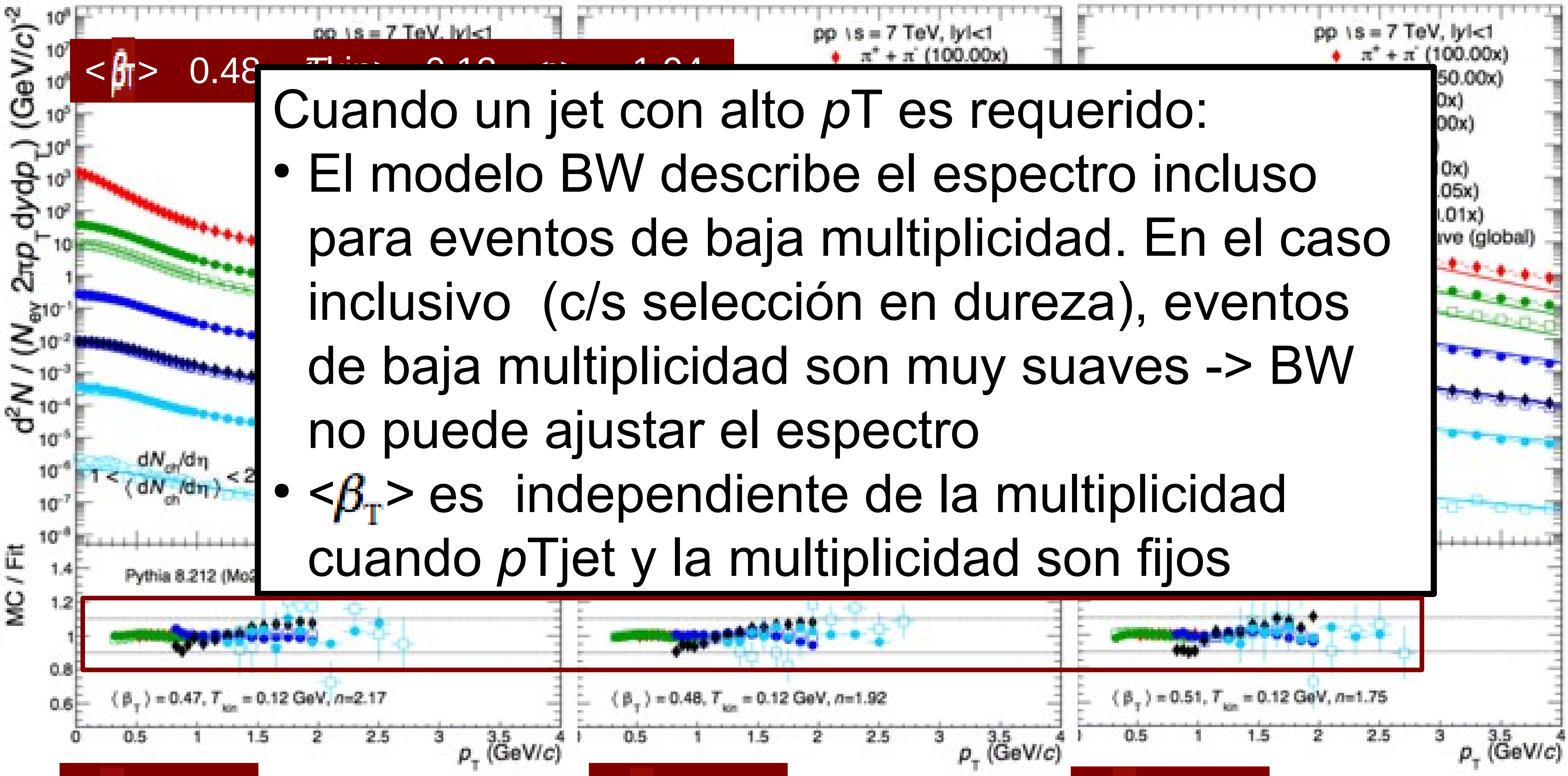
$\langle N_{ch}\rangle_{|\eta|<1}$ 60.47

La calidad del ajuste es mejor & se alcanza un mayor $\langle\beta_T\rangle$

In procedding: Héctor Bello et al, arXiv:1603.05213

15 < pTJet < 20 GeV

PYTHIA 8



Cuando un jet con alto pT es requerido:

- El modelo BW describe el espectro incluso para eventos de baja multiplicidad. En el caso inclusivo (c/s selección en dureza), eventos de baja multiplicidad son muy suaves -> BW no puede ajustar el espectro
- <β_T> es independiente de la multiplicidad cuando pTjet y la multiplicidad son fijos

<β_T> 0.47

<Nch>|η|<1
18.22

<β_T> 0.48

<Nch>|η|<1
38.02

<β_T> 0.51

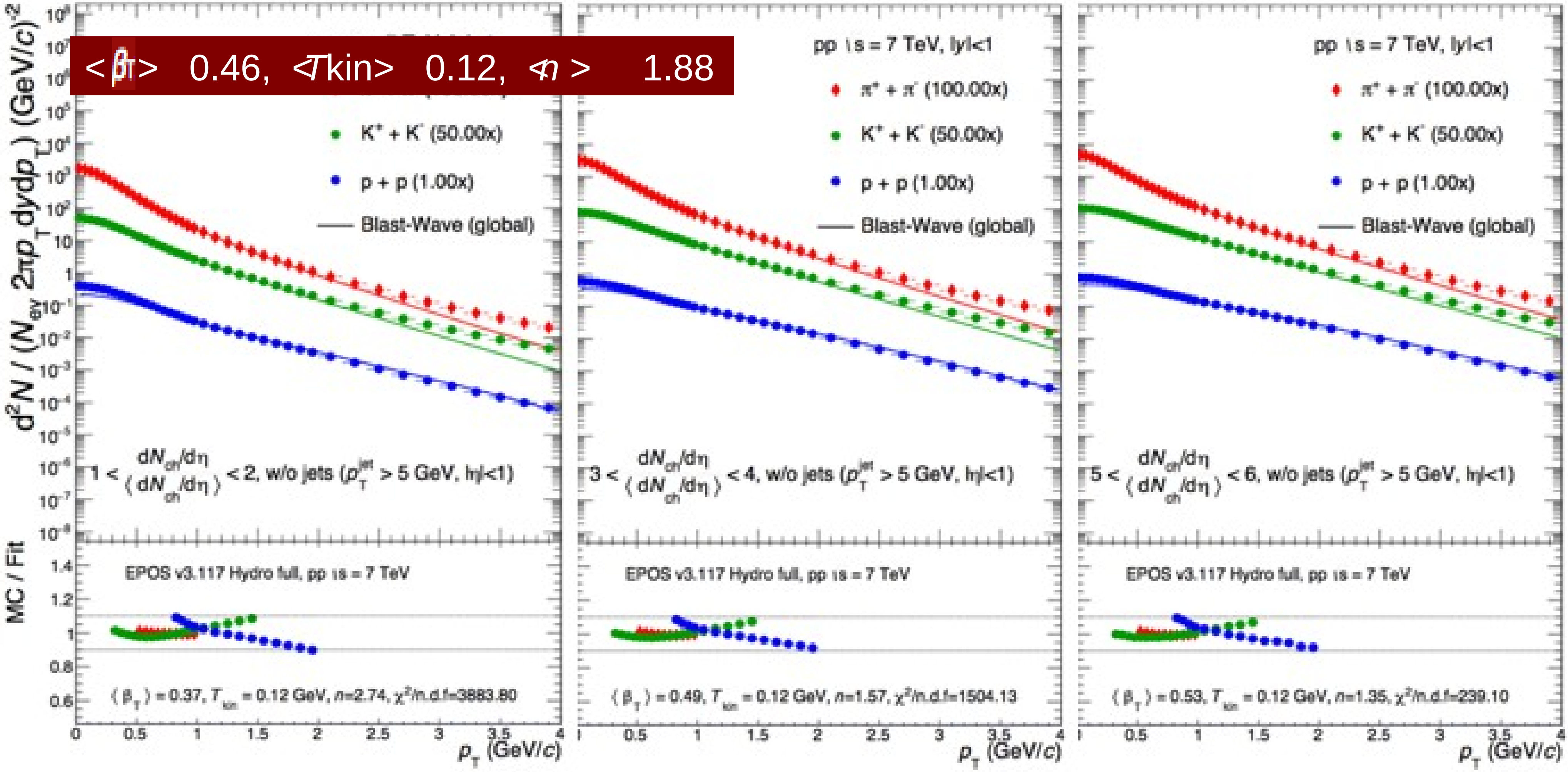
<Nch>|η|<1
59.58

La calidad del ajuste es mejor & se alcanza un mayor <β_T>

In procedding: Héctor Bello et al, arXiv:1603.05213

Análisis p_T vs N_{ch}

EPOS 3



$\langle \beta_T \rangle$ 0.46, $\langle T_{kin} \rangle$ 0.12, $\langle n \rangle$ 1.88

$\langle N_{ch} \rangle_{|\eta|<1}$ 15.27

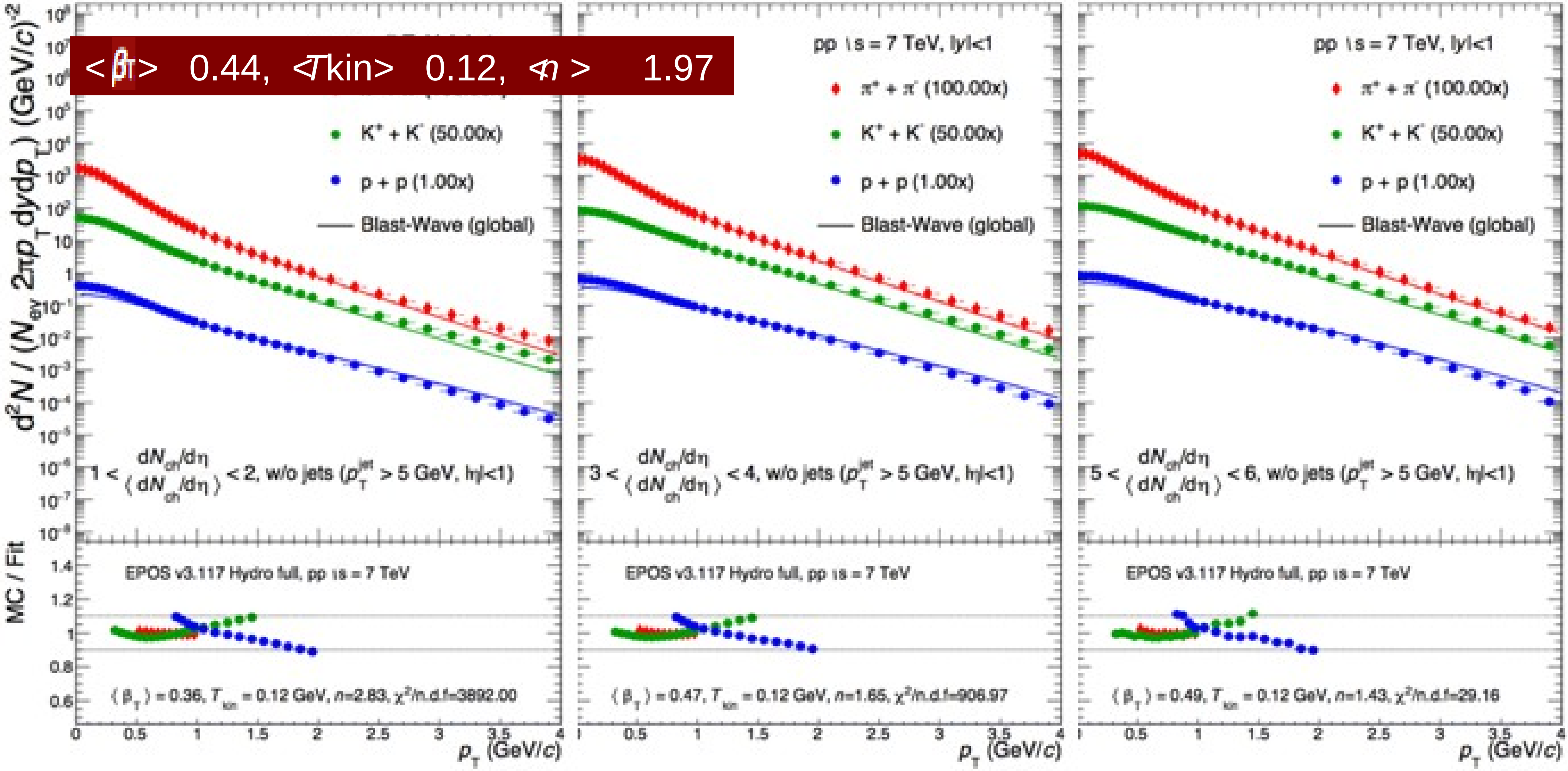
$\langle N_{ch} \rangle_{|\eta|<1}$ 35.12

$\langle N_{ch} \rangle_{|\eta|<1}$ 56.06

paper Under preparation NPA

Sin Jets

EPOS 3



$\langle\beta_T\rangle$ 0.44, $\langle T_{kin}\rangle$ 0.12, $\langle n\rangle$ 1.97

<Nch>|η |<1
15.15

<Nch>|η |<1
34.71

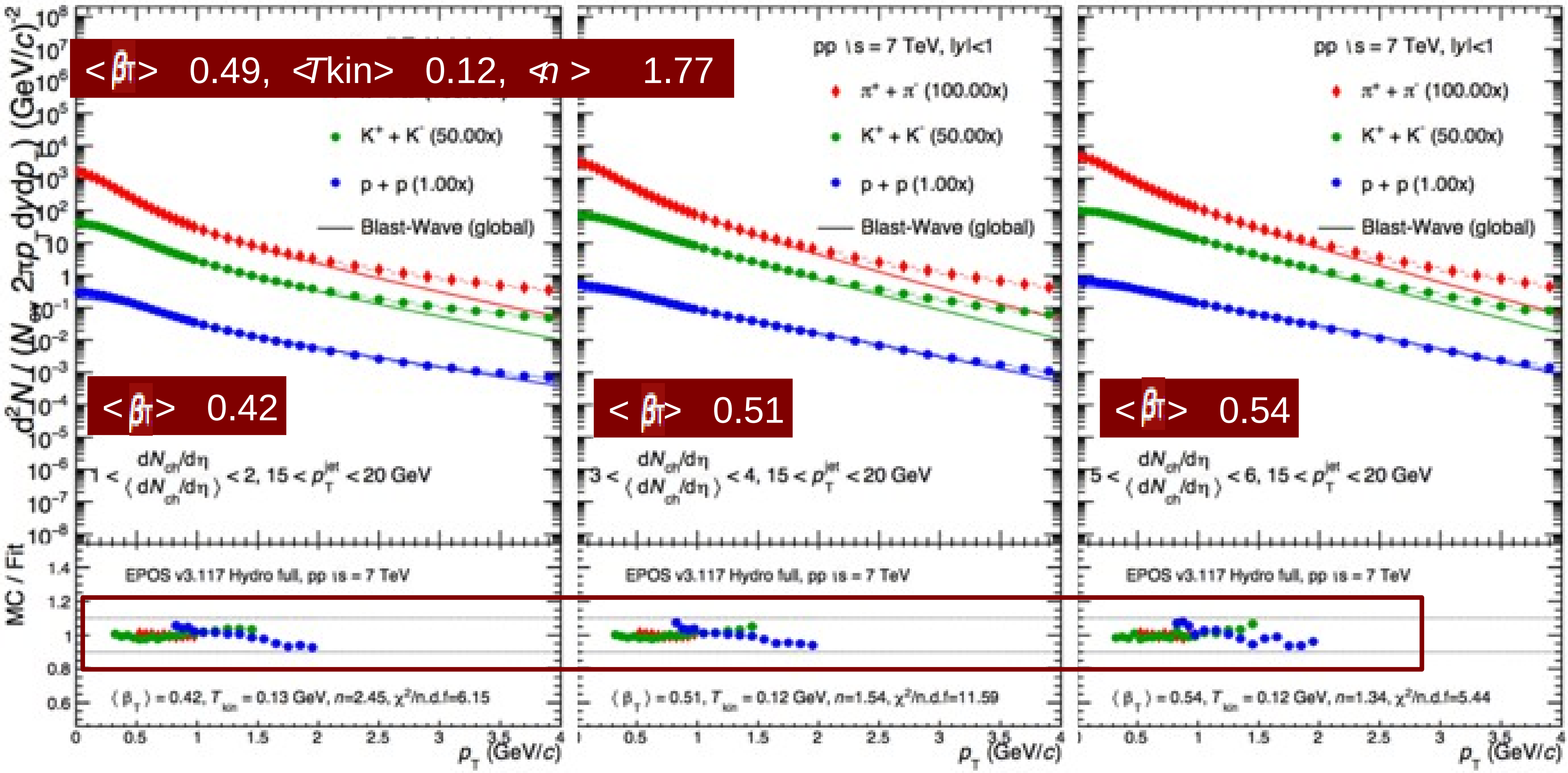
<Nch>|η |<1
55.18

Hector Bello

paper Under preparation NPA

15 < pTJet < 20 GeV

EPOS 3



$<\beta_T>$ 0.49, $<T$kin> 0.12, $<n>$ 1.77

$<\beta_T>$ 0.42

$<\beta_T>$ 0.51

$<\beta_T>$ 0.54

<Nch>|η |<1
16.39

<Nch>|η |<1
35.56

<Nch>|η |<1
56.27

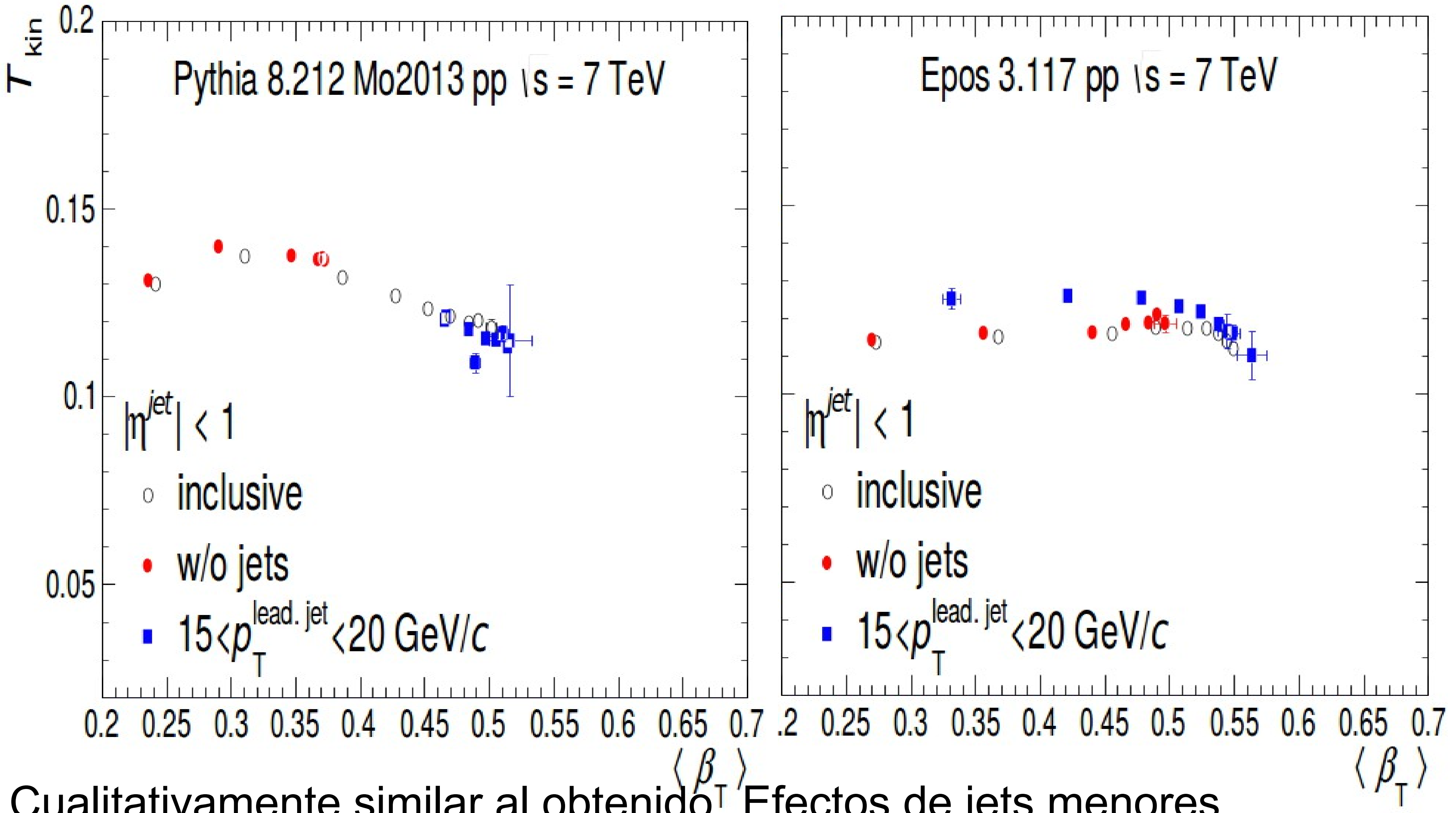
La calidad del ajuste es mejor & se alcanza un mayor $<\beta_T>$
(mayor dependencia en multiplicidad que en Pythia)

paper Under preparation NPA

PYTHIA 8

T_{kin} VS $\langle\beta_T\rangle$

EPOS 3



Cualitativamente similar al obtenido usando la variable de **esferocidad**

Efectos de jets menores.
Fuerte dependencia en multiplicidad

Antonio Ortíz, E. Cuautle and G. Paic
NPA 941 (2015) 78-86

paper Under preparation NPA

Conclusiones

- El efecto de CR, incrementa las razones protón-pión (una evidencia relacionada con el flujo) en especial a alta multiplicidad.

- De ambos Monte Carlos:

Se obtiene menor $<\beta_T>$ para el caso sin jets, que en el caso inclusivo.
Se obtiene el mayor $<\beta_T>$ para el caso con jets.

- Usando Pythia8 para eventos con y sin jets, no se muestra una fuerte dependencia en la multiplicidad como para el caso con EPOS3.

- Para EPOS3 no hay una separación clara en eventos con y sin jets como para Pythia8 en la correlación T_{kin} vs $<\beta_T>$.
  Parece que la evolución hidrodinámica trata por igual a jets

que a eventos sin estos, por el contrario; CR quien produce un efecto tipo flujo, marca una differencia en eventos con jets.

Thank you!

Back Up

Useful tools

- 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");
```

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

- More:

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

- For pileup rejection codes in HMTF

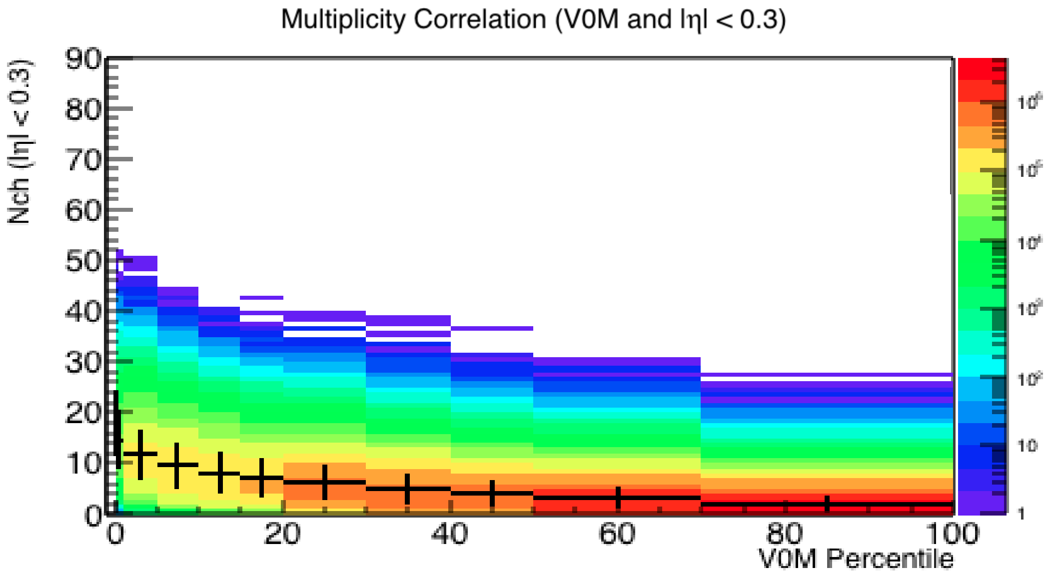
https://twiki.cern.ch/twiki/bin/view/ALICE/AliceHMTFPastFutureProtection

```
AliVVZERO* vzero = fInputEvent->GetVZEROData();

 fMTotV0A = vzero->GetMTotV0A();   fMTotV0C  = vzero->GetMTotV0C();

 fTriggerChargeA = vzero->GetTriggerChargeA();

 fTriggerChargeC = vzero->GetTriggerChargeC();

  onlineV0M     = fTriggerChargeA+fTriggerChargeC;

 offlineV0M    = fMTotV0A+fMTotV0C;
```

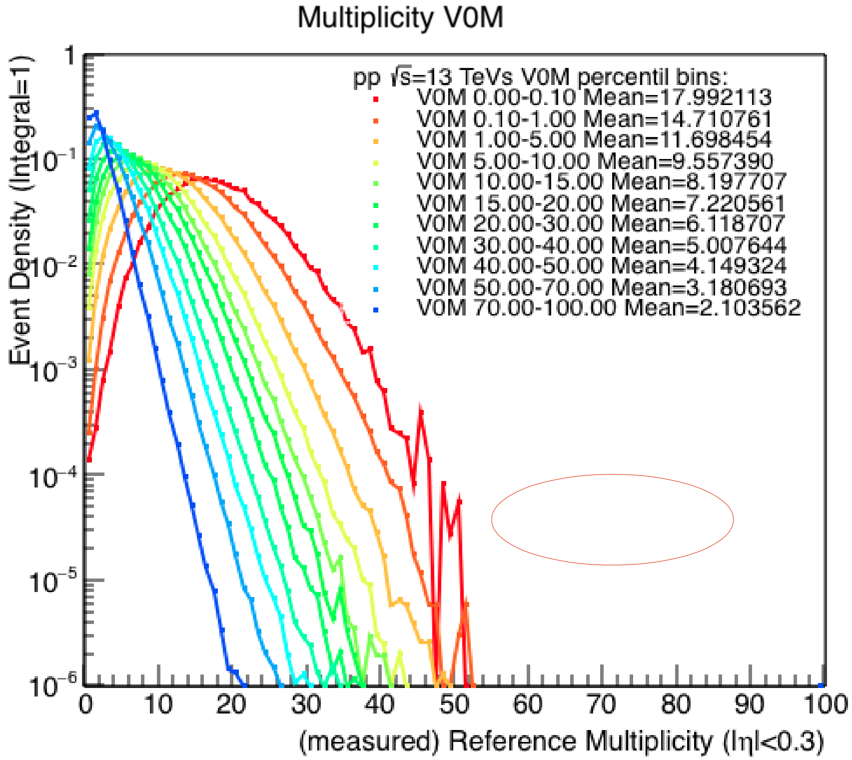
- Thanks David for help on AliMultSelection task info.
- Vytautas for provide the binning
- Yihye Song, and Michele Floris for provide the info on the low diagonal cuts on SPD and V0M online-offline

Some usefull plots for V0M Analysis DATA

With All PU rejection cuts



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

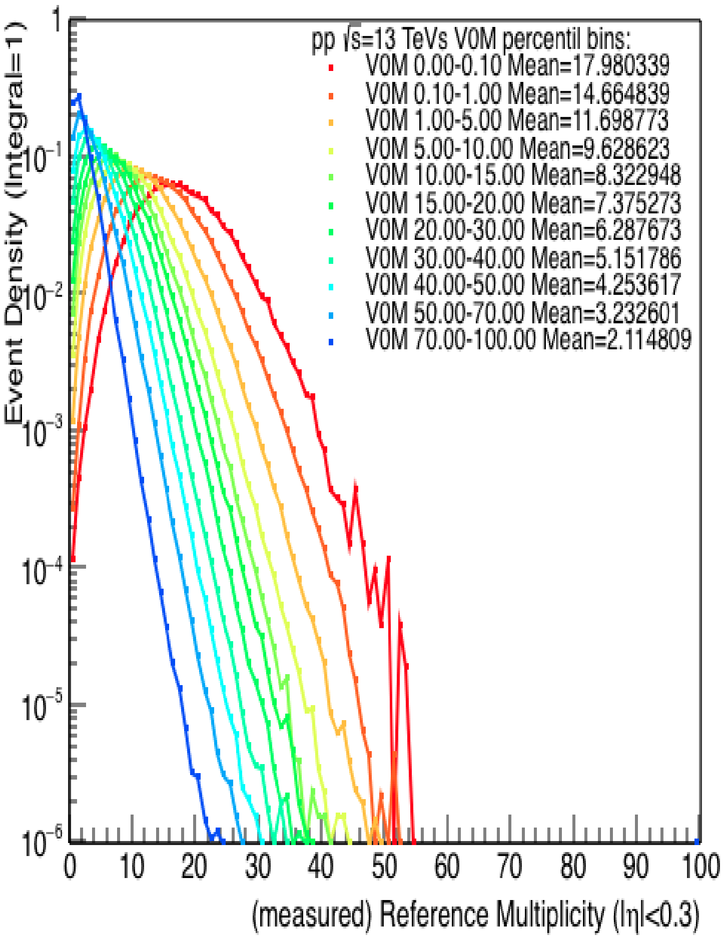


V0M percentil	<d*N*/deta> |eta|<0.3
0.0-0.1,	17.99
0.1-1,	14.71
1-5,	11.69
5-10,	9.55
10-15,	8.19
15-20,	7.22
20-30,	6.11
30-40,	5.00
40-50,	4.14
50-70,	3.18
70-100	2.10

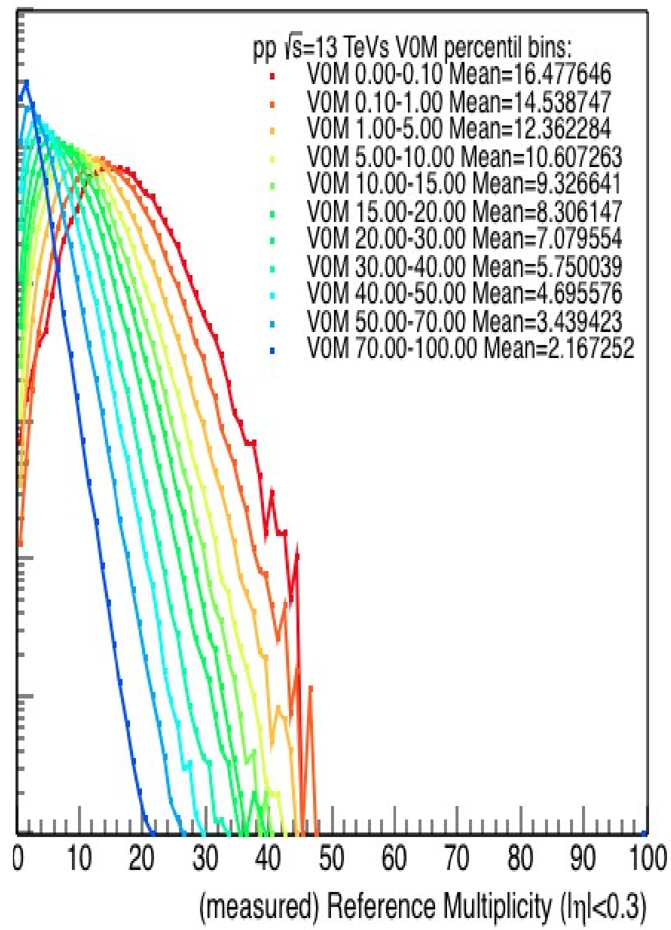
The number of events where taken from each multiplicity class for normalization

Multiplicity density for V0M Ref for:| η | <0.3

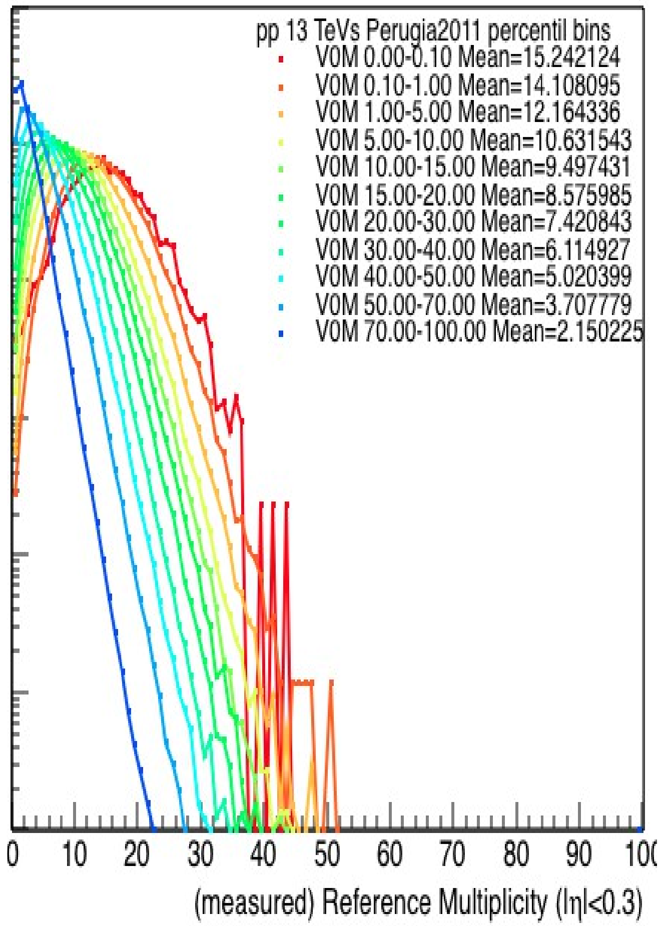
Without efficiency corrections



- LHC15f pass2



- LHC15g3a3

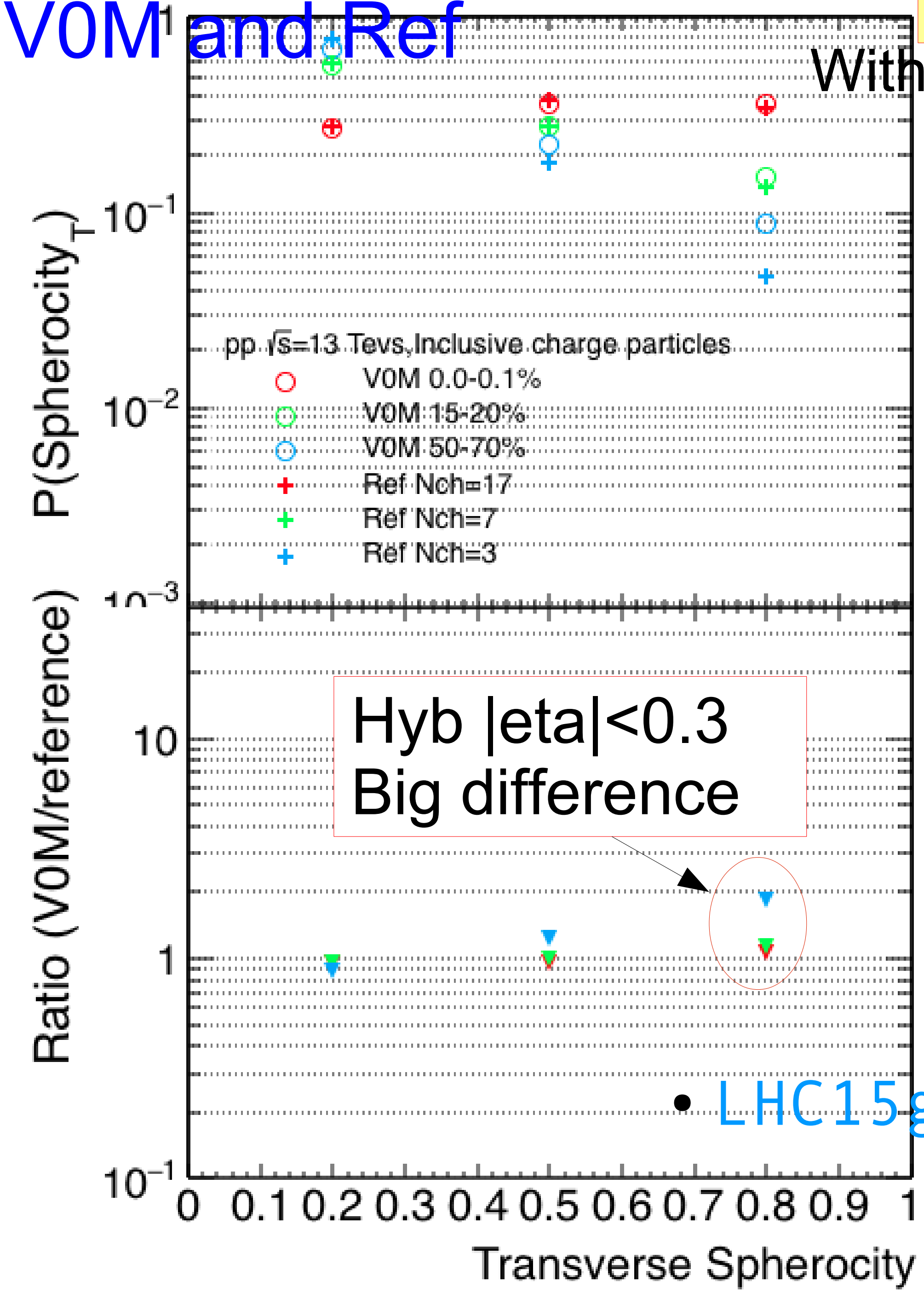


- LHC15g3c3

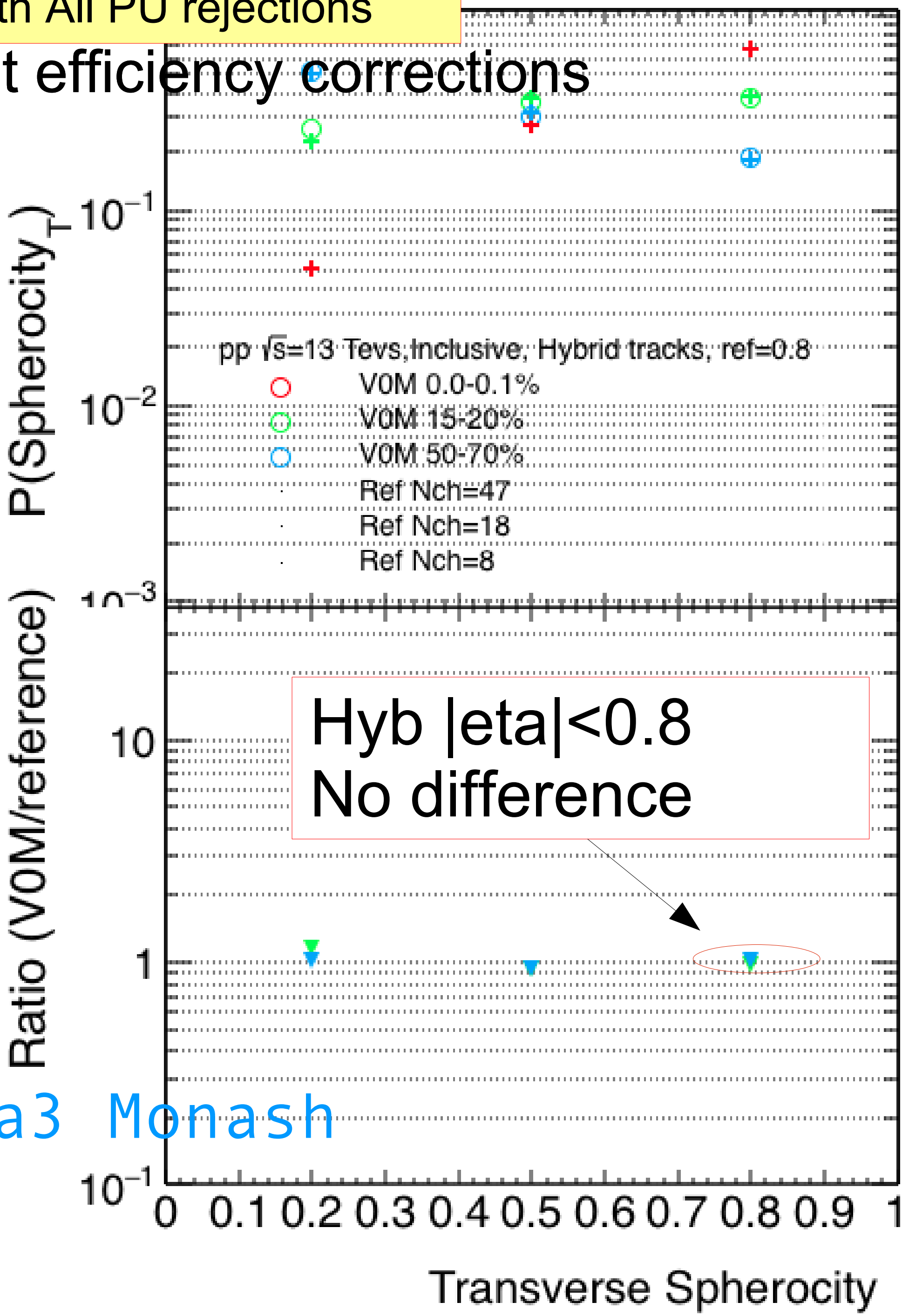
Some test ask for Antonio Monash Tune ESD <P_T> V0M and Ref

With All PU rejections

Without efficiency corrections



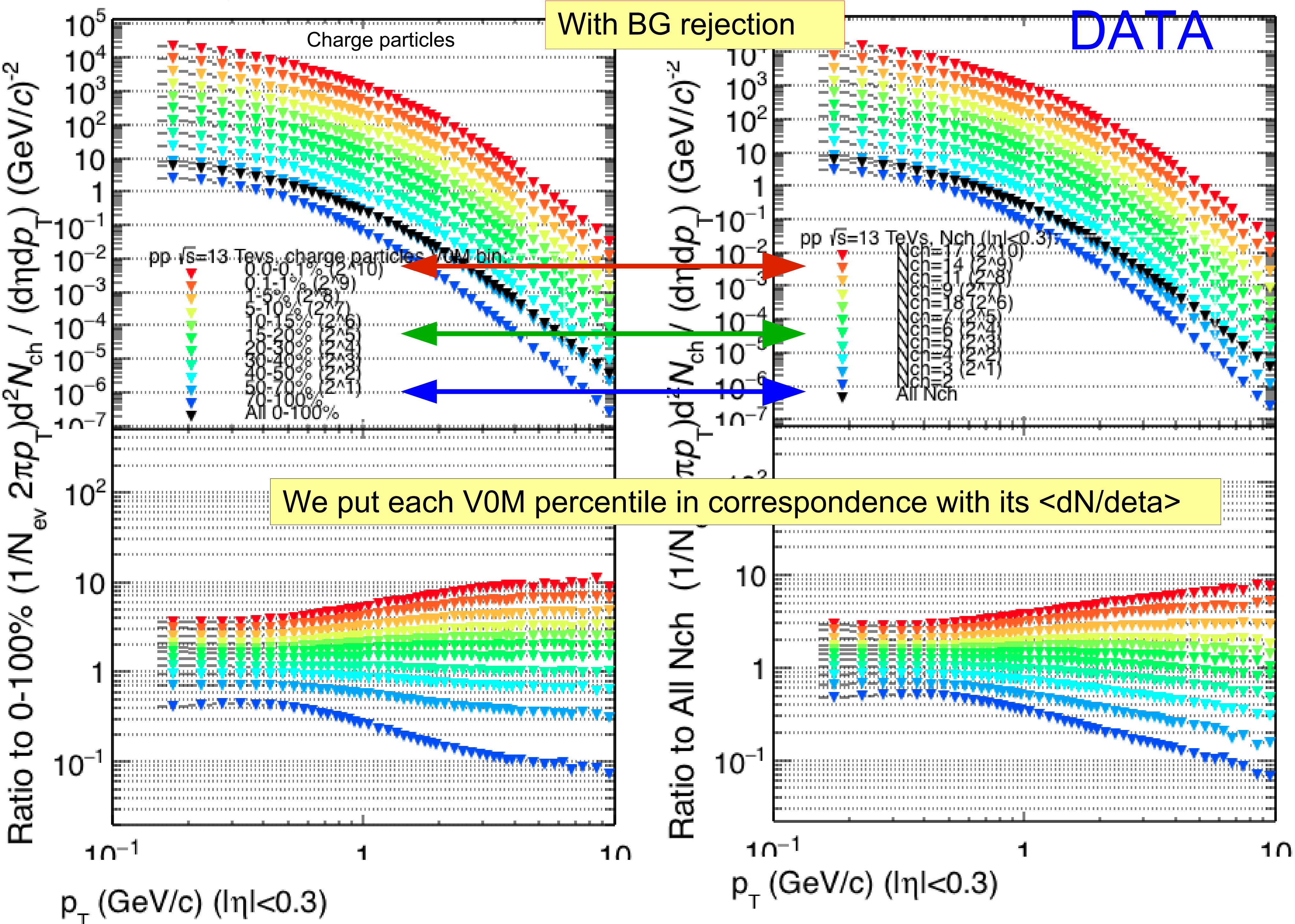
Hyb |eta|<0.3
Big difference



Hyb |eta|<0.8
No difference

- LHC15g3a3 Monash

Comparing for V0M percentils and *N*ch for its <d*N*/deta>

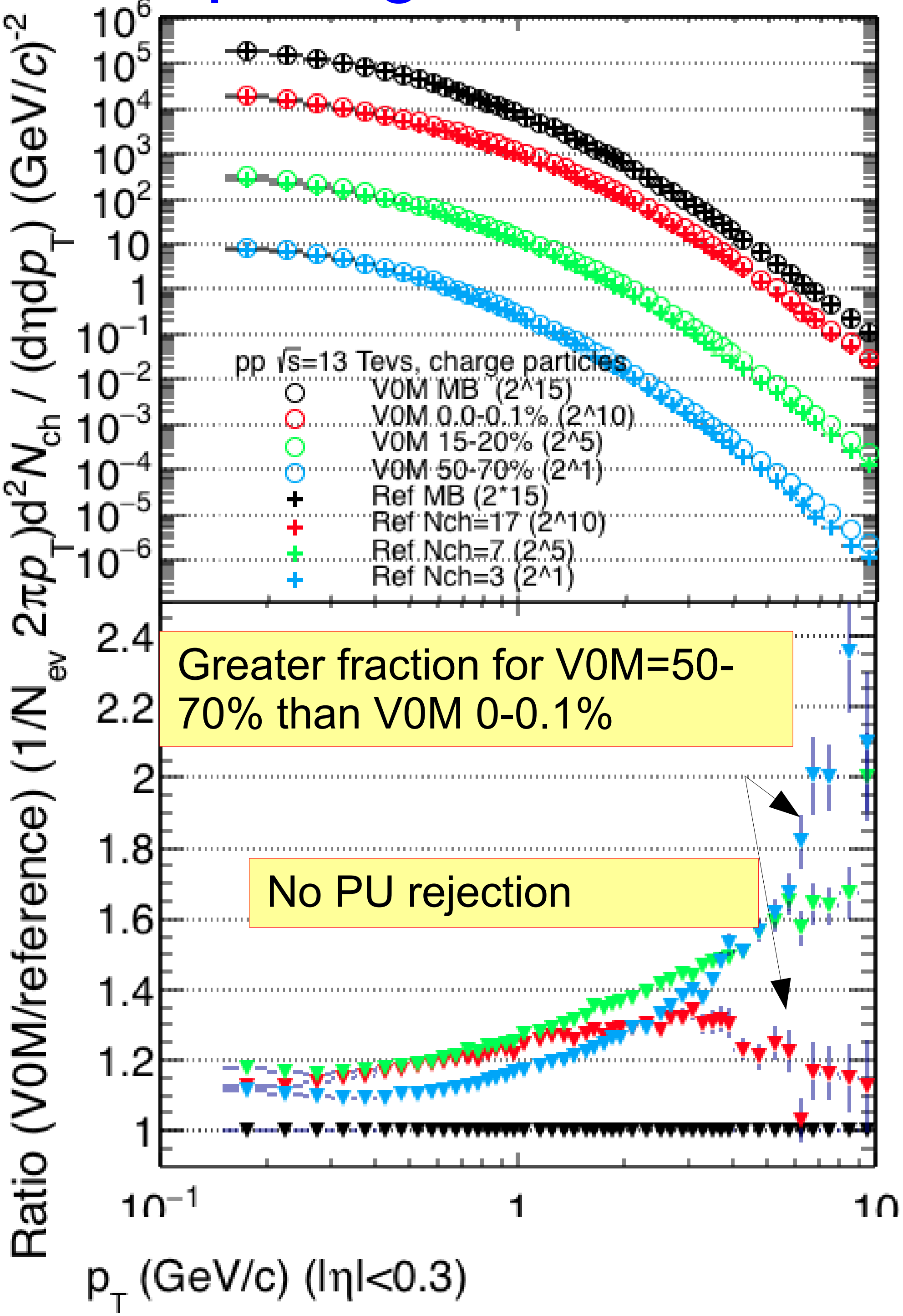


With BG rejection

DATA

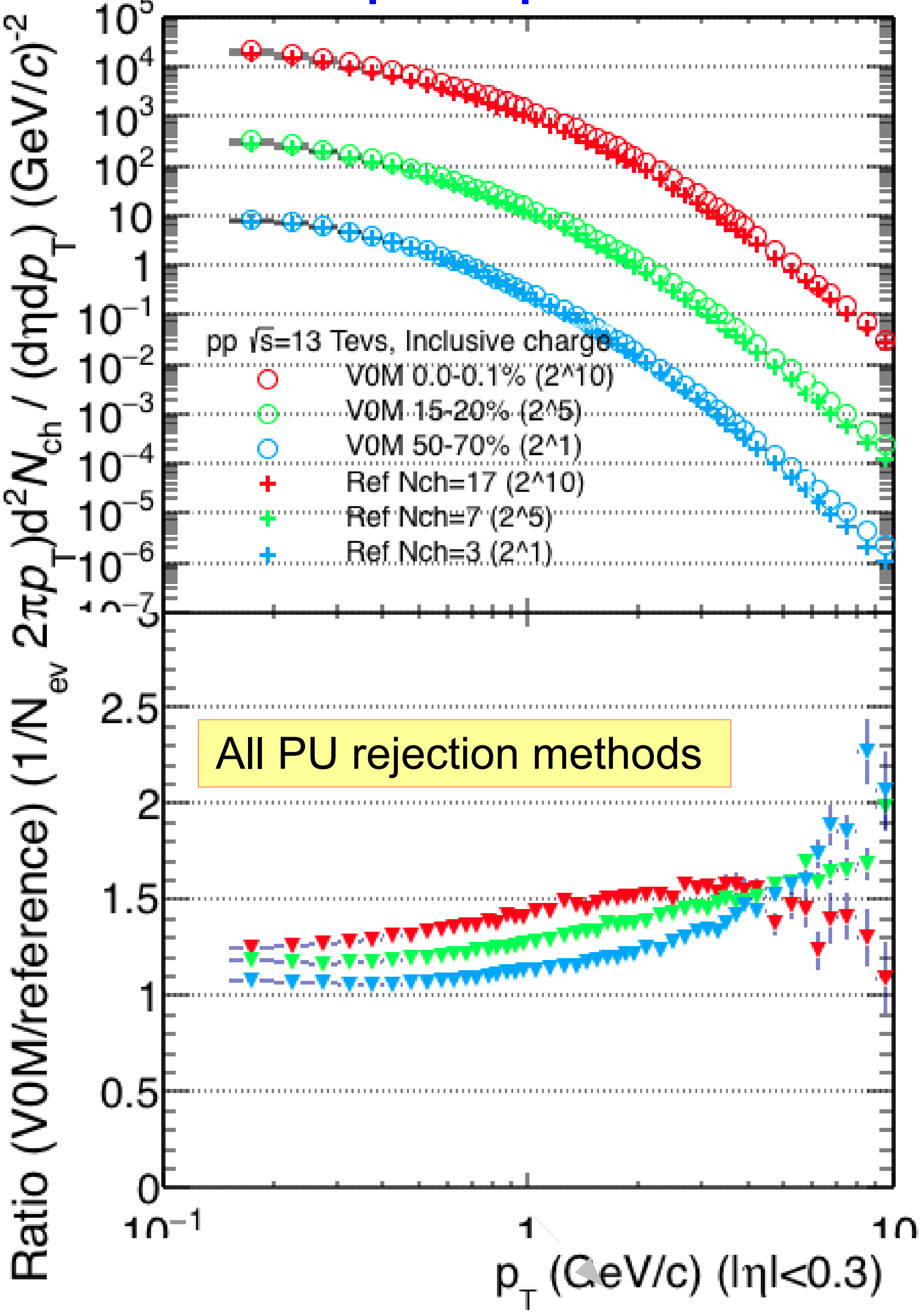
We put each V0M percentile in correspondence with its <dN/deta>

Comparing estimators V0M and Ref | eta| <0.3



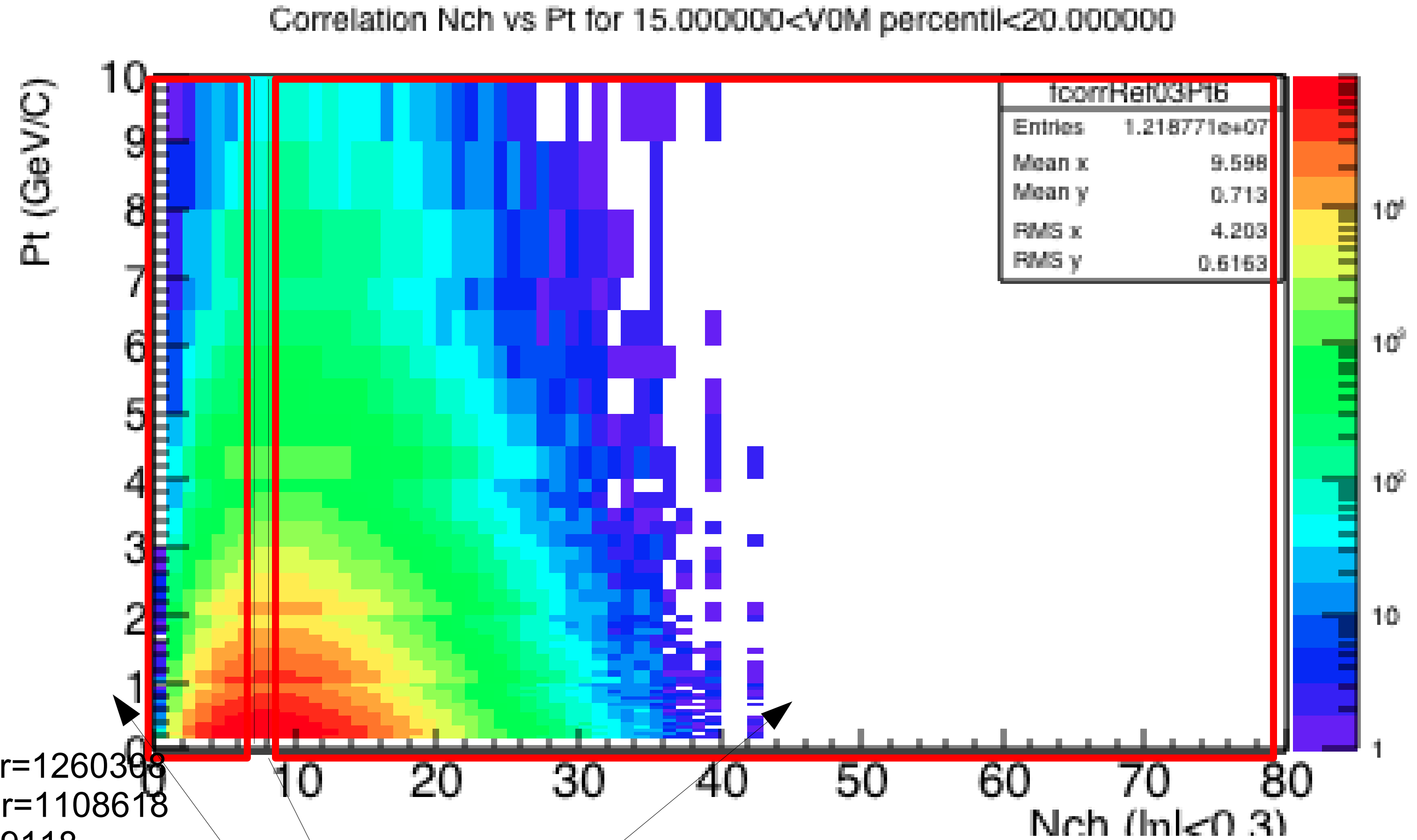
Greater fraction for V0M=50-70% than V0M 0-0.1%

No PU rejection



All PU rejection methods

Correlation pt vs <dN/deta> $_{|eta|<0.3}$

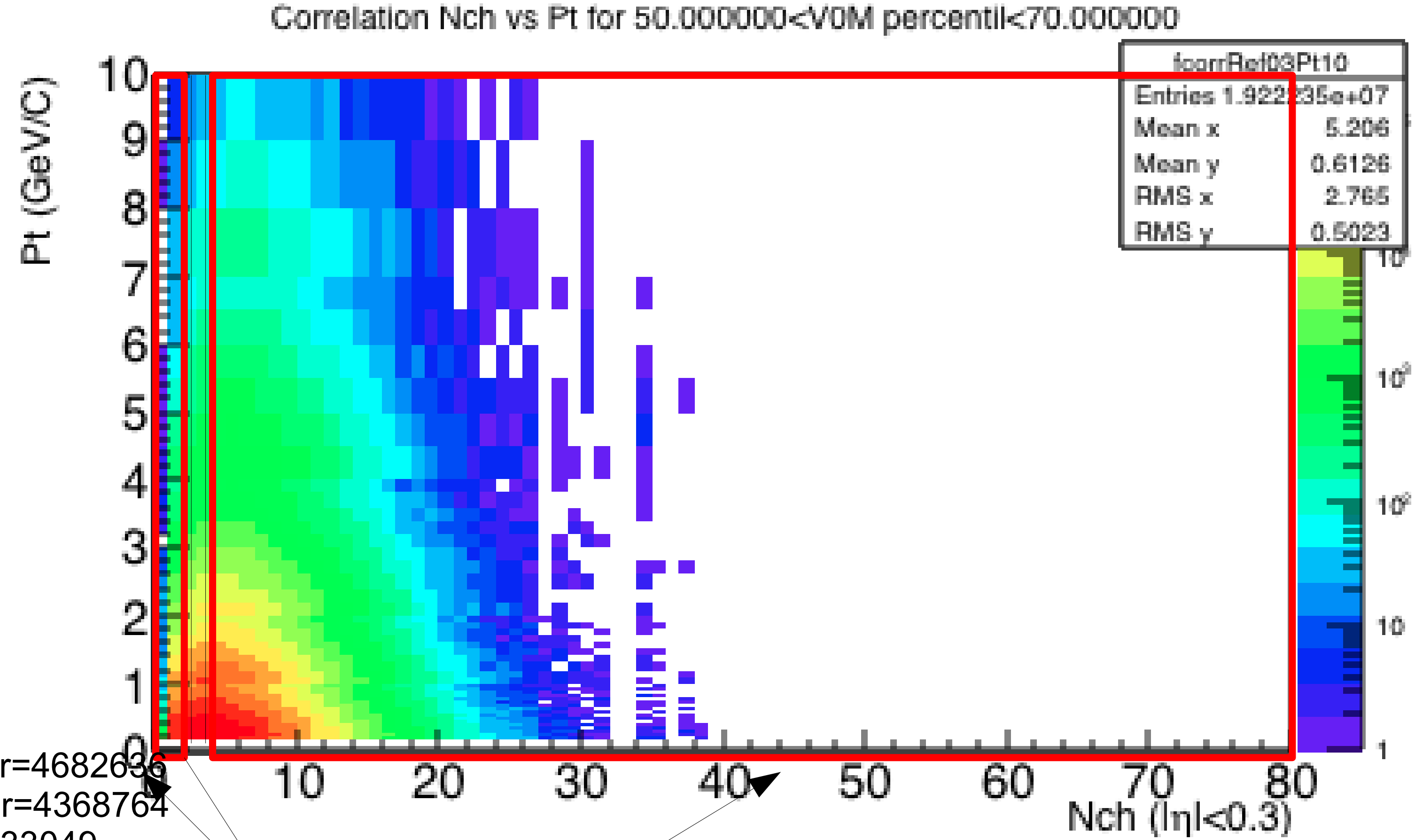


Nev=2648044

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> $_{|eta|<0.3}$



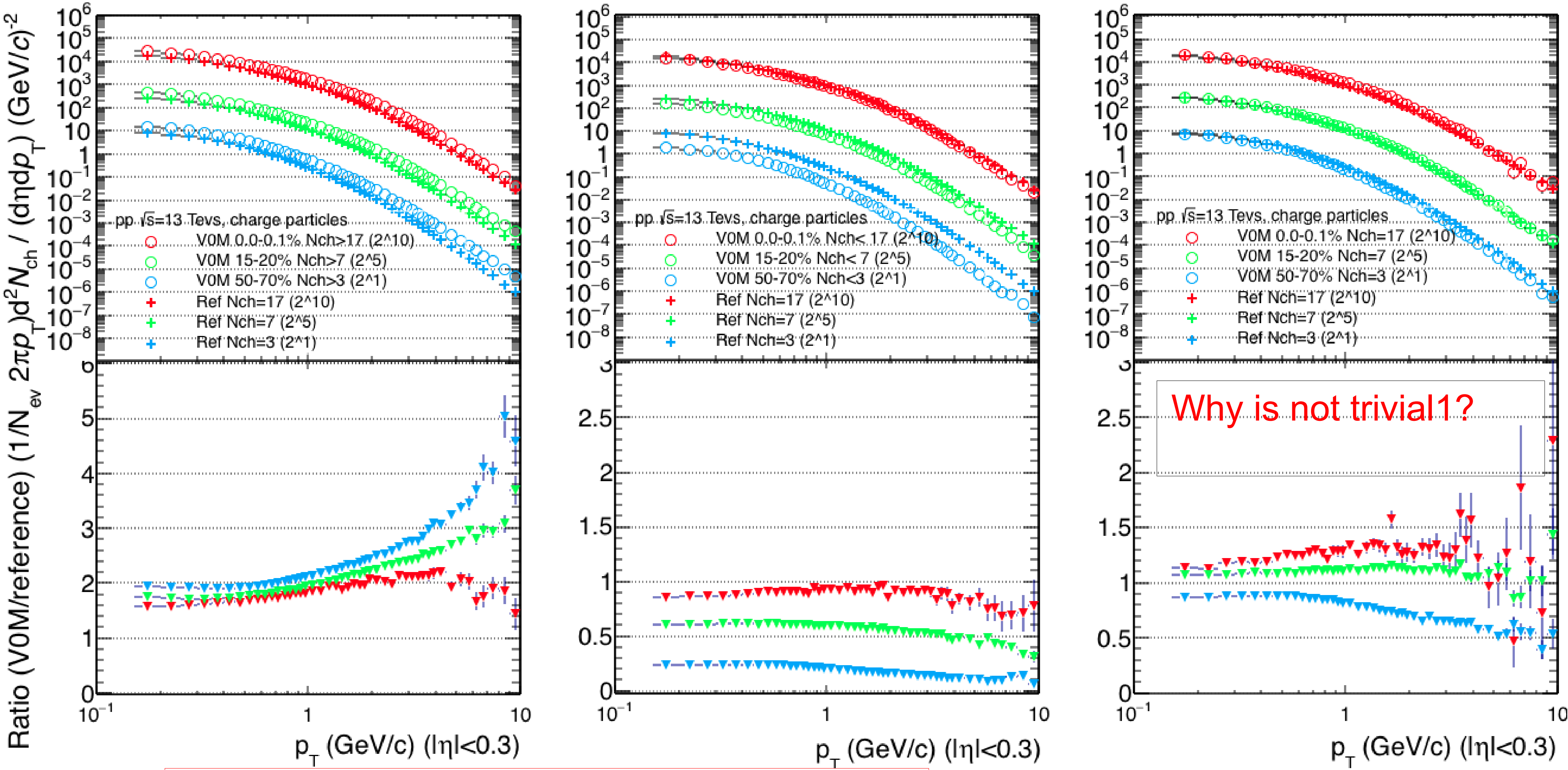
Nev=11084449

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>

With All PU rejection cuts



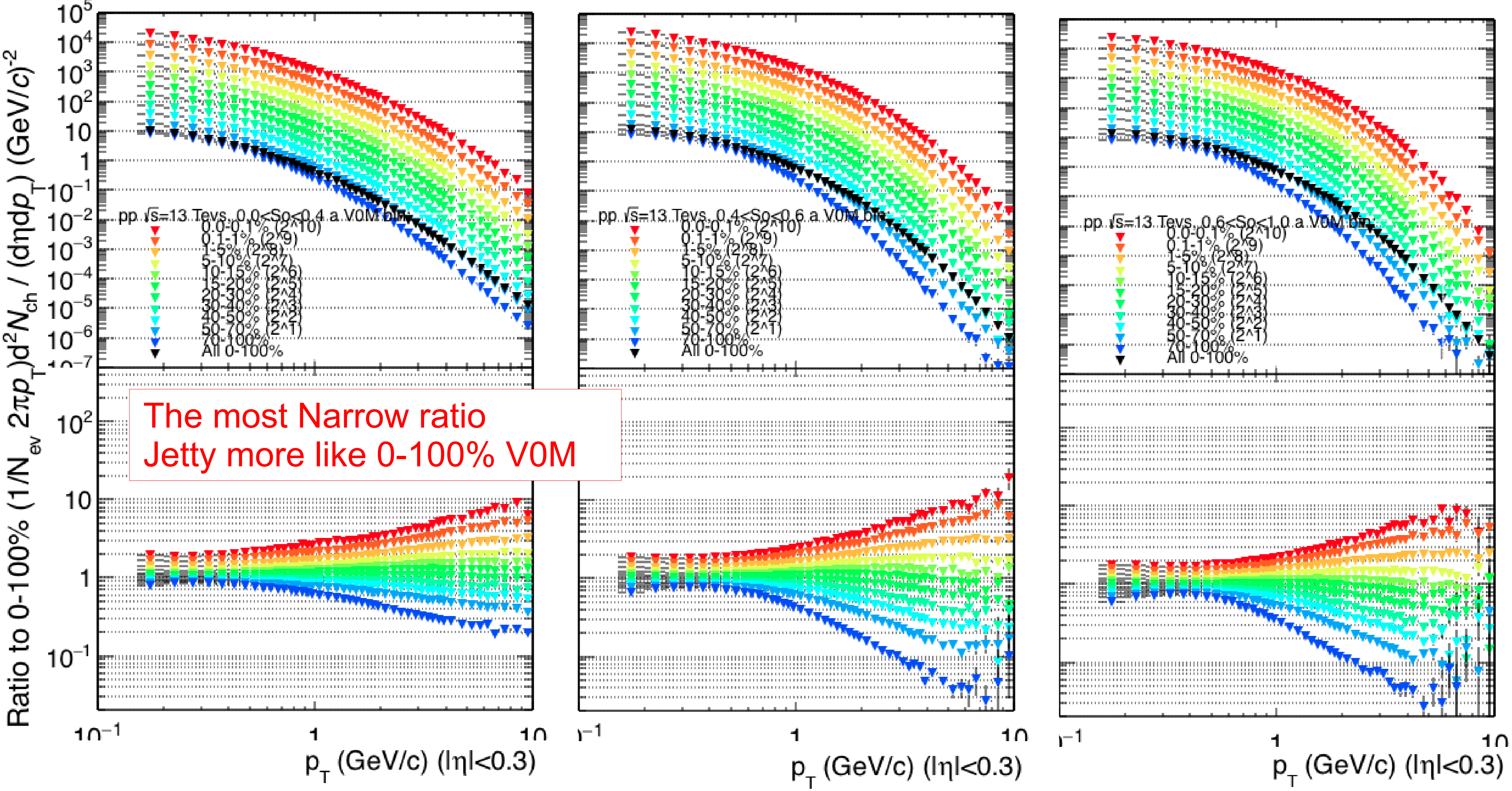
Why is not trivial1?

To check the contribution to the ratio,

A crosscheck in number of events has been taken into account

Comparing for V0M percentils and N_{ch} for its <d*N*/deta> For Spherocity bins

Normalization was done with events for each shape and V0M classes



The most Narrow ratio
Jetty more like 0-100% V0M

0<So<0.4

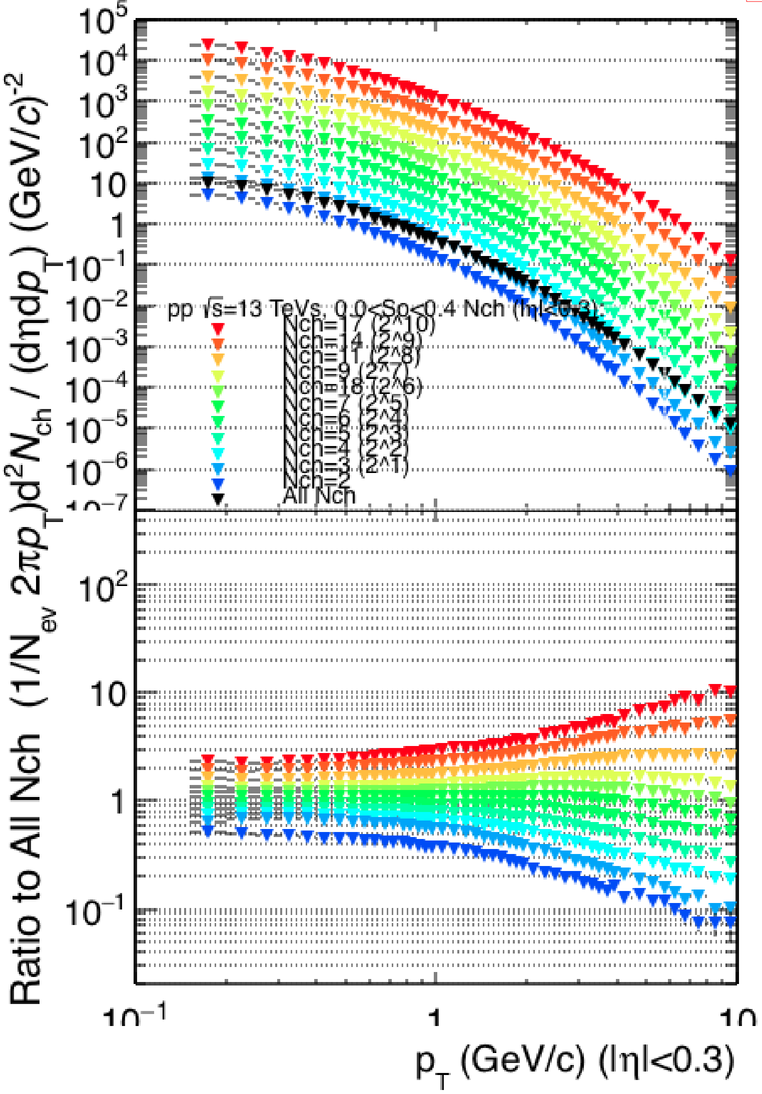
0.4<So<0.6

0.6<So<1

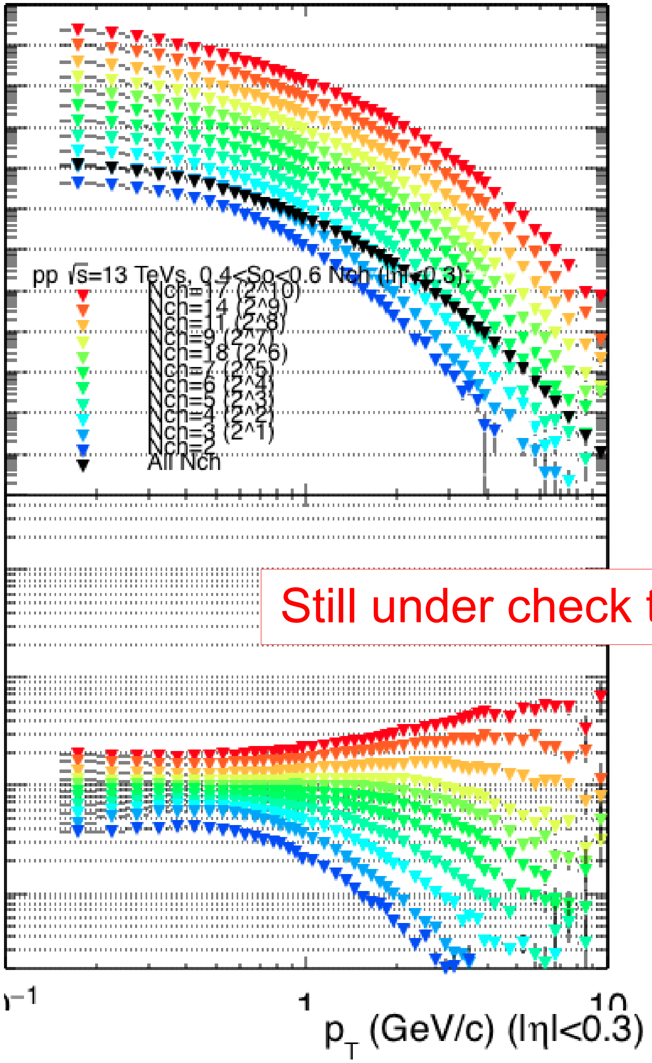
For DATA Comparing for REF estimator | eta| <0.3
For Spherocity bins

Normalization was done with events for each shape and Nch classes

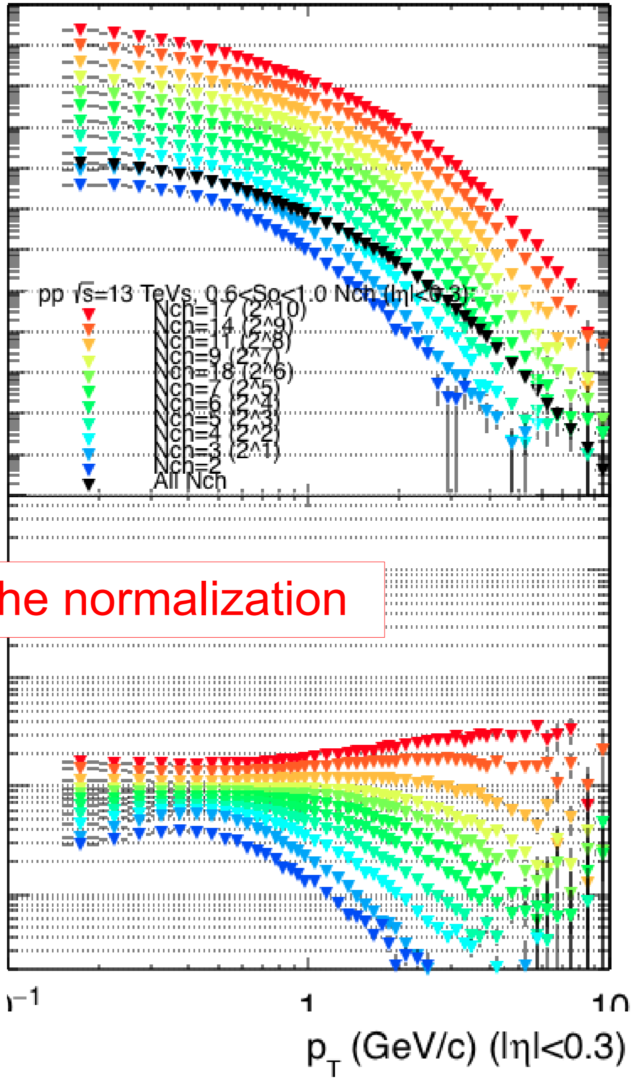
Still under check the normalization



0<So<0.4

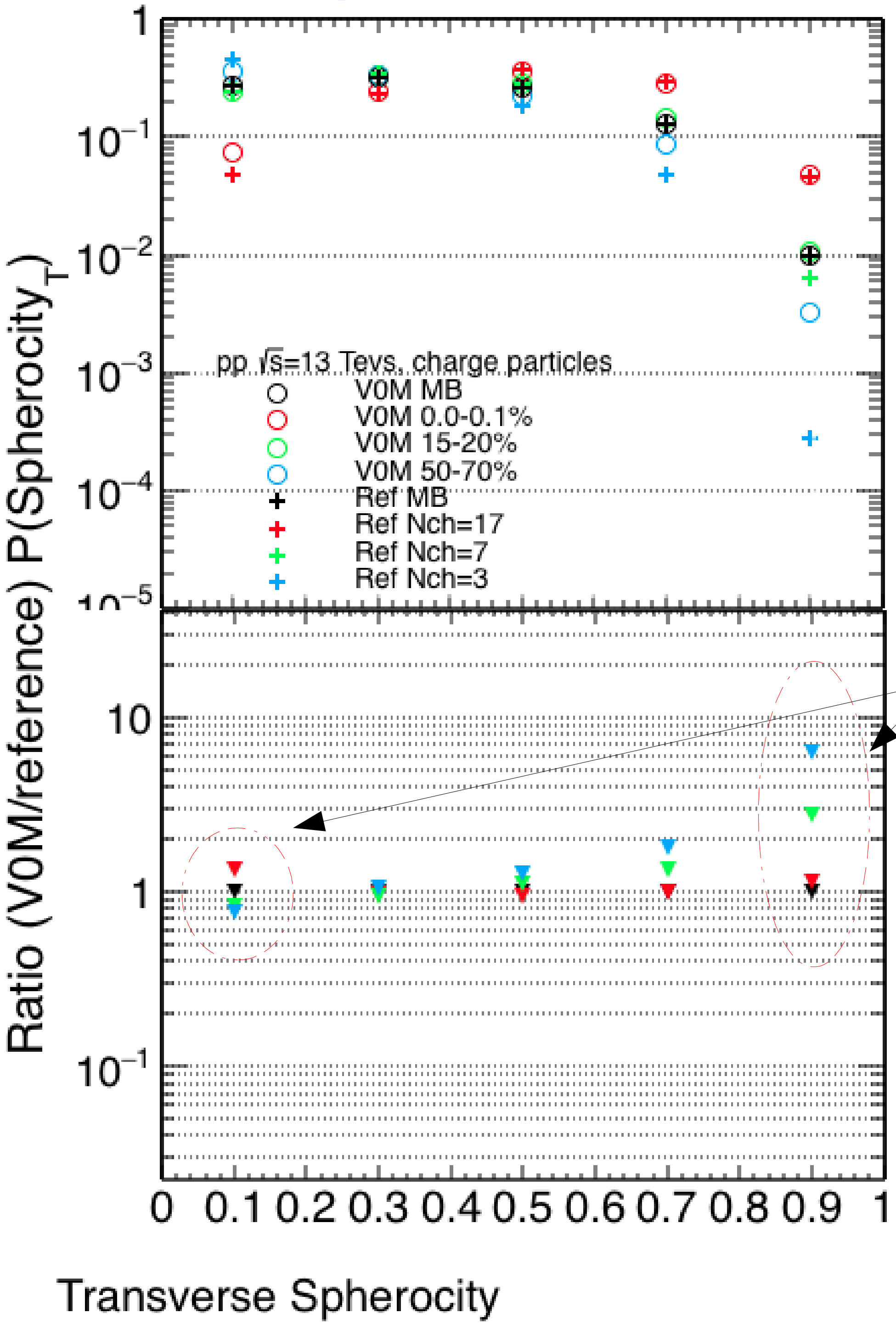


0.4<So<0.6



0.6<So<1

First Comparison for So with estimators V0M and Ref |eta| <0.3



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

Analysis from ESD MC LHC15g3a3 (Pythia8 Monash)

- For MC the way to proced for estimators its a little bit different,
  exchanging emails with David
- Snippets in run.C

```
AliMultSelectionTask *task = AddTaskMultSelection();
task->SetAddInfo(kTRUE);
task->SetUseDefaultCalib(kTRUE); // data *
task->SetUseDefaultMCCalib(kTRUE); // MC *
task->SetAlternateOADBforEstimators("LHC15f"); **
```

```
* For calibrated runs see:
**This get the V0M percentil boundaries from data this avoid some issue errors like:

E-TFile::TFile: file /Users/hectorbellomartinezImaclab/alice/aliphysics/vAN-
20160418/inst/OADB/COMMON/MULTIPLICITY/data/OADB-LHC15g3a3.root does not exist
F-AliMultSelectionTask::SetupRun: Couldn't find requested alternate calibration! Quitting!
```

- Snippets to get V0M percentil (as usual)

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

Multiplicity Task in:

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

For High Multiplicity data period

- Including BG rejection

Due to the way of tracking with SPD there is some background in the reconstructed multiplicity

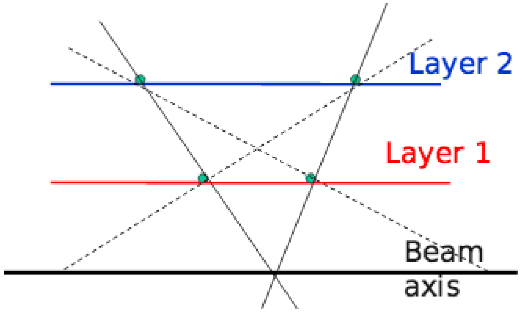
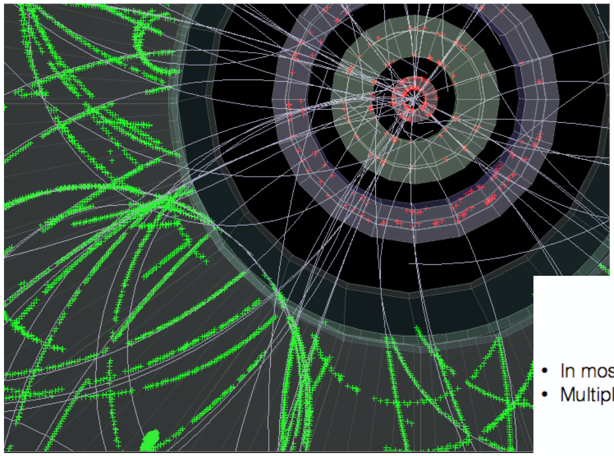


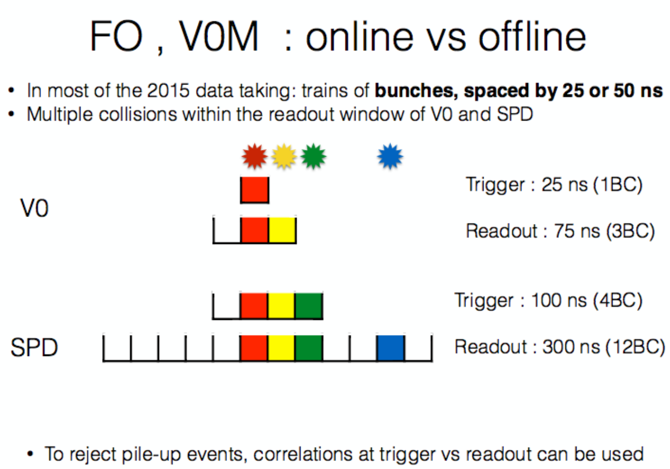
Fig. 8 a): Schematic for SPD tracklets reconstruction, one can see the clusters (pixels hitted in each layers), then the way of obtain the tracklets is matching this clusters in such a way the tracklet has the shortest lenght.

https://twiki.cern.ch/twiki/bin/view/ALICE/AliceHMTFBeamBackground



CUT applied:

```
if(nClustersLayer0+
NclustersLayer1>65+
4*nTracklets)
  continue;
```



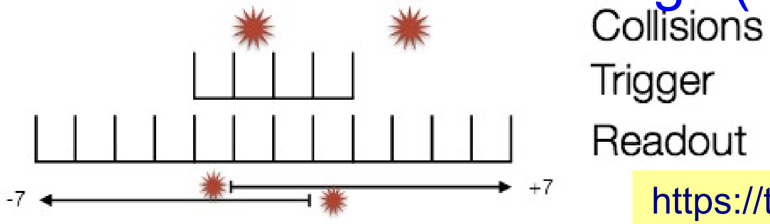
FO , V0M : online vs offline

- In most of the 2015 data taking: trains of **bunches, spaced by 25 or 50 ns**
- Multiple collisions within the readout window of V0 and SPD

- To reject pile-up events, correlations at trigger vs readout can be used

- Past Future protection (PFP)

Other contamination in multiplicity is concerning to the pileup done by the number of bunch crossings (BC) per interaction rate



CUT applied:

```
fIR1 =  fInputEvent->GetHeader()-> GetIRInt1InteractionMap();
for (Int_t i=1;i<=11;i++) isOutOfBunchPileup11BC|=fIR1.TestBitNumber(90-i);
```

https://twiki.cern.ch/twiki/bin/view/ALICE/AliceHMTFCodeSnippets#Physics_Selection

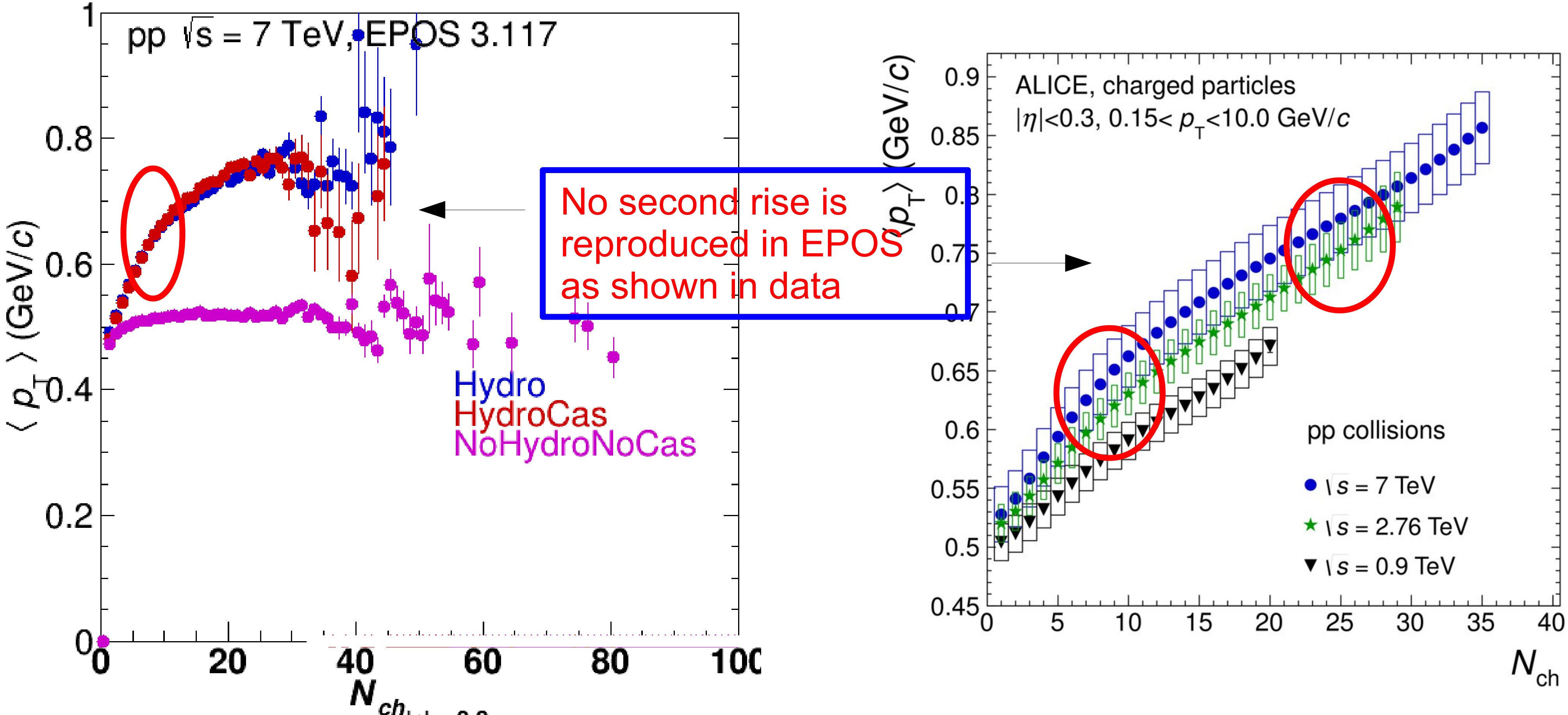
Fig. 8 b): Adding a cut in the interaction rates we can select the multiplicity for a number of bunch crossings after or before the event,

Other topics out of service task

- Monte Carlo EPOS.

To study the models wich discribe the behaviour of the <pT> at high multiplicity is important for example Pythia includes multiparton interactions and color reconnection (presented last reports)

EPOS includes a different Hydrodinamical physics inside three differents tunes:



No second rise is reproduced in EPOS as shown in data

Fig. 17: Mean transverse momentum spectra for 3 differents EPOS tunes, the greater mean pt is due to full EPOS (hydro+cascades).

Other topics out of service task

- Mean p_T and Spherocity analysis pp data @ 13 TeV.

For real data, we obtain the probability of spherocity for different multiplicity bins as shown, also the transverse momentum spectra for inclusive charge particles in different multiplicity bins was obtained.

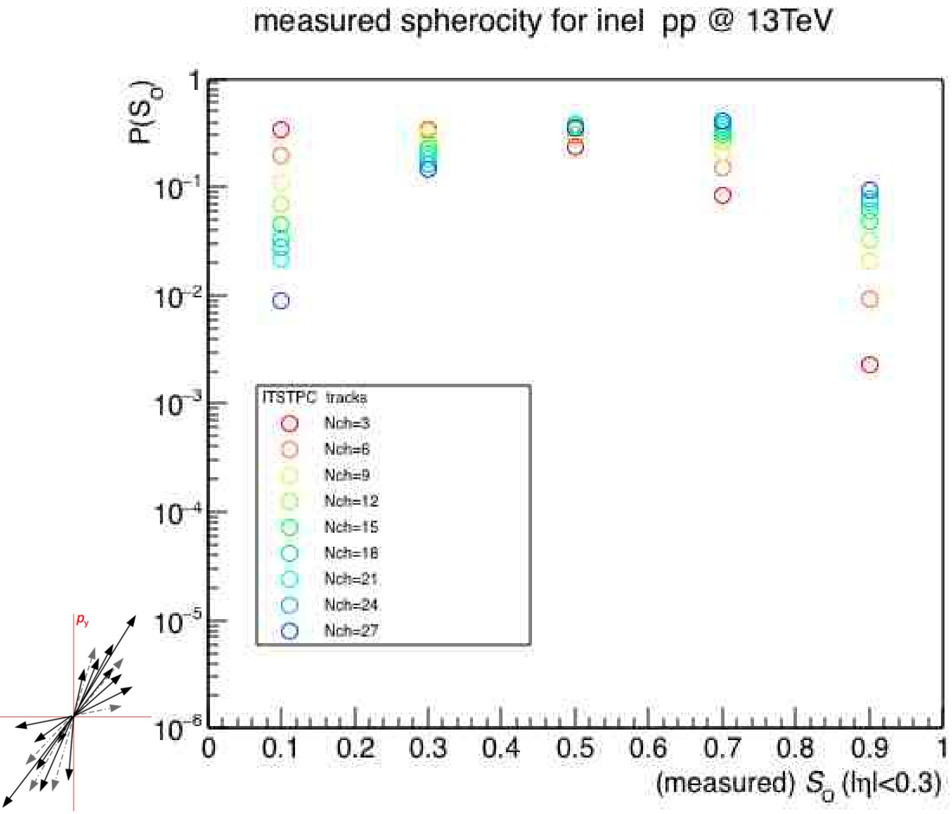
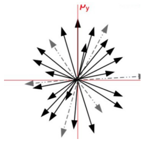


Fig: Spherocity probability distributions for different multiplicity bins for real data pp @ 13 TeV.



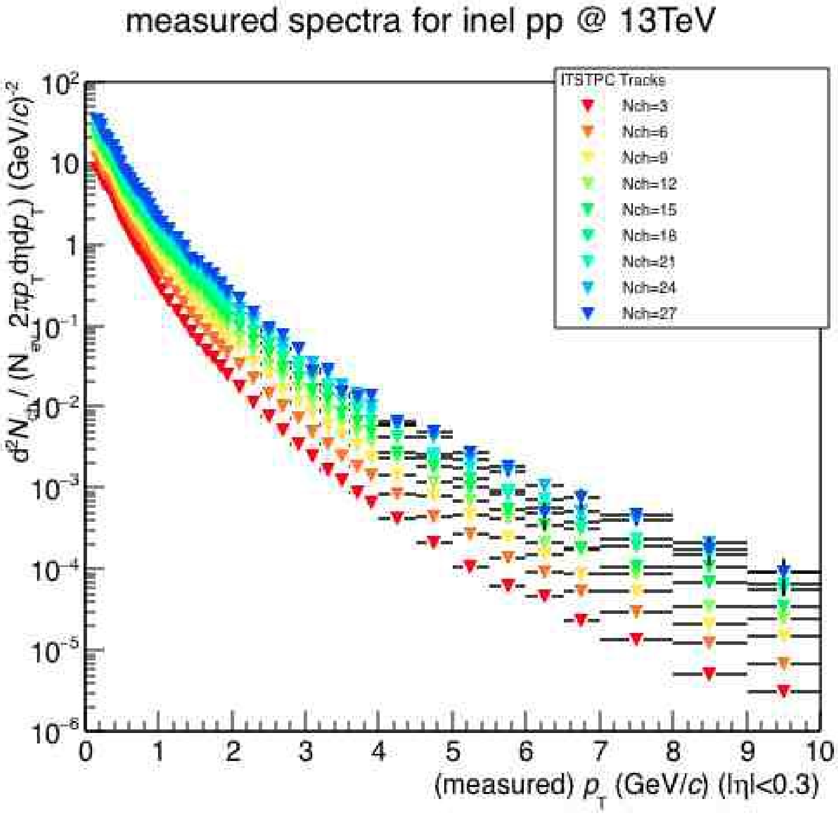


Fig. Momentum spectra for different multiplicity bins for real data pp @ 13 TeV.

Other topics out of service task

- Mean p_T and Spherocity analysis pp MC @ 13 TeV.

Distributions of the generated mean spherocity vs generated multiplicity, and the generated mean transverse momentum for charge particles vs generated multiplicity were obtained for the MC Pythia samples Monash tune.

MC distributions obtained for unfolded corrections

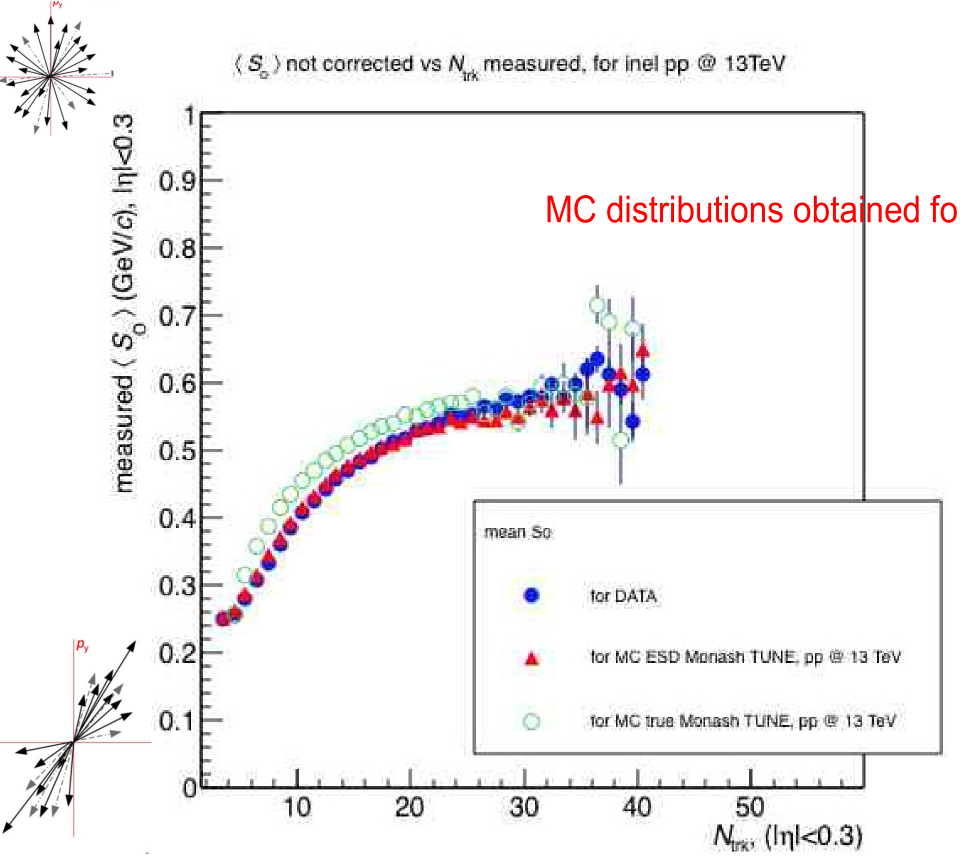


Fig: Uncorrected mean spherocity probability distributions for different multiplicity bins for MC Pythia Monash tune pp @ 13 TeV..

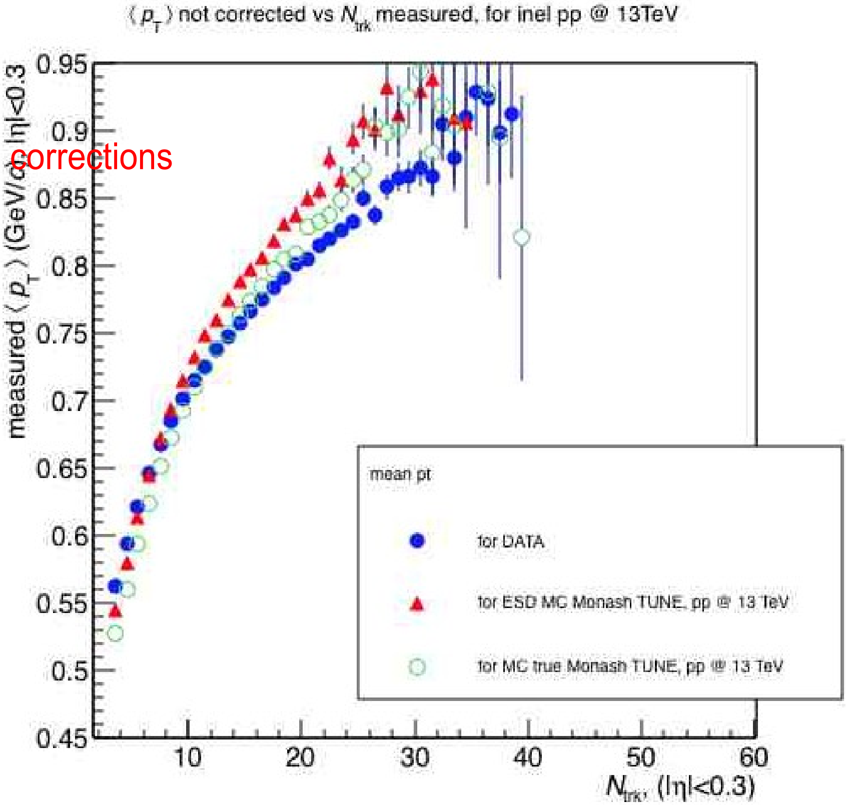


Fig. Uncorrected mean transverse momentum distributions for different multiplicity bins for MC Pythia Monash tune pp @ 13 TeV.

Other topics out of service task

- Mean p_T and Spherocity analysis pp MC @ 13 TeV.

Distributions of the generated mean spherocity vs generated multiplicity, and the generated mean transverse momentum for charge particles vs generated multiplicity were obtained for the MC Pythia samples Perugia2011 tune.

MC distributions obtained for unfolded corrections

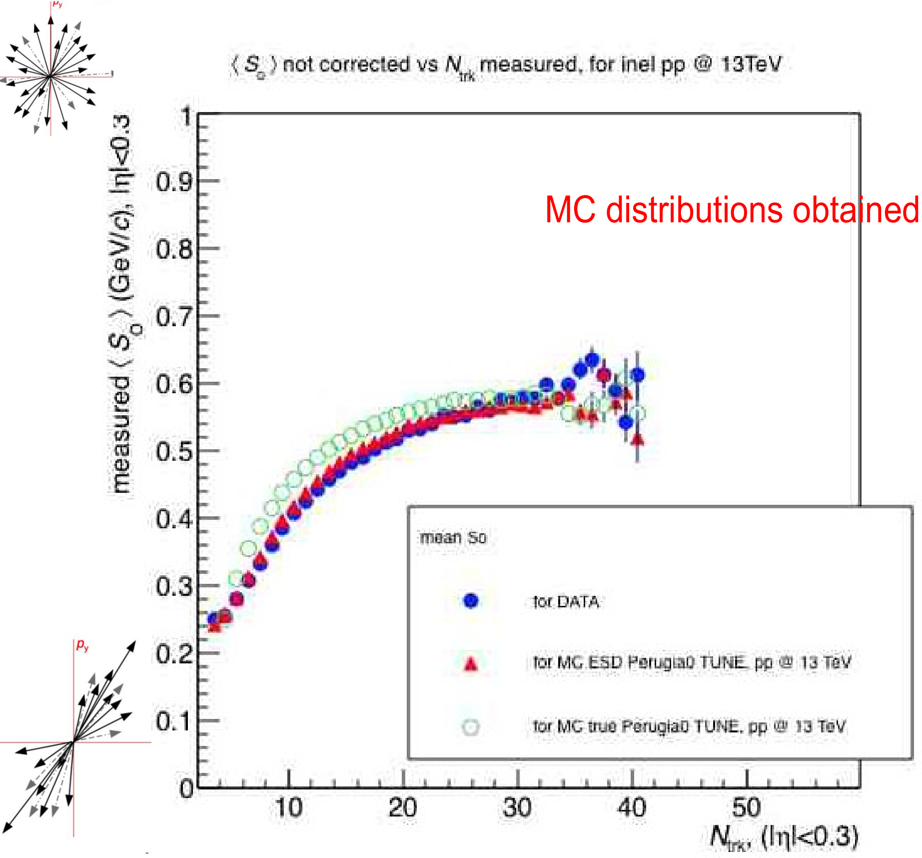


Fig: Uncorrected mean spherocity probability distributions for different multiplicity bins for MC Pythia Perugia 0 tune pp @ 13 TeV..

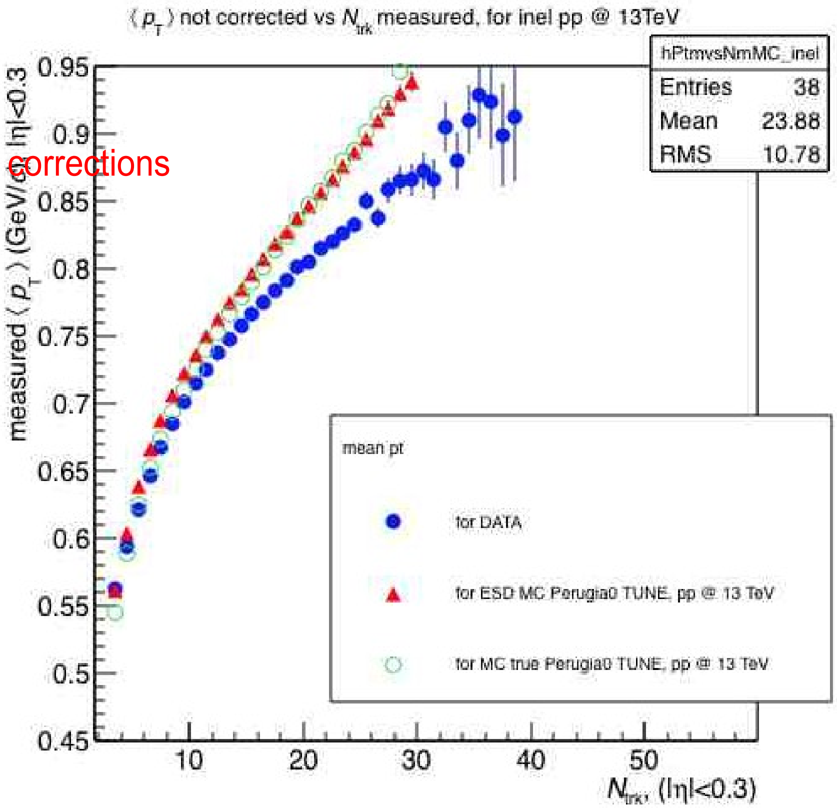
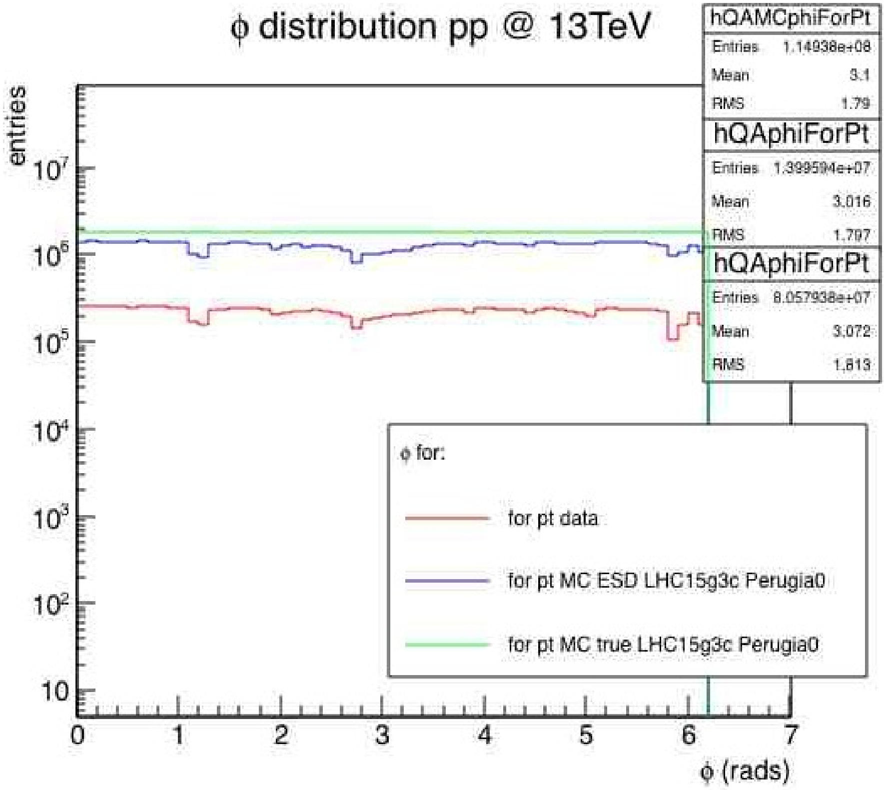
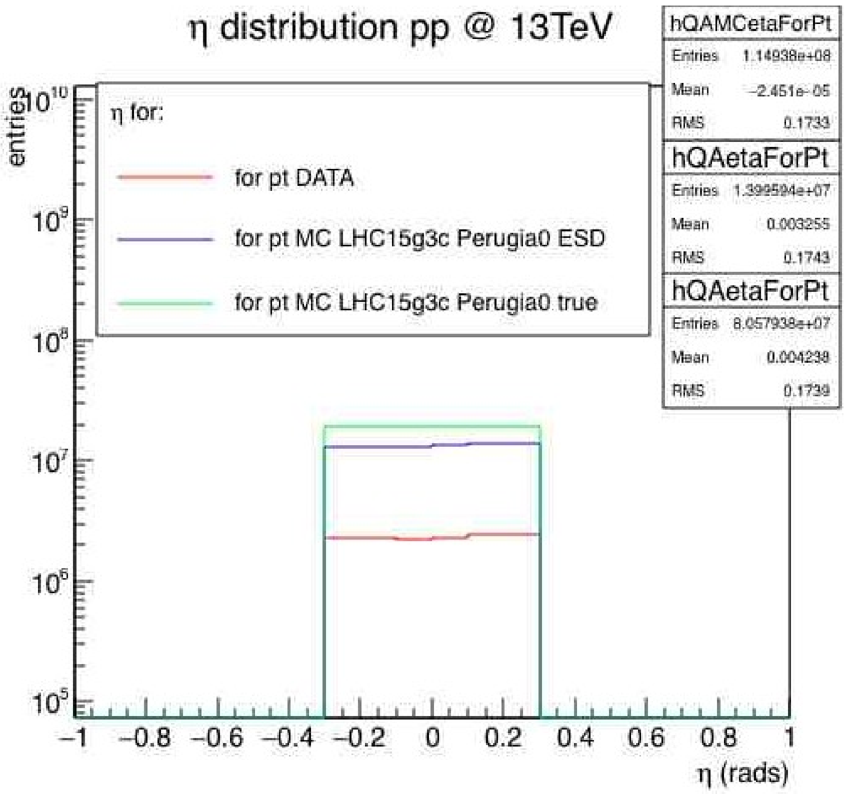


Fig. Uncorrected mean transverse momentum distributions for different multiplicity bins for MC Pythia Perugia 0 pp @ 13 TeV.

BACKUP

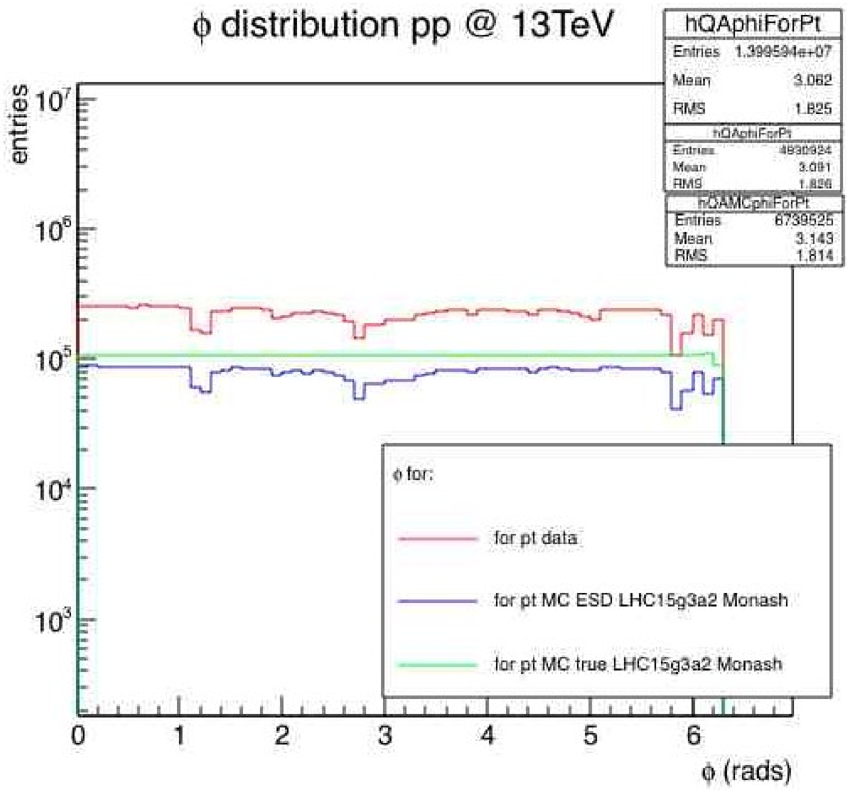
LHC15gc3 Pythia Perugia 2011

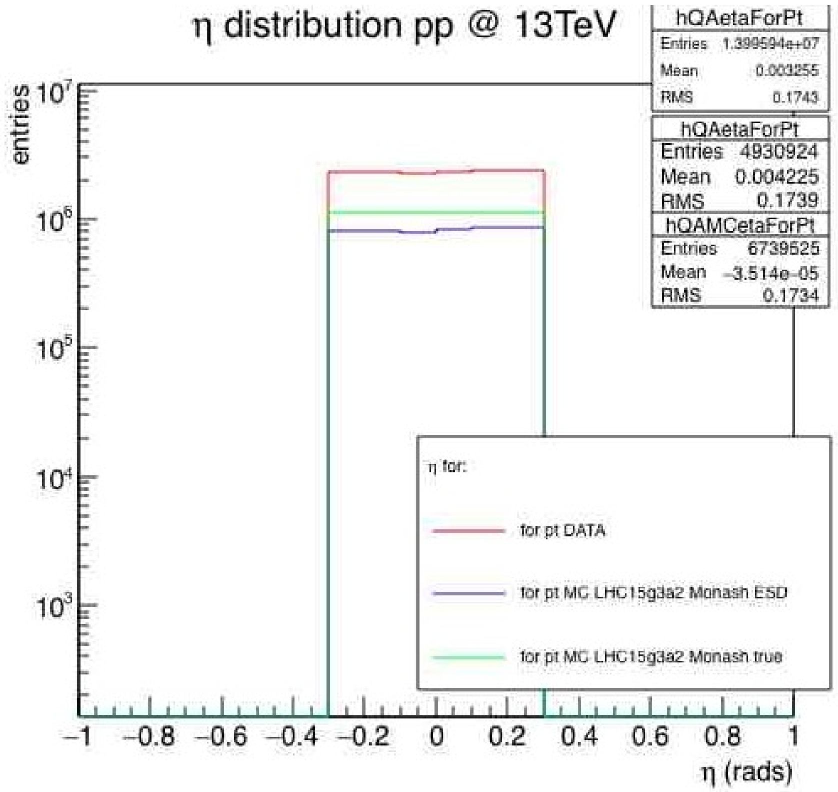




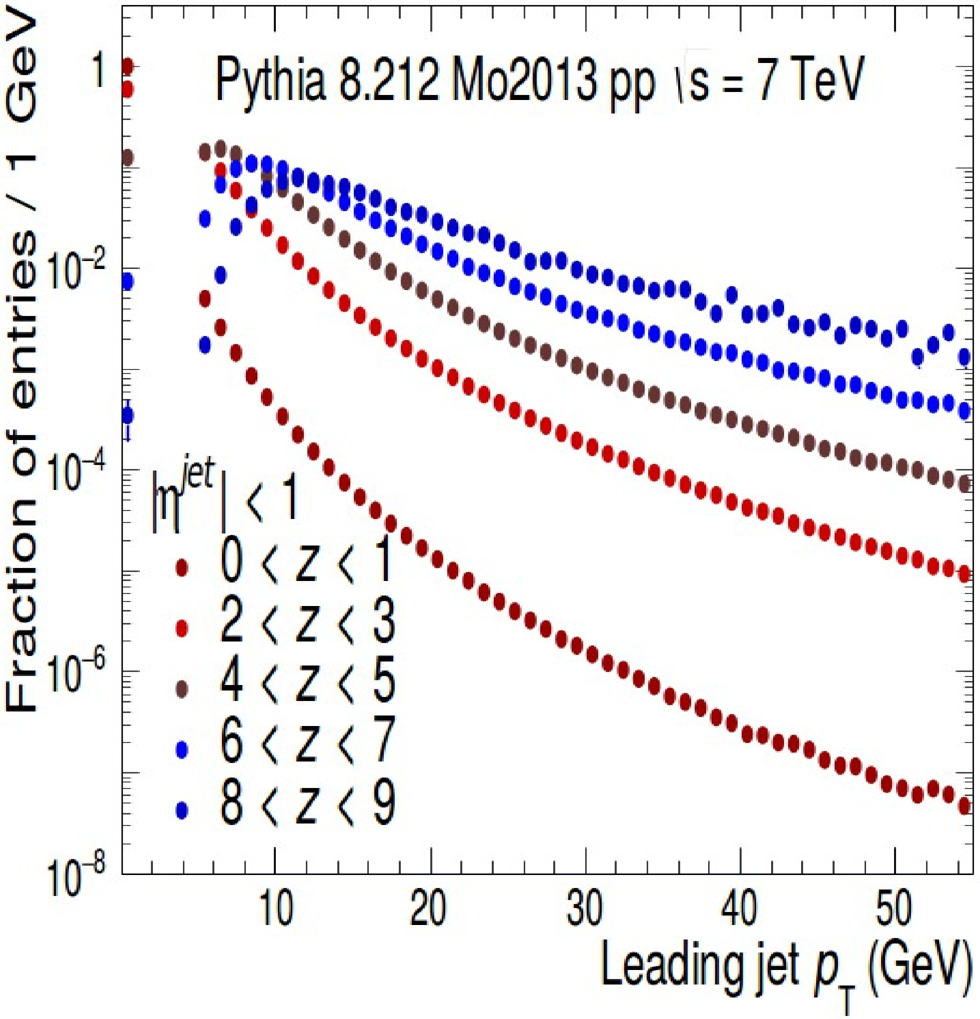
BACKUP

LHC15g3a2 Monash





*p*Tjet vs multiplicidad



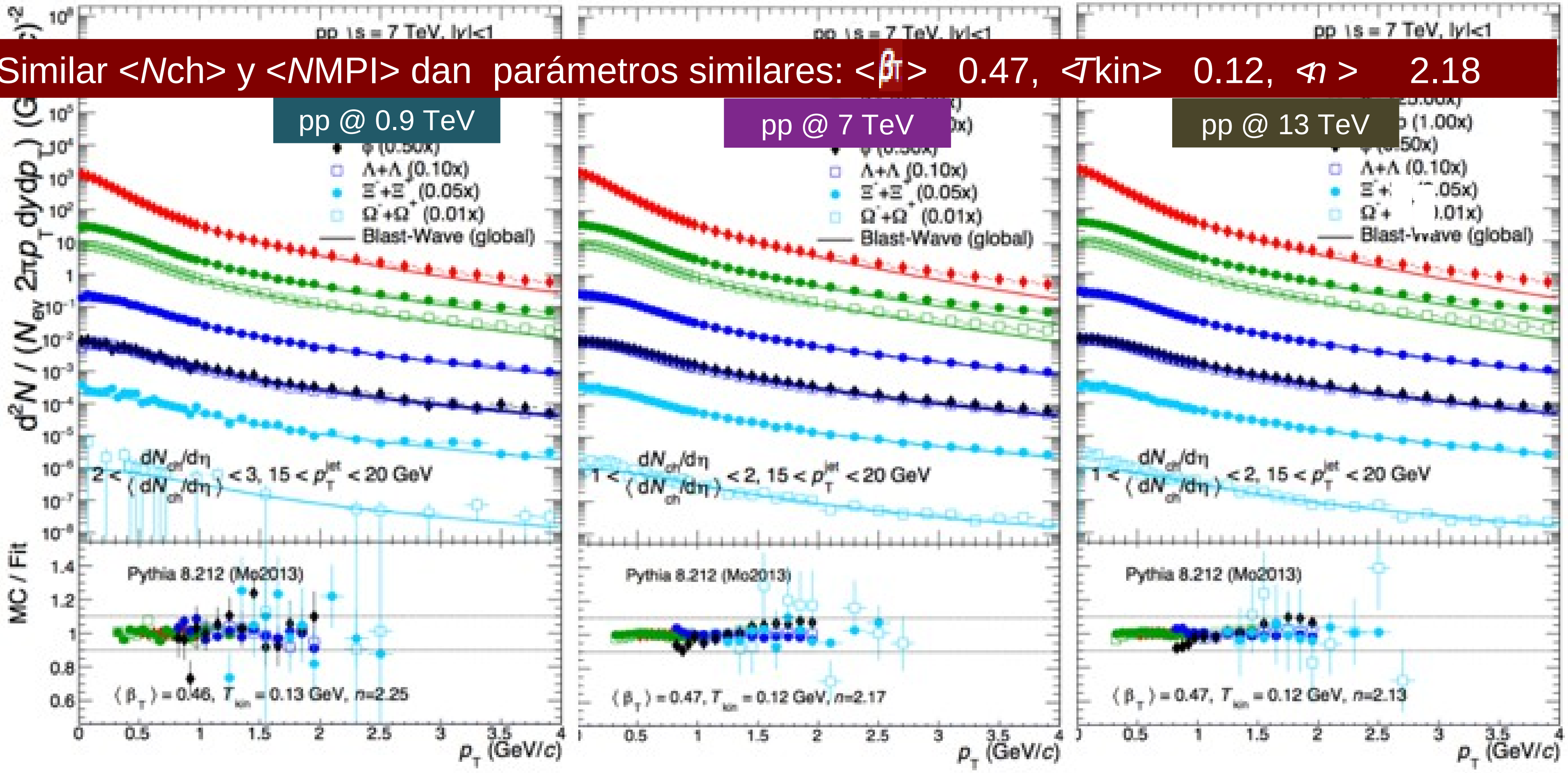
<*z*>	<*p*Tjet> (GeV/*c*)
0.5	7.09
1.5	7.49
2.5	7.83
3.5	8.48
4.5	9.55
5.5	11.1
6.5	13.2
7.5	15.85

Entre mayor multiplicidad del evento, mayor es el promedio del *p*Tjet

Dependencia de la Energía

15 < *p*TJet < 20 GeV

PYTHIA 8



Similar <*N*ch> y <*N*MPI> dan parámetros similares: <β_T>   0.47, <*T*kin>   0.12, <*n* >   2.18

pp @ 0.9 TeV

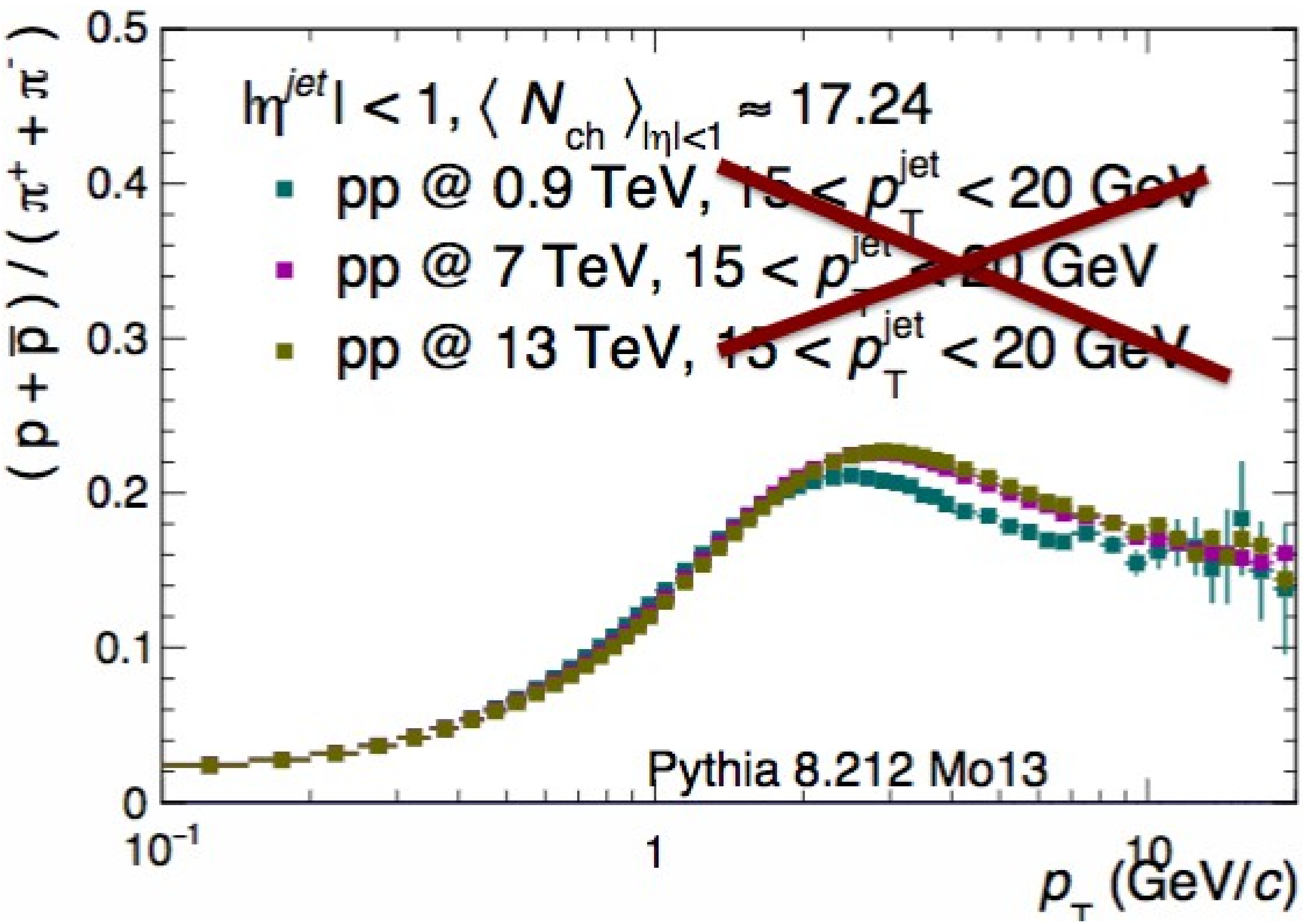
pp @ 7 TeV

pp @ 13 TeV

<*N*ch>|η |<1	<*N*ch>|η |<1	<*N*ch>|η |<1
15.65	17.72	18.35
<*N*MPI> 3.53	<*N*MPI> 4.14	<*N*MPI> 4.26

p/π vs. p_T

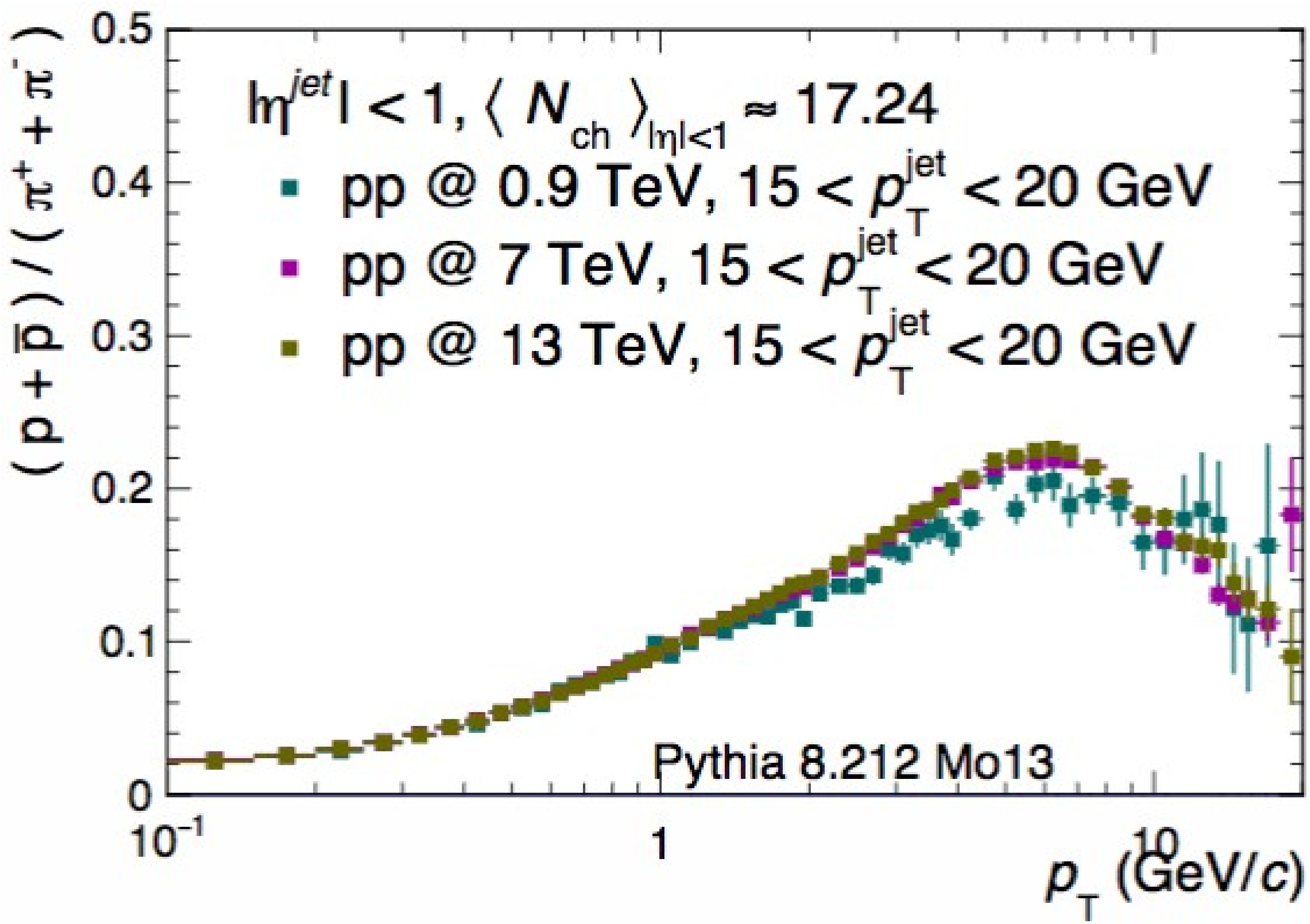
PYTHIA 8



Sin la condición de requerir jets, la razón se ve diferente debido a los diferentes sesgos.

p/π vs. p_T

PYTHIA 8



La razón protón-pión muestra casi ninguna dependencia con s
(La posición del pico de p_T es la misma para los 3 sistemas)