ALICE

$\langle p_T \rangle$ fluctuations in p-p collisions at $\sqrt{s}$ = 13 TeV with spherocity

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Why we use ES?

(ES=Event Shape)

- They measure the geometrical properties of energy flow in QCD events
- Event by event classification of event with hard and soft topology

Definition of ES

Transverse spherocity is used to characterize the events through the geometrical distribution of the p_T's of the charged hadrons, which is by definition collinear and infrared safe.

Avoids the bias from the boost along the beam axis

It's defined for a unit transverse vector which minimizes the ratio

$$S_0 = \frac{\pi^2}{4}\left(\frac{\sum_i |\vec{p}_{\mathrm{T}i} \times \hat{\mathbf{n}}|}{\sum_i p_{\mathrm{T}i}}\right)^2$$

A. Ortiz, G. Paić and E. Cuautle, Nucl. Phys. A 941 (2015) 78.
E. Cuautle, R. Jimenez, I. Maldonado, A. Ortiz, G. Paic and E. Perez, arXiv:1404.2372.

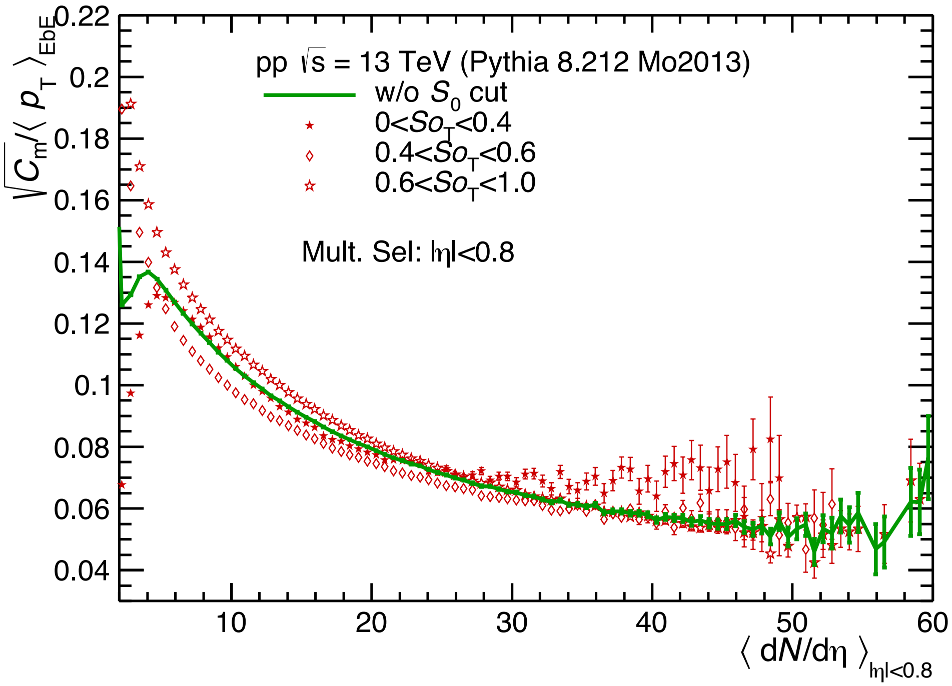
ES soft and hard

We use spherocity as a tool to split the sample in soft and hard

$$S_0 = \begin{cases} 0 & \text{“pencil-like” limit (hard events)} \\ 1 & \text{“isotropic” limit (soft events)} \end{cases}$$

ES characterize the distribution of the outgoing particle energy from high energy collision. In hadron-hadron collision they are restricted to the transverse component w.r.t. beam axis (avoid the bias from the boost)

Mean transverse momentum fluctuations as a function of Spherocity



Warning: MC with out detector effects

We already discussed about the bias of this selector. Using spherocity, we see that for high multiplicity jetty-like events larger fluctuations are obtained

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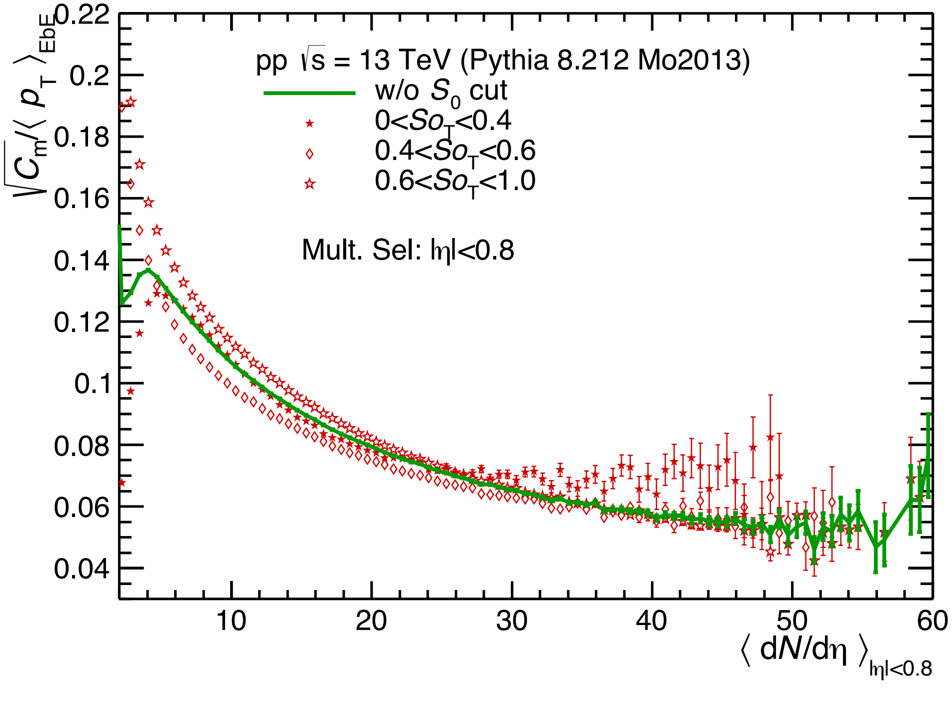

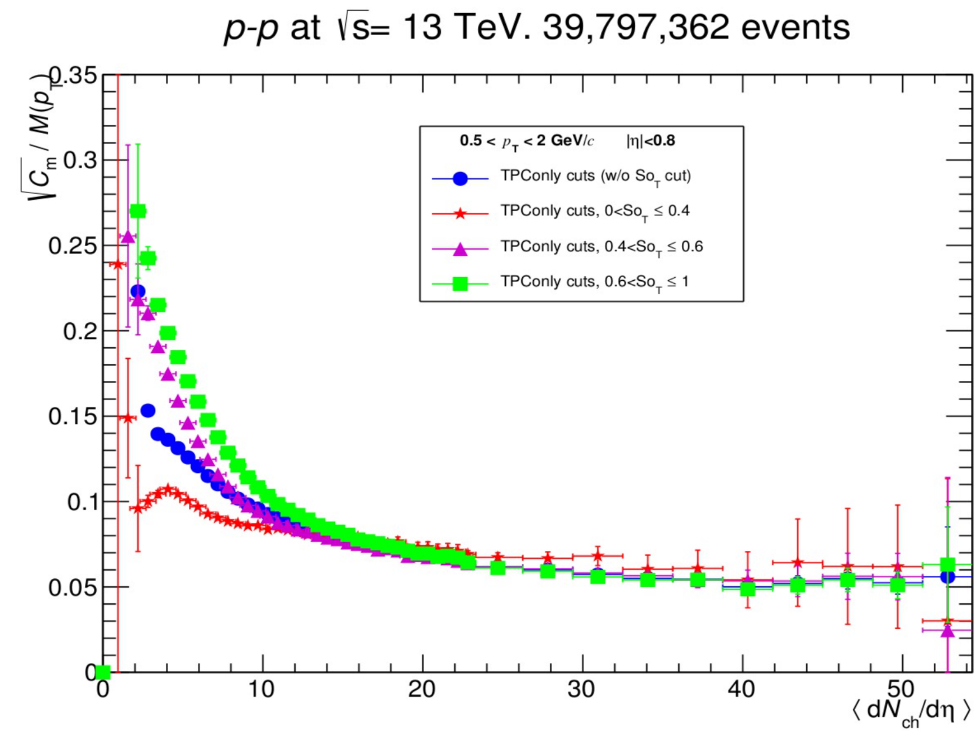

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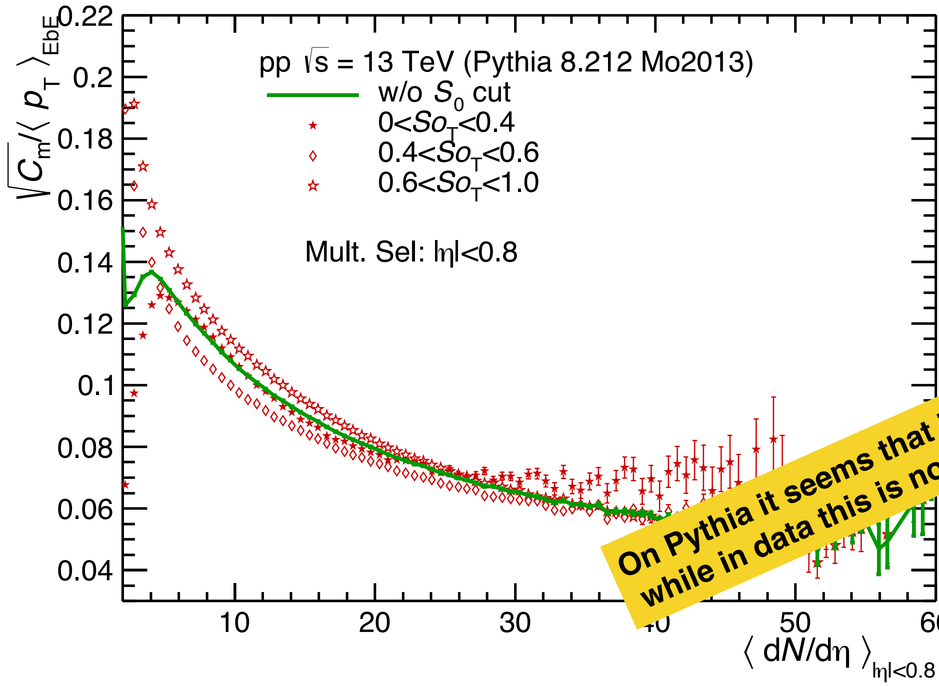

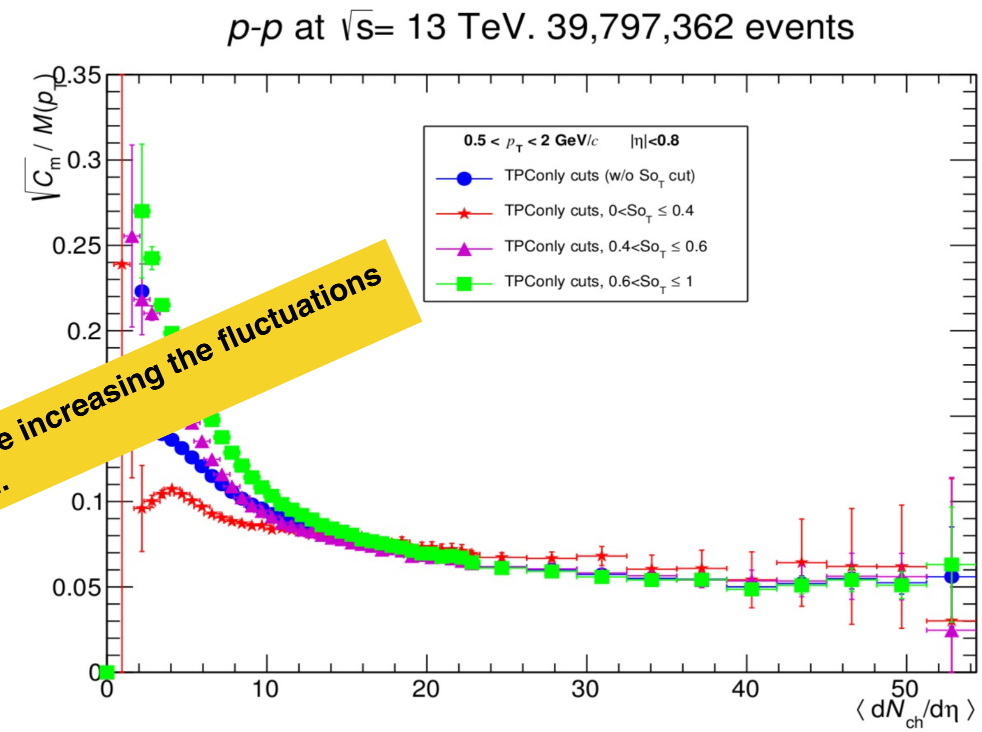

On Pythia it seems that jets are increasing the fluctuations while in data this is not seen.

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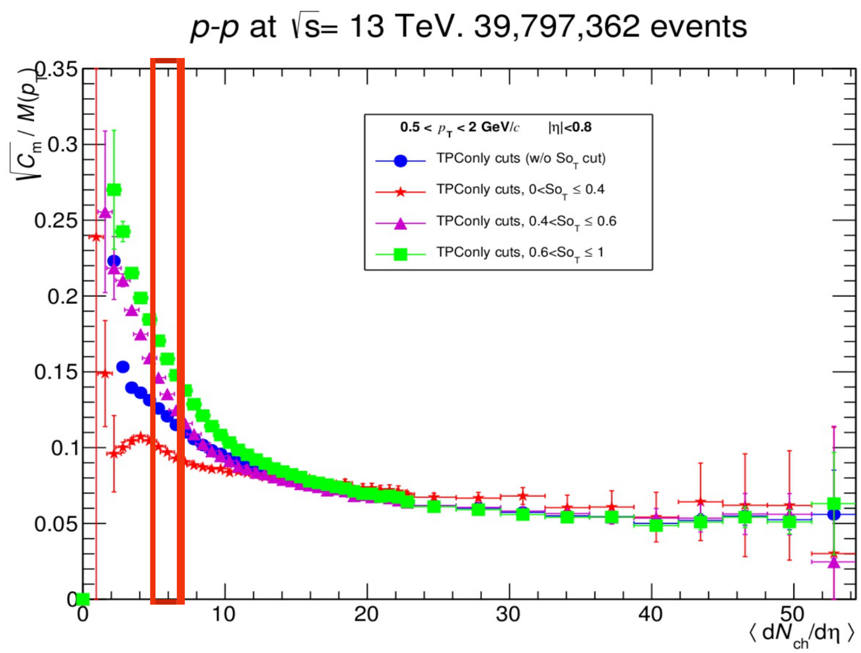
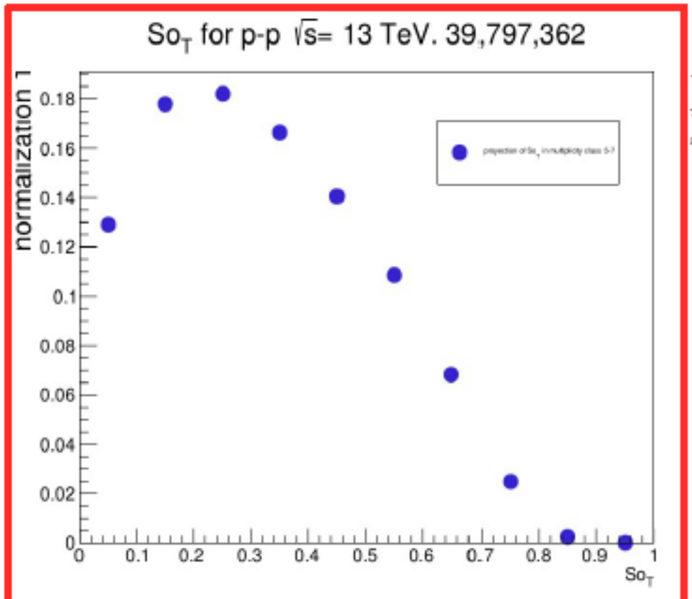
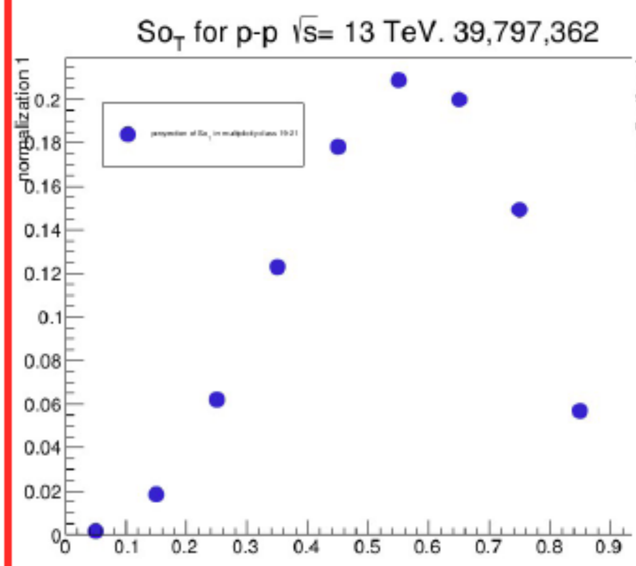
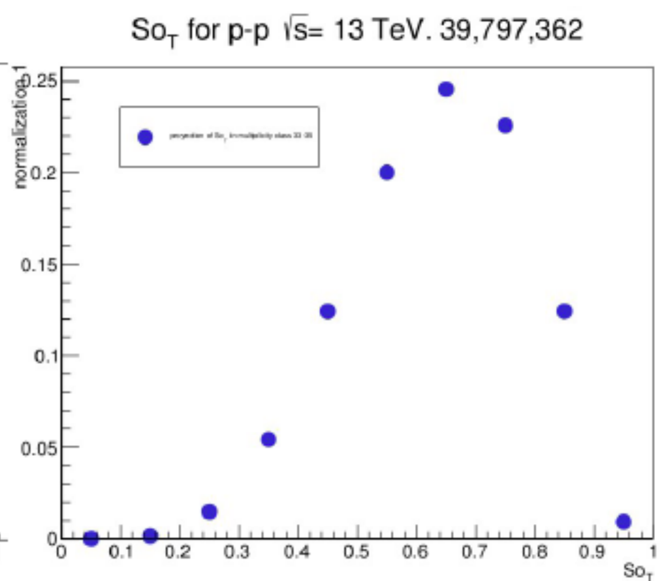
Spherocity (data)

<dN/dη> interval: 5-7









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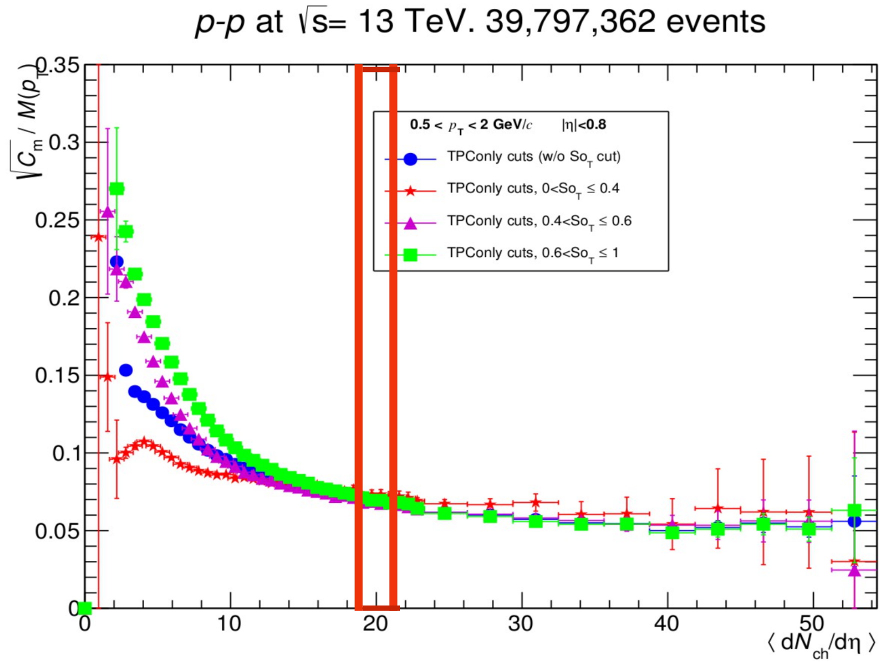
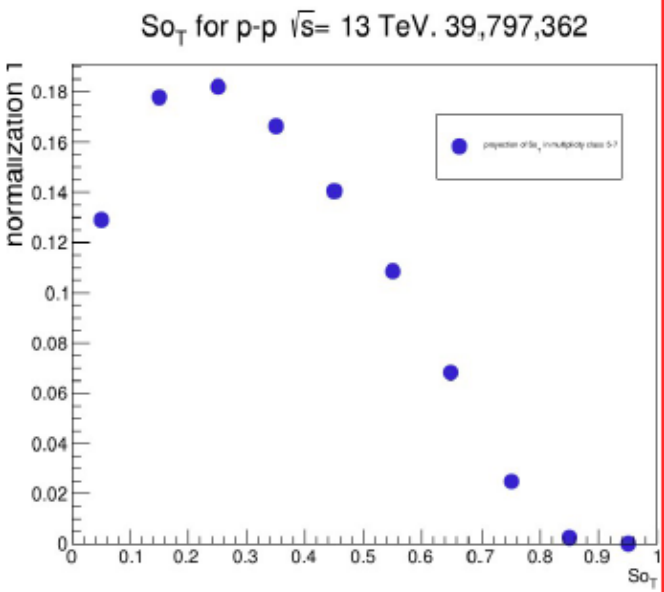
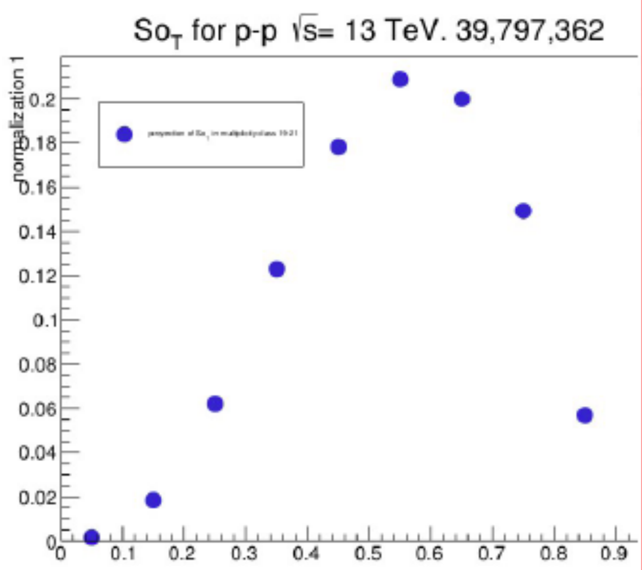
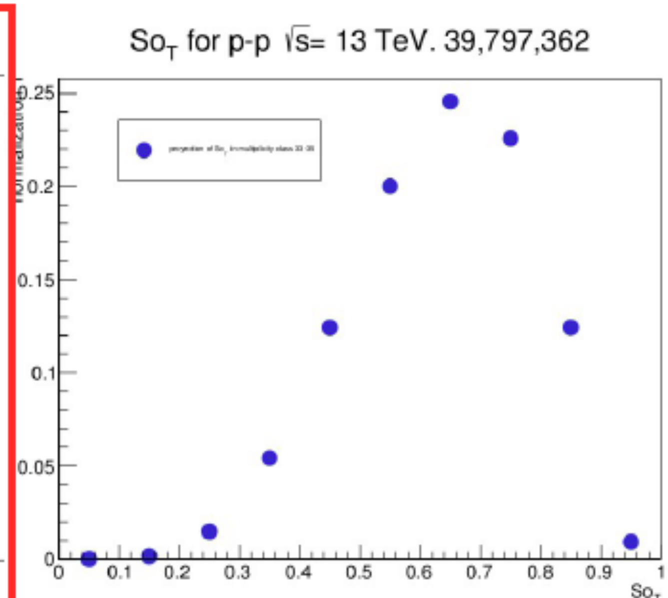


<dN/dη> interval: 19-21

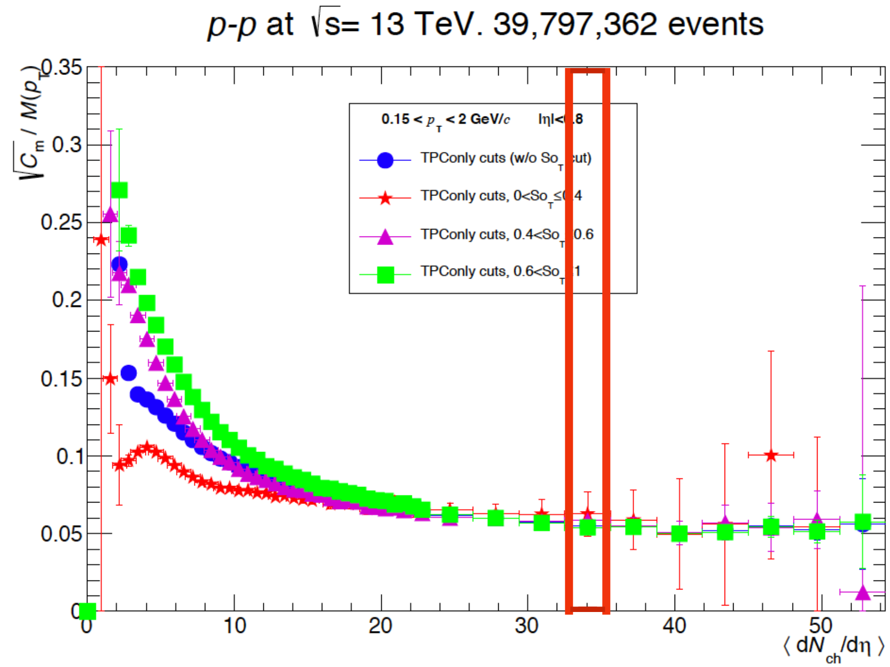


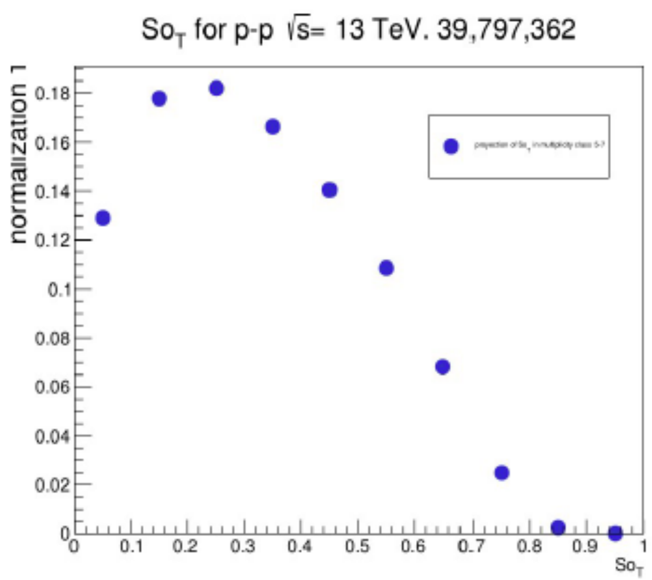


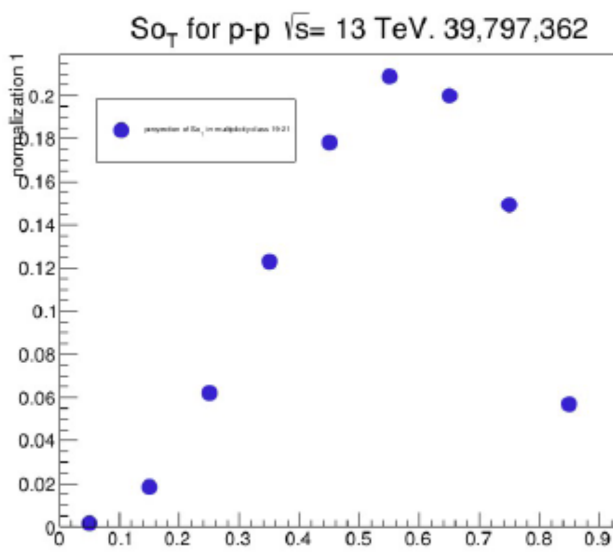


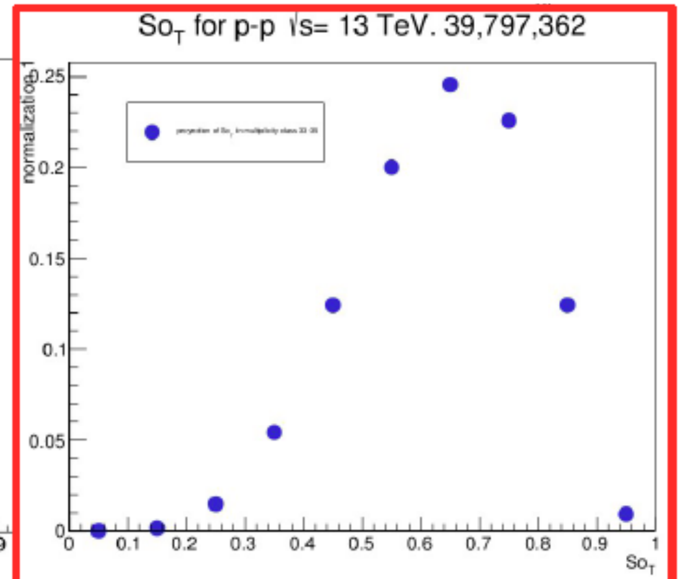
Spherocity (data)

<dN/dη> interval: 33-35









Conclusions

There is a significant difference on fluctuations seen with the cuts on spherocity at high multiplicity on data this is also seen on MC data therefore:

It seems that fluctuations are higher in jetty events and lower at isotropic events as it was expected.

Could this be a differentiate study to study jet bias at high multiplicity?

We need to make further checks.

Further checks will come …

Thank you !!!

Spherocity (MC)

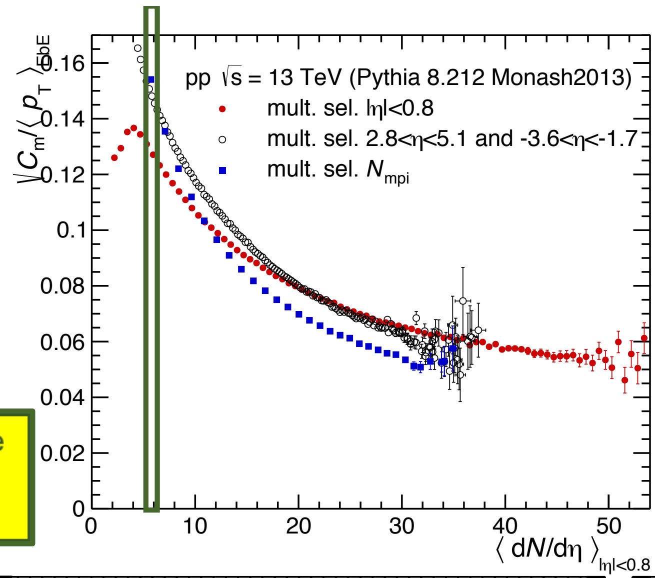
We now inspect transverse spherocity:

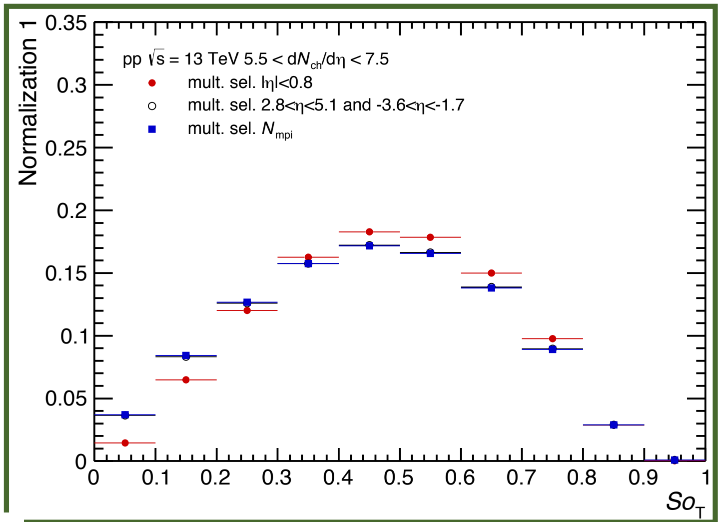
$$So_{\mathrm{T}} = (\min \hat{\mathbf{n}}) \, \frac{\pi^2}{4} \left(\frac{\sum_j |\vec{p}_T \times \hat{\mathbf{n}}|}{\sum_j p_{\mathrm{T},j}} \right)^2$$

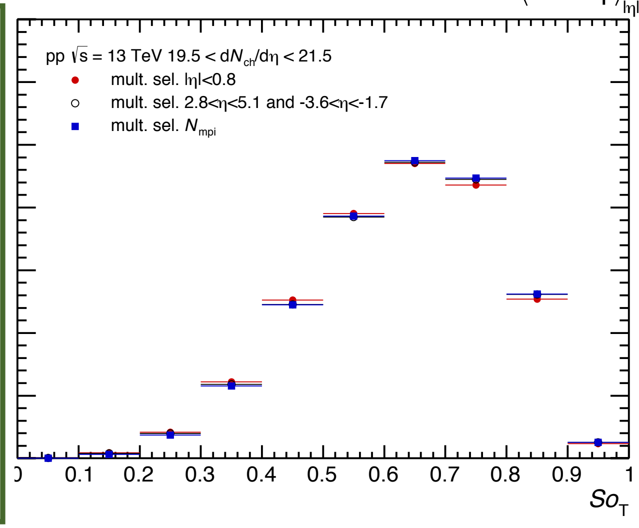
In jetty events, the unitary vector is roughly the jet axis. In this case $So_{\mathrm{T}} \approx 0$

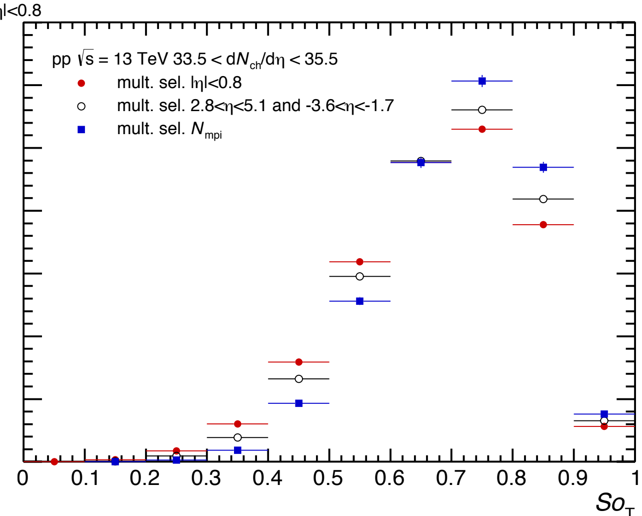
For isotropic events, $So_{\mathrm{T}} \rightarrow 1$

Low <dN/dη>: <N_{mpi}>'s are more or less the same for the different classes. However, if the selection is done with N_{mpi} or VZERO acceptance, the events are more jetty









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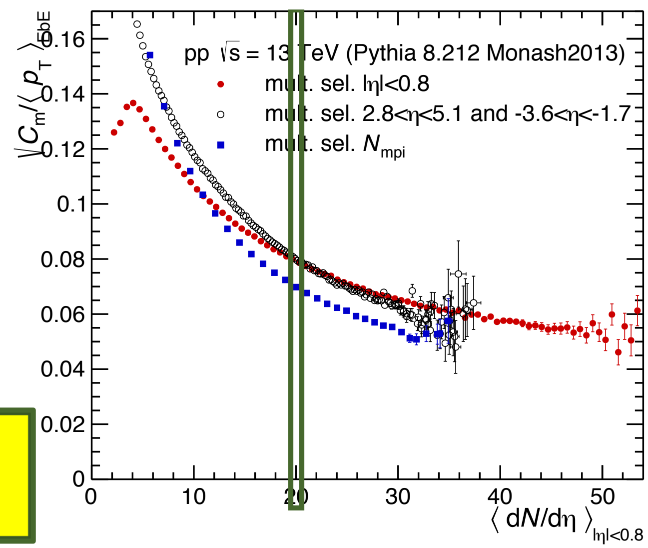
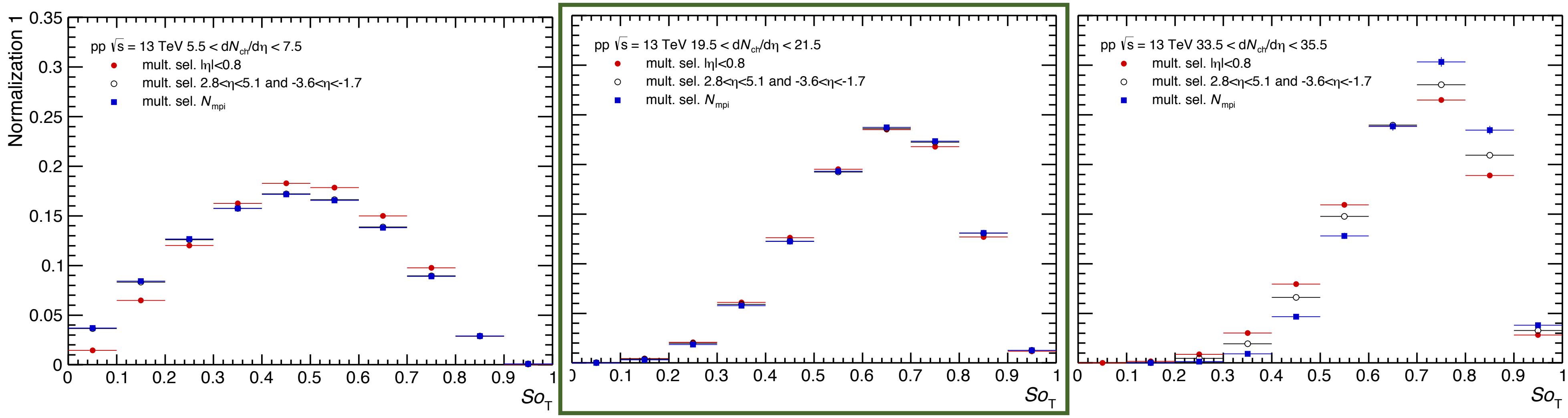


Intermediate <d*N*/d*η*>: Slightly different <N_{mpi}> for the different event selections, however So_{T} distributions look very similar



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High <d*N*/d*η*>: mid-rapidity selector gives a smaller average N_{mpi} and more jetty events than the selector based on N_{mpi}