Interplay between color reconnection and multiple parton interactions and the effects on forward-backward correlations

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Outline

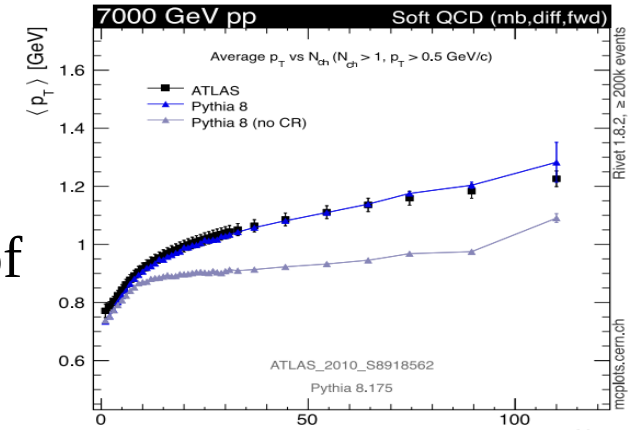
- Motivation:
  - Color Reconnection
  - Multiple Parton Interactions
- Forward-Backward multiplicity correlations
  - Color reconnection effects
  - Multiple parton interctions
- Conclusions

Modeling Color Reconnection

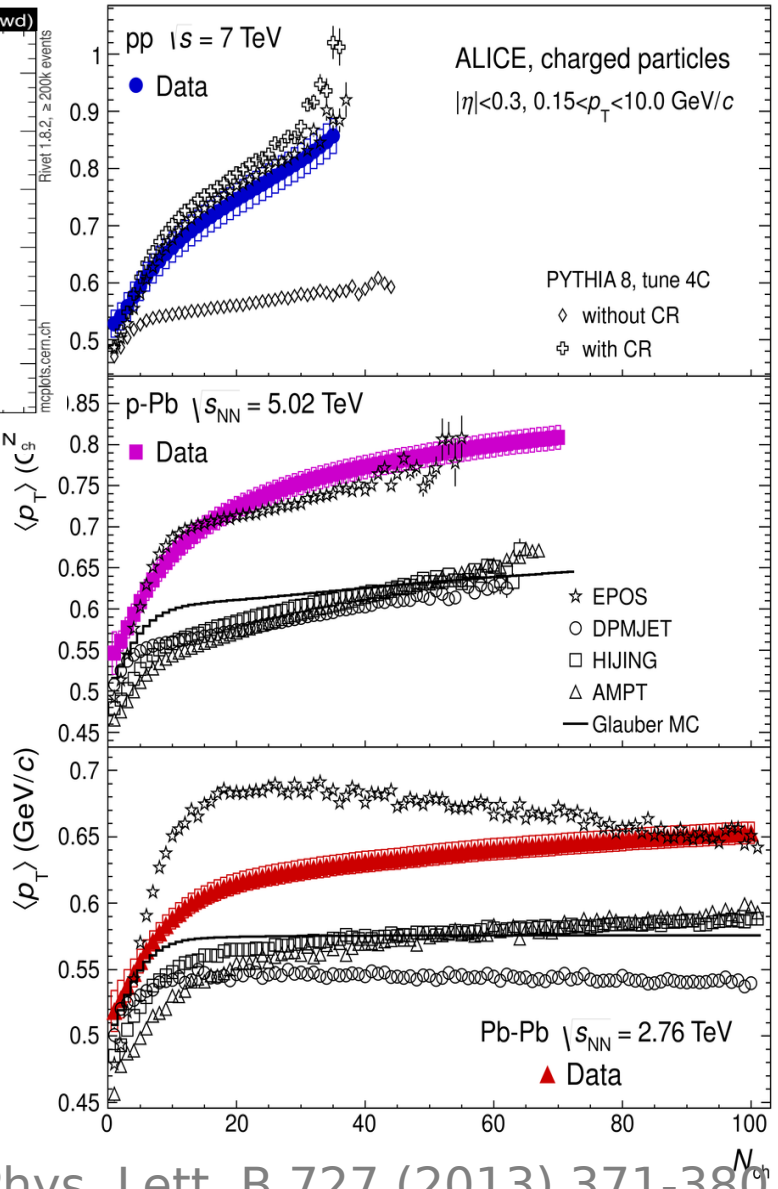
Models of Color Reconnection:
There are different models of CR, one of them is based in the scheme of parton interaction. They are classified by which nMPI system they belong to in function of the transverse moment. The strength of reconnection is defined by,

$$P_{rec}(p_T) = \frac{(R_{rec}p_T)^2}{(R_{rec}p_T)^2 + {p_T}^2}$$

$$p_T \downarrow \Longrightarrow P_{rec} \uparrow$$

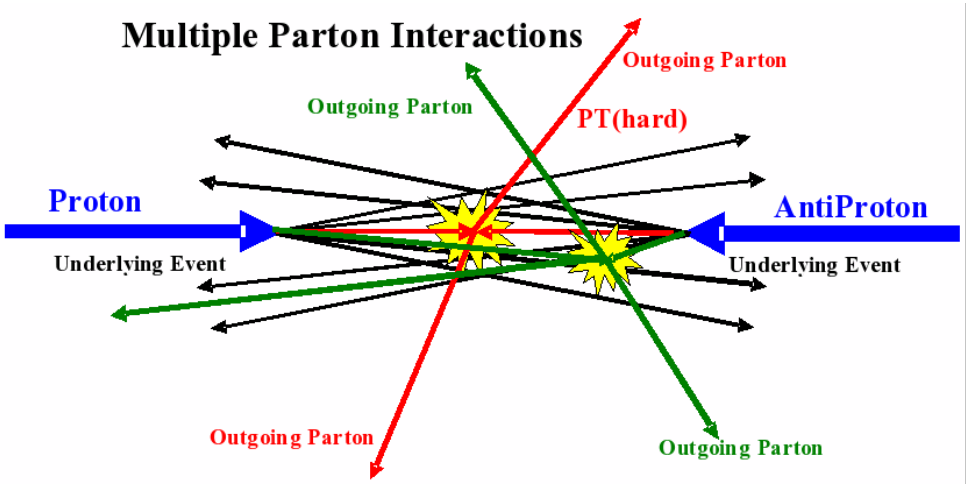


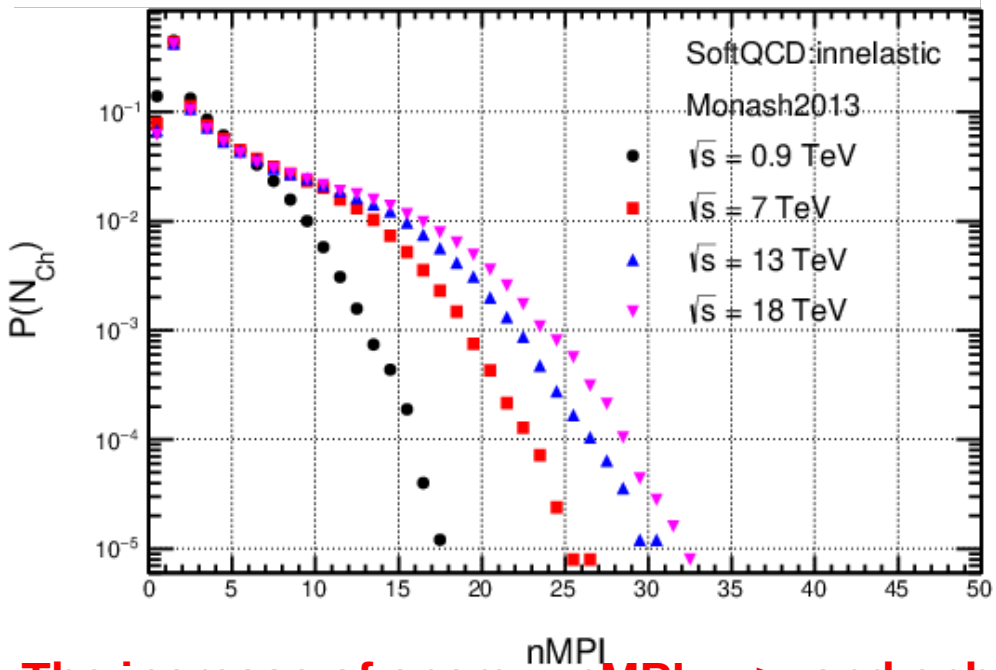
arXiv:1310.8073

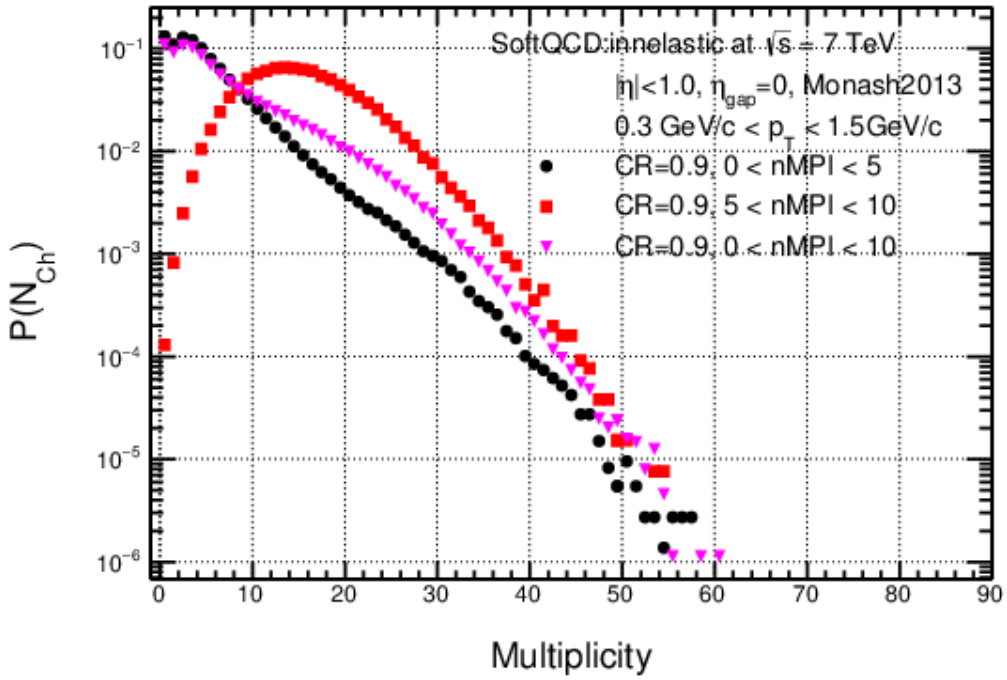


Phys. Lett. B 727 (2013) 371-380

Multiplicity and nMPI distributions



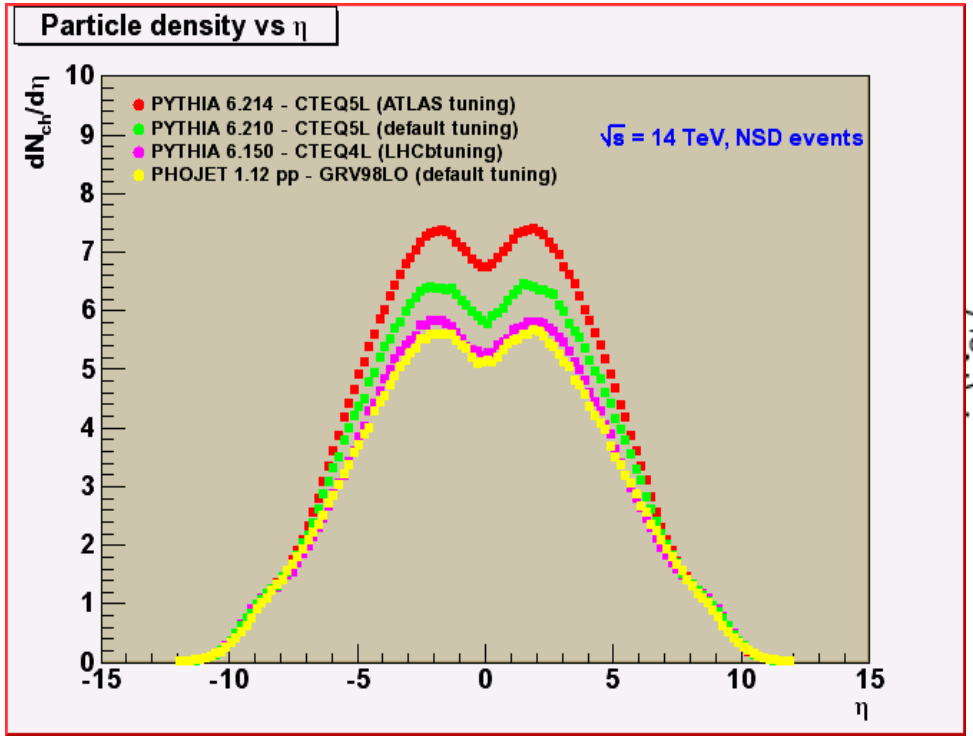


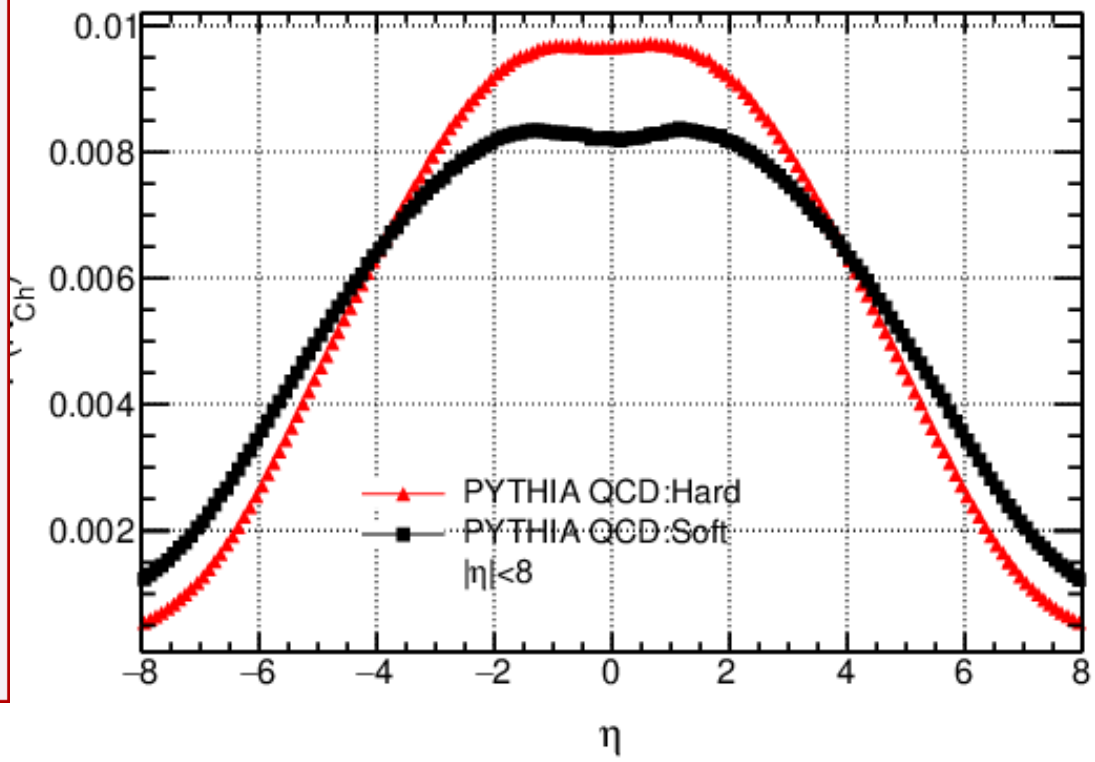


The multiplicity distributions depends of various factors, one of them is the nMPI

The increase of energy ==> nMPI ==> and enhancement of multiplicity ==> increase of b_{corr}

Models to pseudorapidity





Different models predict different multiplicity

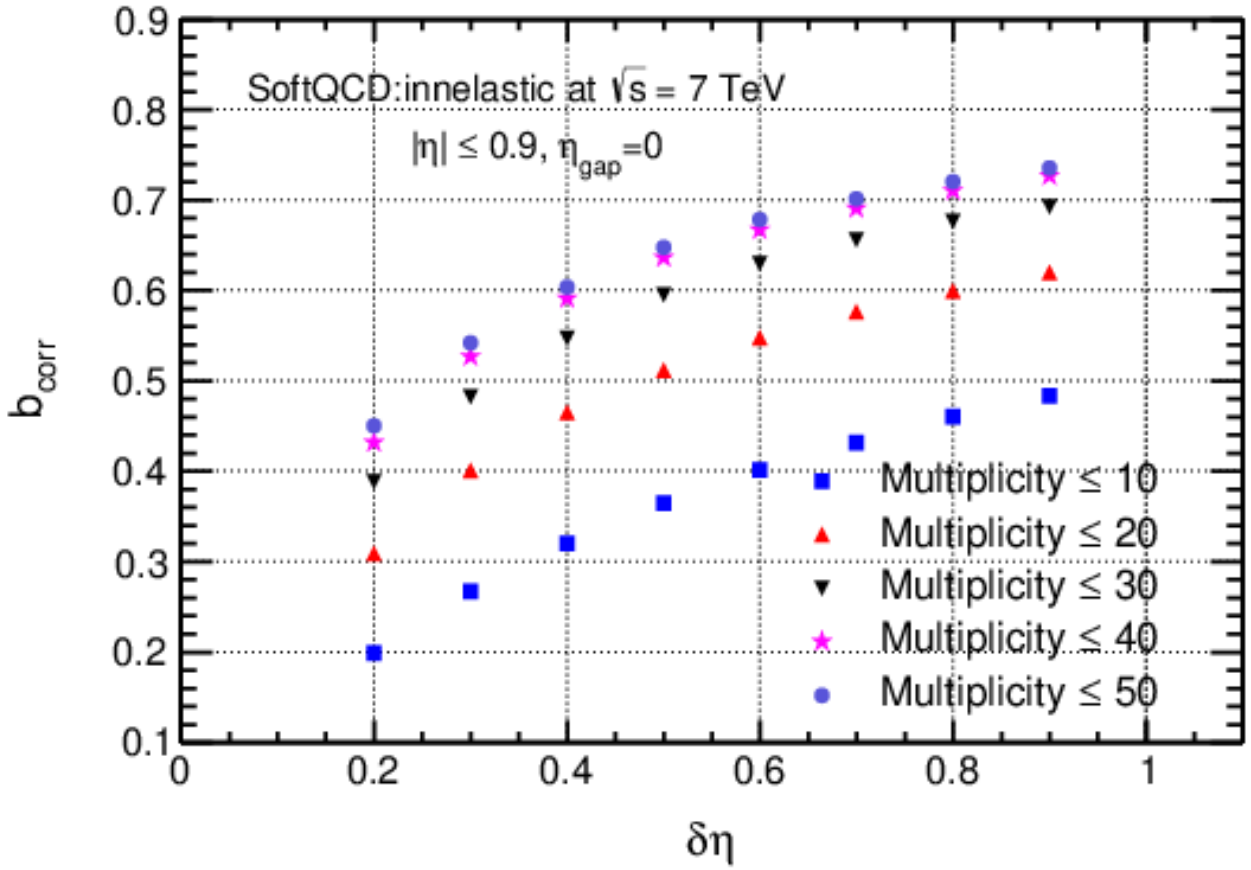
$$\eta = \frac{1}{2}\ln\left(\frac{P+P_z}{P-P_z}\right) = -\ln\left(\tan\frac{\theta}{2}\right)$$

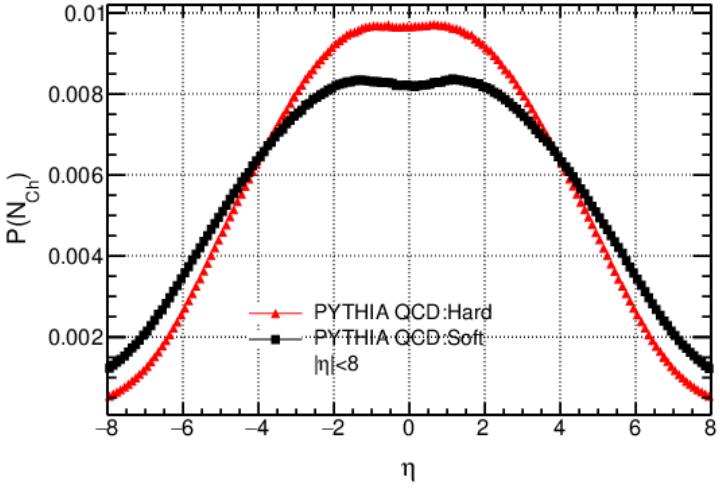
Definition of the F-B Correlation

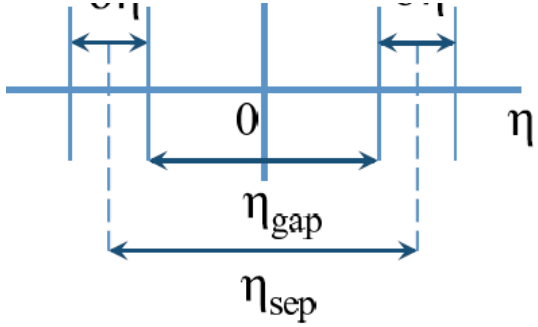
The Correlation is theoretically defined event by event, comparing the integrated density of particles produced in different ranges of pseudorapidity;

$$b_{Corr} = \frac{\langle n_F n_B \rangle - \langle n_F \rangle \langle n_B \rangle}{\langle n_F^2 \rangle - \langle n_F \rangle^2}$$

b_{corr} vs multiplicity bins

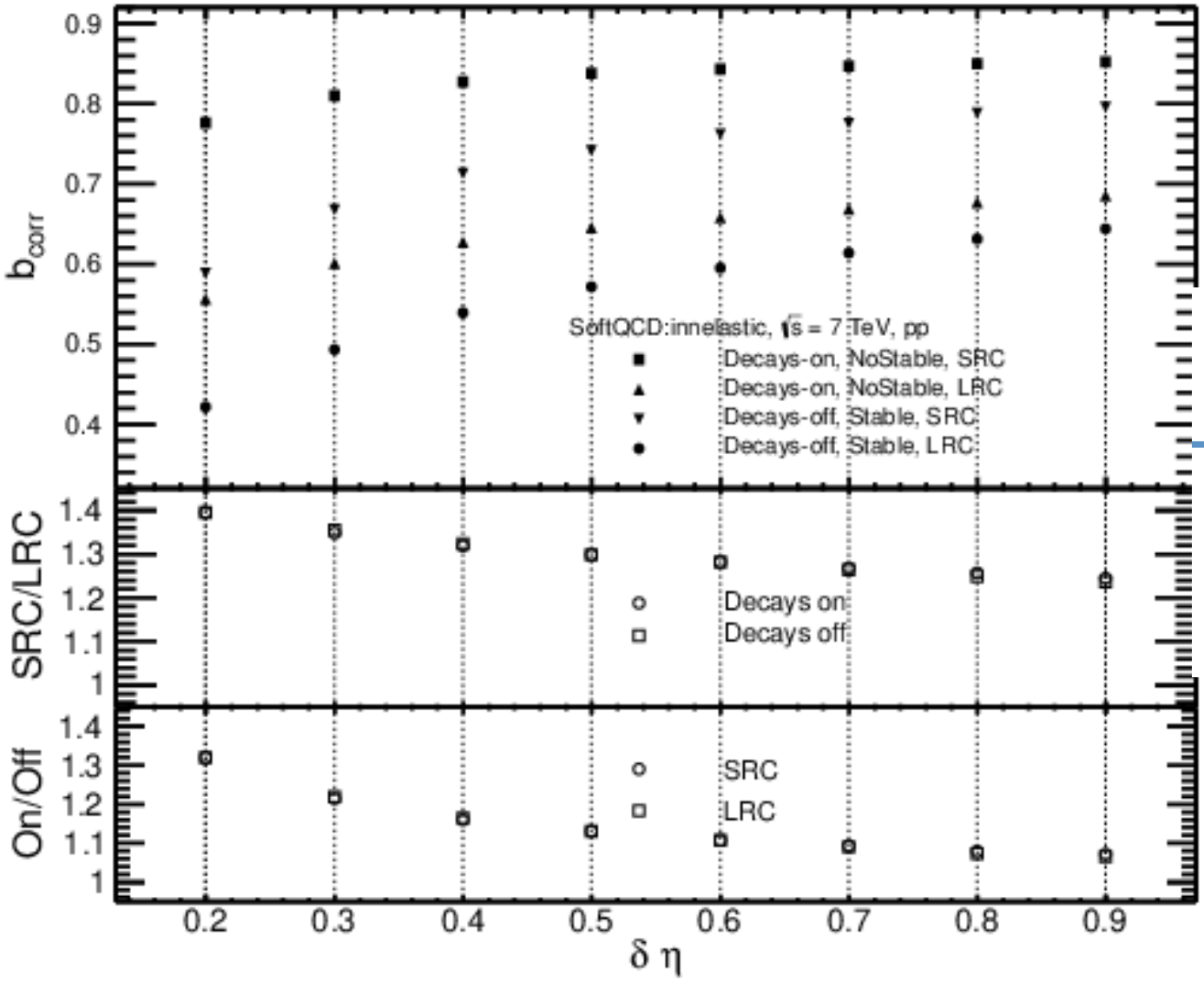


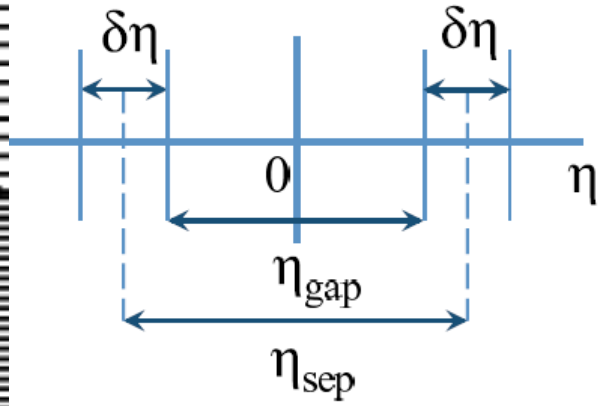




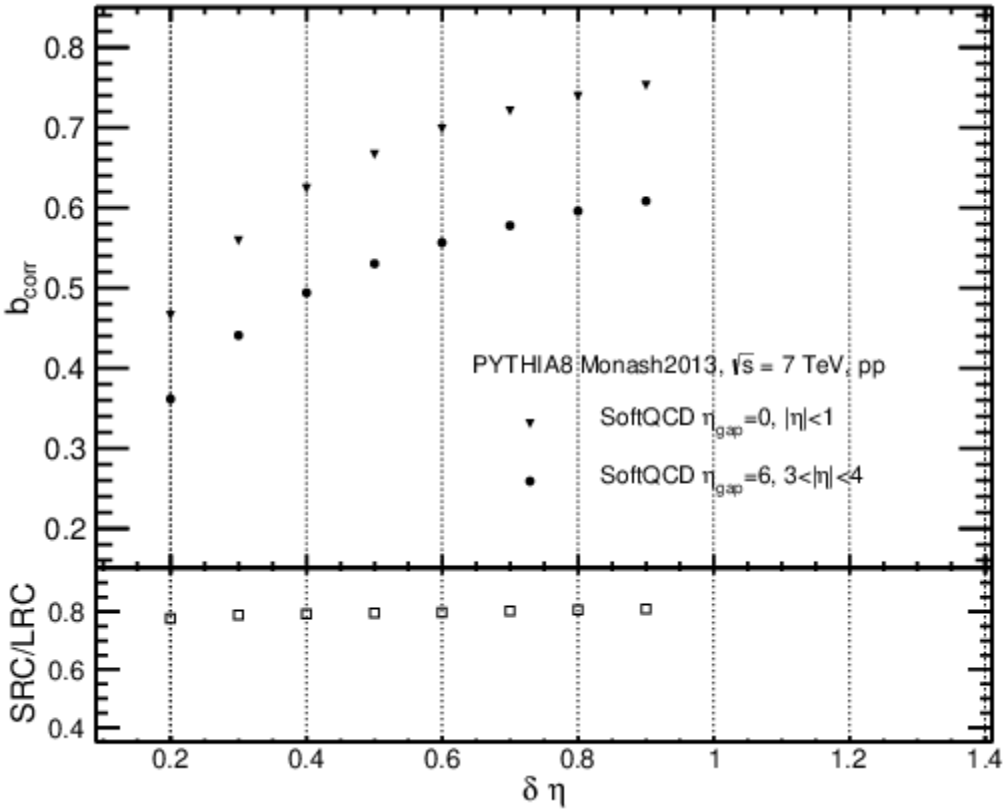
Increase of multiplicity distribution produce and enhancement of the b_{corr}.

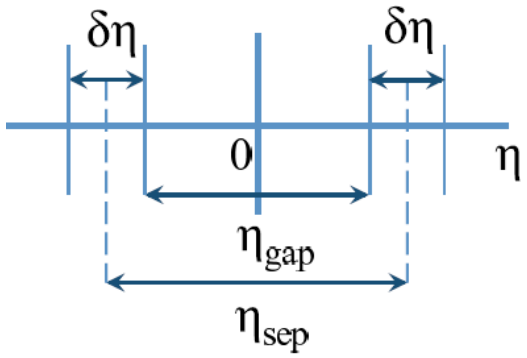
b_{corr} and resonances affects





b_{corr} for soft QCD processes



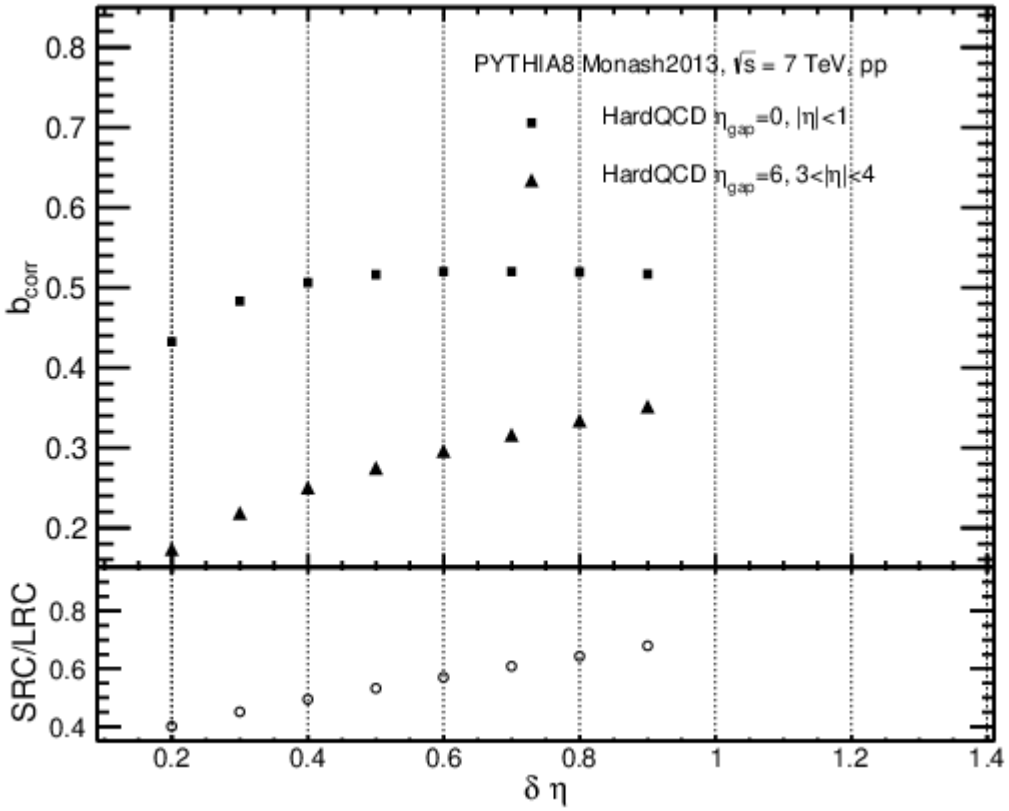


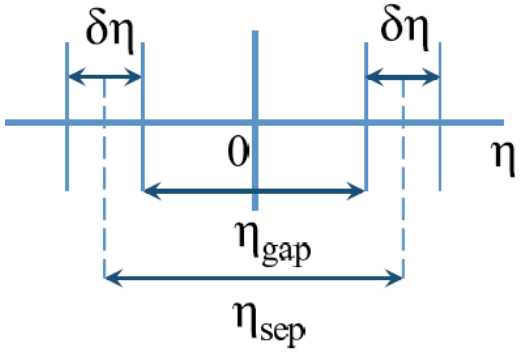
pp at 7 TeV.
b_{corr} for short and long range correlations.

Strength of the correlations is larger for central pseudorapidty regions w.r.t. forward region.

Hardness of the events also contribute to and increase of the correlation.

b_{corr} for Hard QCD processes





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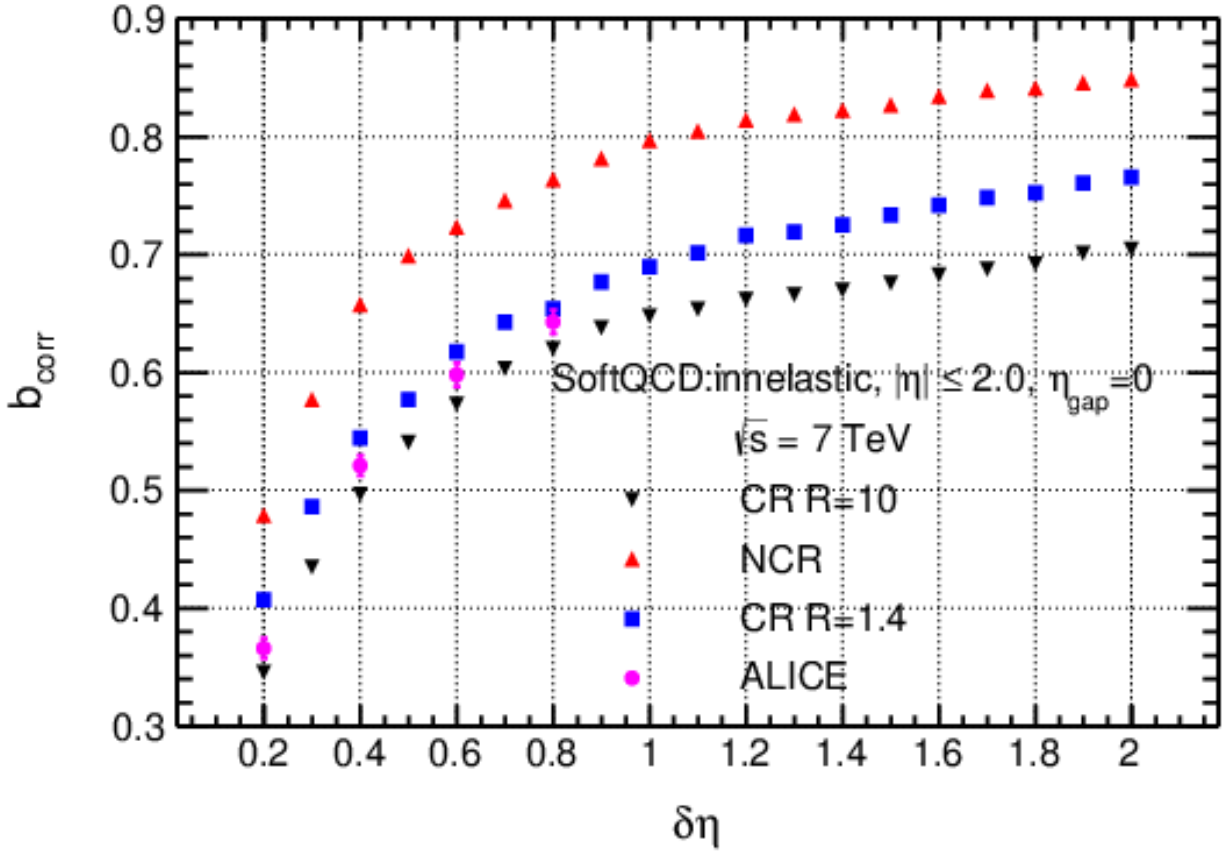
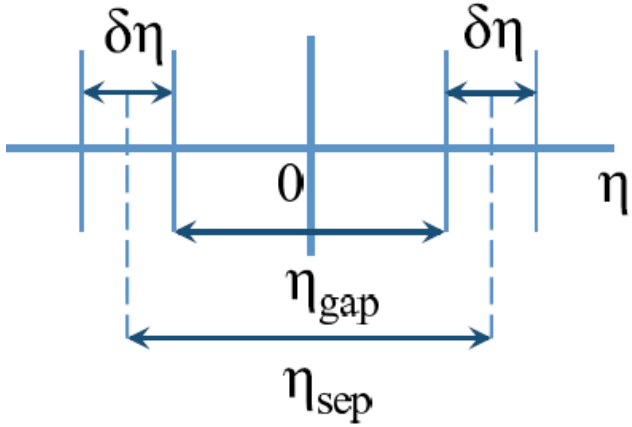
Color reconnection and b_{corr}



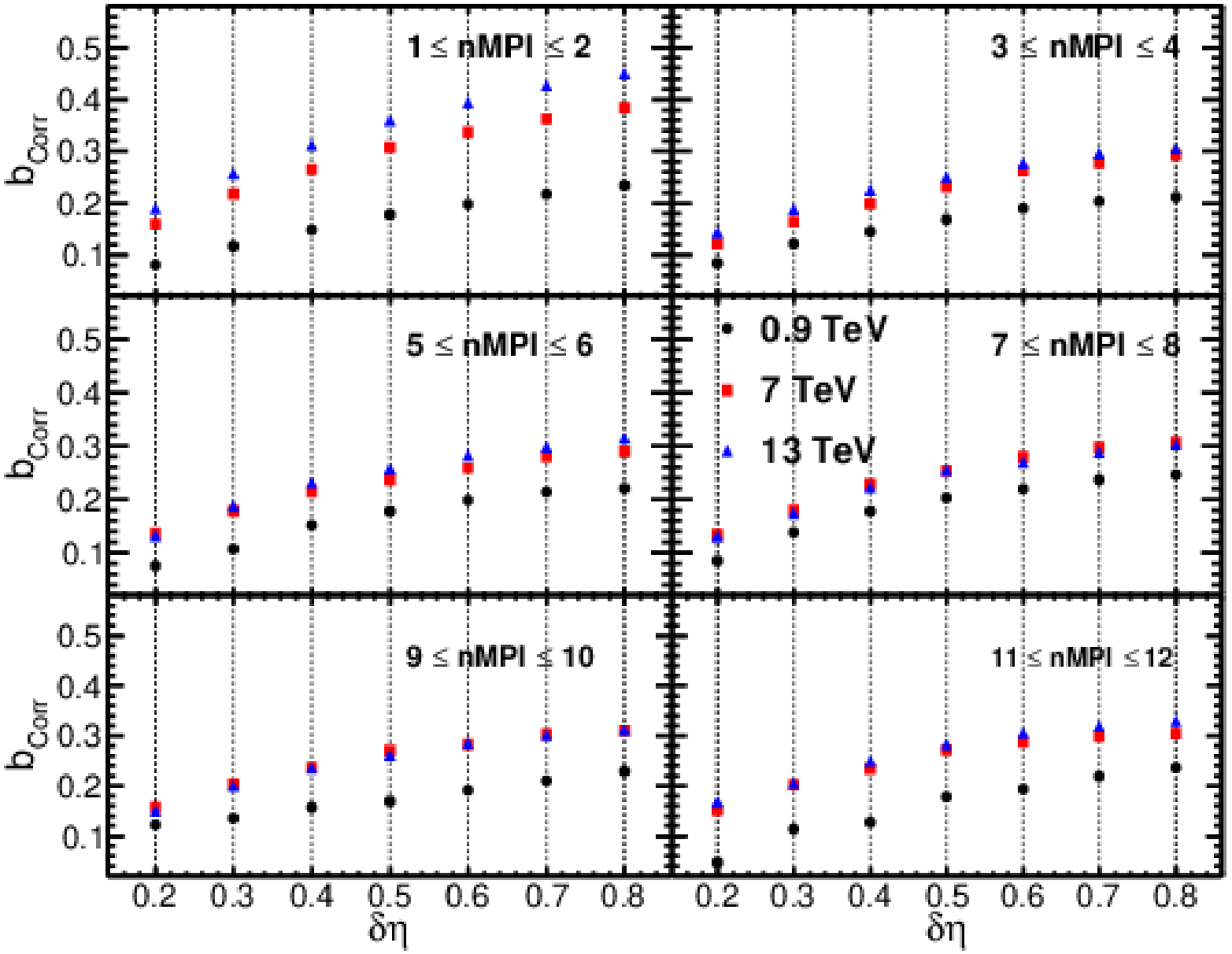
pp at 7 TeV
Soft processes |η| < 2

Color reconnection parameter 1.4-10

Results for 3 values of CR and the comparison to experimental data.



nMPI and b_{corr} for pp at 0.9, 7 and 13 TeV



b_{corr} vs CR and nMPI

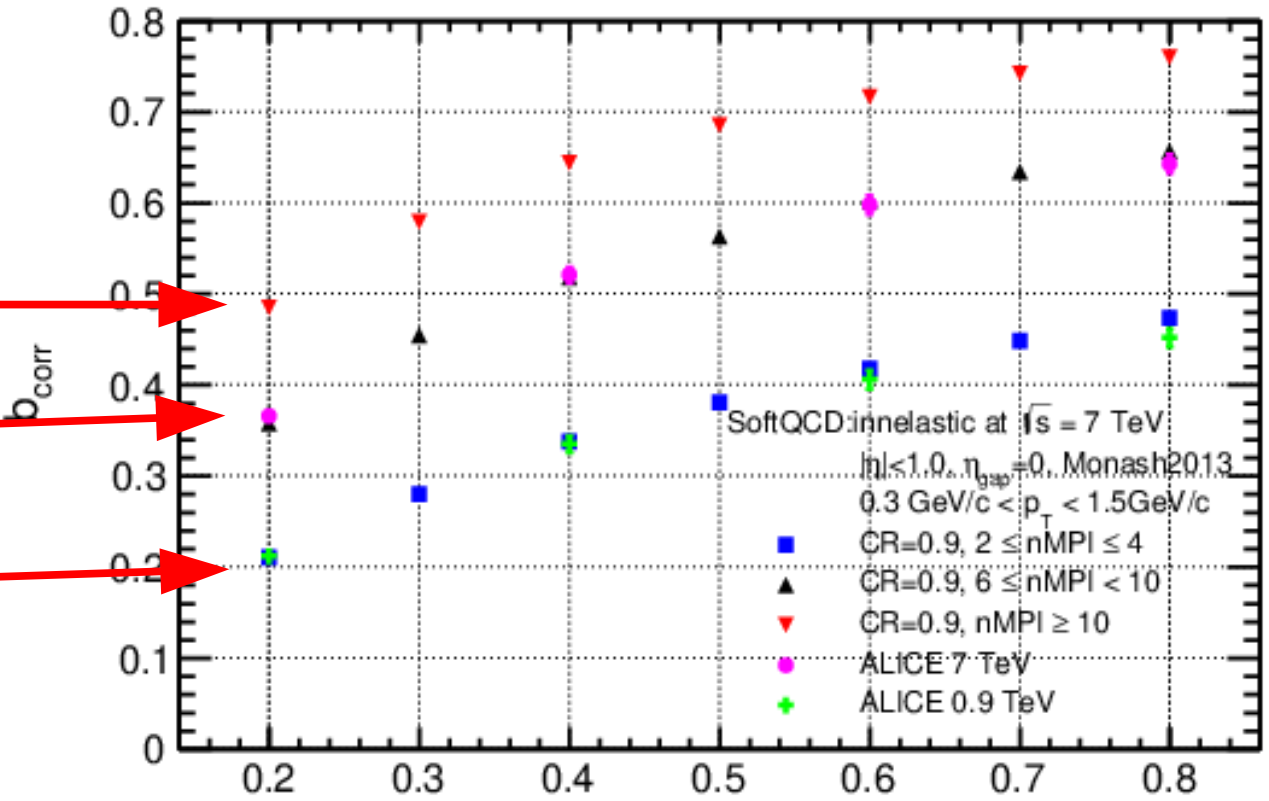
Pp at 7 TeV, different cuts on nMPI:

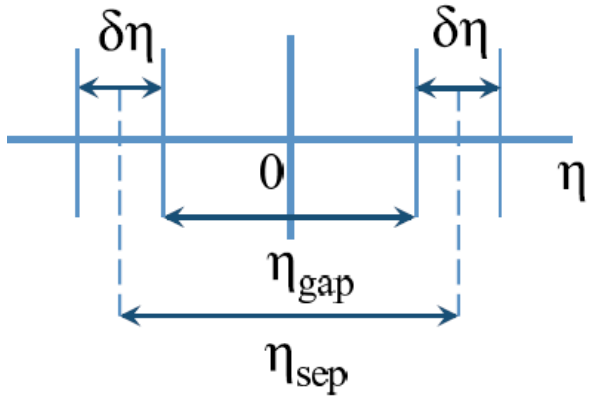
Prediction at 13 TeV

Data at 7 TeV
6 < nMPI < 10

Data at 0.9 TeV
2 < nMPI < 4

pp at determined energy and with nMPI selections can reproduce data at different energy!





Conclusiones

Using PYTHIA event generator, we have analyzed the effects of CR and nMPI for QCD processes (Soft and Hard) on calculation of forward-backward multiplicity correlations.

- Soft QCD process are more correlated than the Hard ones.
- Correlation decrease as CR increase. CR Collectivity?
- The CR models produce different shape of , the larger discrepancy among them are about
- Higher nMPI produce a higher mean multiplicity, however the correlation produce a small change on the shape of it .
- The correlation increase as the energy does, It just not at scaled.

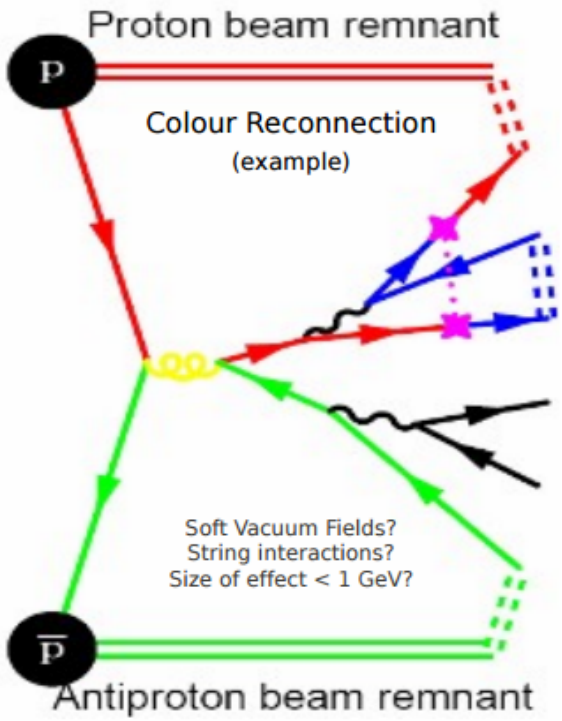
There is a relationship between nMPI and CR, so measuring the first one and computing the second, one could extract physical information of events.

There is possible to predict the bcorr for different energy just defining the nMPI.

Multiple parton interaction could be used to clasify events and understand soft QCD processes

There are two more CR models that we use. One is based in QCD and the other in Gluon-move, the idea from this two models is to reduce the string length (λ).

$$\lambda \quad \langle n_{hadrons} \rangle$$



CR-QCD model takes into account the hadronization based in the colour rules of SU(3) to determine if two strings are colour compatible using a junction structure.

arXiv1507.02091

Gluon-move is a Toy Model, in which it is tried to reduce λ by moving a gluon between a pair.

arXiv1407.6653

Multiple Parton Interactions

The original idea was proposed by T. Sjostrand and M. Van Zijl, Phys. Rev. D 36 (1987) 2019:

- There is a theoretical fact: differential cross section diverges as.
- The solution is introduce a cut-off to ensure finite and calculable results.

$$\frac{d\sigma}{dp_T^2} \propto \frac{\alpha_s^2\left(p_T^2\right)}{p_T^4} \rightarrow \frac{\alpha_s^2\left(p_T^2+p_{T0}^2\right)}{\left(p_T^2+p_{T0}^2\right)^2}$$

This solution implies:

- nMPI independent, which leads to a Poisson process, with minimal 1 interaction . arXiv:1410.3012
- All event generators use this model, but they differ in the choice of and also in the subsequent shower.