



The leading particle spectra as a tool to tune the Color reconnection models

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Present problems with Pythia

- A "minimal" colour flow only via the beam remnants does not result in a sufficiently steep rise of $\langle pT \rangle(n_{ch})$.
- The true origin of this behaviour and the correct mechanism to reproduce it remains one of the big unsolved issues at the borderline between perturbative and nonperturbative QCD.
- There are new new schemes that tries to incorporate more of the colour knowledge from QCD

Three different implementations of the color reconnection

The original PYTHIA

the gluons of a lower- pT MPI system are merged with the ones in a higher- pT MPI.

New scheme *J.R. Christiansen and T. Sjöstrand, JHEP 04 (2014) 115 [arXiv:1401.5238 [hep-ph]]*

The QCD colour rules are incorporated in the colour reconnection, and determine the probability that a reconnection is allowed

Gluon motion

gluons can be moved from one location to another so as to reduce the total string length

Analysis Details.

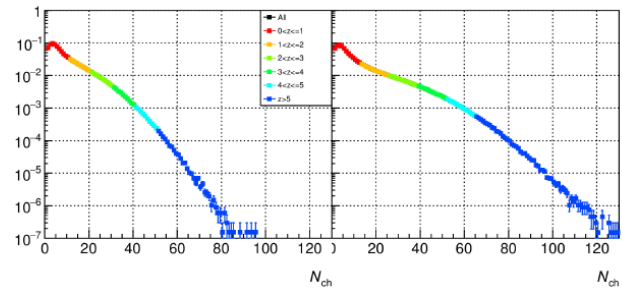
- 100M events generated with pythia8210 for each CR model.
- p-p collisions at 7 TeV
- Particle selection:
 - Only charged particles
 - Only particles in final state.
 - Exclude weak decays.
 - $|\text{Eta}| < 0.8$
- SoftQCD:all = on
- CR models used:
 - Mode0 → The MPI-based original Pythia 8 scheme.
 - Mode1 → The new more QCD based scheme.
 - Mode2 → The new gluon-move model.
 - W/o color reconnection.
- Any other parameters set as default.

Main areas of comparison

- We need experimental parameters which can provide the test bench for the determination of the color reconnection scheme and strength.

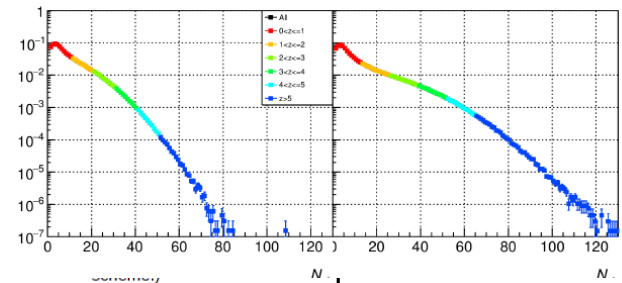
multiplicity

CR 0



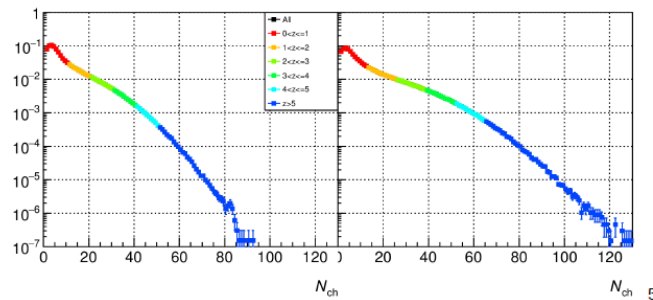
NO CR

CR 1



Necessity to
introduce CR to fit
simultaneously
multiplicity and pt
spectra

CR 2



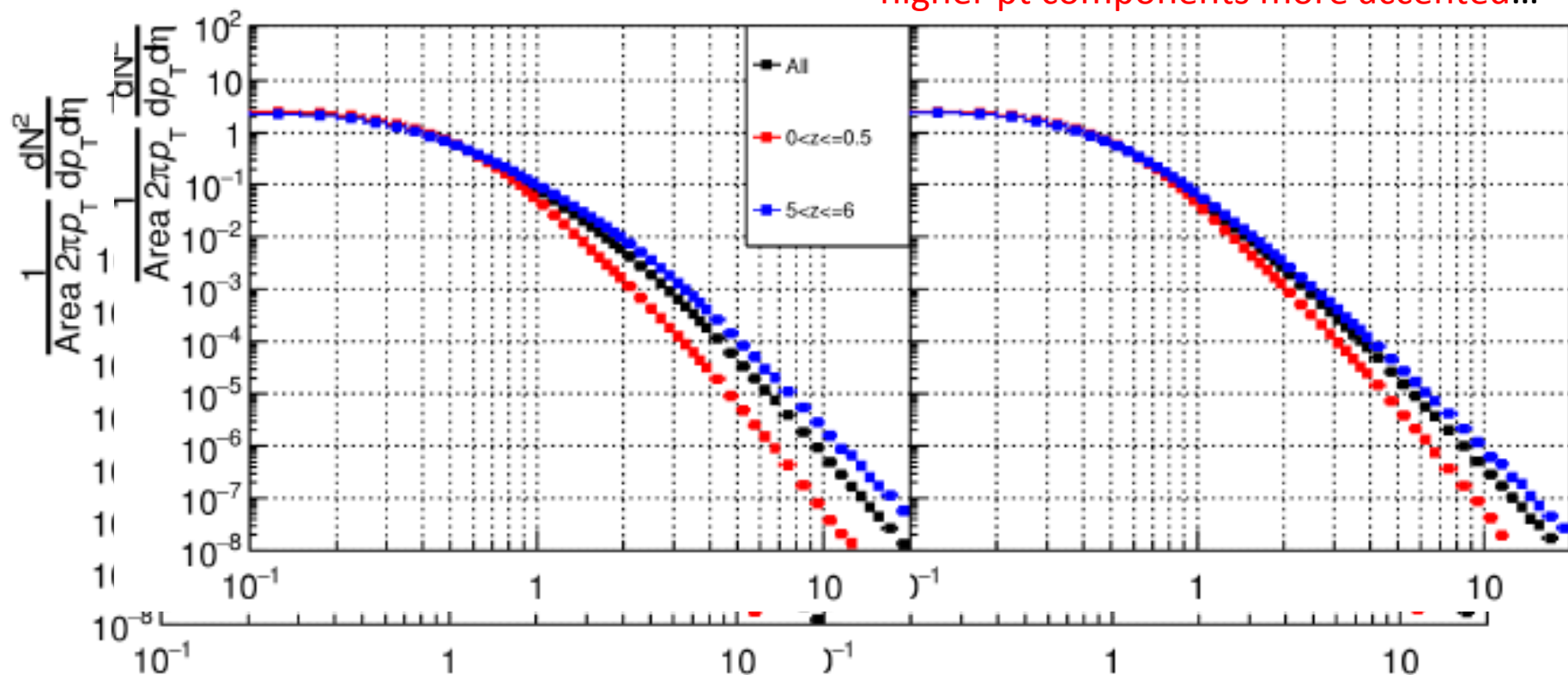
P_t Inclusive Distribution.

All Charged

- ColourReconnection:reconnect = on
- **ColourReconnection:mode = 2**
 - (The MPI-based original Pythia 8 scheme.)

- ColourReconnection:reconnect = off

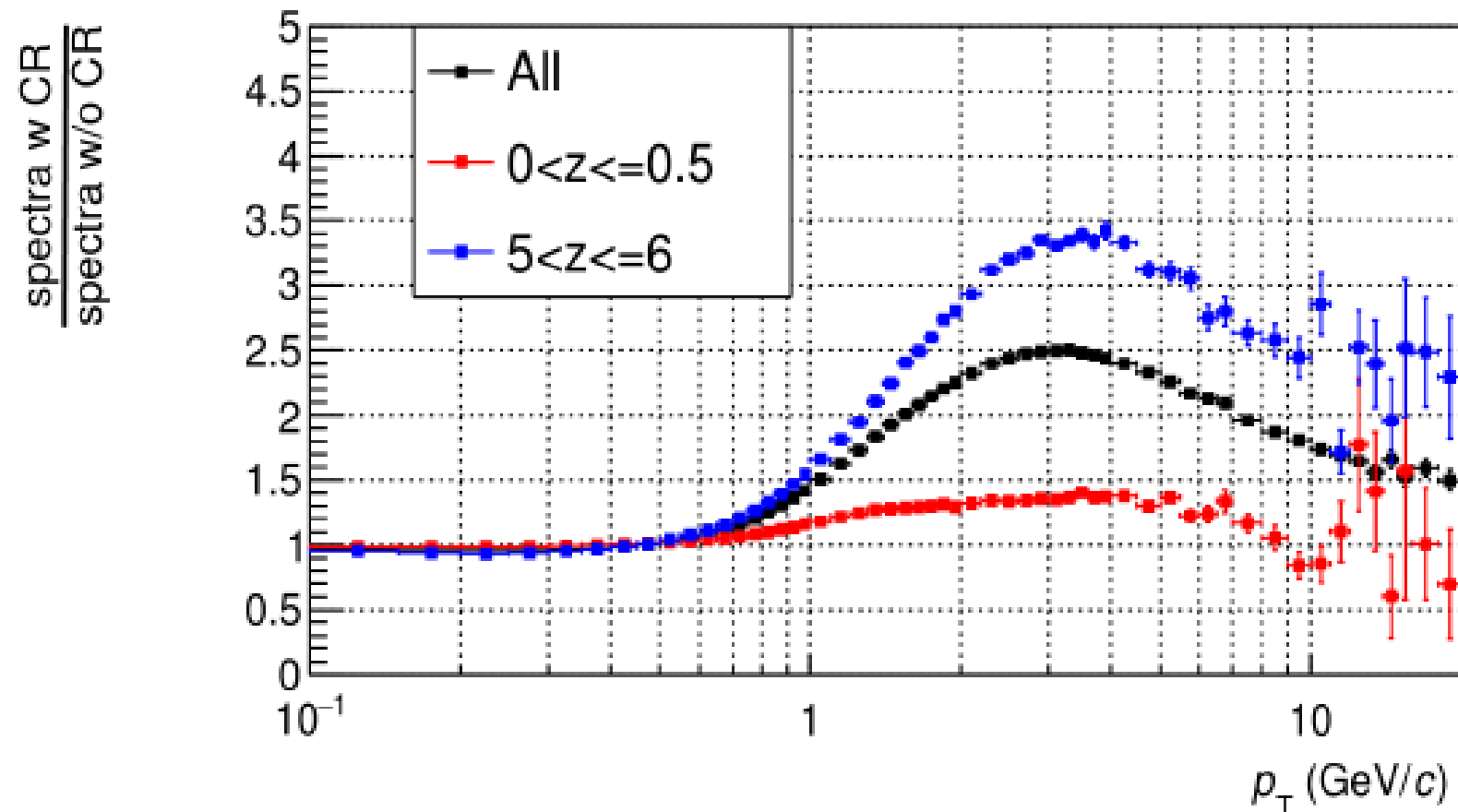
At high multiplicities the spectra have higher pt components more accented...



Ratio $(P_t^{\text{Inclusive CR}}) / (P_t^{\text{Inclusive NoCR}})$

Mode 2

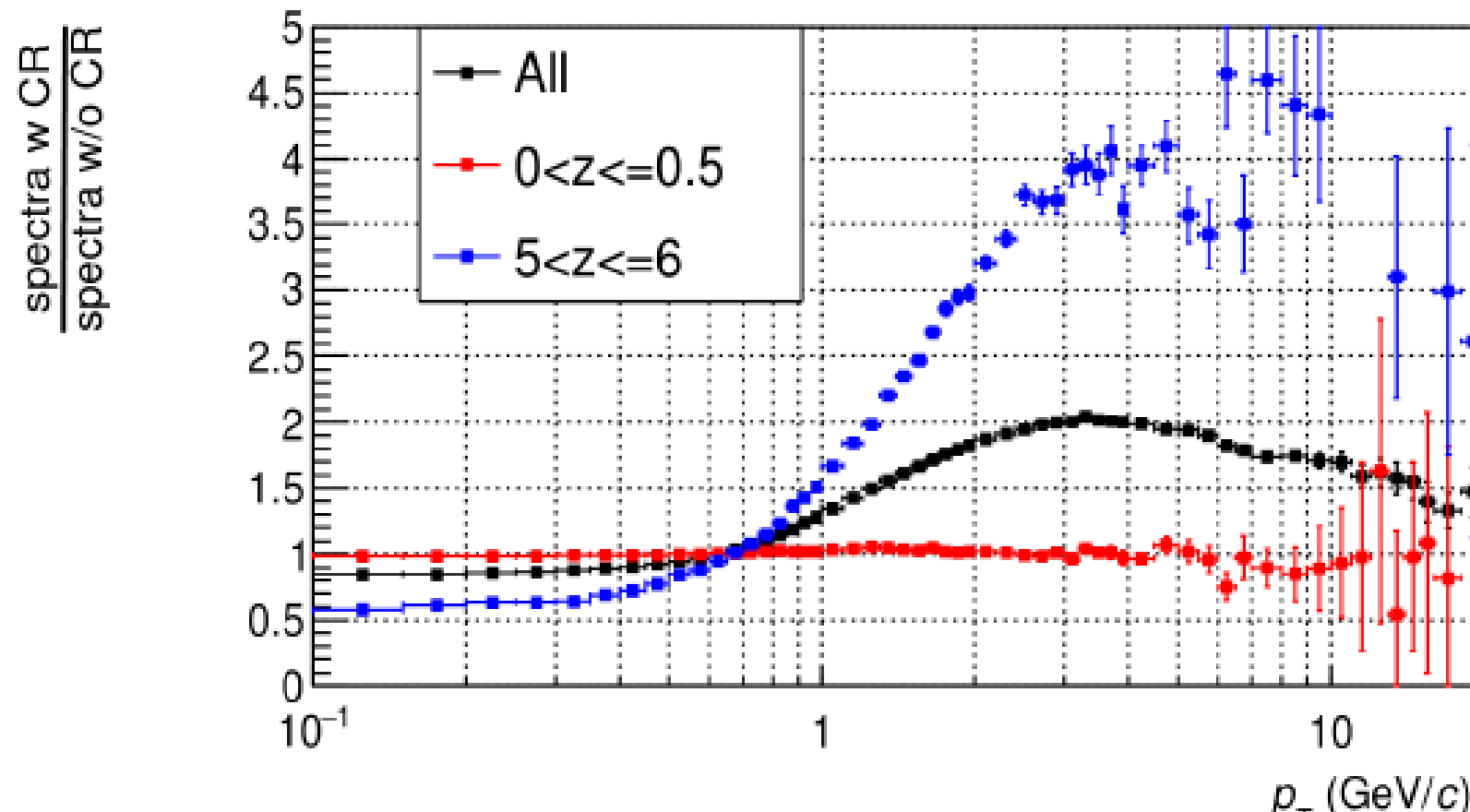
Pions



Ratio $(P_t^{\text{Inclusive CR}}) / (P_t^{\text{Inclusive NoCR}})$

Mode 1

Protons

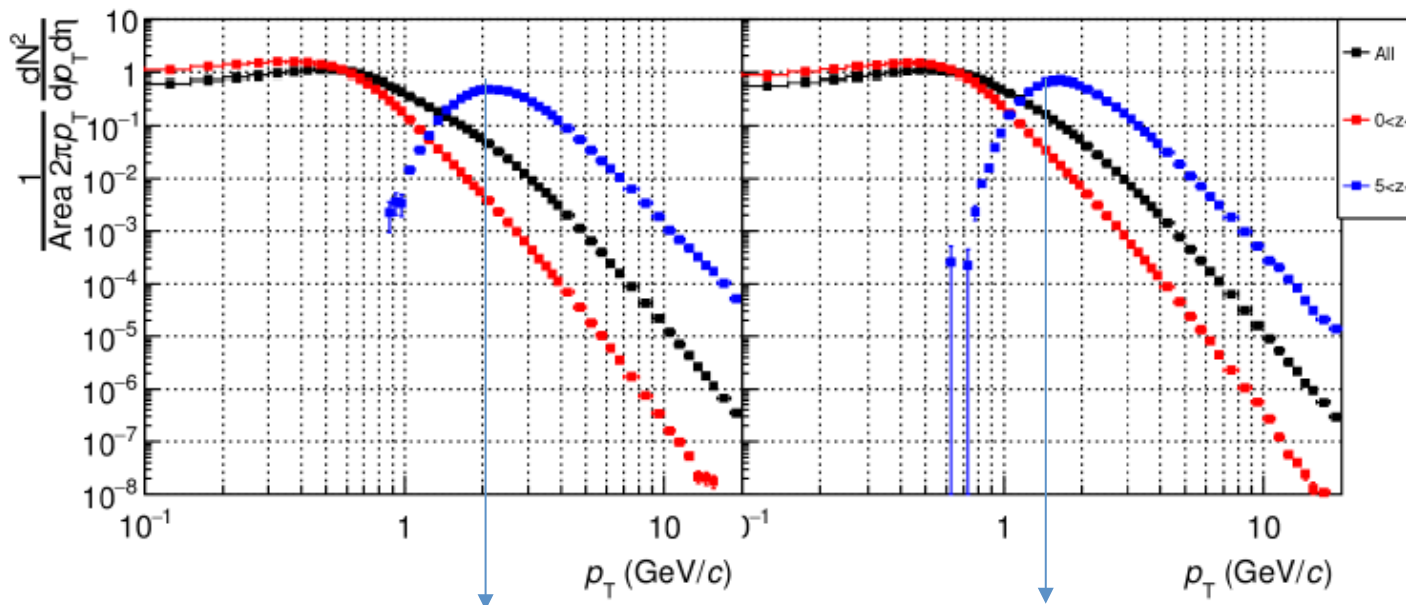


P_t leading Distribution.

All Charged

- ColourReconnection:reconnect = on
- **ColourReconnection:mode = 1**
 - (The MPI-based original Pythia 8 scheme.)

- ColourReconnection:reconnect = off



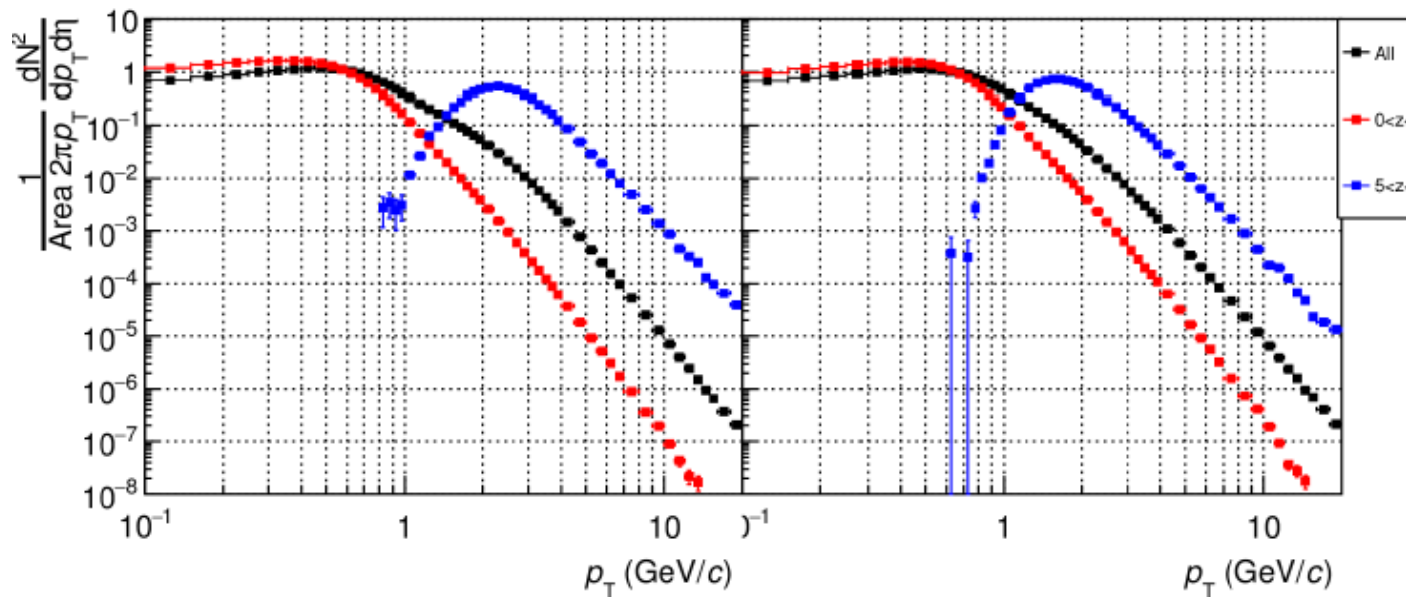
A considerable shift in the peak!!!

P_t leading Distribution.

Pions

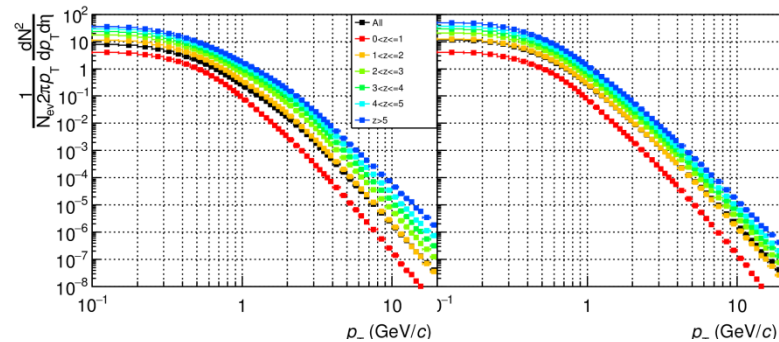
- ColourReconnection:reconnect = on
- **ColourReconnection:mode = 0**
 - (The MPI-based original Pythia 8 scheme.)

- ColourReconnection:reconnect = off



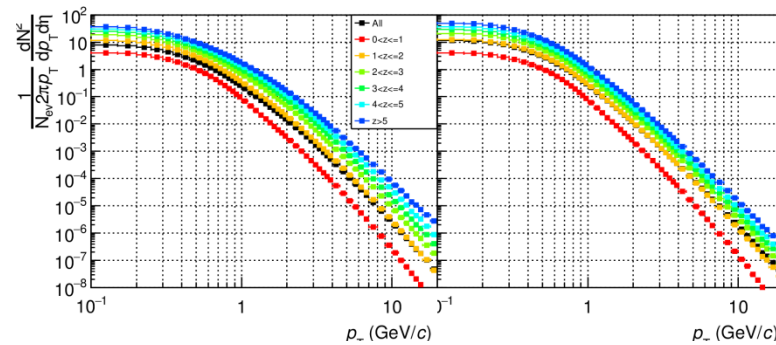
Inclusive charged particle spectra

CR=0



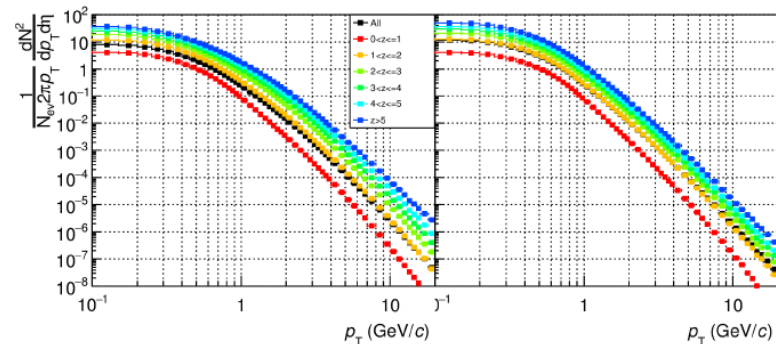
No CR

CR=1

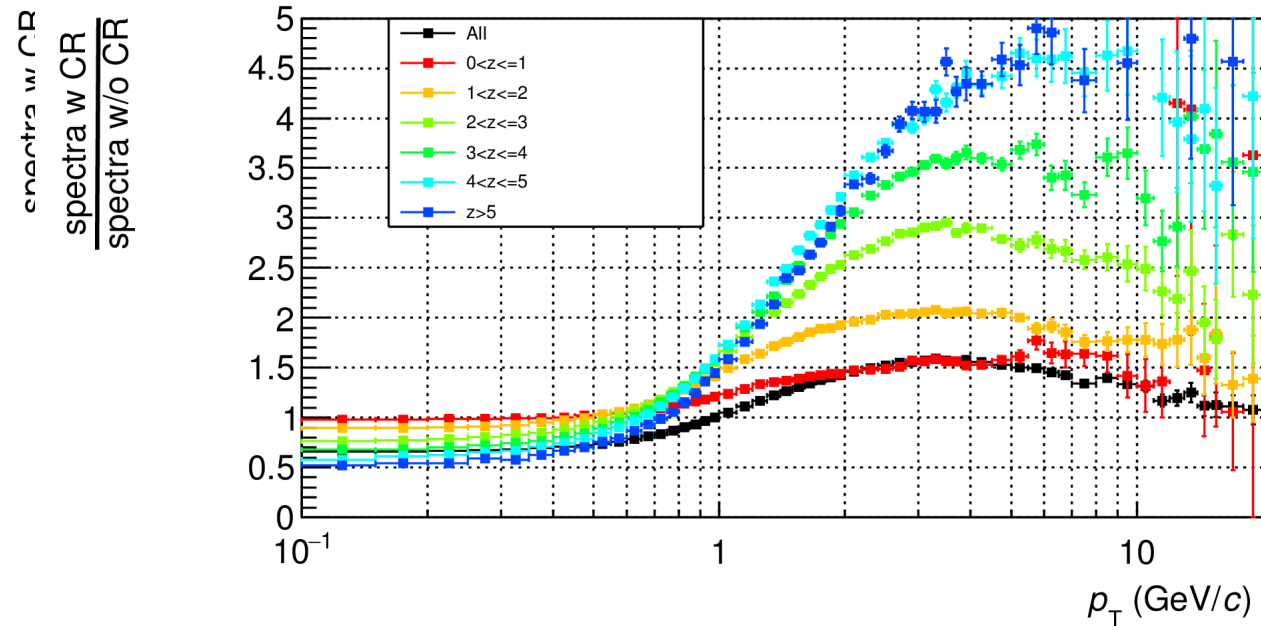


At high multiplicities
the spectra have
higher pt components
more accented...

CR=2

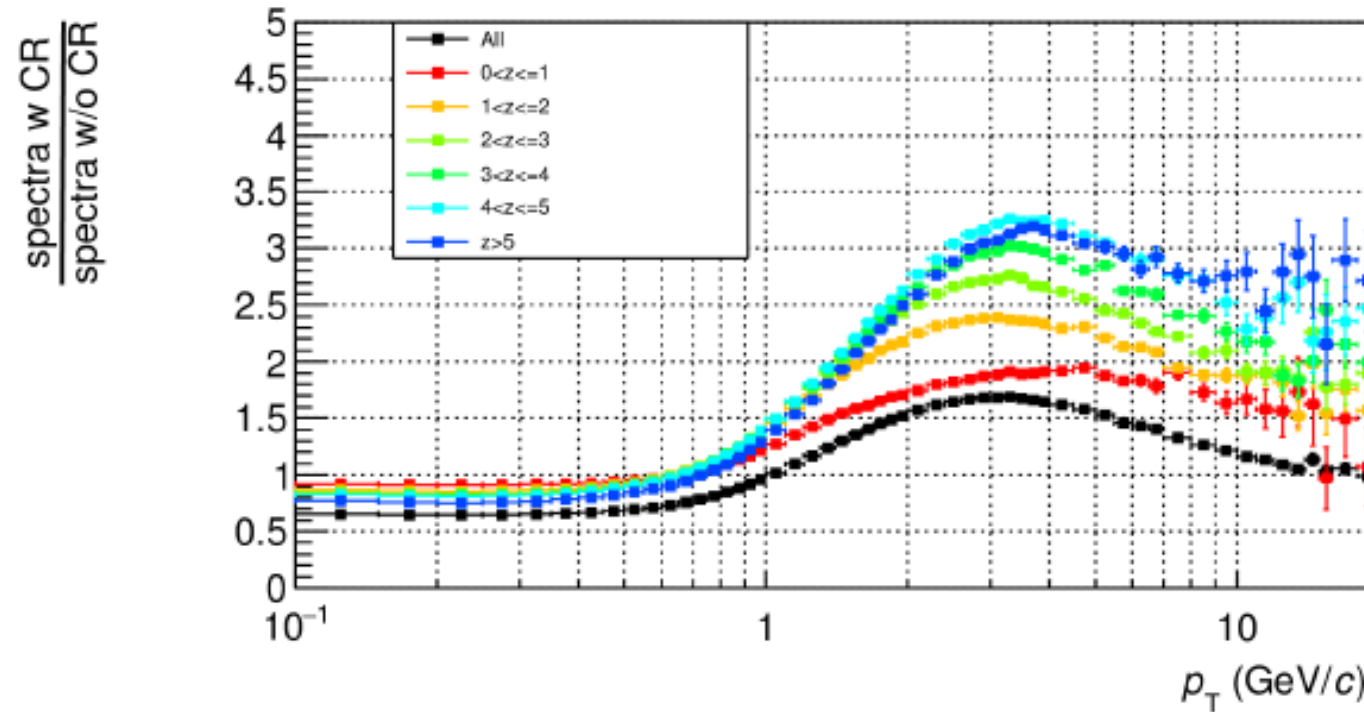


Ratio of pt spectra

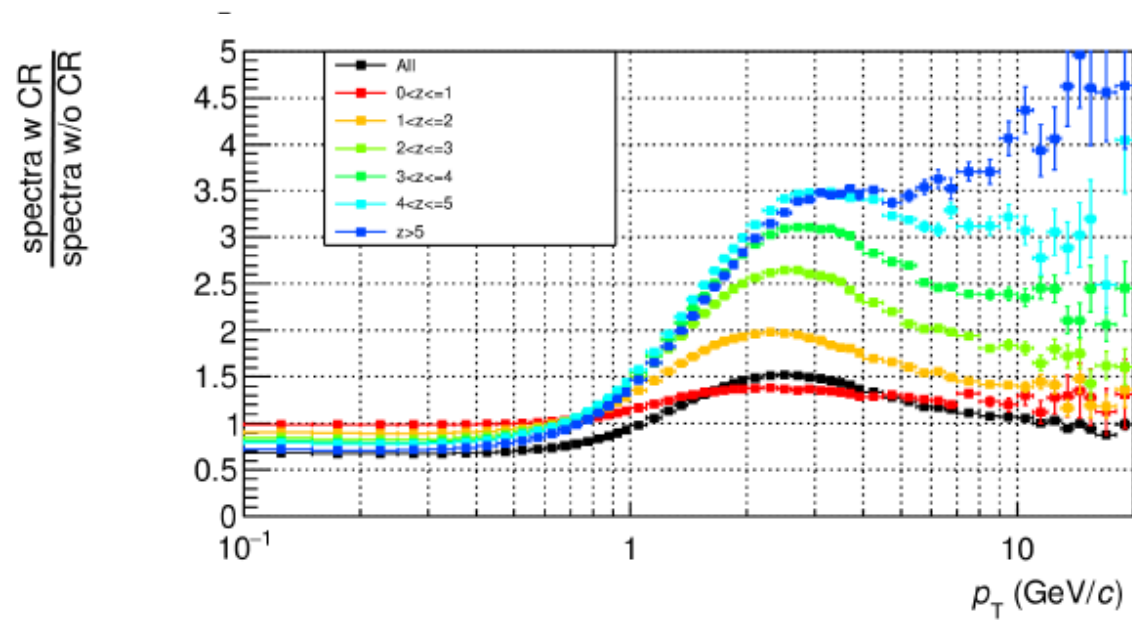


The ratio of pt spectra with color reconnection shows a marked suppression at low p_T and an enhancement at high p_T which depends on the CR scheme used.

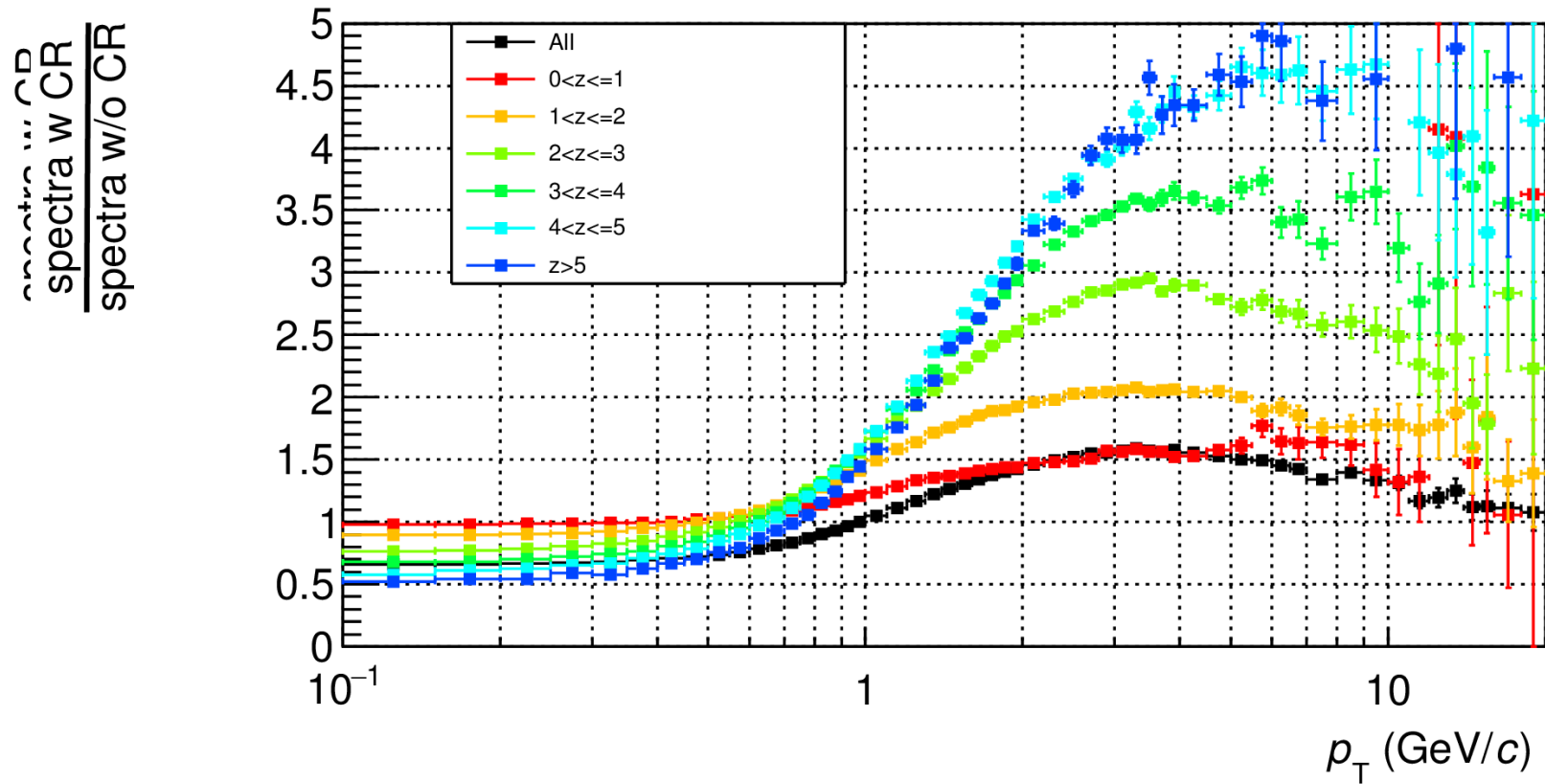
Comparison CR no CR for inclusive spectra

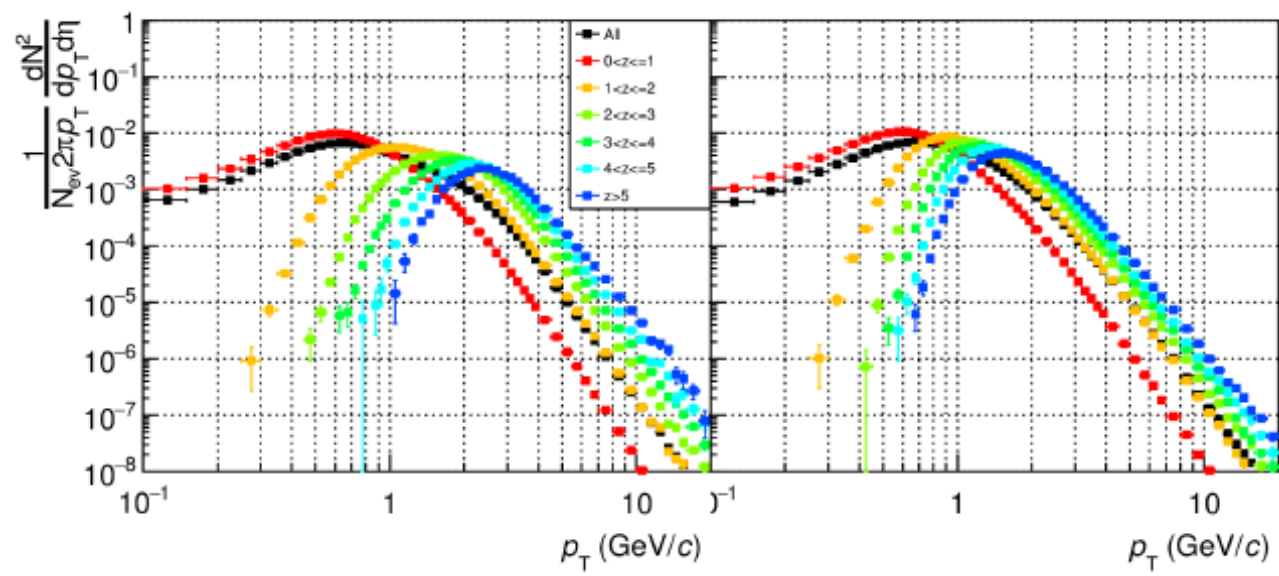


Ratio CR/no CR for pions and protons

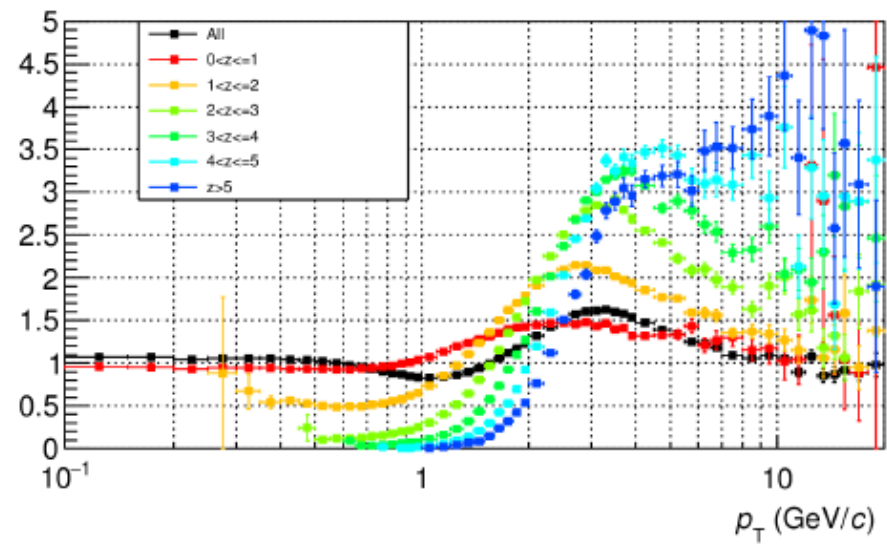


Ratio CR1/no CR pions protons

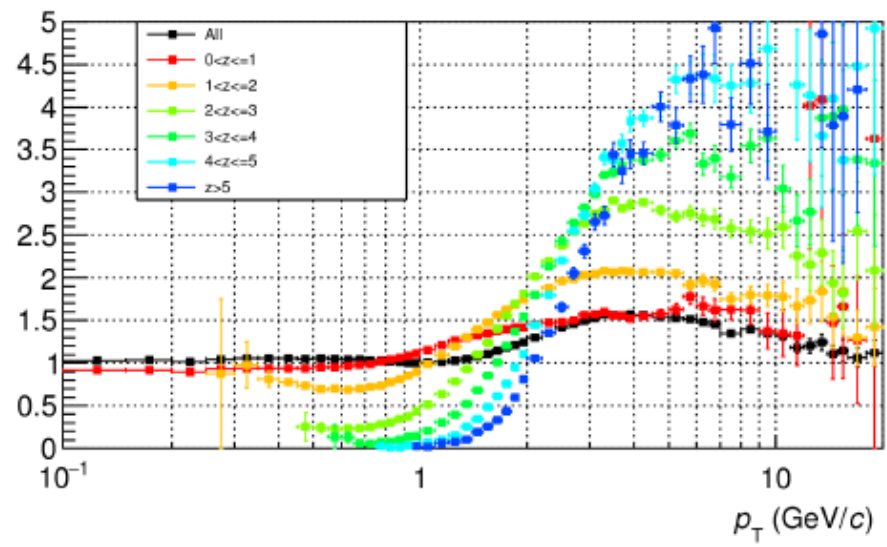




$\frac{\text{spectra w CR}}{\text{spectra w/o CR}}$

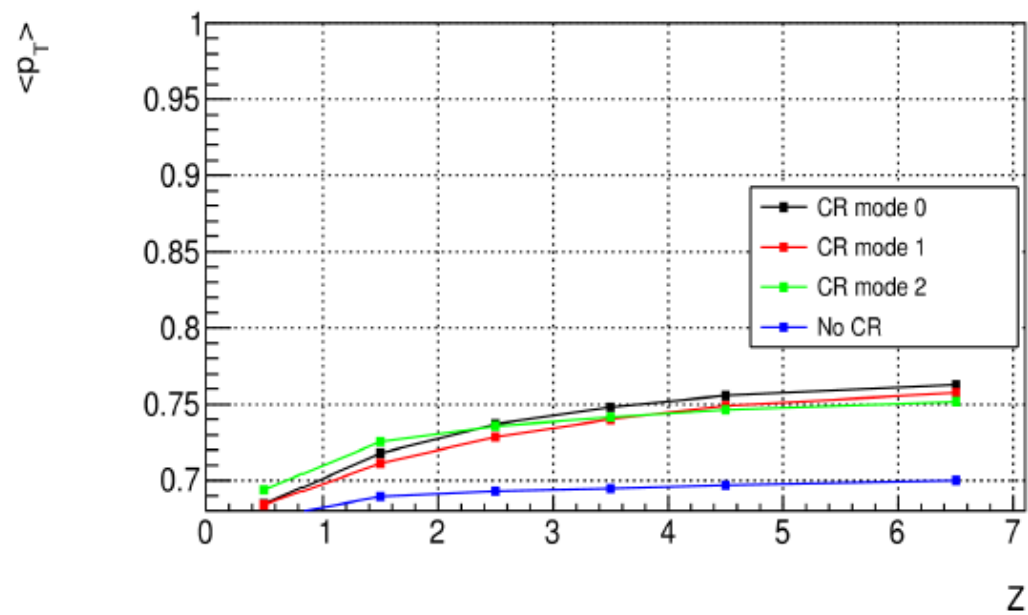


$\frac{\text{spectra w CR}}{\text{spectra w/o CR}}$



$\langle p_T \rangle$ vs Nch

SoftQCD
Pions



$\langle p_T \rangle$ vs Nch

SoftQCD
Protons

