PYTHIA studies of differential energy-energy correlators

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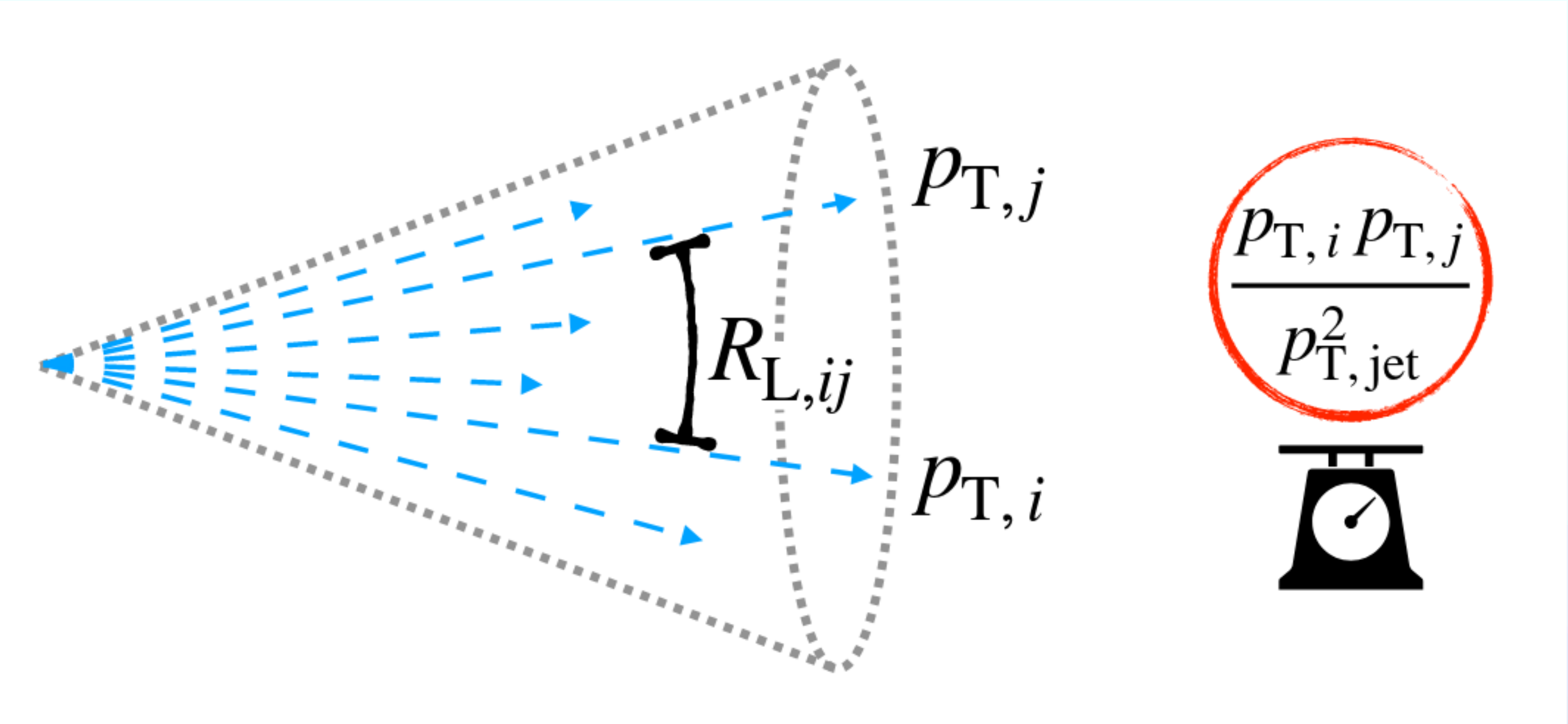
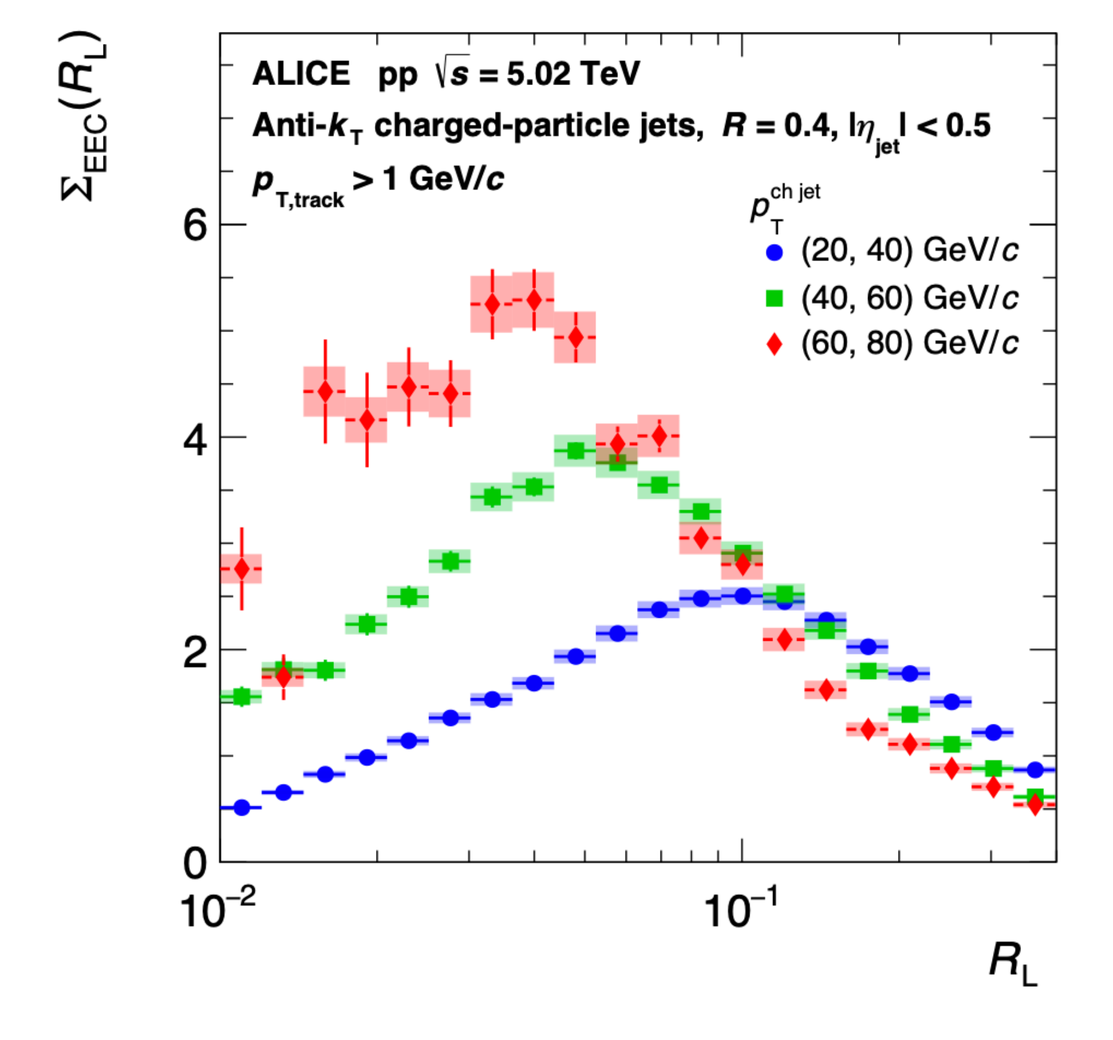
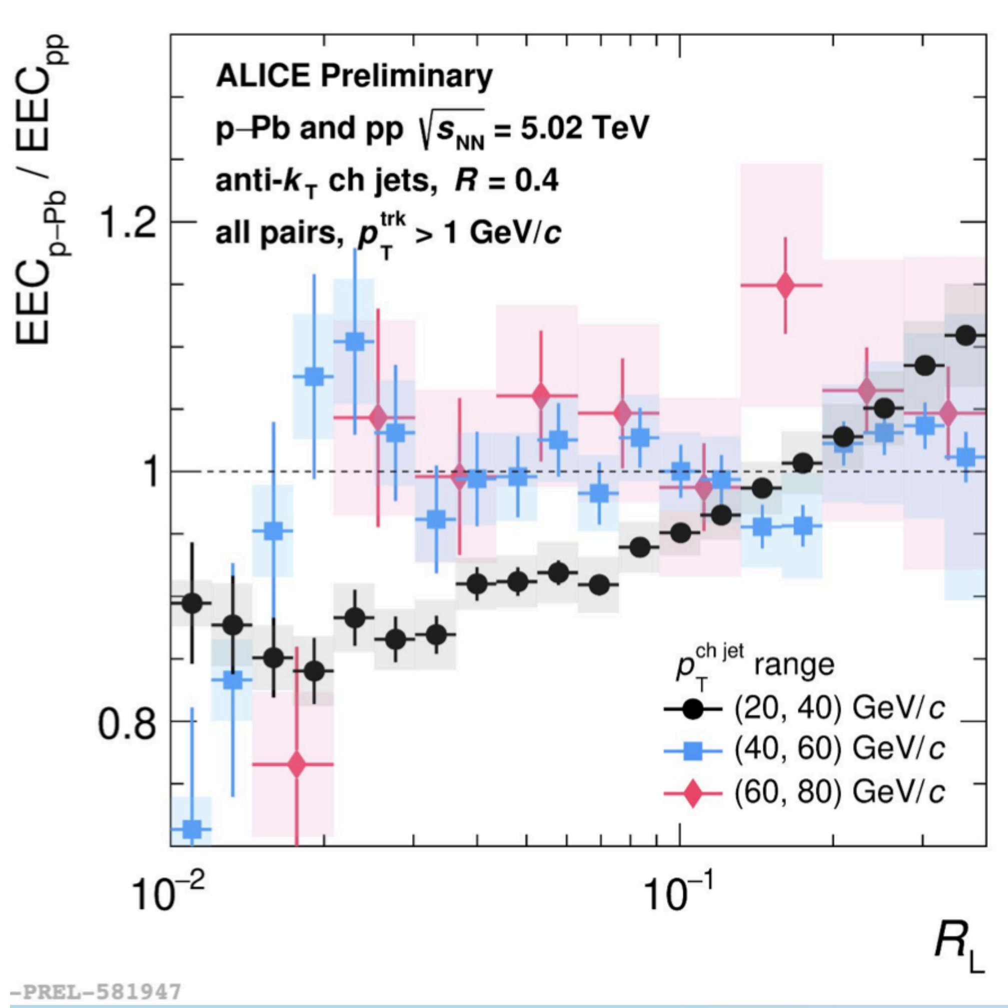
Energy energy correlators: a reminder

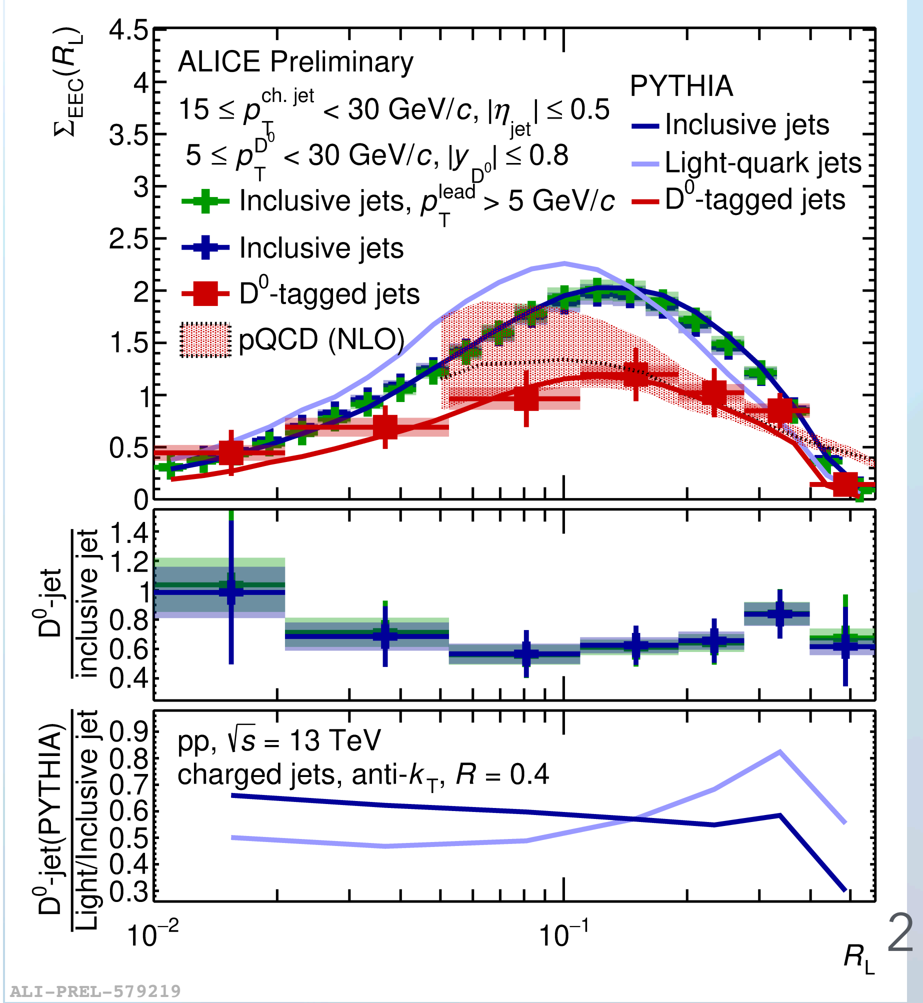
- Energy-weighted cross section of particles pairs
- Allows us to probe partonic-level jet formation and how partons are confined into hadrons – *Hadronization*
- Hadronization separates the regions dominated by perturbative and non-perturbative effects



- Approved ALICE measurements:
  - inclusive jets in p-p collisions
  - inclusive jets in p-Pb collisions
  - D-jets in p-p collisions

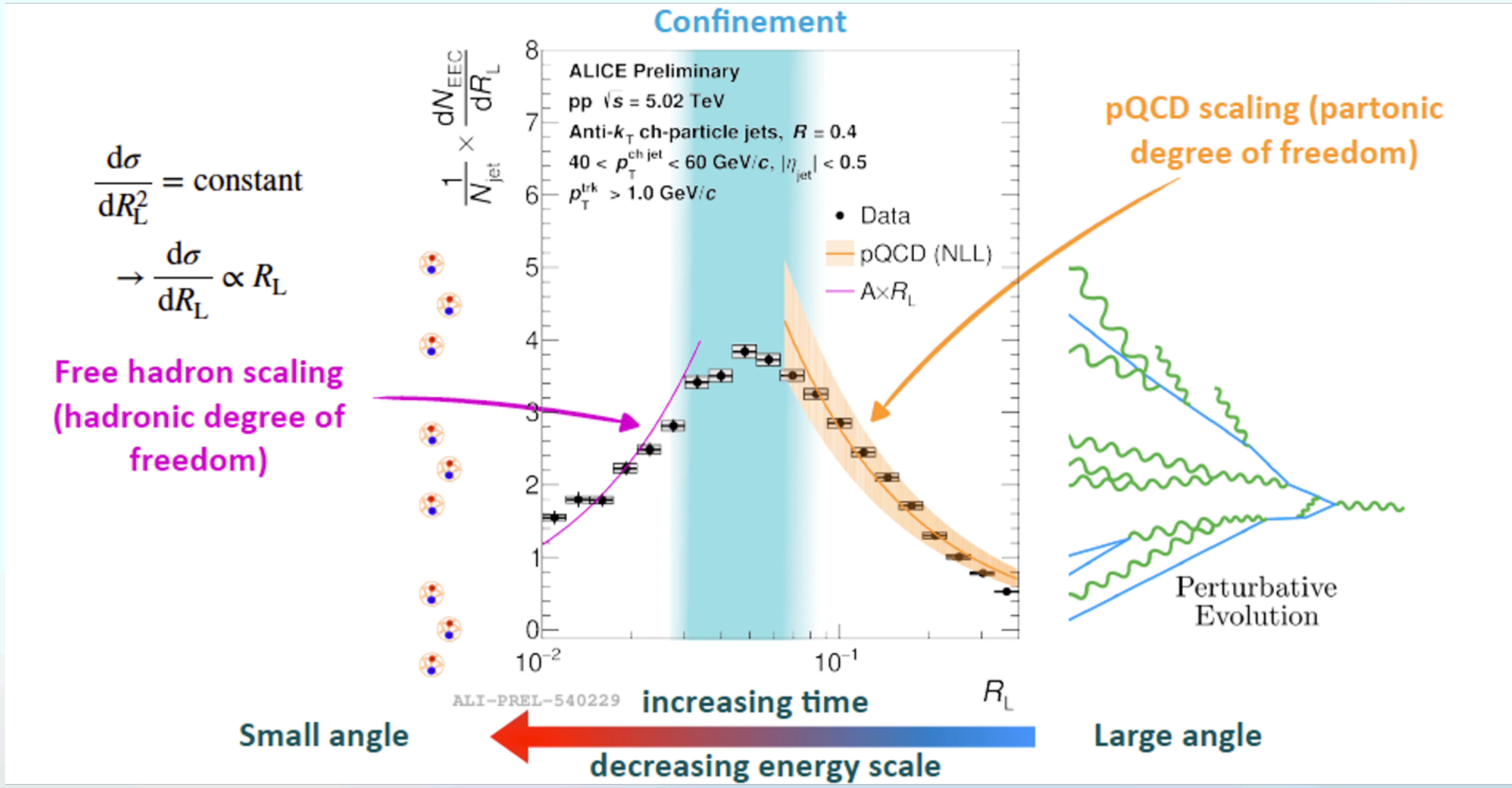




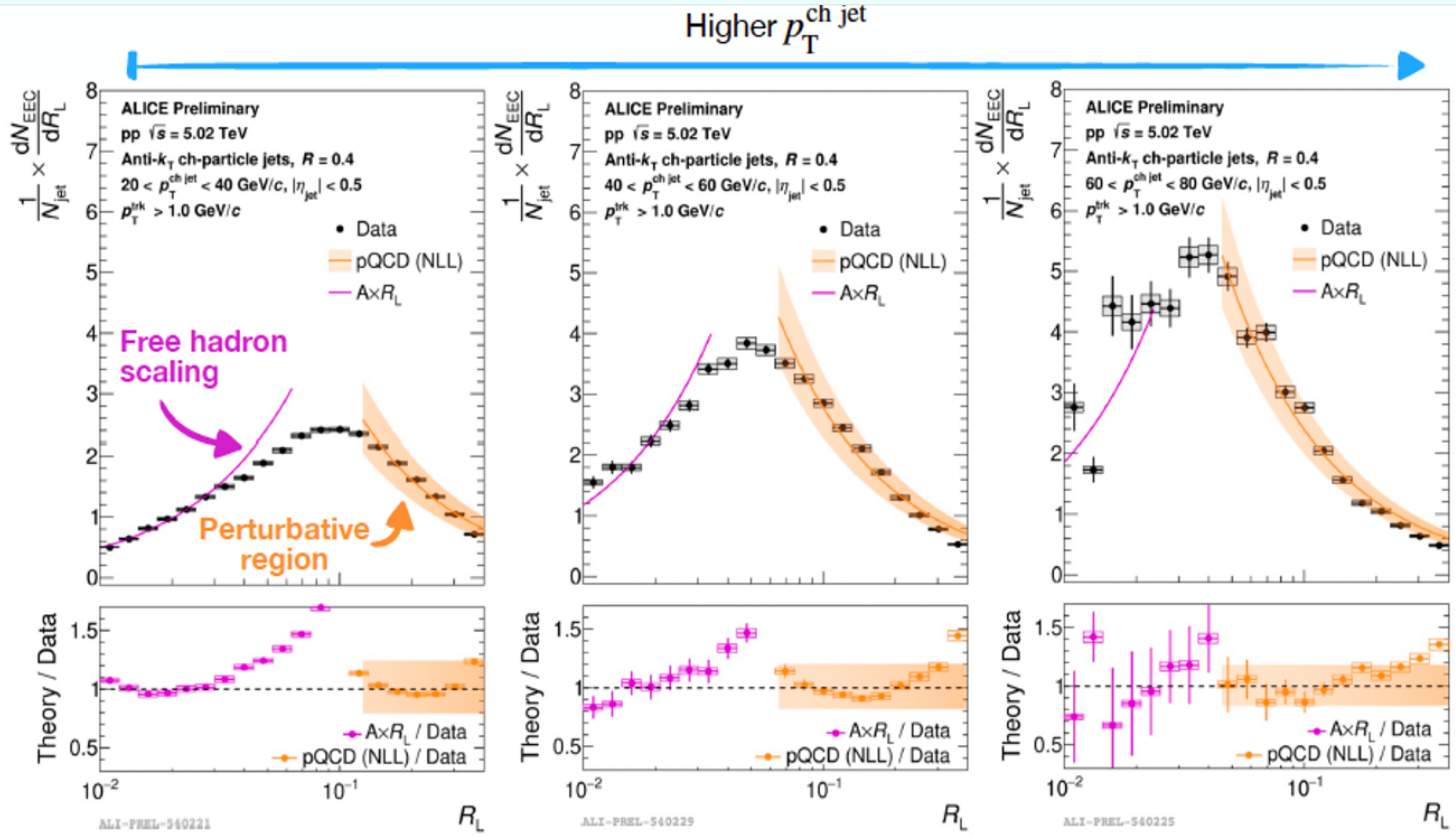


A deeper look into EECs

- Looking at the properties of pairs
- Do these pairs exhibit different behavior in the different regimes? (partonic, confinement, hadronic)
- To answer this: Going more differentially to study the difference in momentum, energy weight, and charge

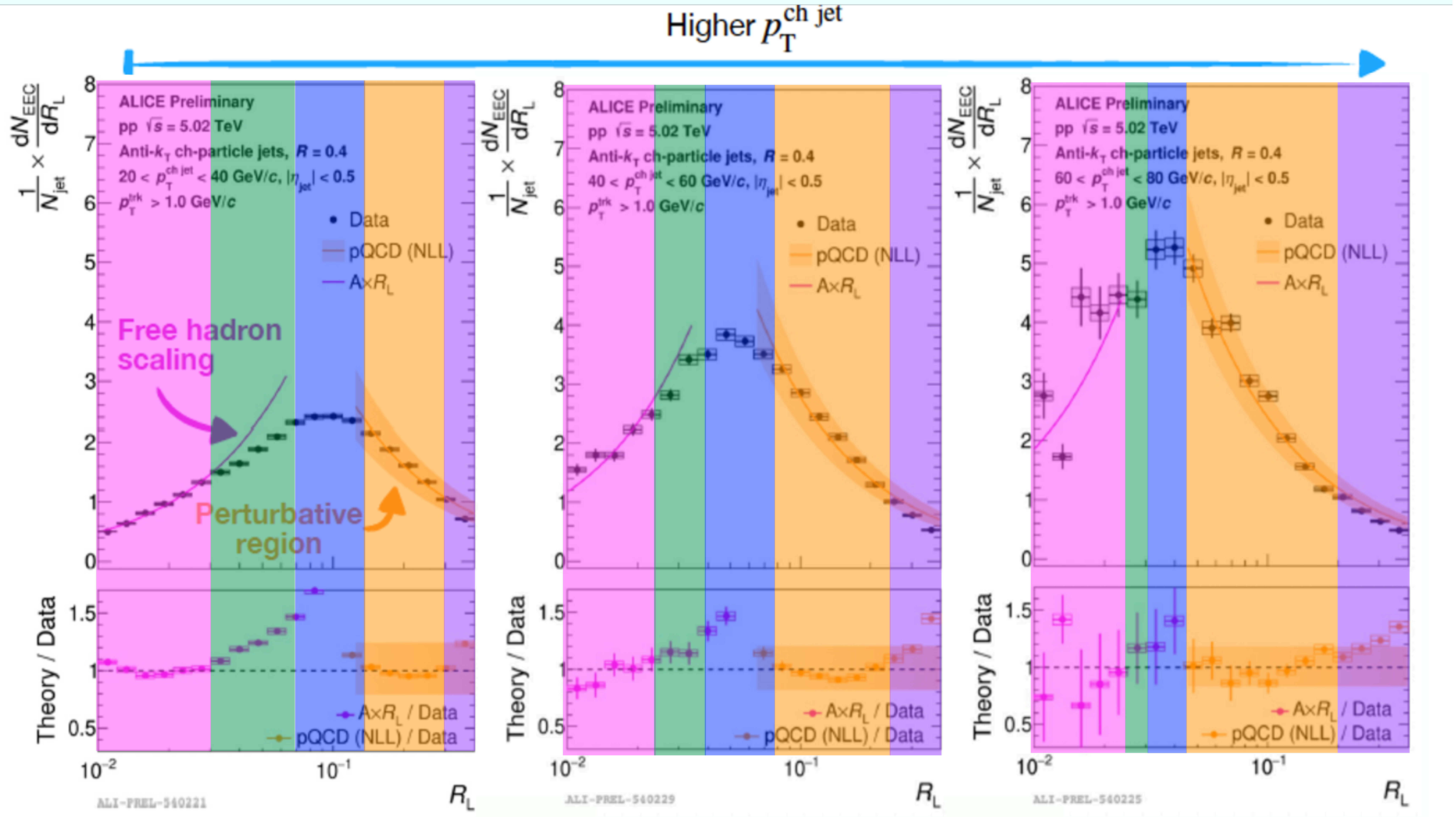


EECs as a function of jet p_T



NLL calculations correspond to full (charged+neutral) jets and are normalized to data in perturbative region

Defining R_L regions



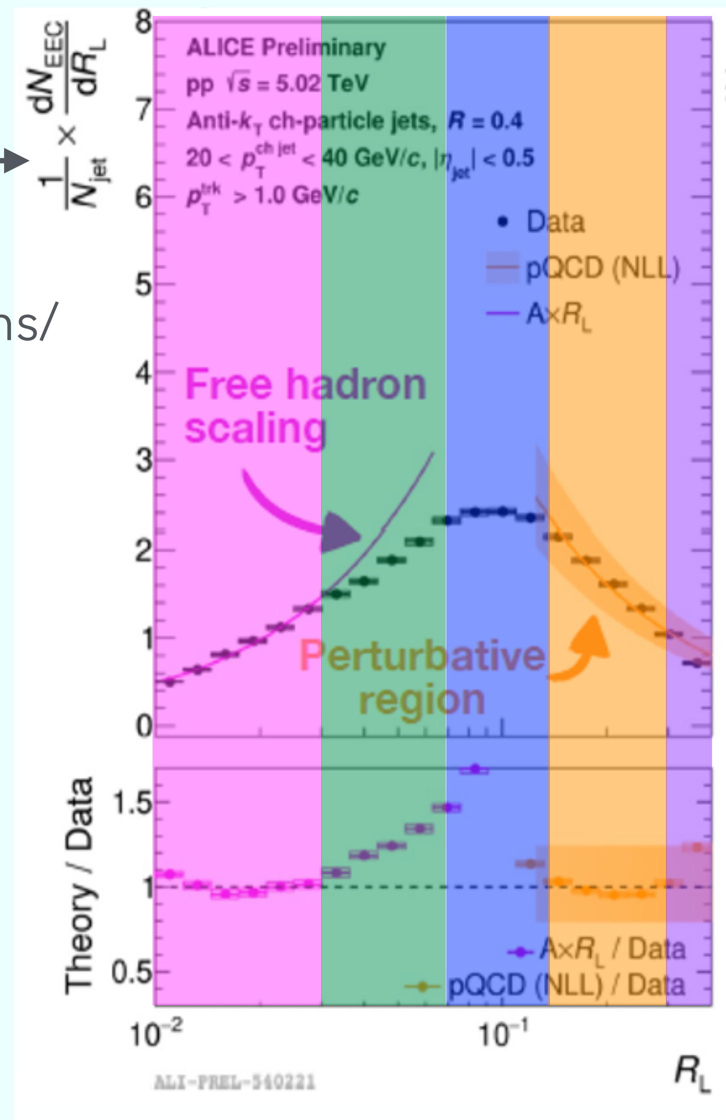
NLL calculations correspond to full (charged+neutral) jets and are normalized to data in perturbative region

Δp correlation in EECs

Unweighted, normalized by # of jets

20 < $p_{T,jet}$ < 40

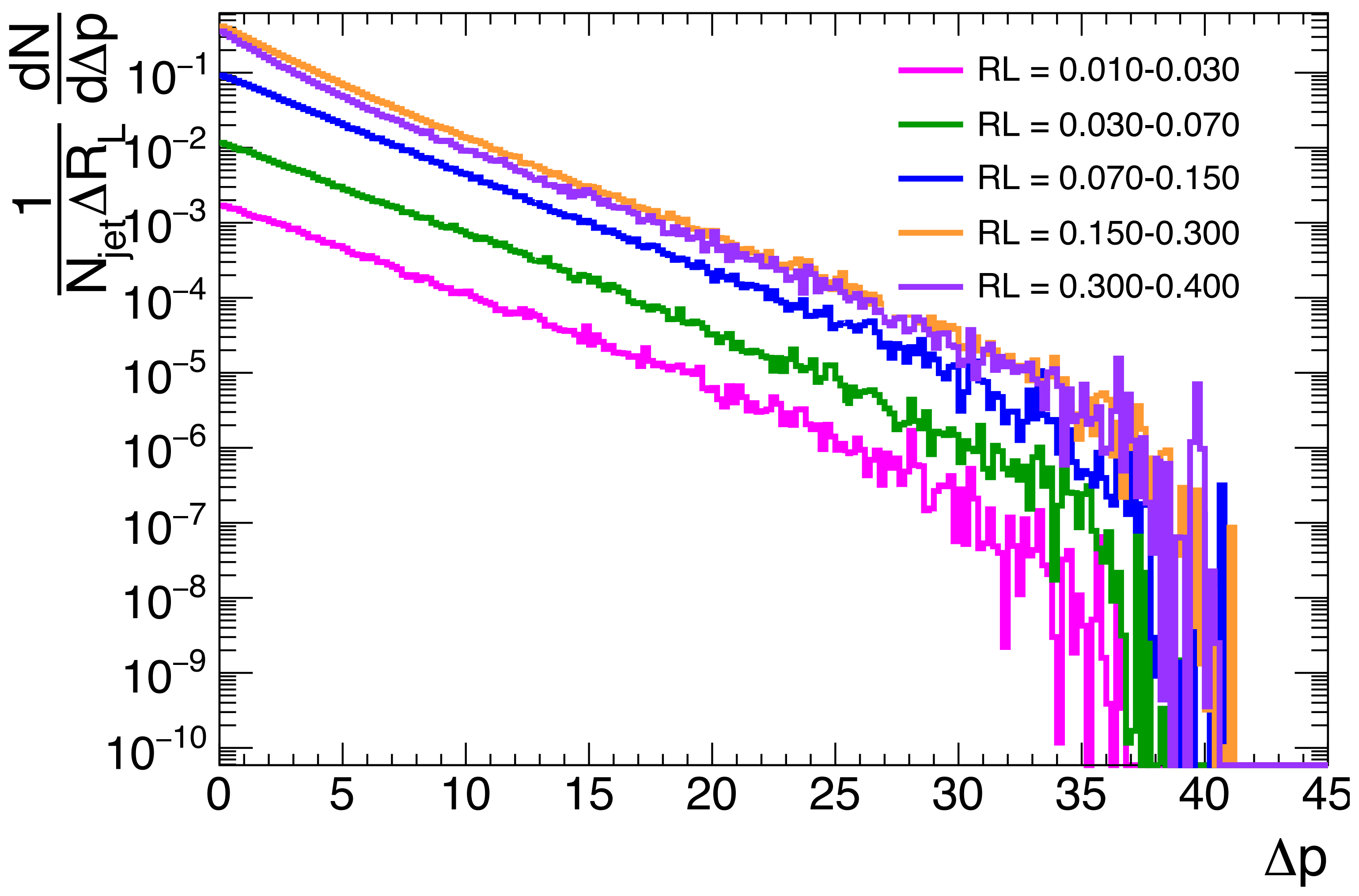
refer to slide 5 for other jet p_T regions/ full view



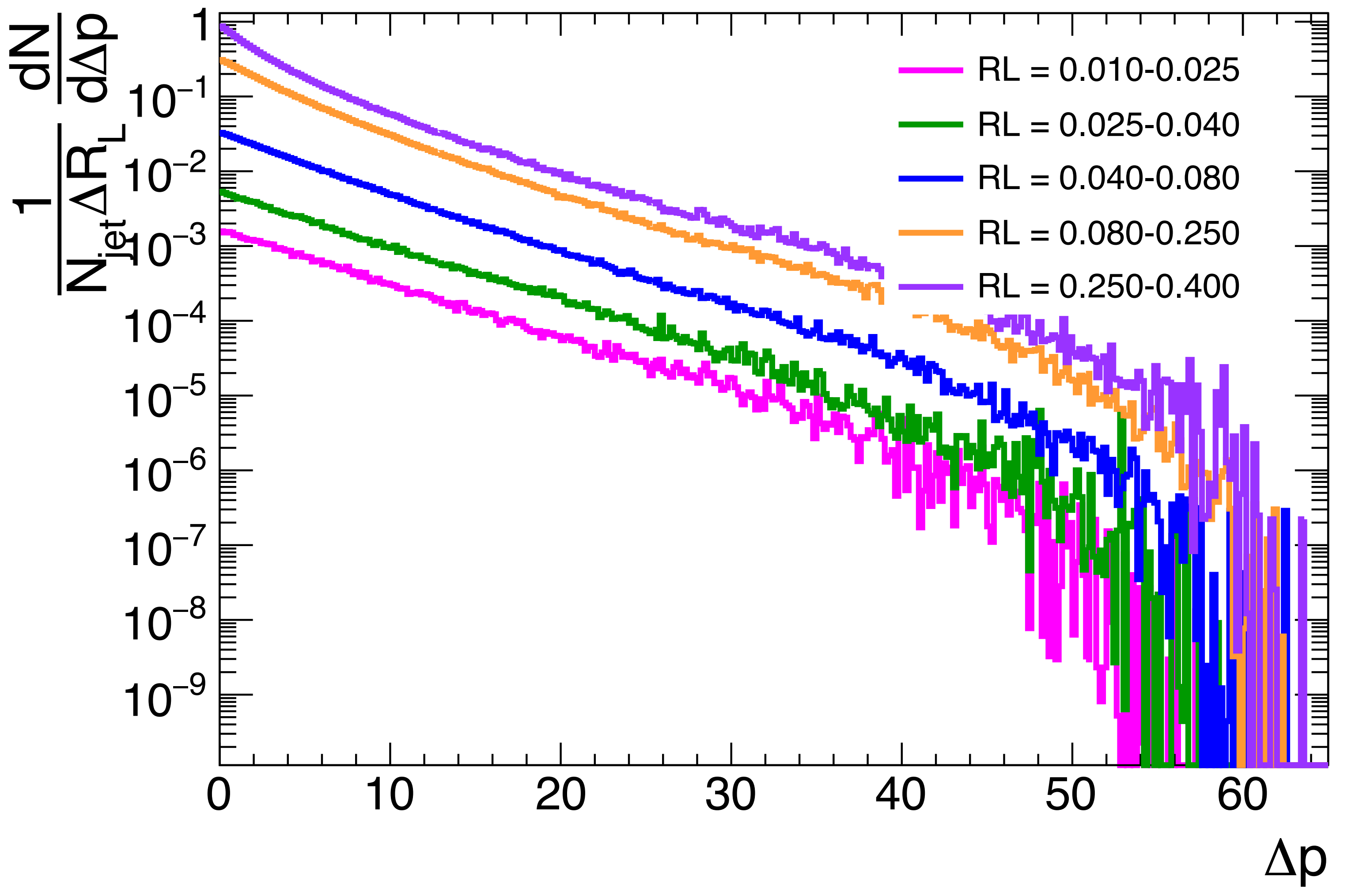
pythia

5 TeV

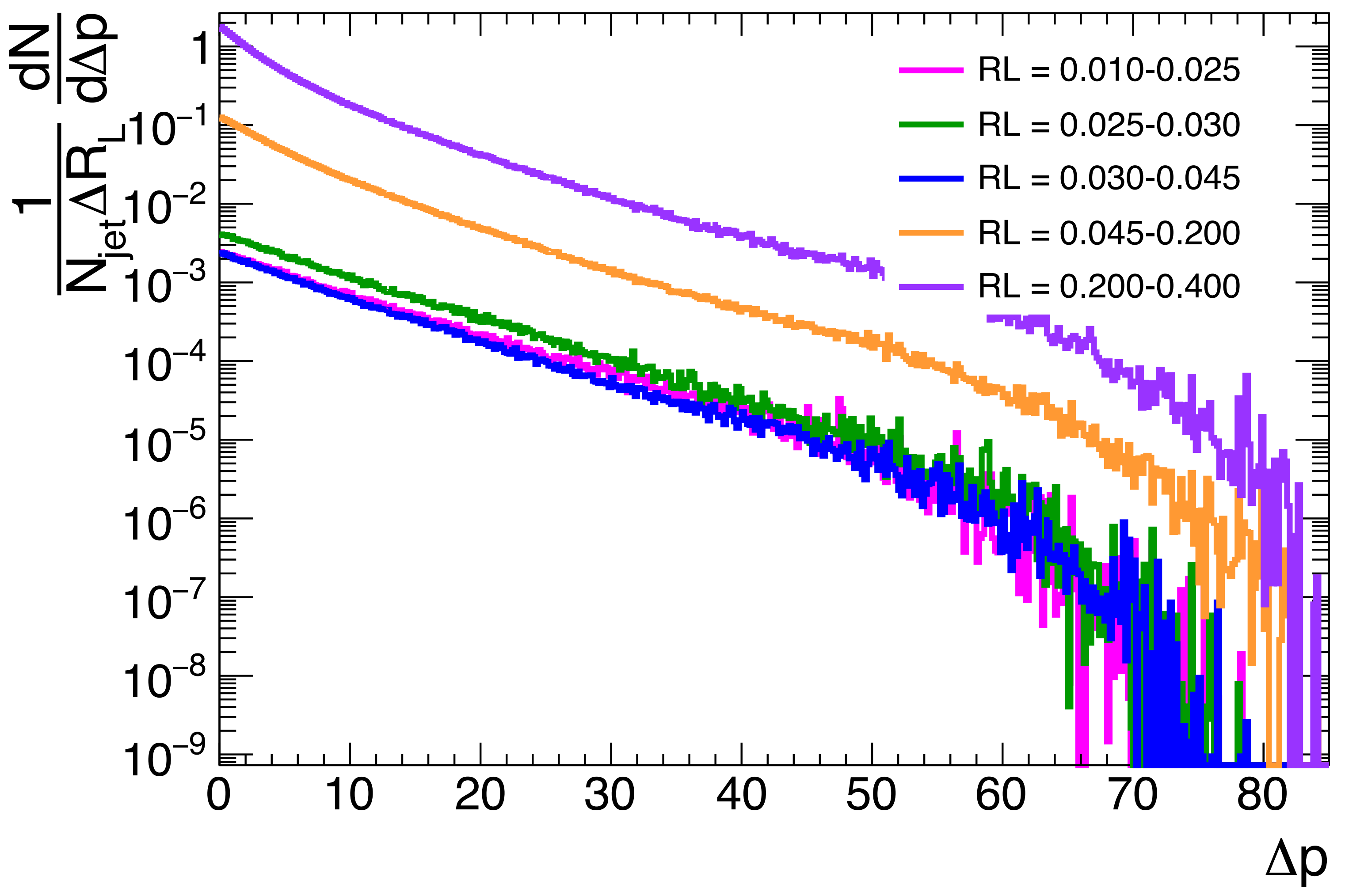
20 < jet pT < 40 GeV/c



40 < jet pT < 60 GeV/c



60 < jet pT < 80 GeV/c

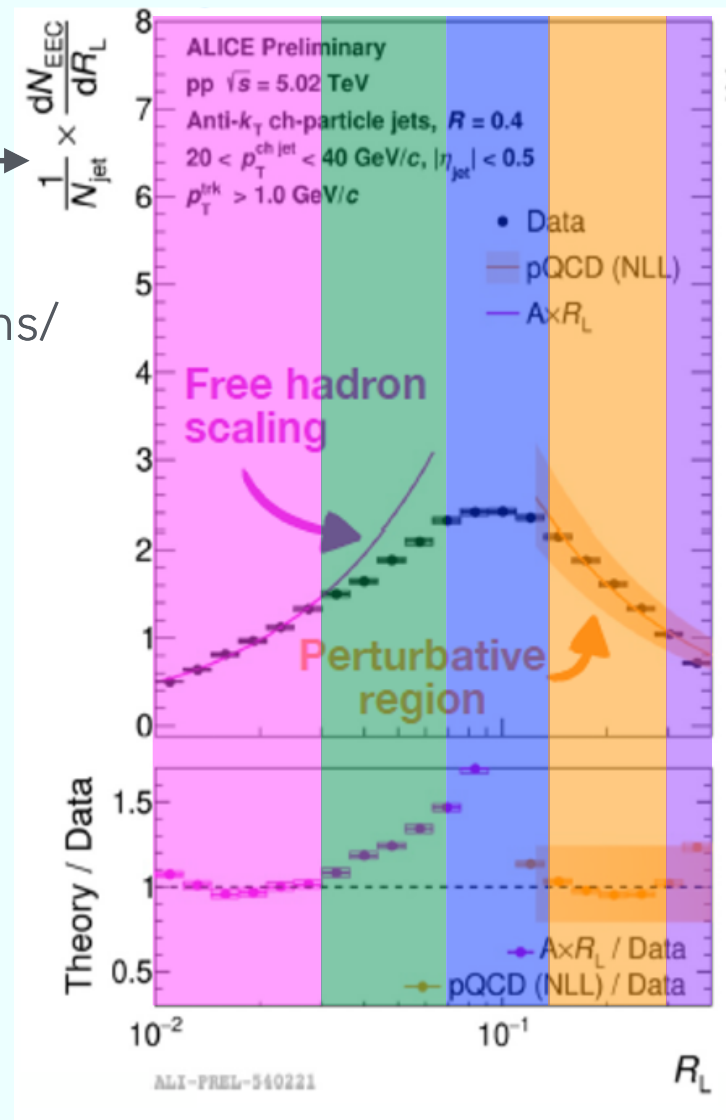


Δp_T correlation in EECs

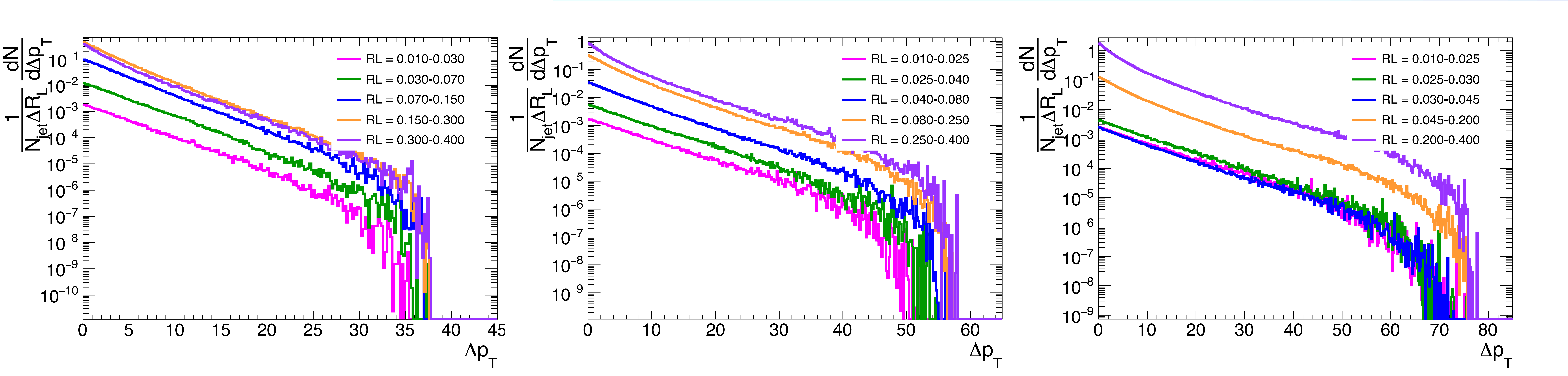
Unweighted, normalized by # of jets

$20 < p_{T,jet} < 40$

refer to slide 5 for other jet p_T regions/ full view



20 < jet pT < 40 GeV/c | 40 < jet pT < 60 GeV/c | 60 < jet pT < 80 GeV/c



pythia

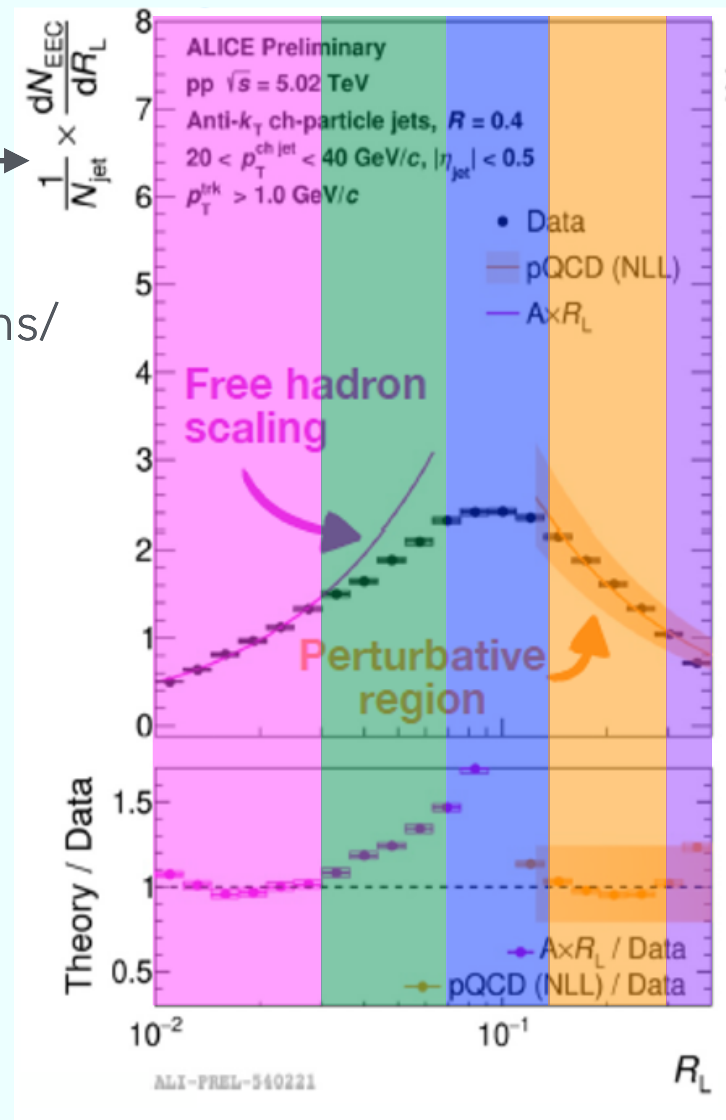
5 TeV

Δp_L correlation in EECs

Unweighted, normalized by # of jets

20 < $p_{T,jet}$ < 40

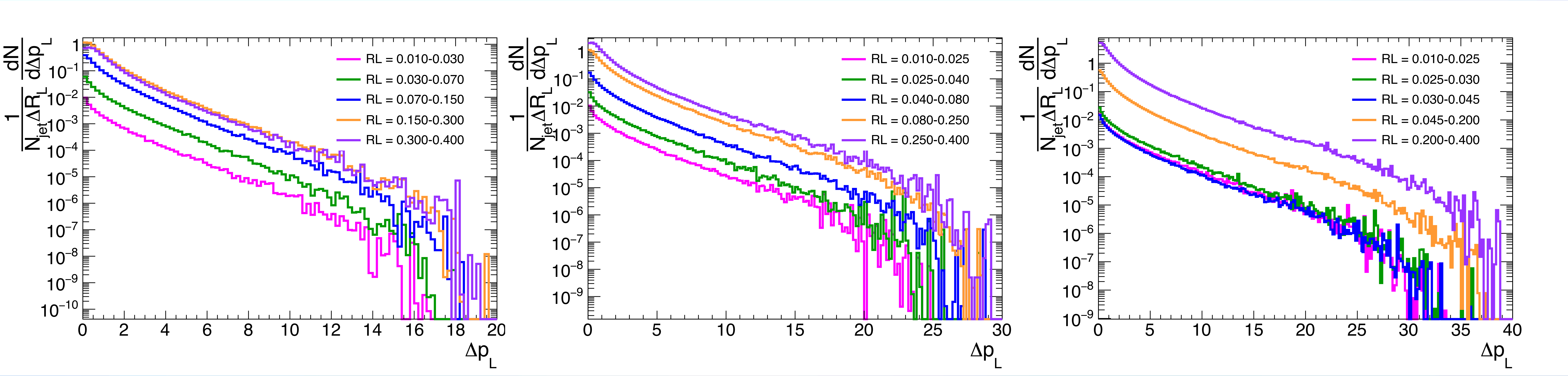
refer to slide 5 for other jet p_T regions/ full view



20 < jet pT < 40 GeV/c

40 < jet pT < 60 GeV/c

60 < jet pT < 80 GeV/c



pythia

5 TeV

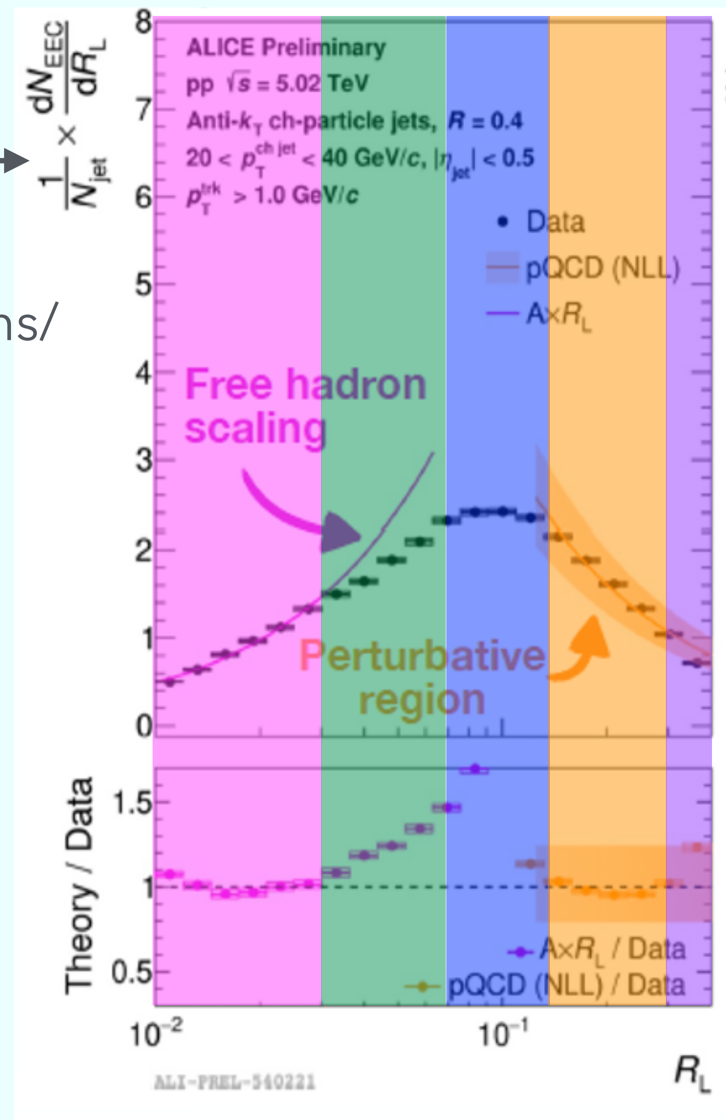
Energy weights in EECs

Unweighted, normalized by # of jets

$$\mathrm{EW} = \left(\frac{p_{T,1}p_{T,2}}{p^2_{T,jet}}\right)$$

$20 < p_{T,jet} < 40$

refer to slide 5 for other jet p_T regions/ full view



20 < jet pT < 40 GeV/c

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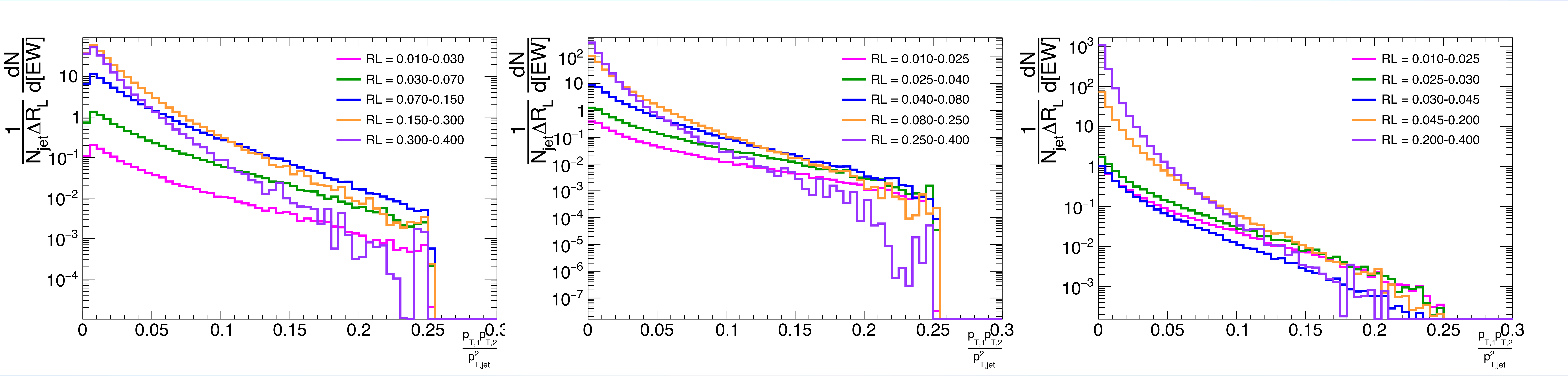


pythia

5 TeV

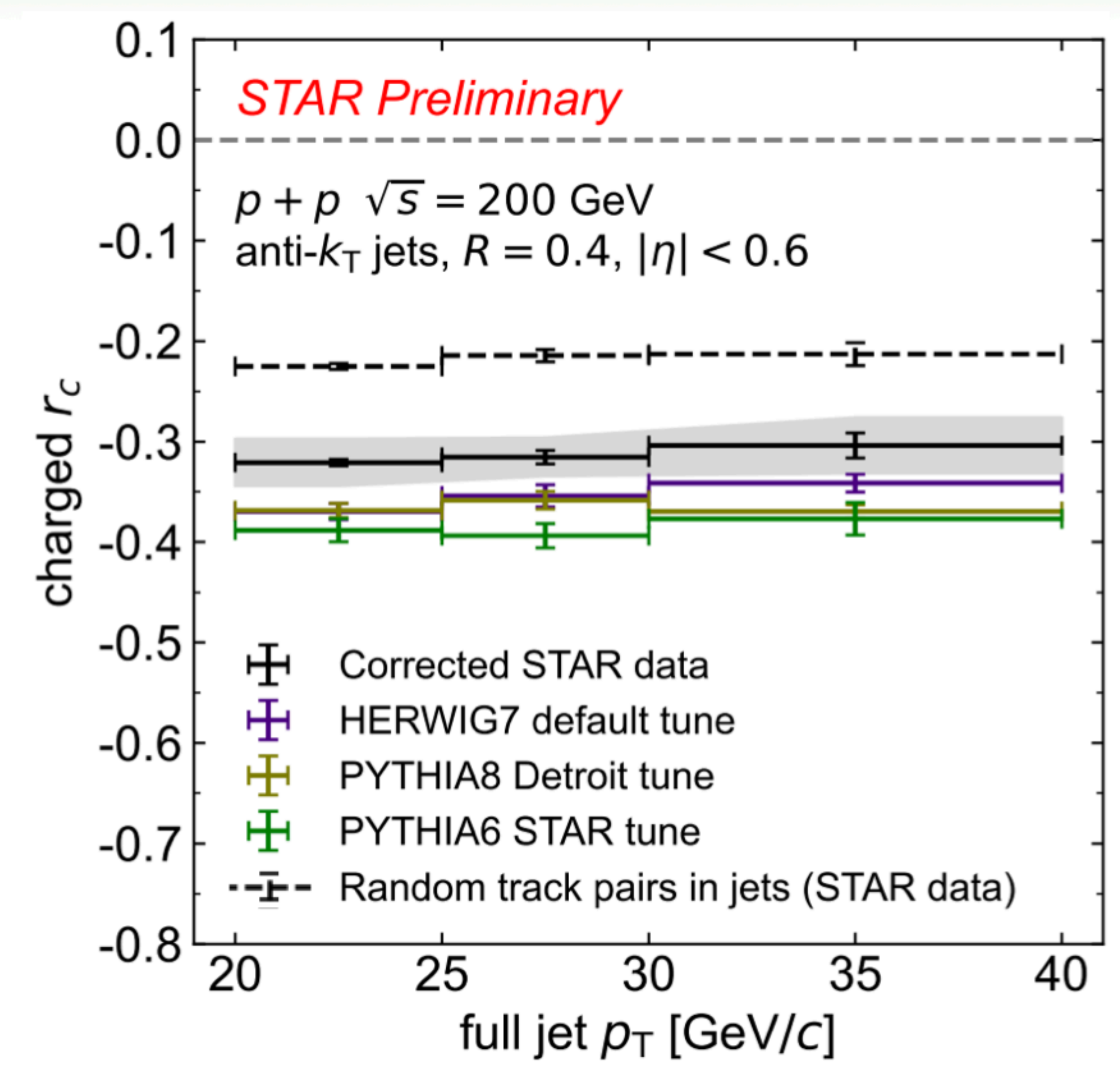
Energy weights vs Δp_T

pythia

20 < jet pT < 40 GeV/c

https://indico.cern.ch/event/1339555/contributions/6041014/attachments/2934142/5153305/hp_092524_v5.pdf

Introduction to r_c



Definition: $r_c = \dfrac{N_{h_1 h_2} - N_{h_1 \bar{h}_2}}{N_{h_1 h_2} + N_{h_1 \bar{h}_2}}$

Procedure:

- Count the number of like-sign pairs and the number of unlike-sign pairs in each R_L bin.
- Calculate r_c for each R_L & p_T bin.

If r_c is negative, that means there are more opposite sign pairs than same sign pairs.

Potential hadronization insights - i.e. hadronization via string breaking conserves charge locally.

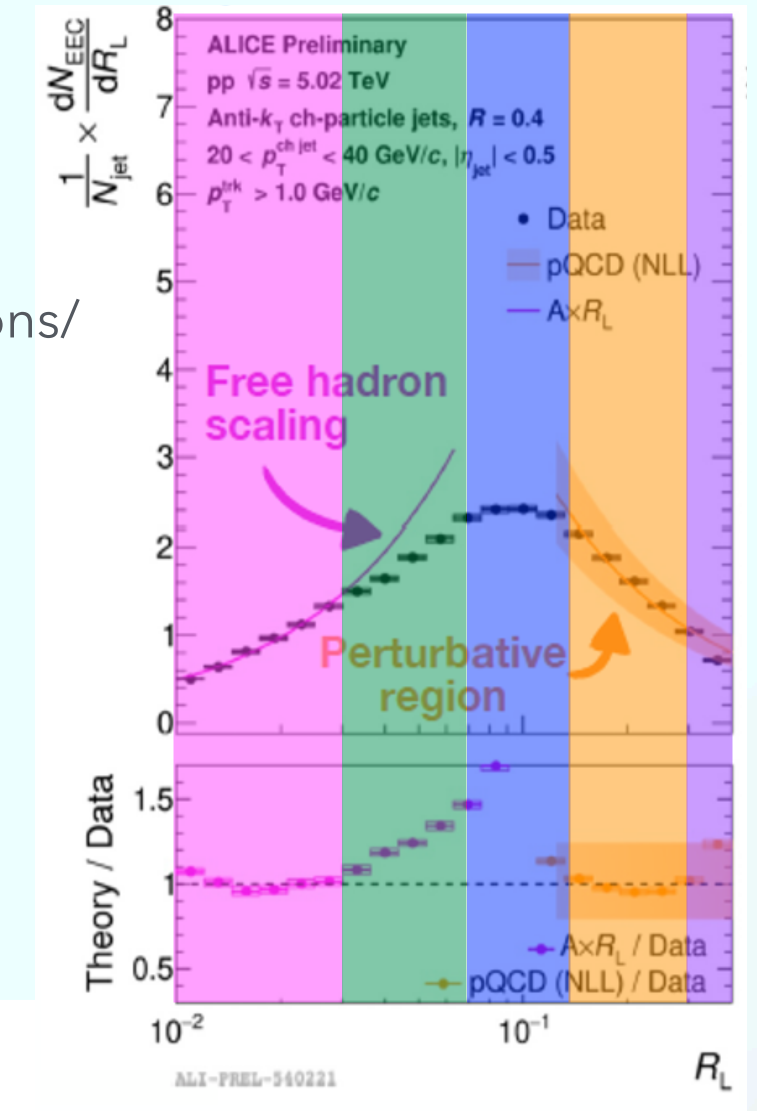
r_c in EECs

pythia

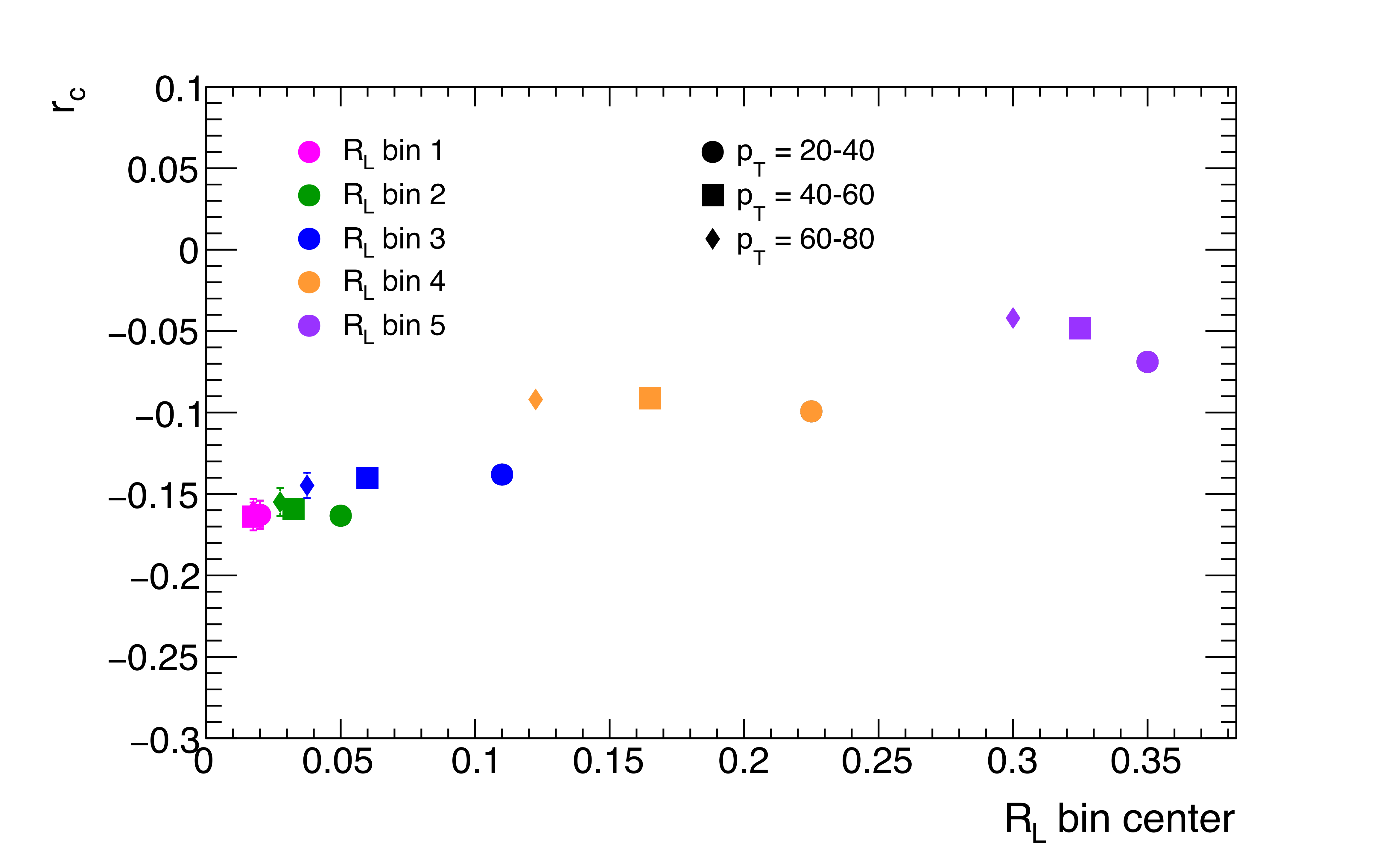
5 TeV

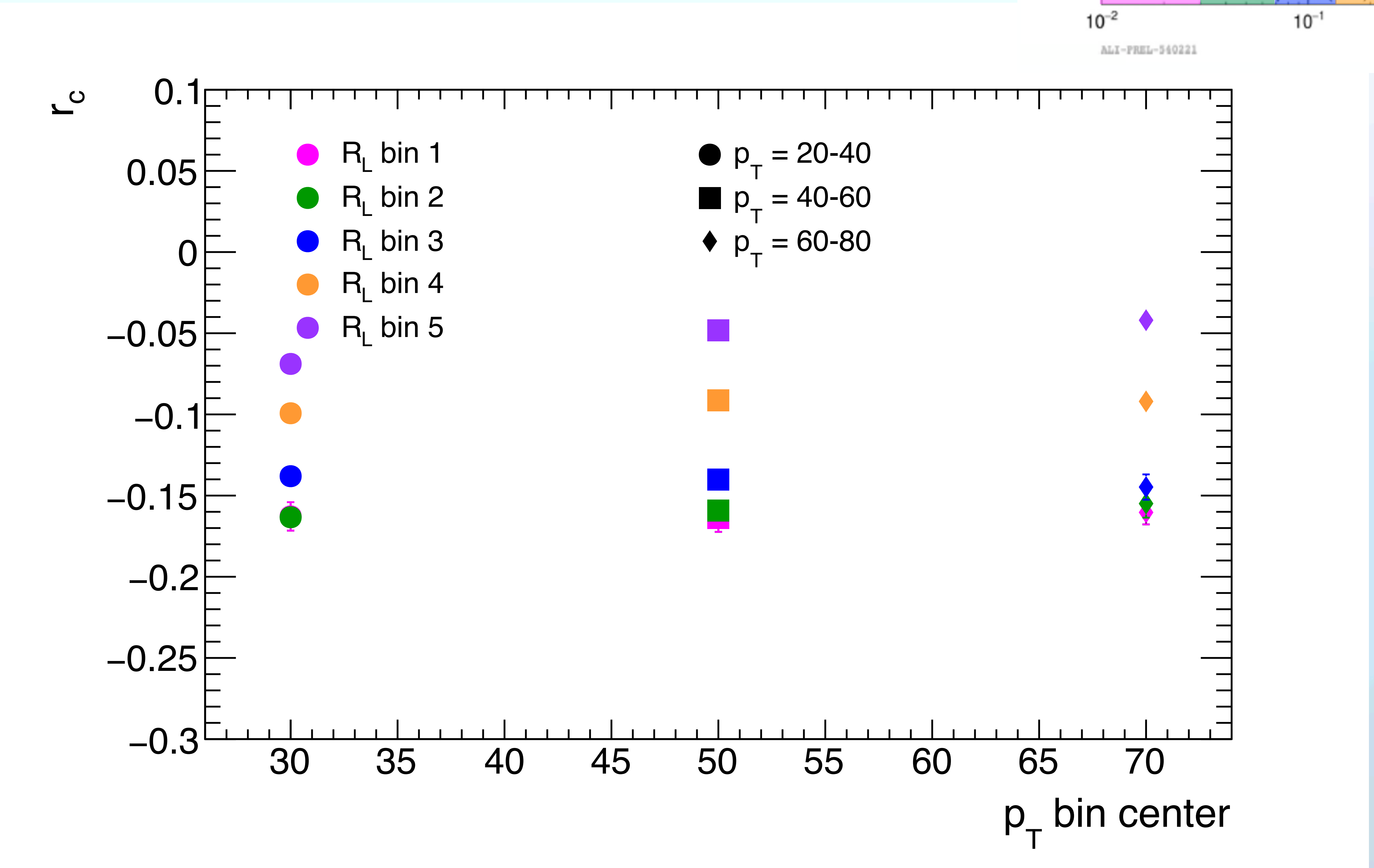
$20 < p_{T,jet} < 40$

refer to slide 5 for other jet p_T regions/ full view



Definition: $$r_c = \frac{N_{h_1 h_2} - N_{h_1 \bar{h}_2}}{N_{h_1 h_2} + N_{h_1 \bar{h}_2}}$$





as a function of R_L

as a function of jet p_T

Ongoing work and next steps

- Currently, an analysis of the ALICE data is being done.
- We expect to show some preliminary results at APS in Anaheim.
- We welcome any thoughts/questions!

Backup

Energy weights vs Δp_T

pythia

40 < jet pT < 60 GeV/c

Energy weights vs Δp_T

pythia

60 < jet pT < 80 GeV/c