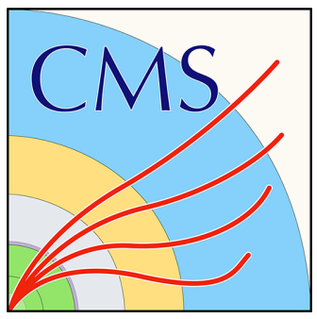
Fragmentation of J/ψ in jets in pp collisions at $\sqrt{s}$ = 5.02 TeV in CMS

Batoul Diab on behalf of CMS

Rencontres QGP France

04/07/2018



Motivation

J/ψ are used as a probe for QCD phenomena like the QGP in PbPb collisions

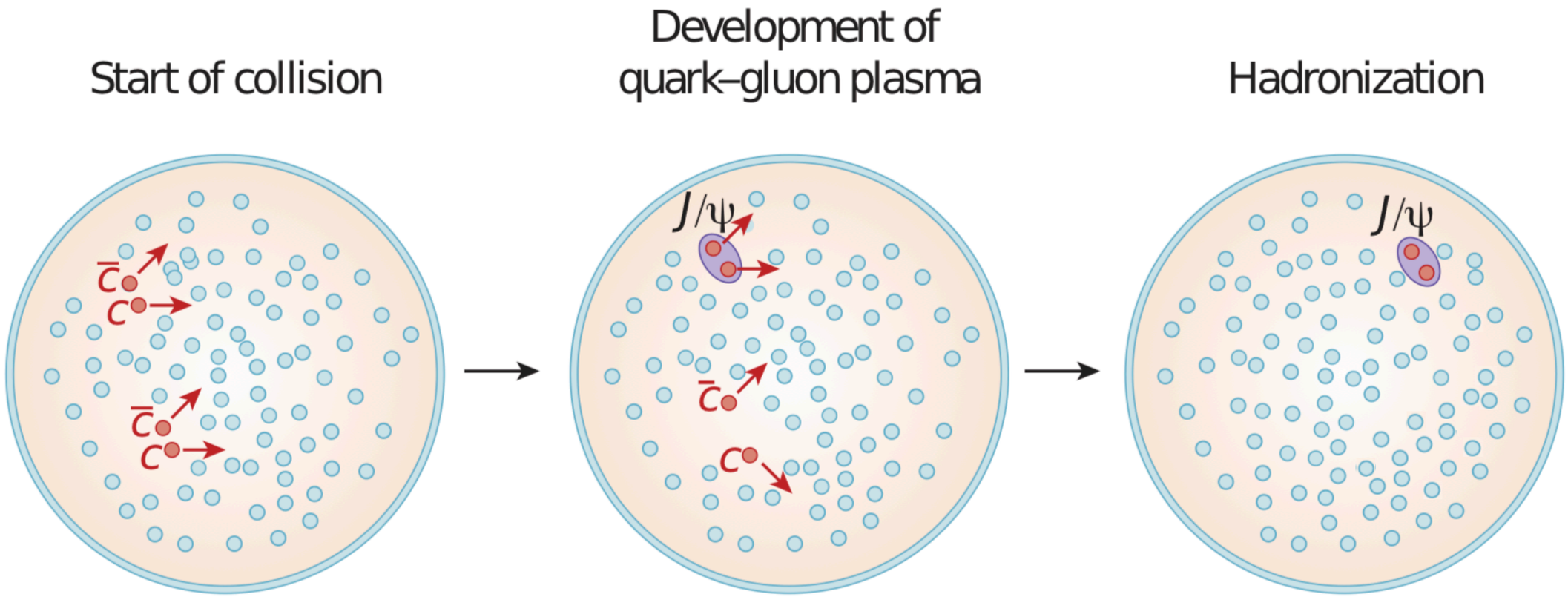
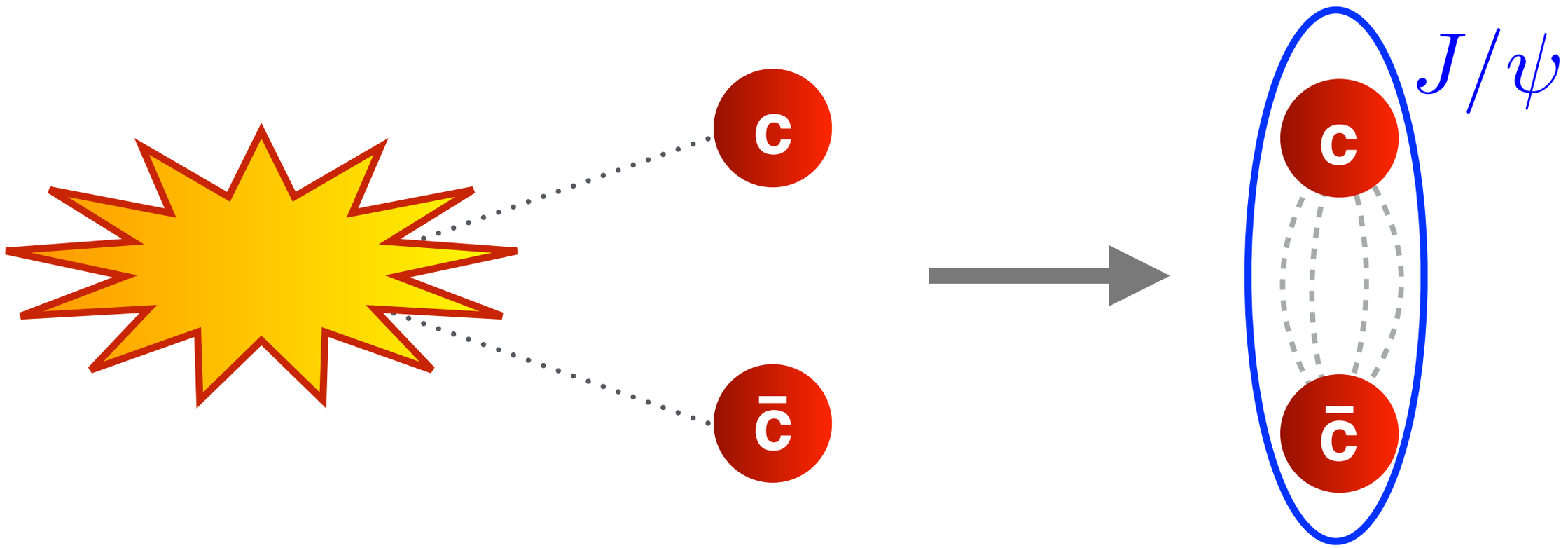


Fig. adapted from P. Braun-Munzinger, J. Stachel Nature 448 06080 (2007)

$$\tau^{c\bar{c}}_{formation} < \tau^{QGP}_{formation} < \tau^{QGP}_{evolution} < \tau^{J/\psi}_{decay}$$

Motivation

First we need to understand J/ψ production



$$d\sigma(pp \to J/\psi X) \;=\; \sum_n d\sigma[pp \to c\bar{c}(n)X] \qquad \langle O^{J/\psi}(n)\rangle$$

$c\bar{c}$ production cross section

Non-perturbative matrix elements

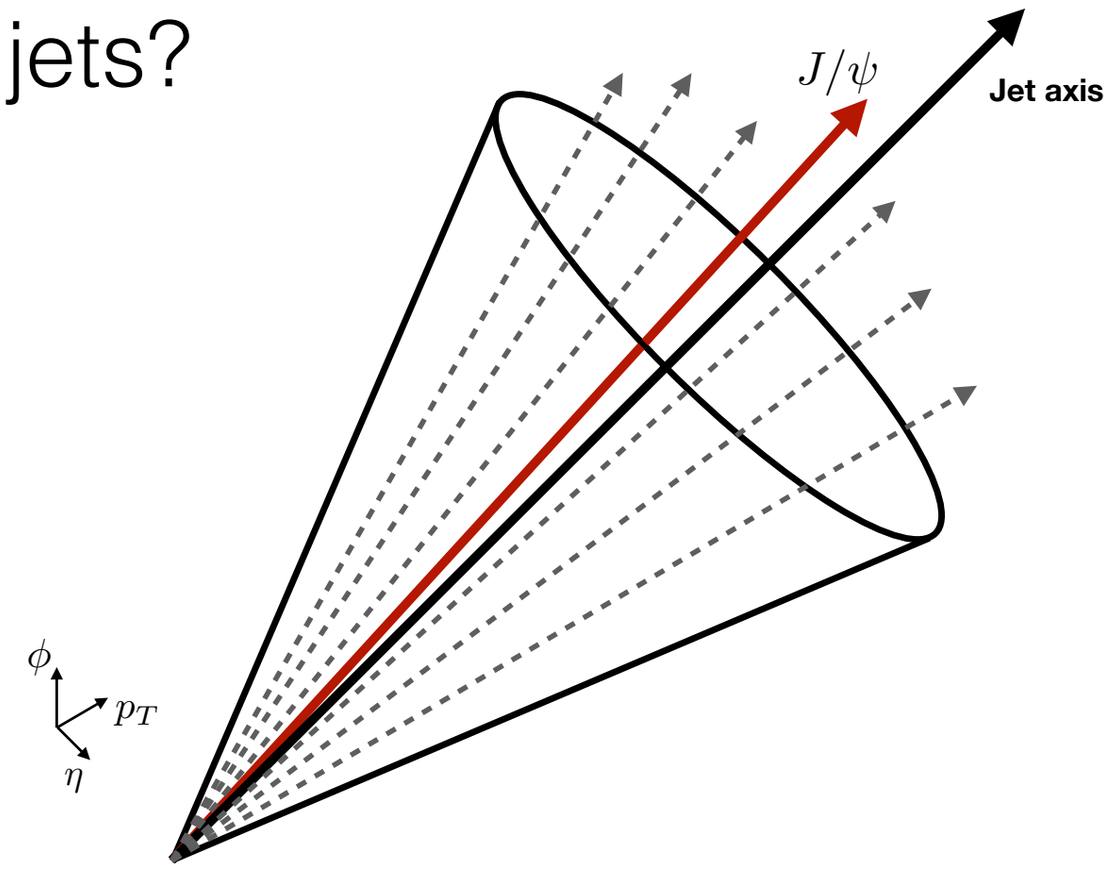
$$n \equiv {}^{2S+1}L_J^{[i]}$$

Motivation

Are J/ψ isolated? → J/ψ in jets

- fragmentation pattern?
- fraction of J/ψ produced in jets?

$$z = \frac{p_{T,J/\psi}}{p_{T,jet}}$$



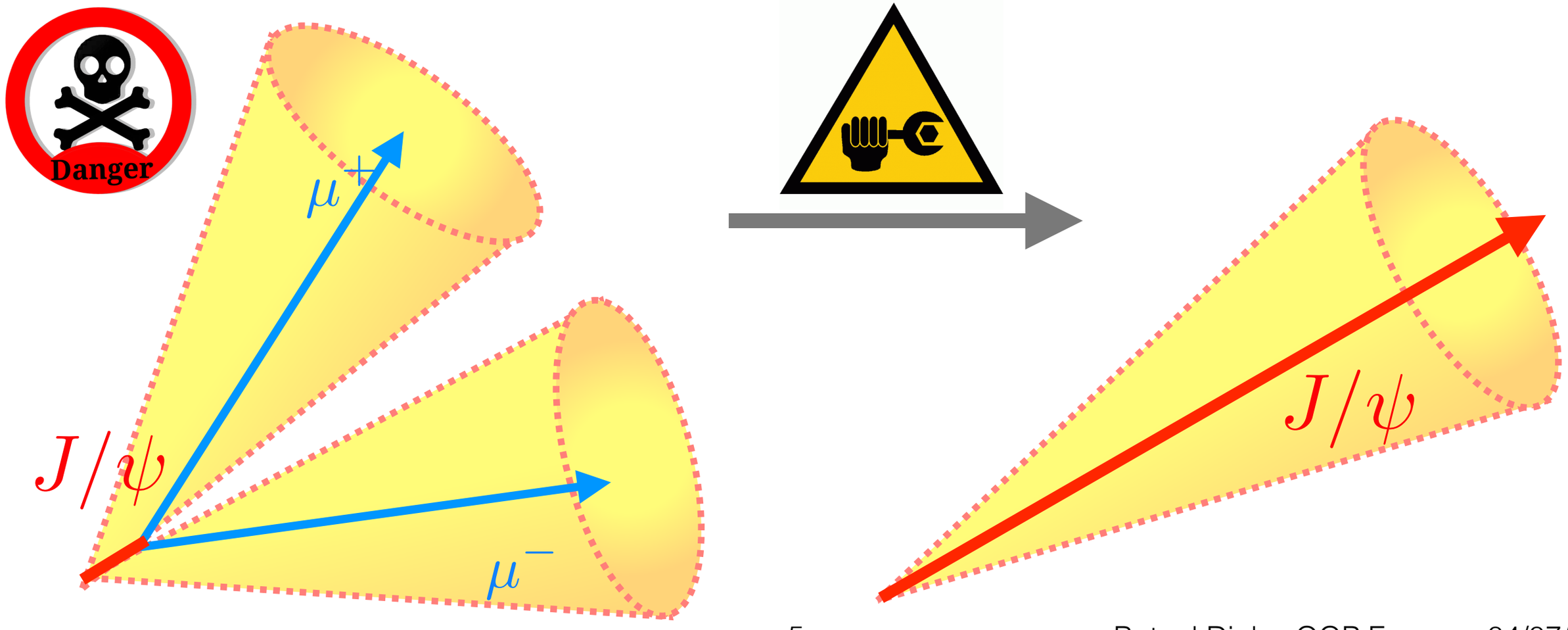
Start in **pp collisions**: No nuclear matter effects

*measured also by LHCb (PRL 118, 192001)

J/ψ-jet correlation

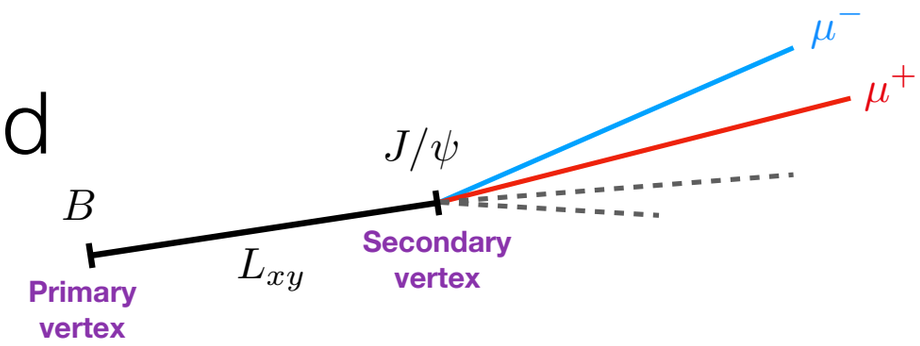
Jets are clustered using the anti-k_t algorithm with R =0.4

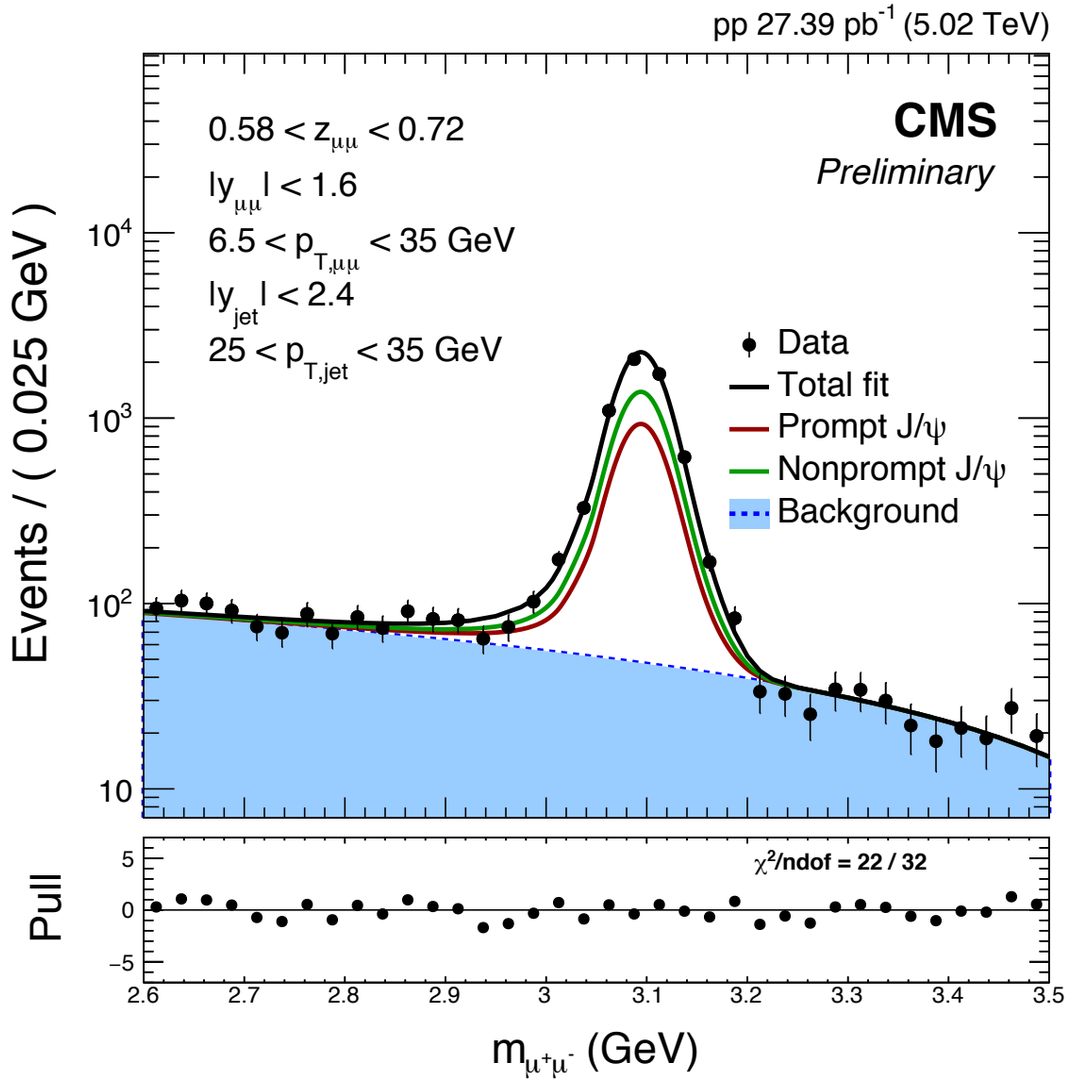
Muons from the same J/ψ might end up in different jets:
We reclustered jets with the J/ψ meson instead of the pair of muons.

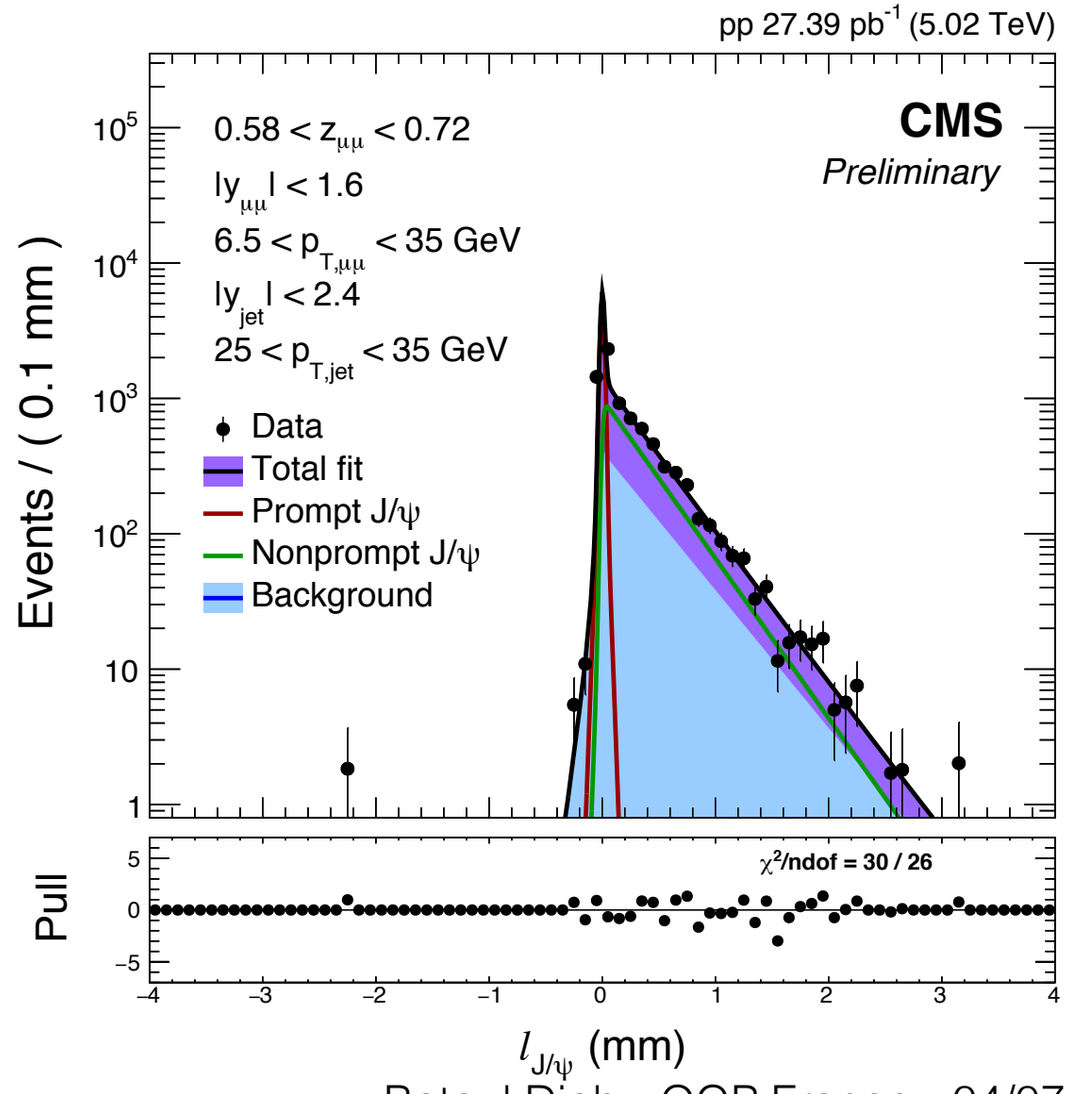


Prompt vs nonprompt J/ψ

- Different production mechanisms: we need to separate prompt and nonprompt
- Done with 2D fits of invariant mass and decay length



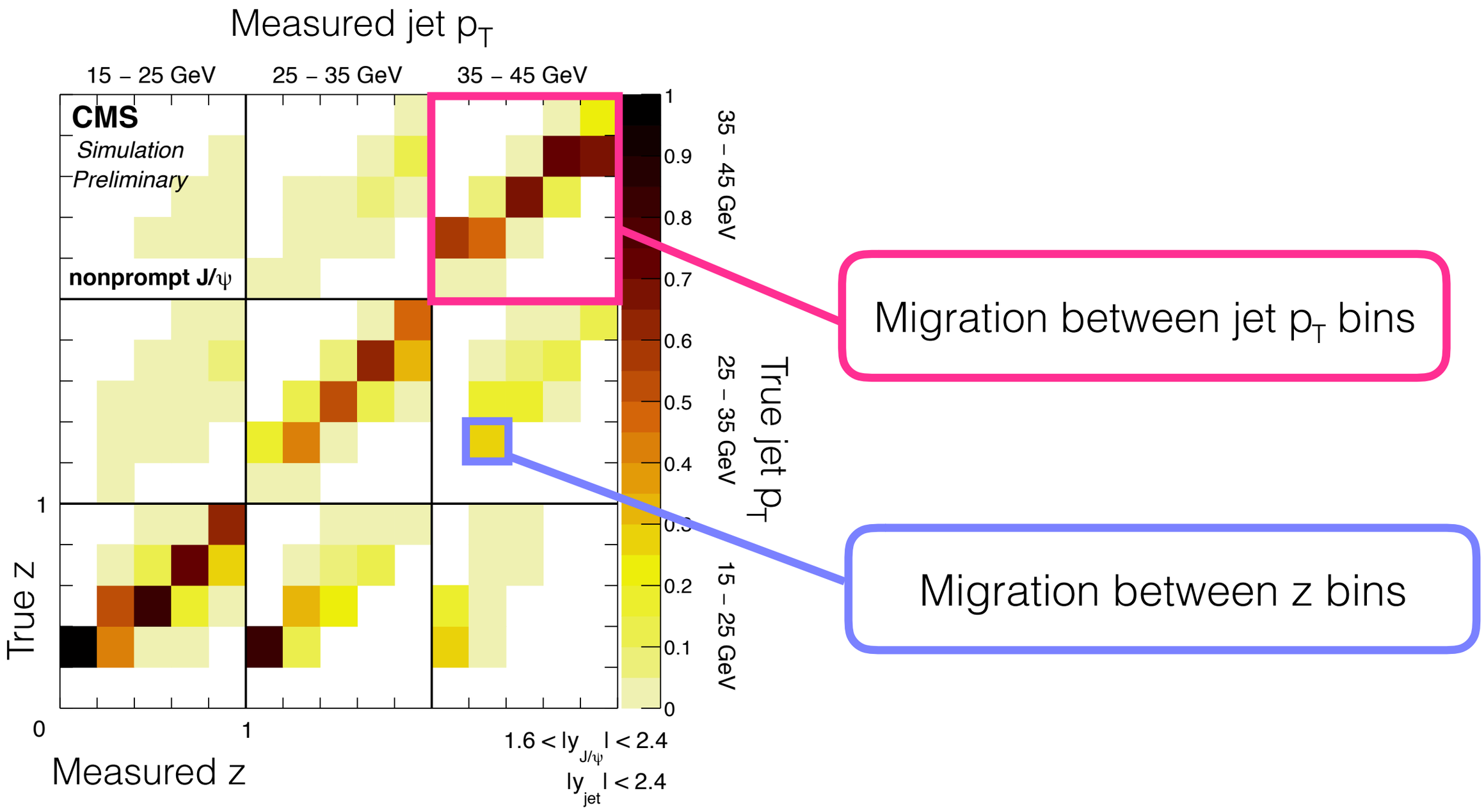




Correction for detector effects

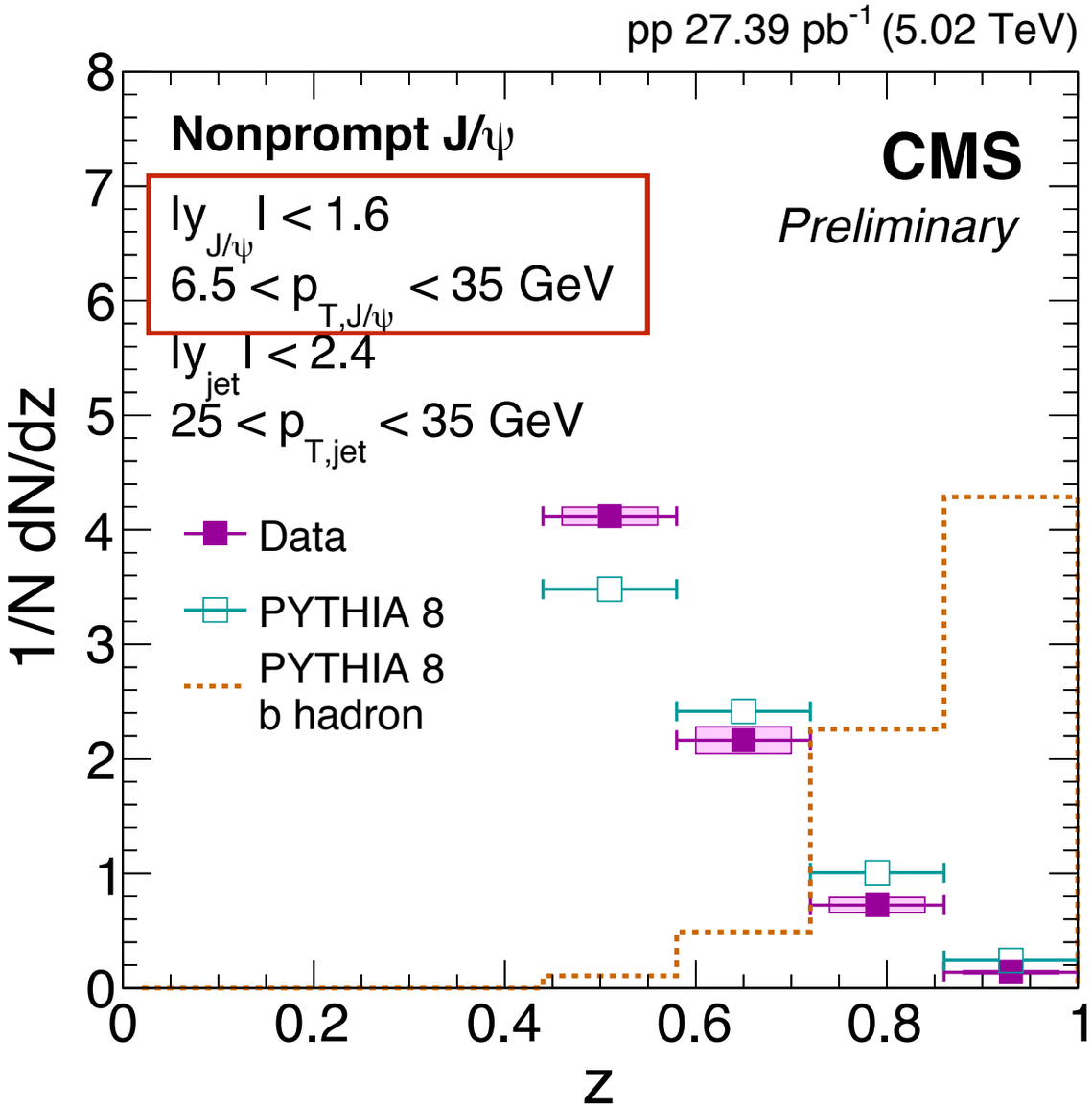
2D unfolding: z and jet p_T

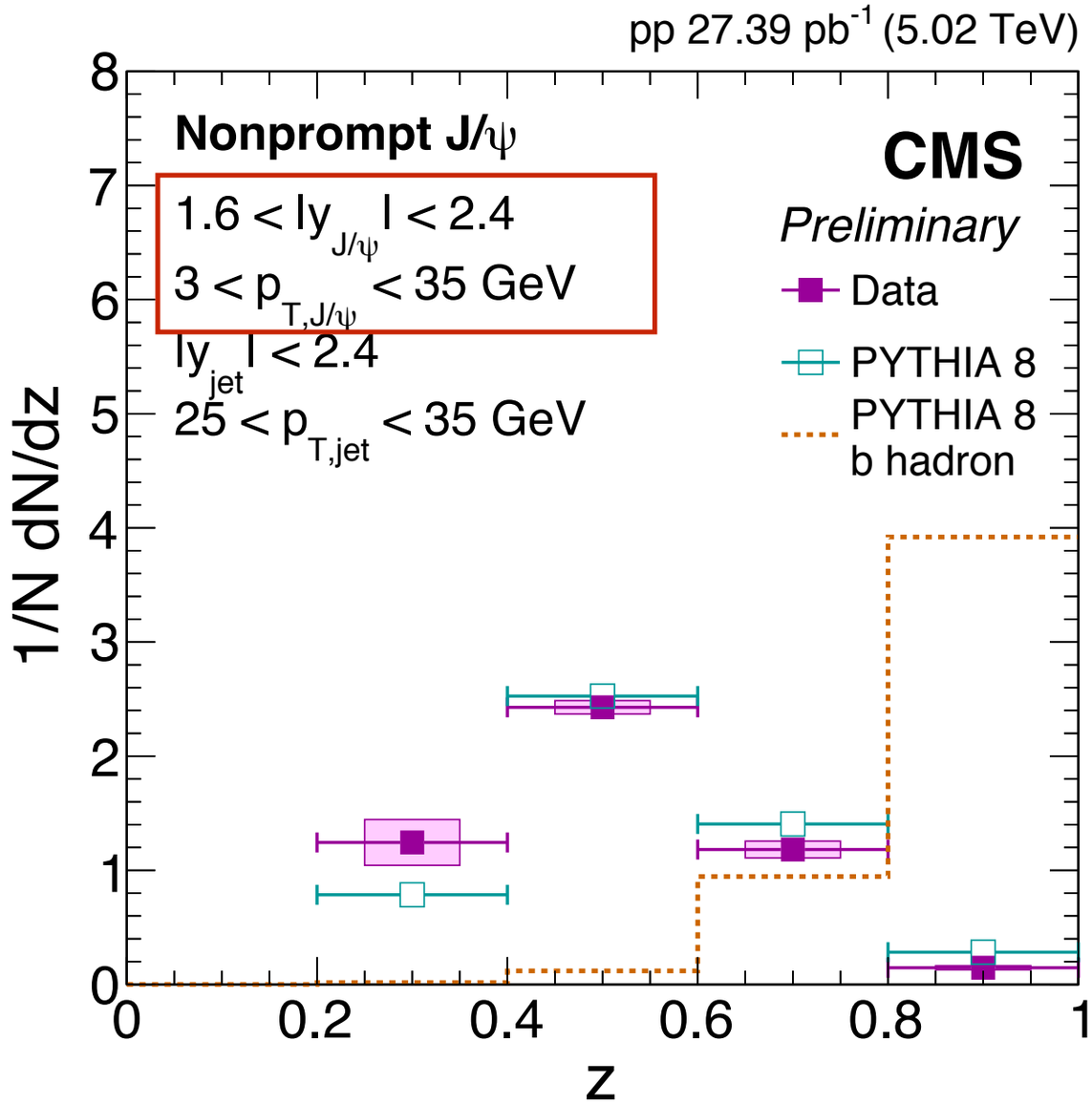
Using D'Agostini's iterative method



Final results at "particle level"

Nonprompt J/ψ results

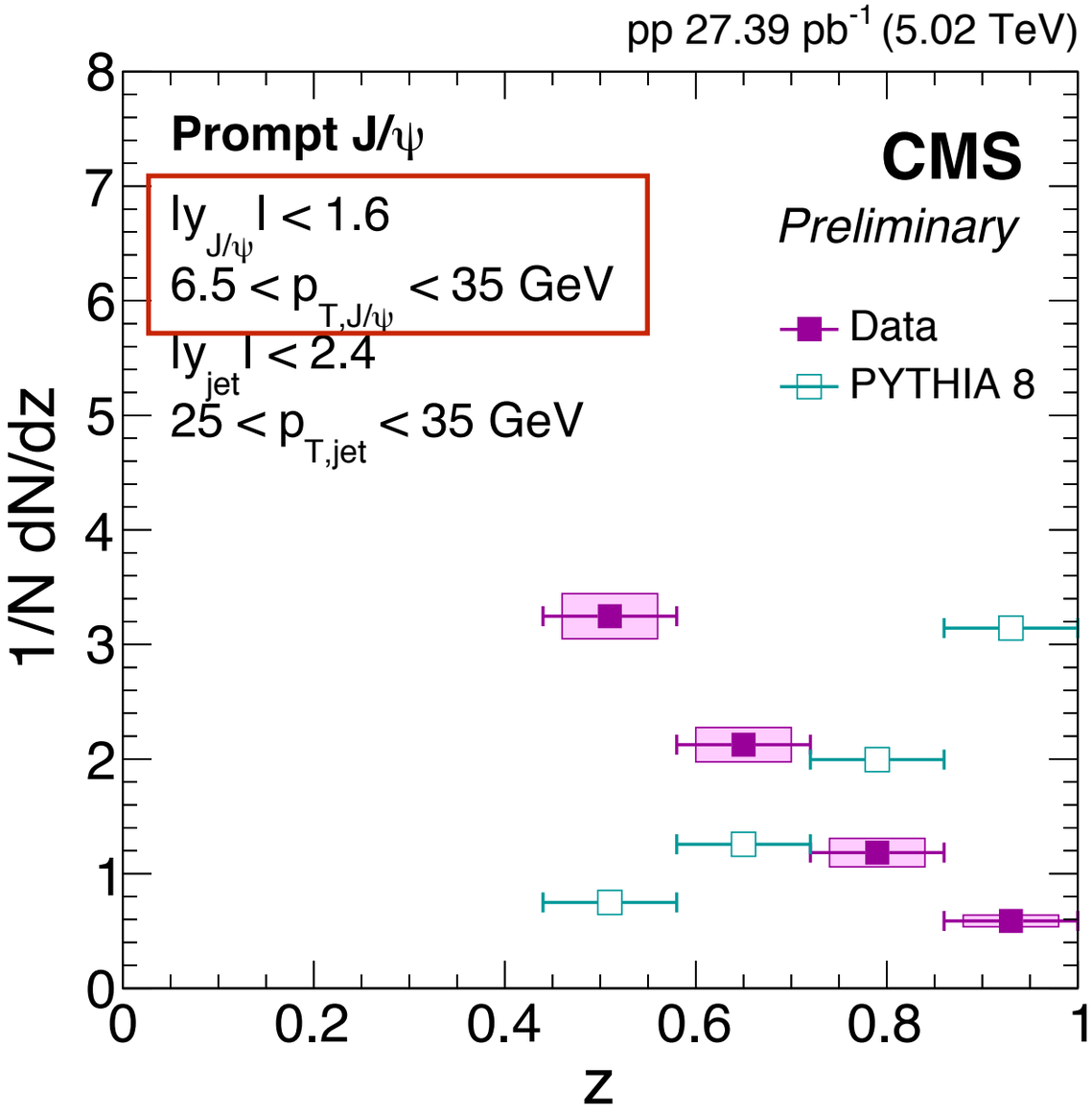


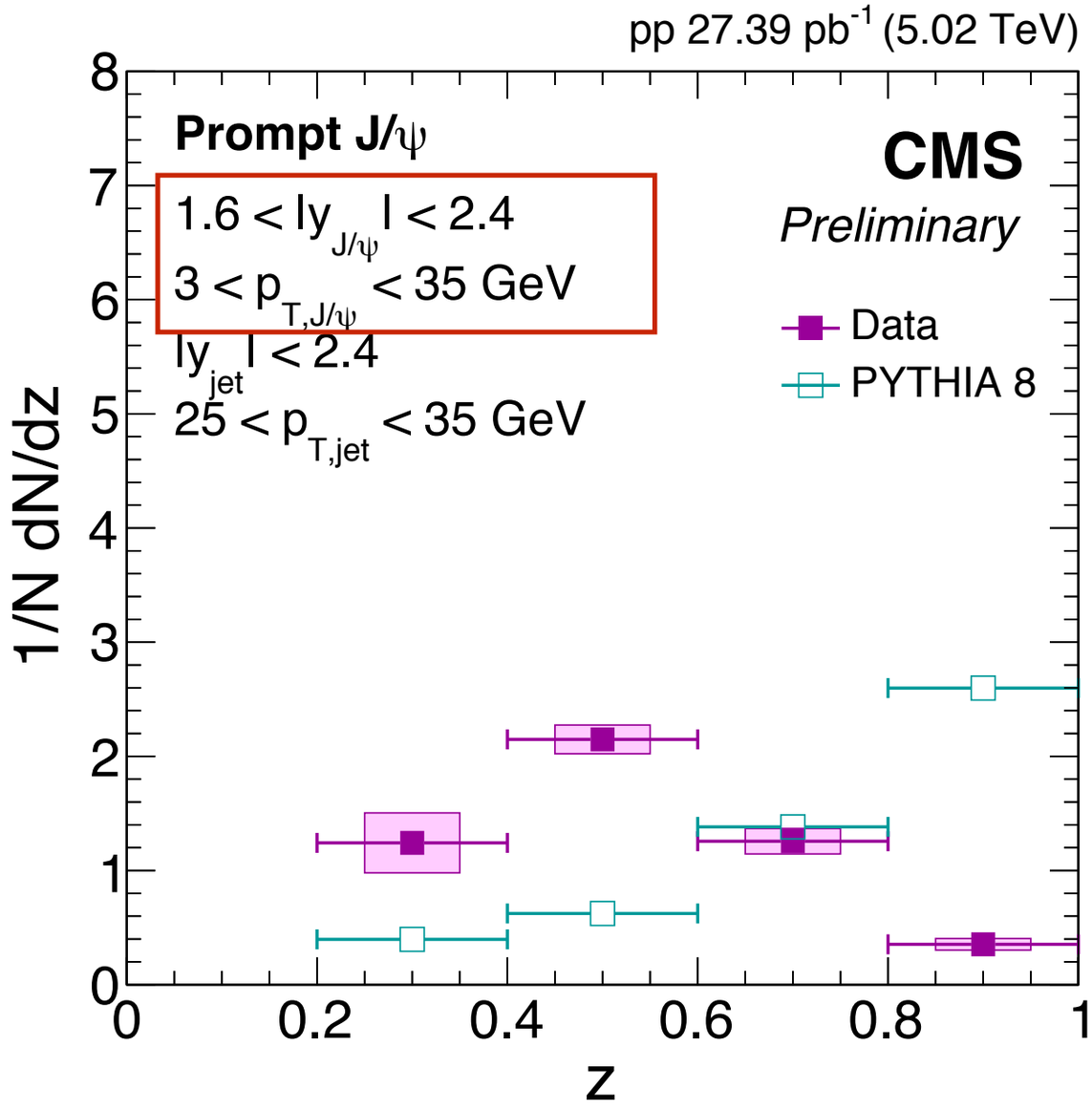


Similar behaviour in data and Pythia

Expected due to the decay kinematics

Prompt J/ψ results

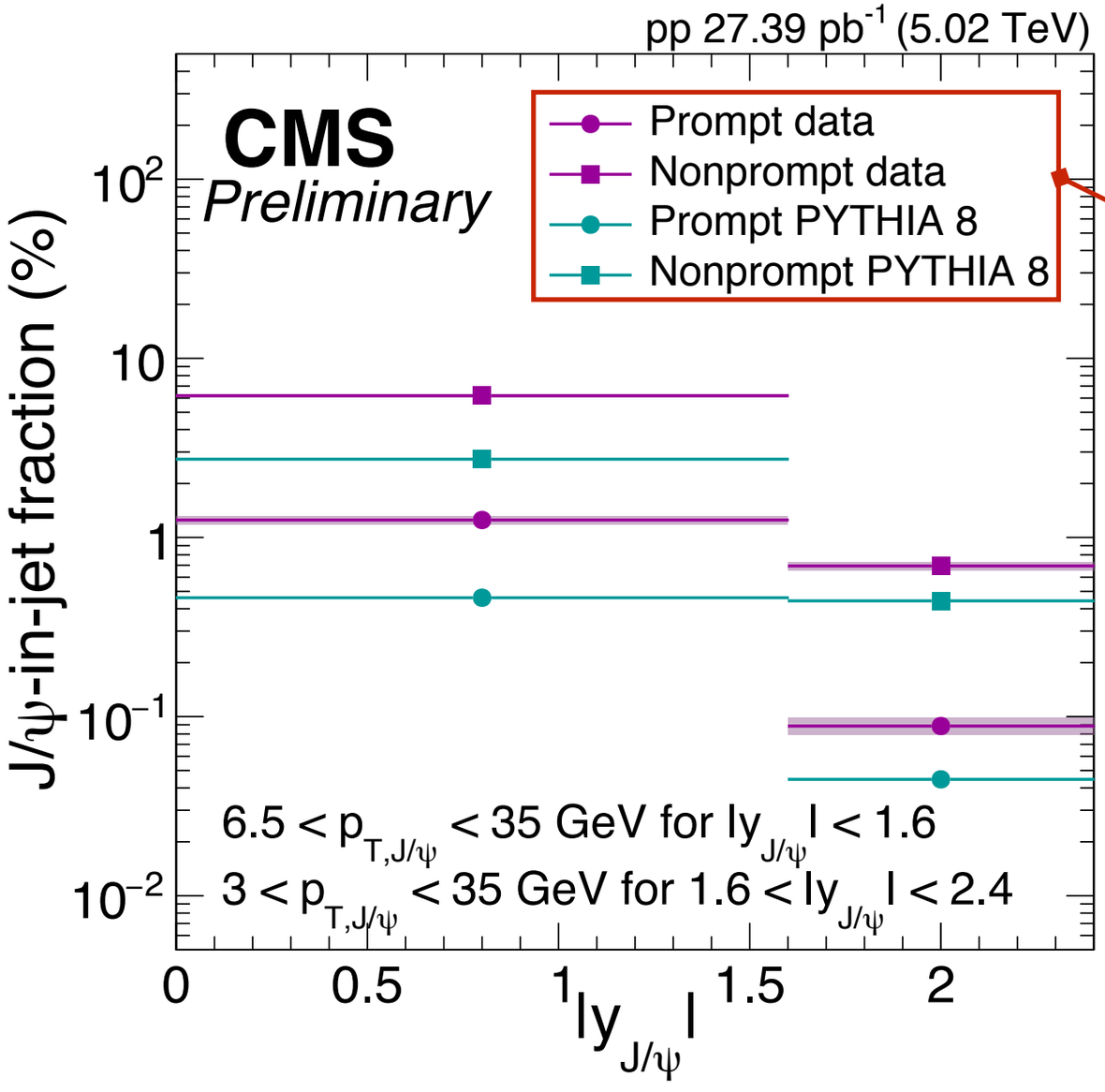


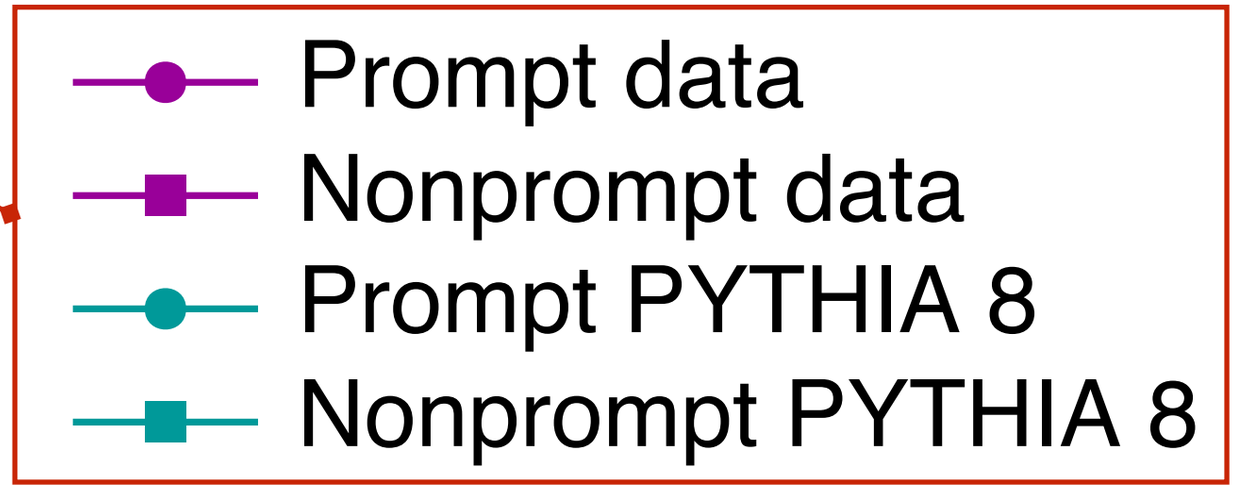


Different behaviour in data and Pythia

J/ψ are less isolated in data

J/ψ-in-jets fraction

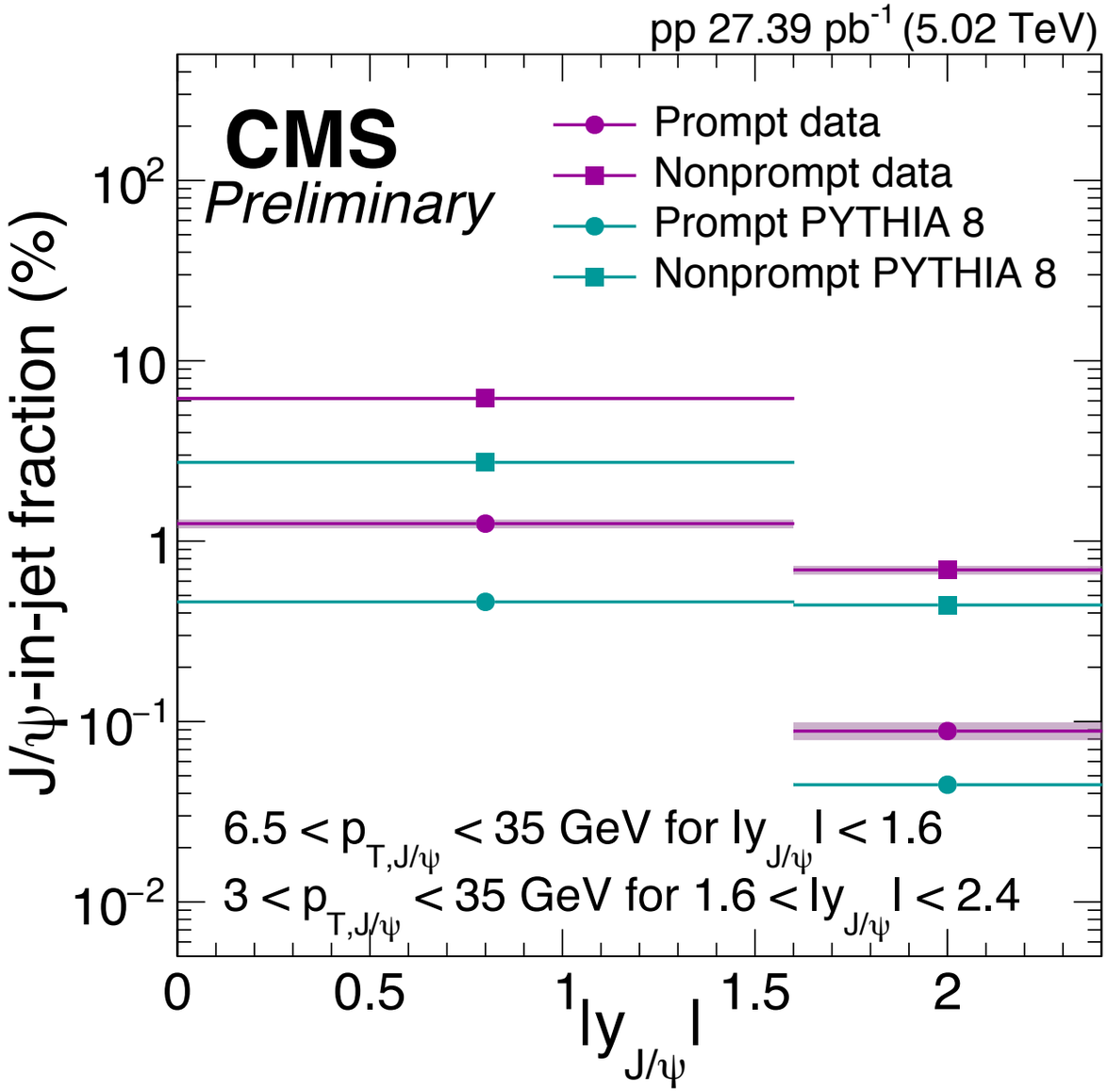


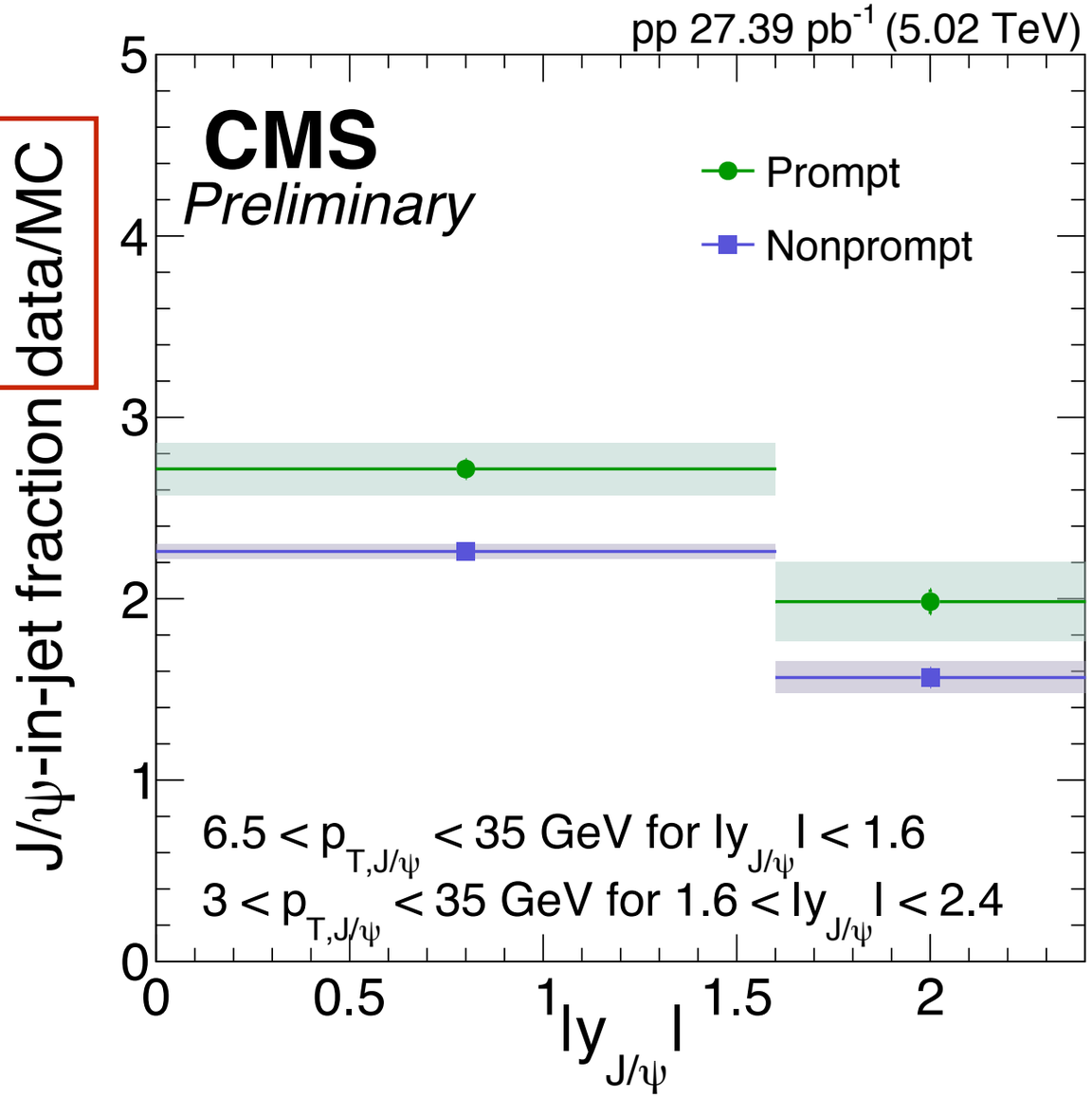


Less than 7% of J/ψ produced in jets

Under-predicted in Pythia

J/ψ-in-jets fraction



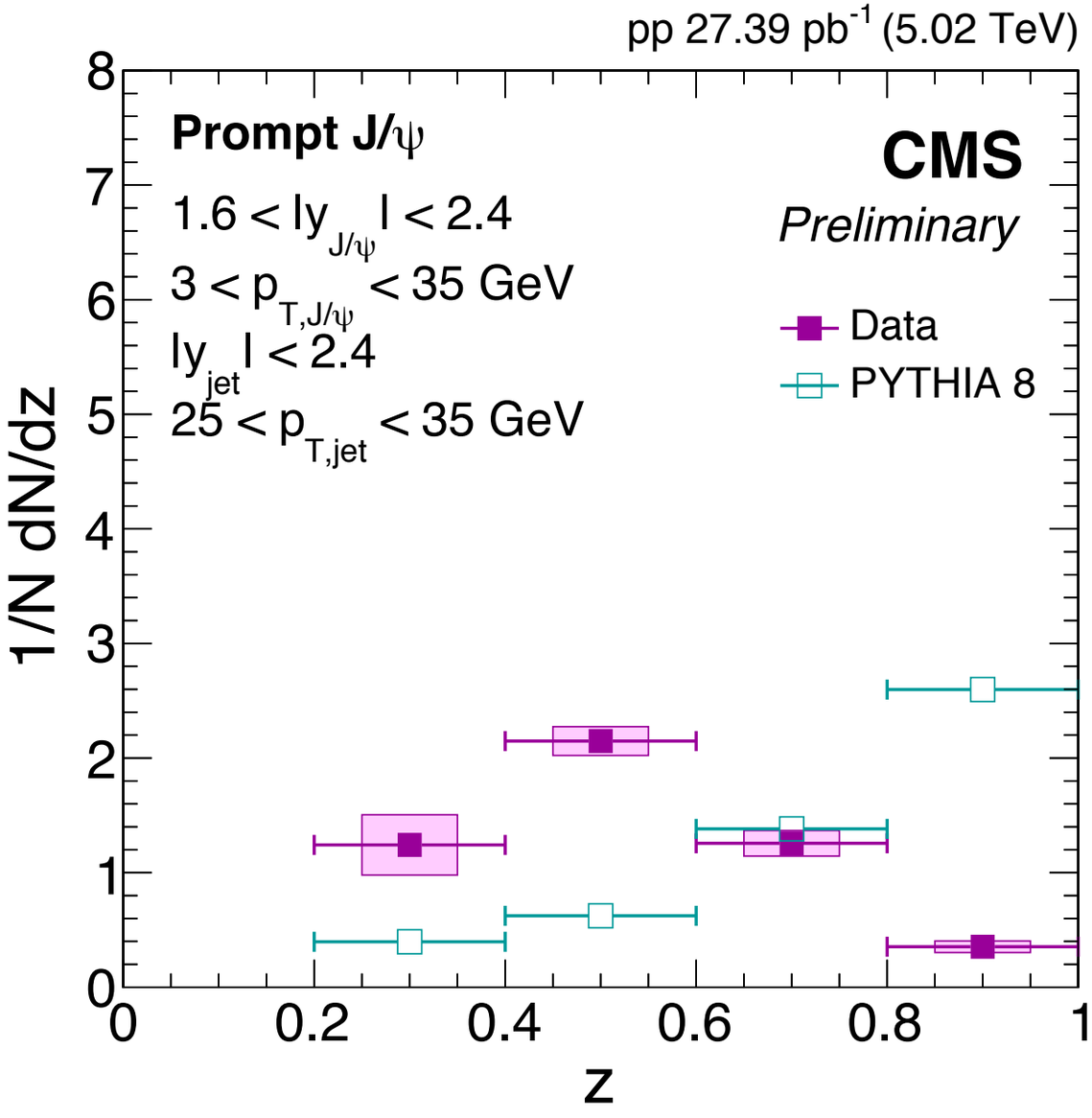


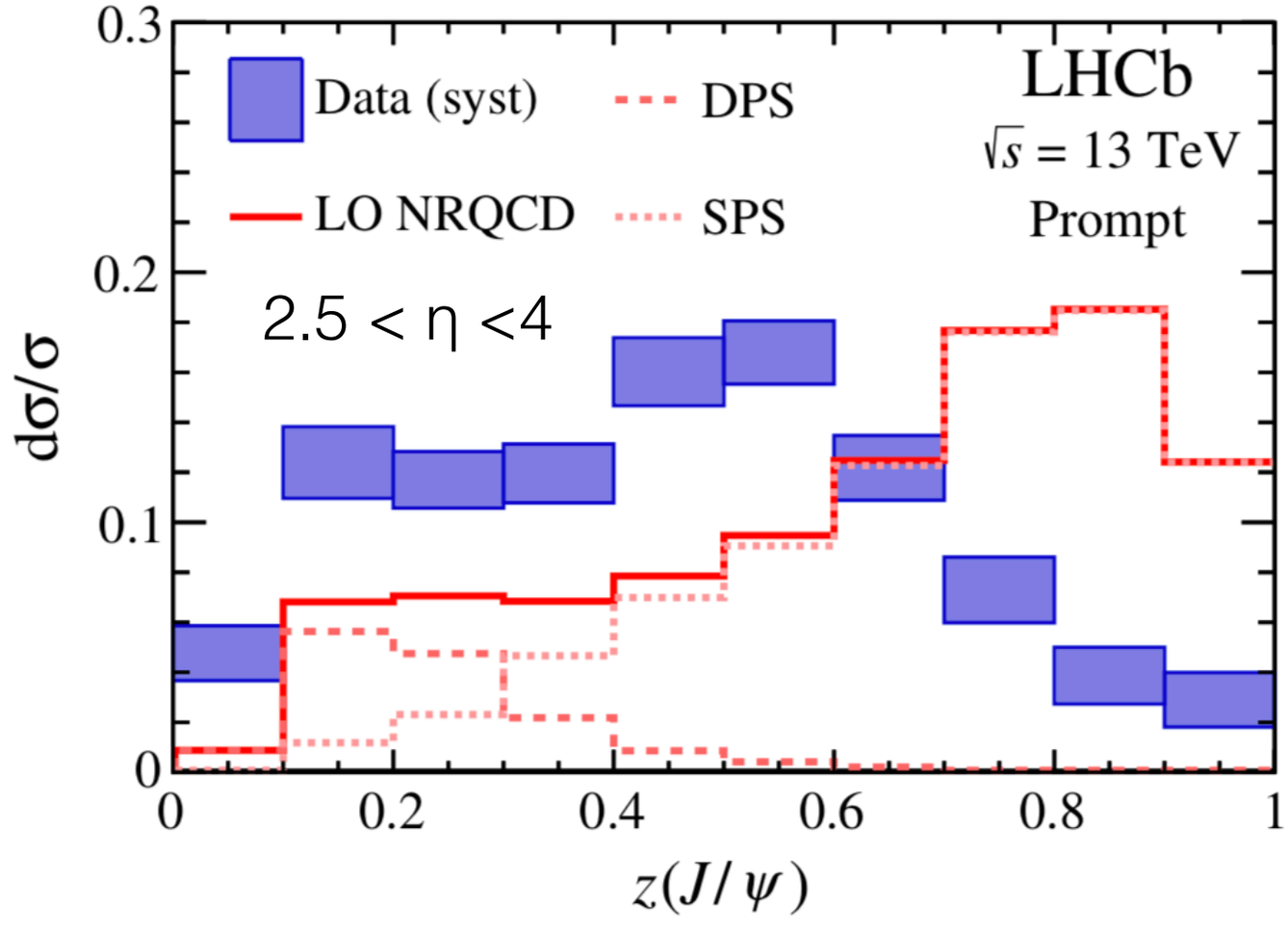
Less than 7% of J/ψ produced in jets

Under-predicted in Pythia

CMS Vs LHCb

Similar results in CMS and LHCb in different kinematic regions



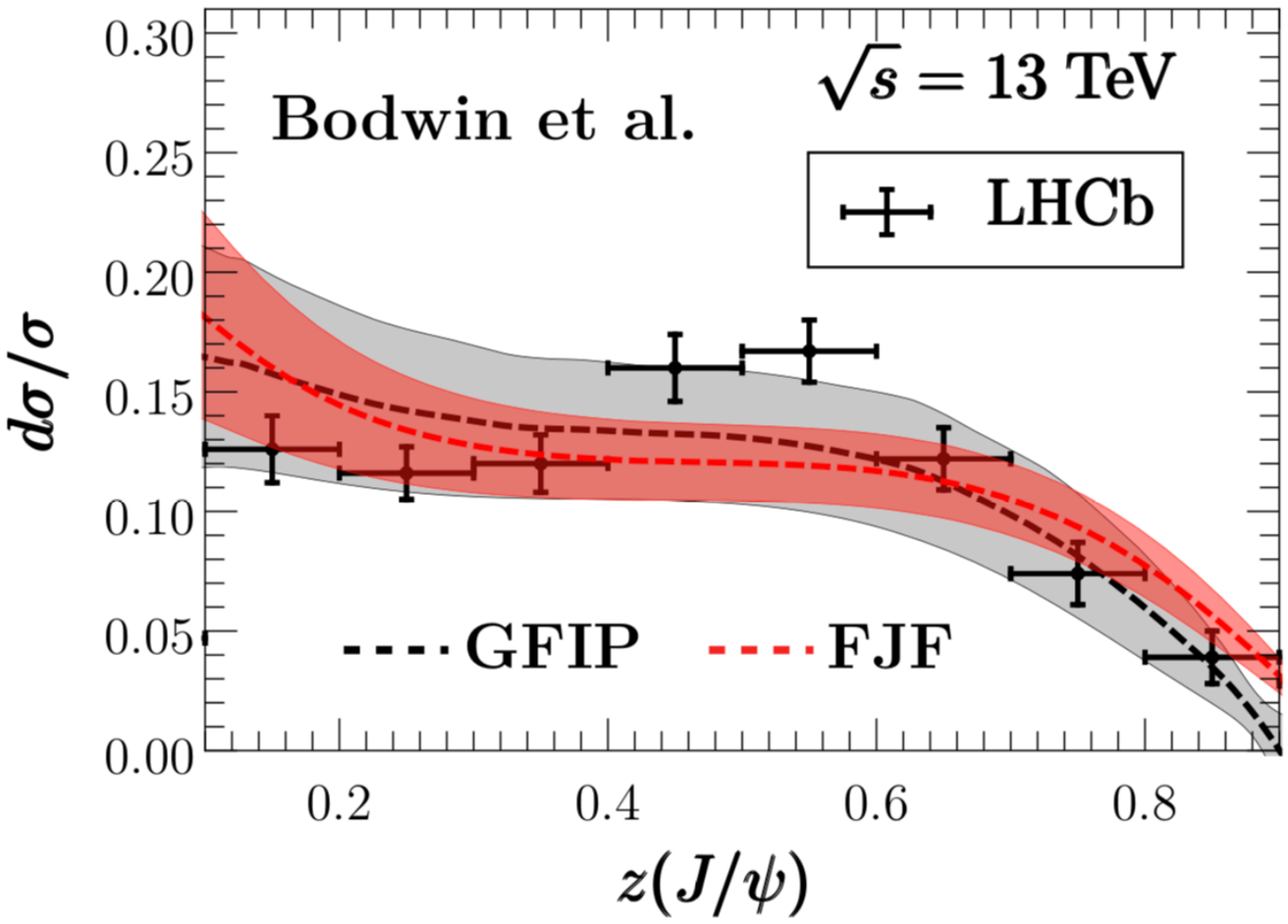


NRQCD on J/ψ in jets

Recent theoretical approach: J/ψ could be produced in parton showers

Hard gluon→ shower → gluon of virtuality $2m_c$→ **J/ψ**

Better agreement with LHCb results than Pythia



PRL 119, 032002

GFIP: Gluon Fragmentation Improved Pythia

FJF: Fragmentation Jet Functions

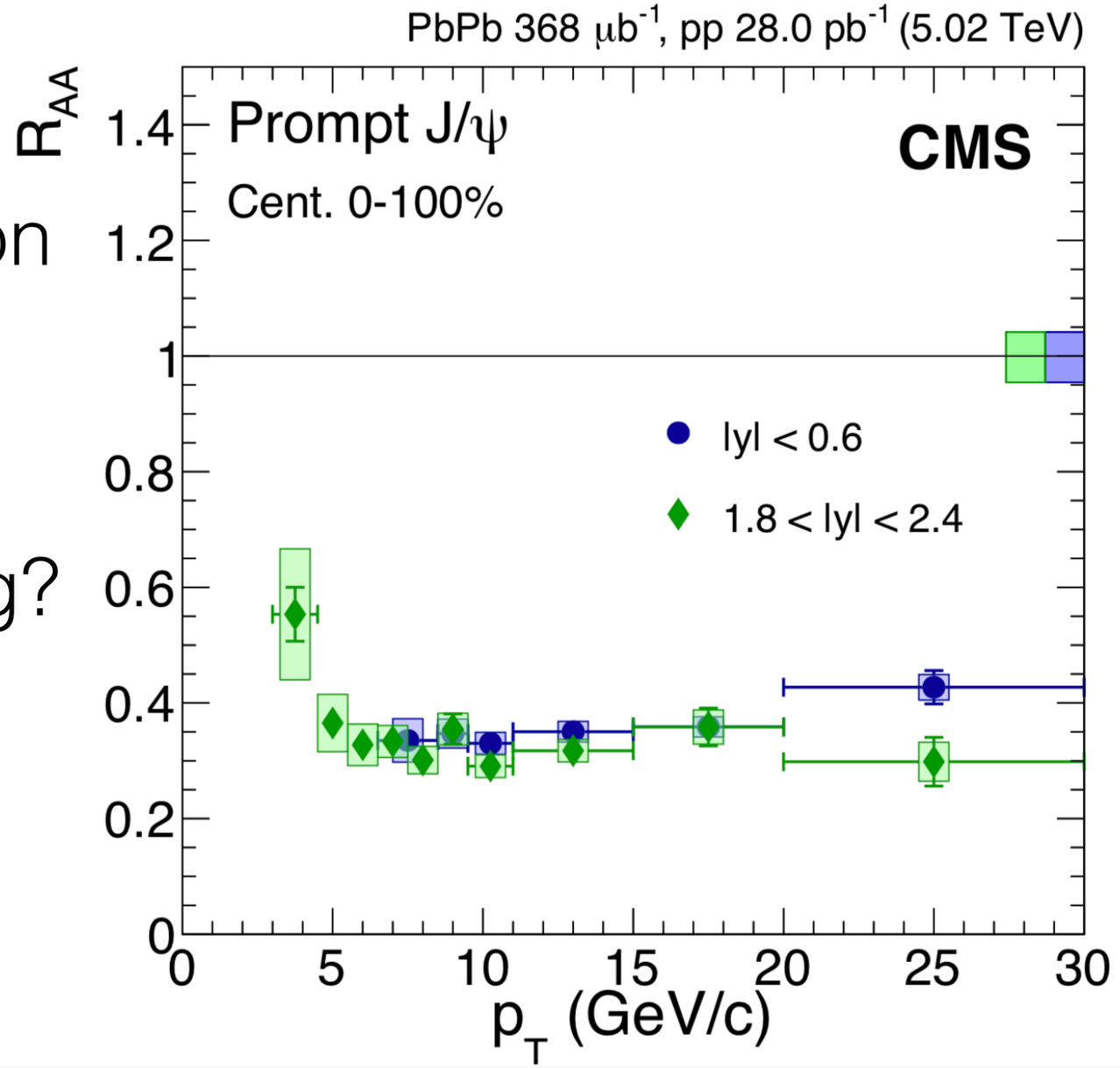
J/ψ in PbPb

Might change the interpretation of J/ψ results in HI

J/ψ suppression in PbPb:

- More than Debye screening?
- Role of jet quenching?

EPJ C78, 509



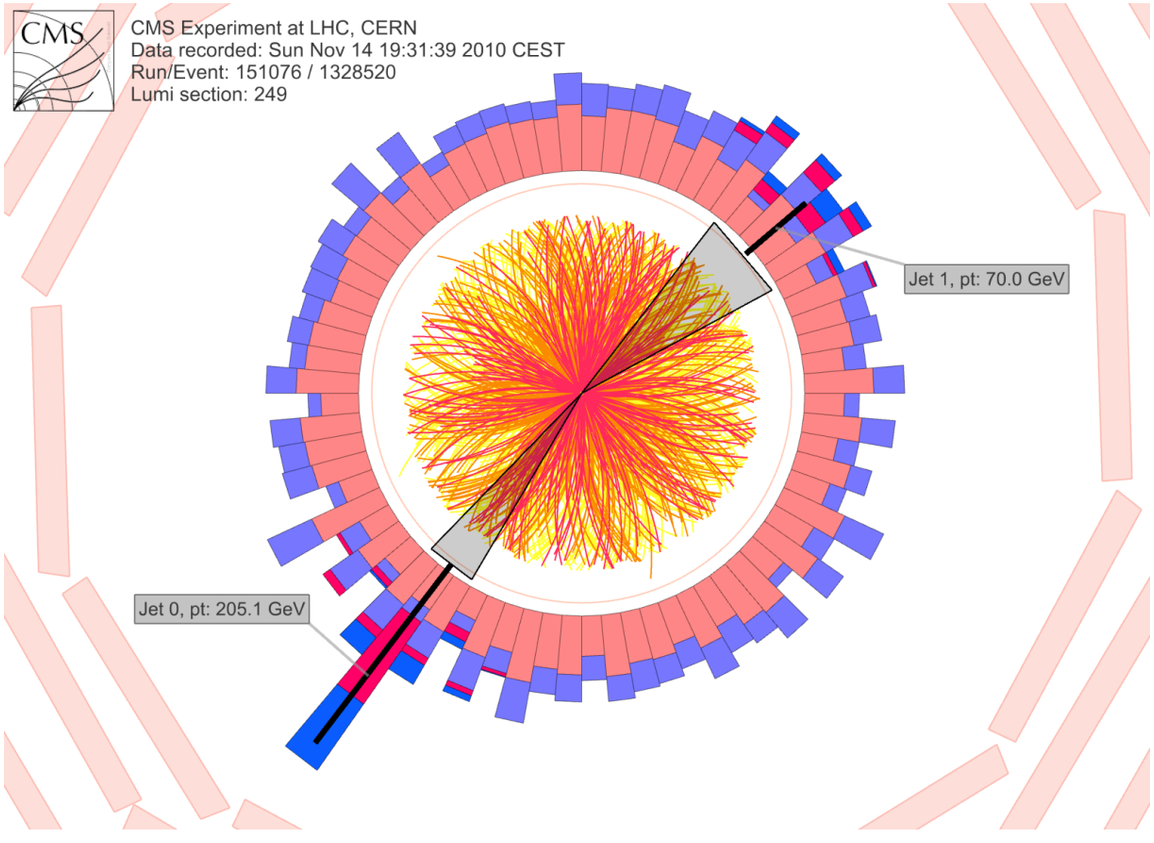
Conclusion

J/ψ are produced in a **jettier** environment than implemented in Pythia

Indication of prompt J/ψ being produced in a **parton shower**

Prospects

Study fragmentation of J/ψ in jets in PbPb



CMS-PAS-HIN-18-012

Thank you

Motivation

J/ψ fragmentation in jets was studied by LHCb for 2.5 < η <4

PRL 118, 192001