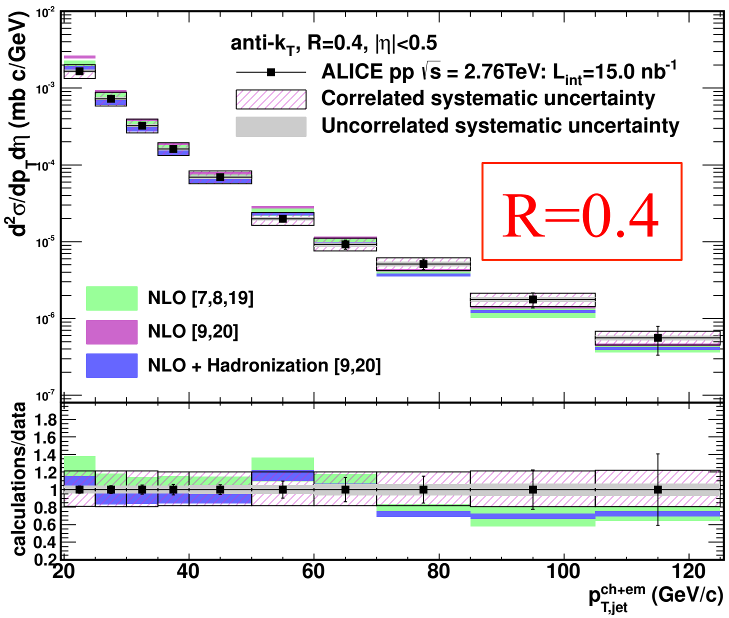
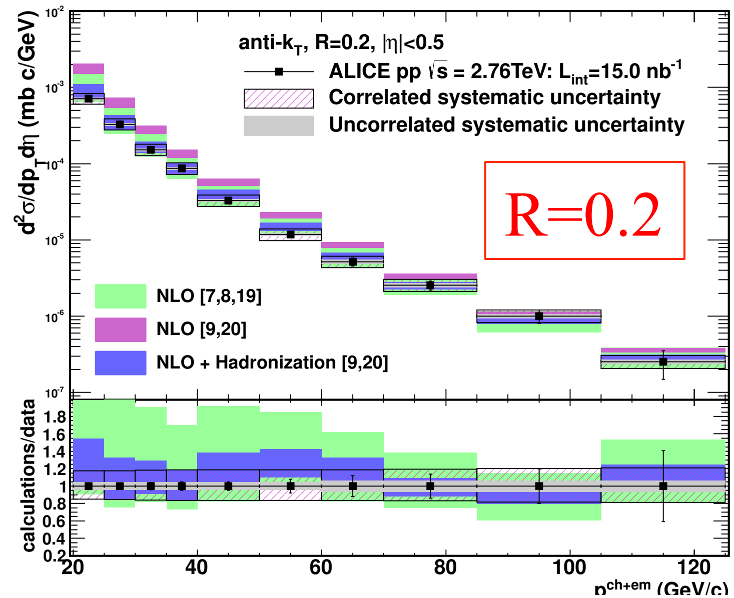
Jet reconstruction: discussion

Peter Jacobs, LBNL

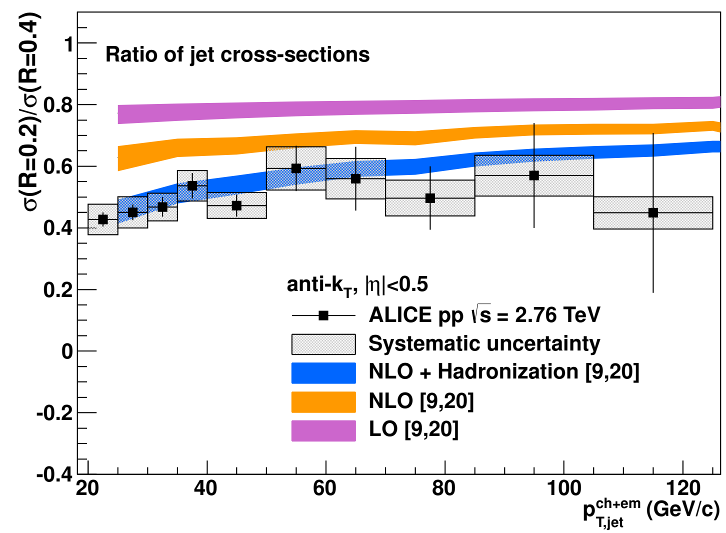
ALICE: inclusive jet cross section in 2.76 TeV p+p





- From 3-day run in March 2011
  - Statistics are limiting
- Use part of upcoming run for more p+p @ 2.76??
  - Next opportunity is 2015 (!)
  - How to prioritize vis a vis p+Pb?

(Side comment: p+Pb also not at 2.76)



Heavy ion jet reconstruction strategy: ALICE

Minimize jet reconstruction biases ➔avoid *ad hoc* modification of events

- no pedestal subtraction
- Minimal cuts on constituents (p_T>150 MeV)
- No hard fragmentation bias to suppress background (for certain observables)
- Low material budget
  - Uniform response within acceptance

Bkgd fluctuations corrected entirely on ensemble basis via unfolding:

- Measured using embedding (universal δp_T distibutions)
  - Very broad due to low cut on constituent p_T
  - Challenging measurement
- ρ is single scalar for each event
- v_2 (etc.) fluctuations accounted for on ensemble basis (reaction plane-dependent δp_T)

Heavy ion jet reconstruction strategy: ATLAS

A. Angerami, QM12

- Perform **event-by-event subtraction** per calorimeter cell in jet

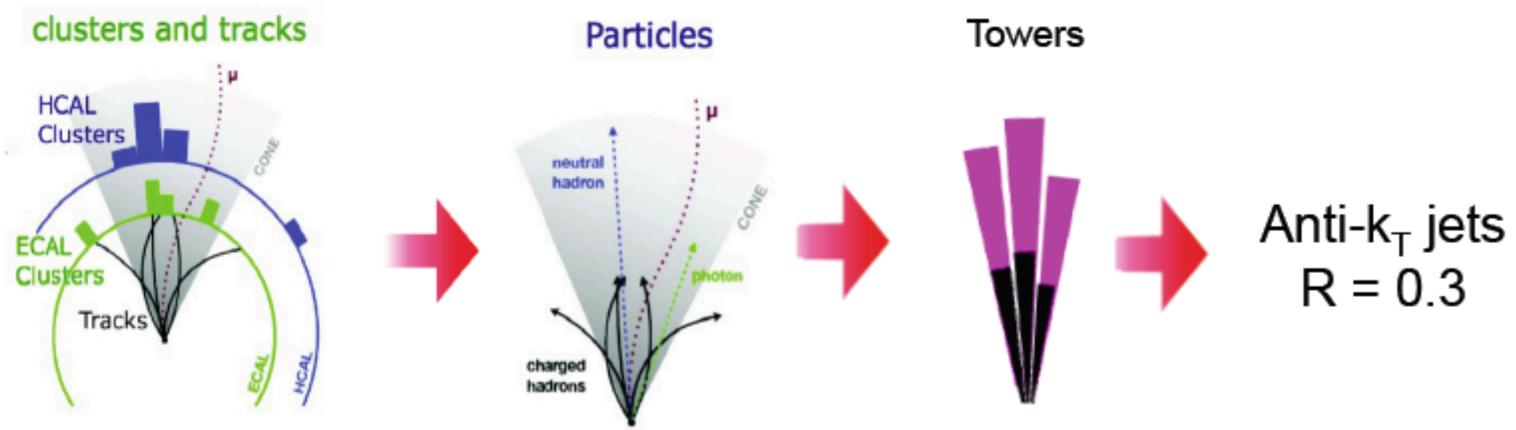
$$E_{\mathrm{T}}{}_j^{\mathrm{sub}} = E_{\mathrm{T}}{}_j - A_j \; \rho_i(\eta_j) \left(1 + 2v_{2i} \cos\left[2\left(\phi_j - \Psi_2\right)\right]\right)$$

indices:
i for cell
j for layer

  - Average, η-dependent background E_T density: ρ
  - Elliptic flow modulation: η and p_T averaged v_2
    - **Jet energy unaffected by global elliptic flow**
- Two-step procedure to prevent jets from biasing subtraction
  - Define jet "seeds" and exclude from ρ and v_2 determination

Heavy ion jet reconstruction strategy: CMS I

M. Nguyen, QM12

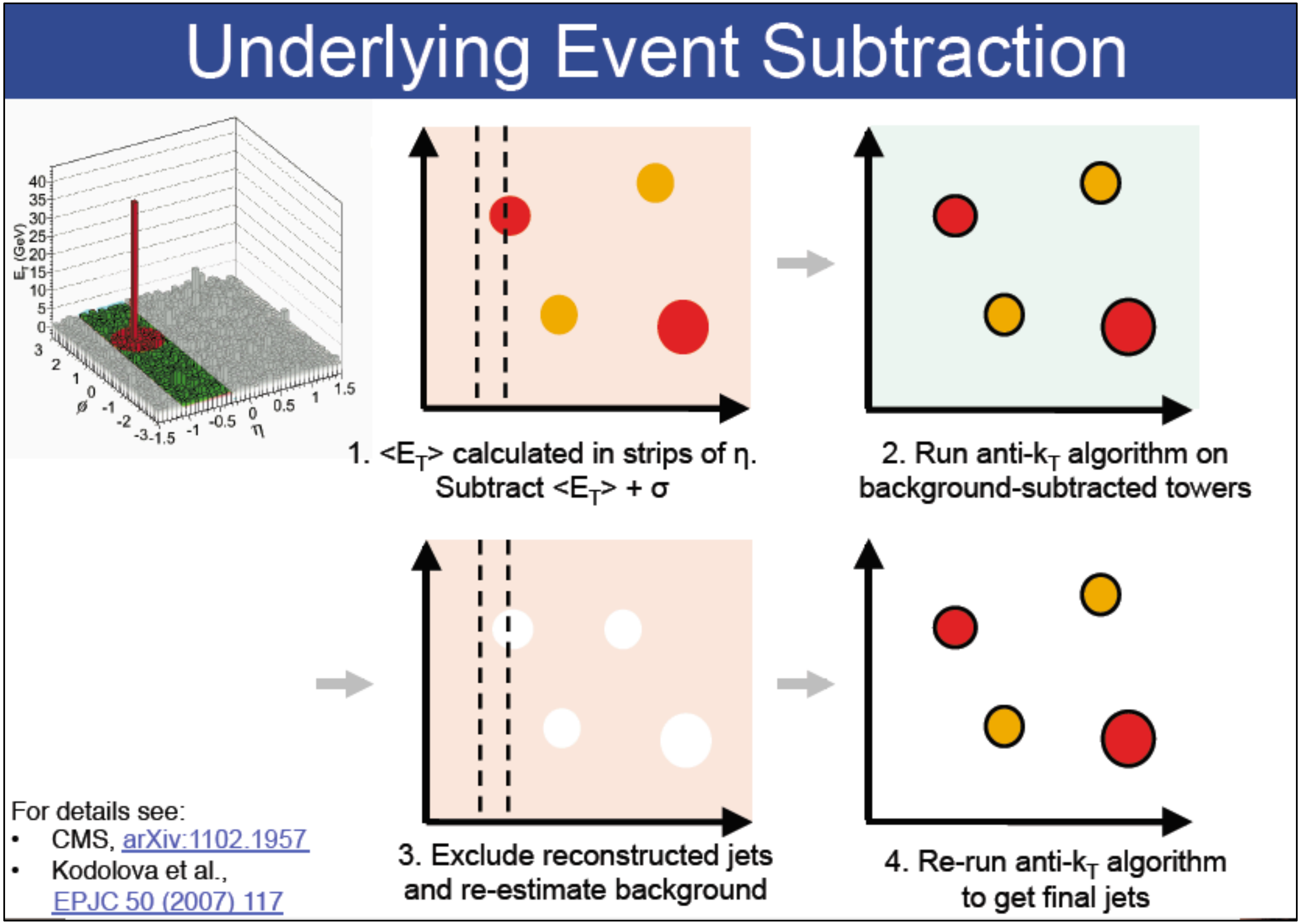


- Information from all sub-detectors are combined into particle candidates → "Particle flow" event reconstruction [1-2]
- Allows to exploit the excellent resolution of the tracker for the charged hadron component of the jet
- Also includes a fully consistent treatment of electron and muons inside jets
- Particle candidates combined into towers in order to subtract the heavy-ion background

[1] arXiv:1107.0179
[2] CMS-PAS-PFT-09-001

Heavy ion jet reconstruction strategy: CMS II

M. Nguyen, QM12



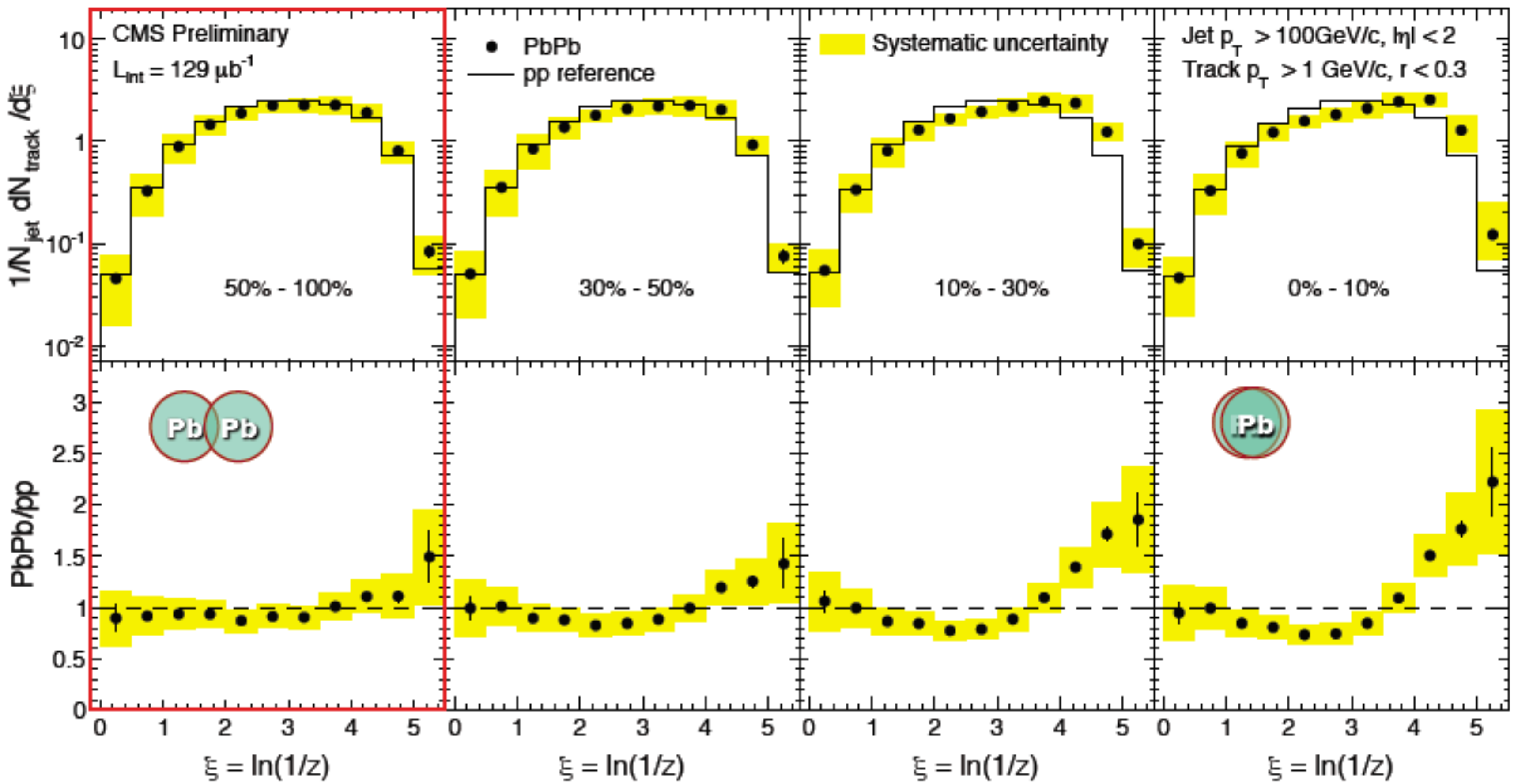
Jet reconstruction: generic features

	ALICE	ATLAS	CMS
Clustering algorithm	Anti-kT	Anti-kT	Anti-kT
Acceptance	$\|\eta\|<0.5$, full azimuth (charged), 25% of azimuth (full jets)	$\|\eta\|<2.1$, full azimuth	$\|\eta\|<2.0$, full azimuth
Jet constituents	Charged tracks + EM clusters	EM+HA calorimetry	Particle flow: EM+HA calorimetry, charged tracking
Jet energy resolution in p+p	18% @ 100 GeV	12% (?) @ 100 GeV	13% @ 100 GeV

Jet reconstruction: heavy ion-specific

	ALICE	ATLAS	CMS
Max R in heavy ions (thus far)	0.4	0.5	0.5
Pre-clustering pedestal subtraction	No	No	Yes
ρ estimate	Scalar for event; Jet exclusion optional	η rings, hard jets excluded	η rings, hard jets excluded
Correction for background v_2	Ensemble-level (rxn plane dependent δp_T)	ρ modulated event-by-event by p_T-averaged v_2	Not yet implemented
Hard fragmentation cut	Depends on observable	Yes: track jet or EM cluster>7 GeV (tracks have p_T>4 GeV)	No
Effective constituent p_T cut	0.15 GeV	Smooth turn-on: low p_T calorimeter response	Smooth turn-on: low p_T calorimeter + tracking response
σ of background fluctuations (central Pb+Pb, R=0.4)	11 GeV (charged) ~16 GeV (full)	10 GeV (full)	5.2 GeV (R=0.3)

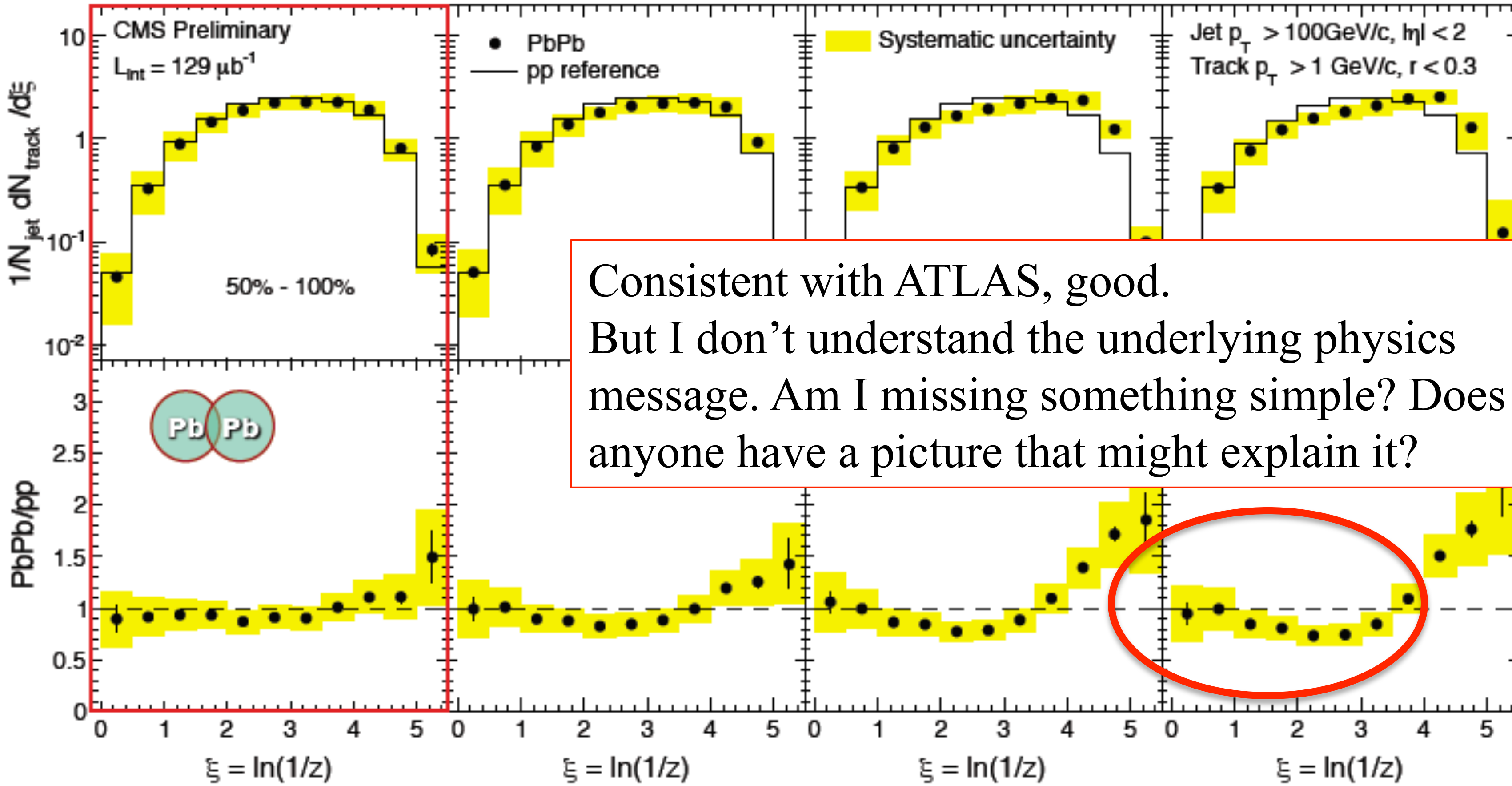
Jet Fragmentation Function



- PbPb peripheral events in good agreement with pp
- Expected but non-trivial

$$\left(z = \frac{p_{\parallel}^{\mathrm{track}}}{p^{\mathrm{jet}}} \right)$$

Jet Fragmentation Function



Consistent with ATLAS, good.
But I don't understand the underlying physics message. Am I missing something simple? Does anyone have a picture that might explain it?

- PbPb peripheral events in good agreement with pp
- Expected but non-trivial

$$\left(z = \frac{p_{\parallel}^{track}}{p^{jet}} \right)$$