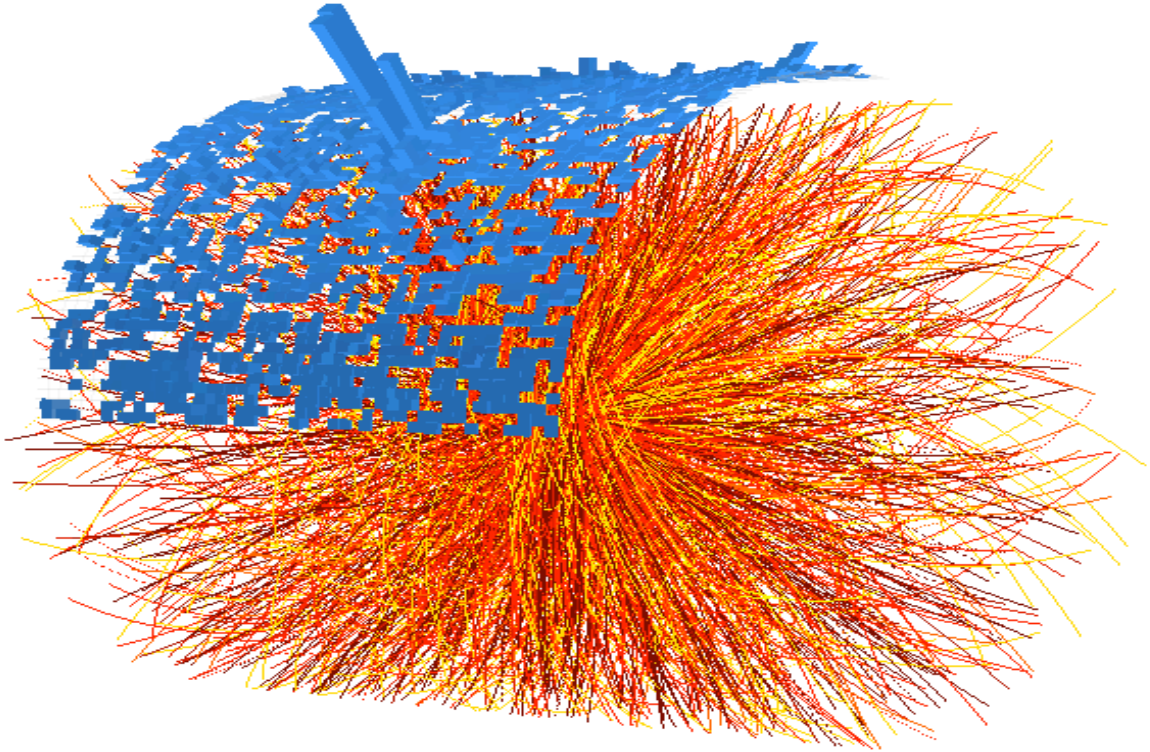
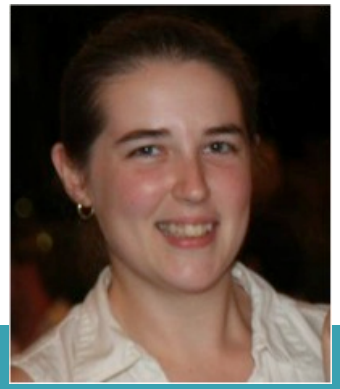
JET RESULTS FROM ALICE



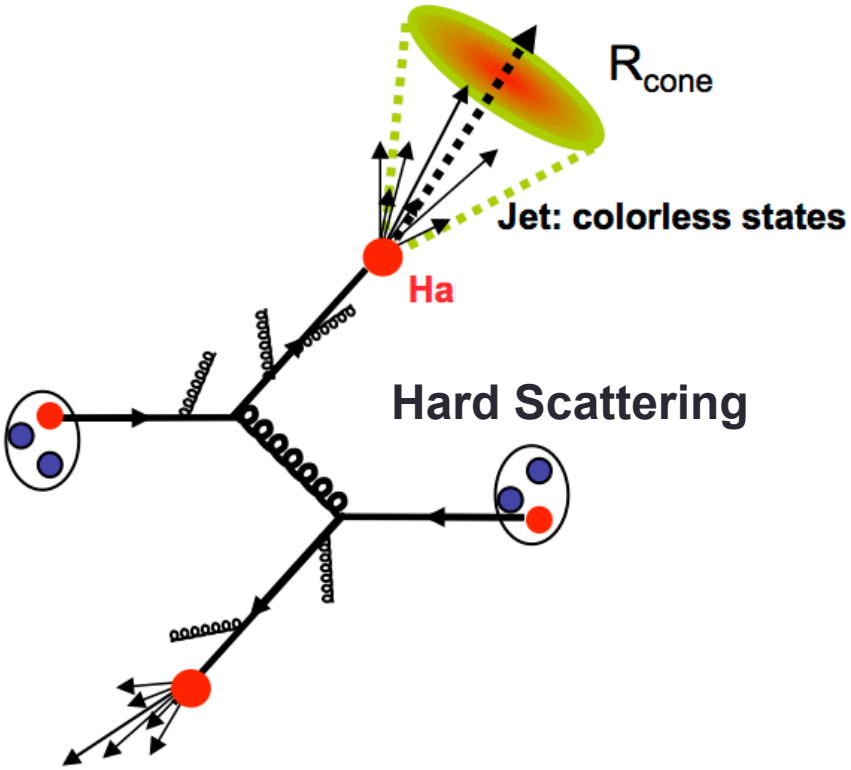
Megan Connors (Yale University)

US LHC Users Meeting

November 14, 2014

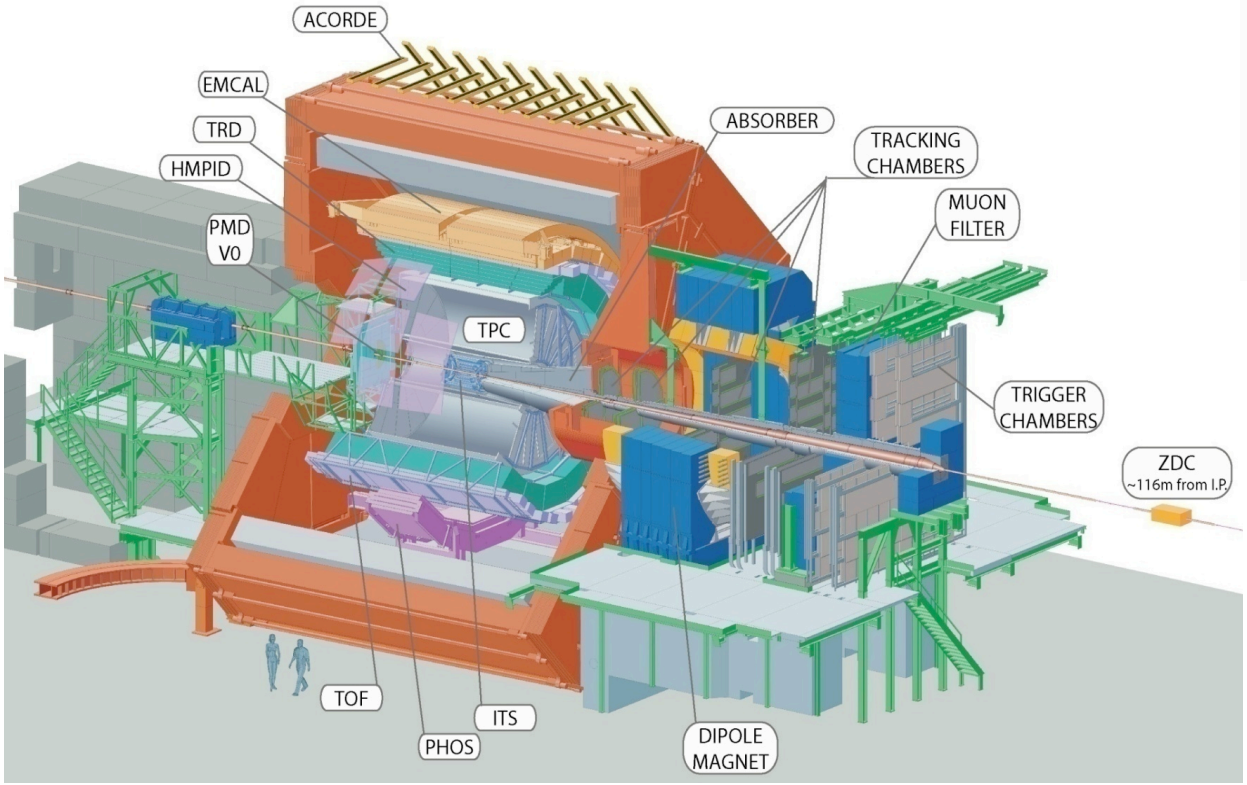


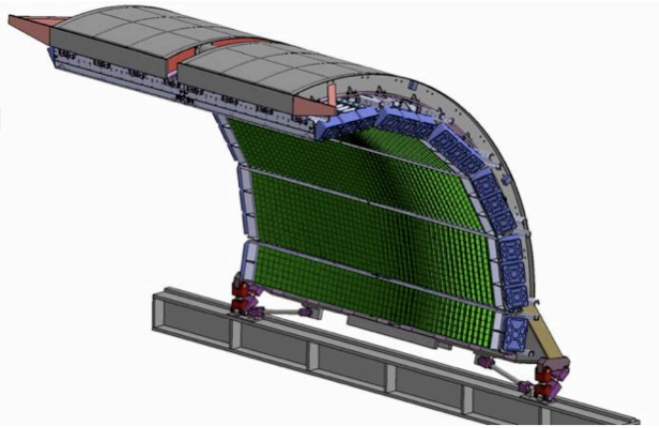
Defining a Jet



- Collimated spray of particles
  - Originating from a hard scattering
  - Radiation of soft gluons and quarks
  - Hadronization
- Defined by the jet finder
  - Anti-k_T
- Useful probe to study QGP
  - Experimentally and theoretically
  - Reflects hard scattered parton kinematics
  - Scattering occurs prior to QGP formation
  - Partons traverse the QGP and lose energy

Jets at ALICE





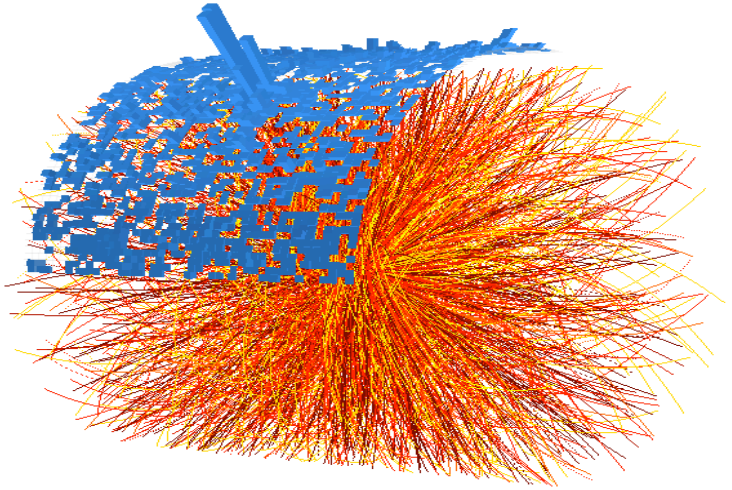
EMCal is a Pb-scintillator sampling calorimeter which covers:

- $|\eta| < 0.7$,
- $1.4 < \varphi < \pi$

Tracking:
$|\eta| < 0.9$, $0 < \varphi < 2\pi$
TPC: gas drift detector
ITS: silicon detector

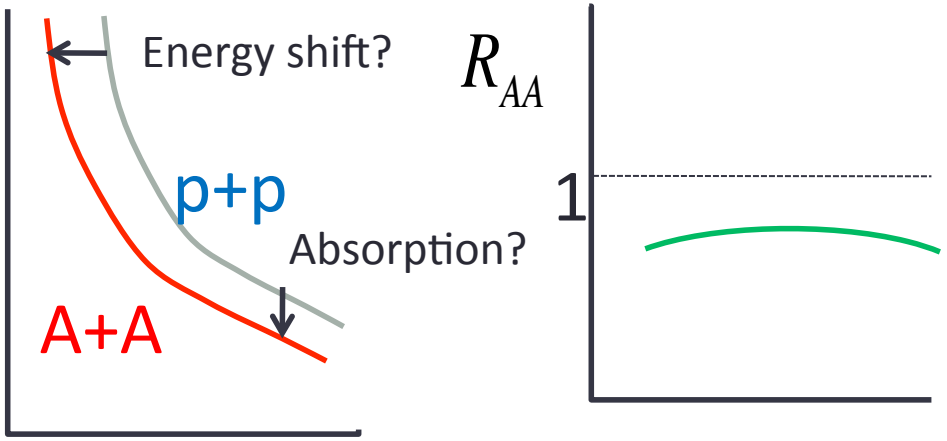
Charged particles → **JET** ← ***Neutral particles***

Jets in Pb-Pb



- Is AA simply a superposition of pp collisions?

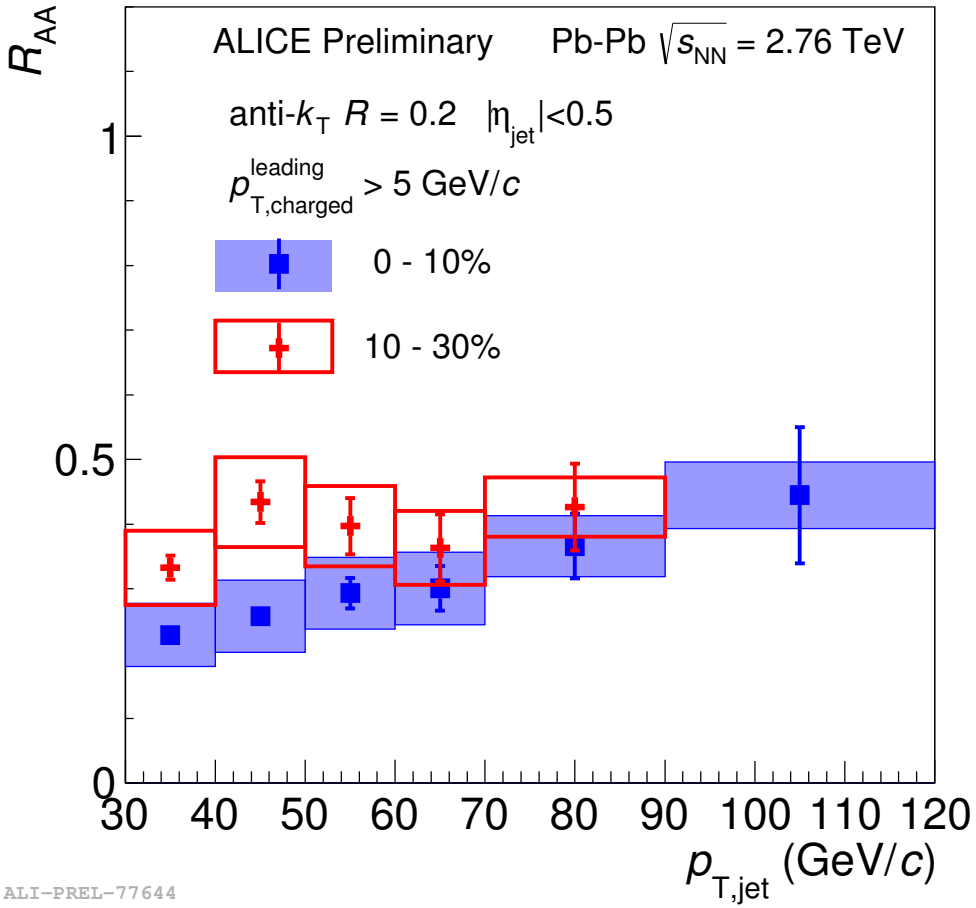
$$R_{\mathrm{AA}}(p_{\mathrm{T}}) = \frac{\mathrm{d}^2 N_{\mathrm{ch}}^{\mathrm{AA}}/\mathrm{d}\eta\,\mathrm{d}p_{\mathrm{T}}}{\langle T_{\mathrm{AA}}\rangle \mathrm{d}^2\sigma_{ch}^{\mathrm{pp}}/\mathrm{d}\eta\,\mathrm{d}p_{\mathrm{T}}}$$



R_{AA}=1 implies yes!
R_{AA} < 1 implies energy loss

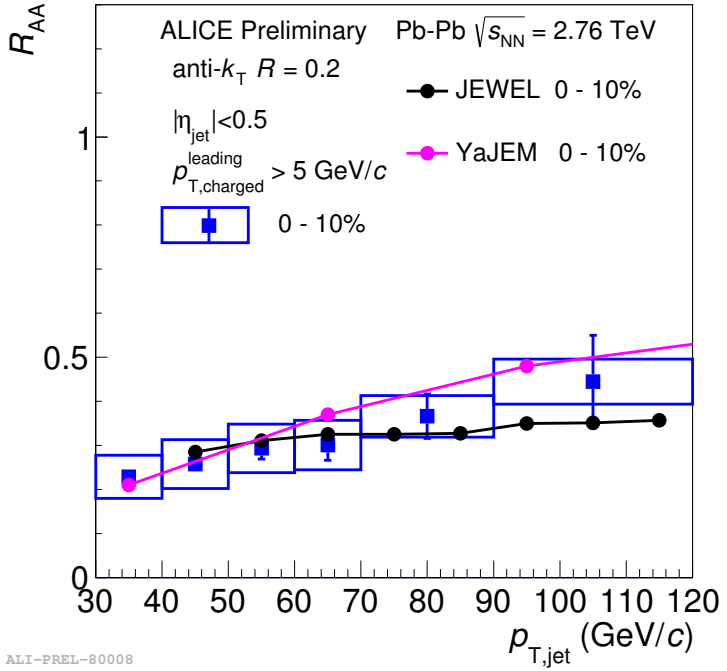
- Energy density subtracted event-by-event
- Unfold for detector effects and background fluctuations

Jets in Pb-Pb



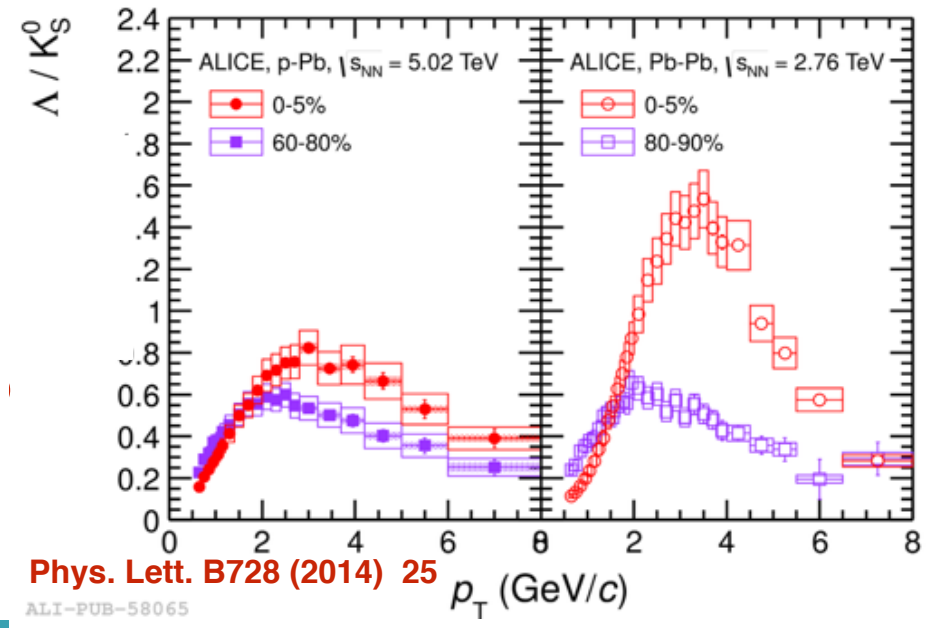
Central Pb-Pb collisions

- Jet Quenching!
- Suppression observed relative to N_{coll} scaled pp
- Good agreement with energy loss models



Motivation for Jets in p-Pb

- Could some of the suppression observed in Pb-Pb result from Cold Nuclear Matter (CNM) effects?
- Is multiplicity dependence of particle ratios observed in p-Pb present in the jet fragmentation?
- Is the fragmentation behavior of jets different in p-Pb?



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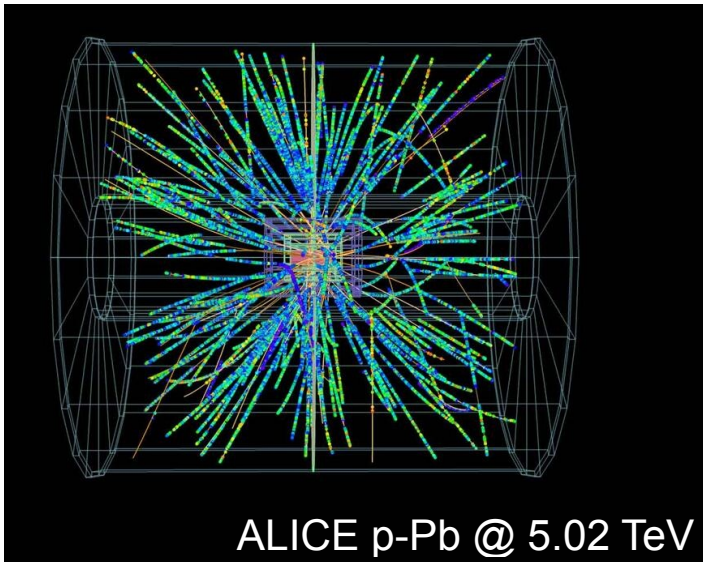


Jets in p-Pb

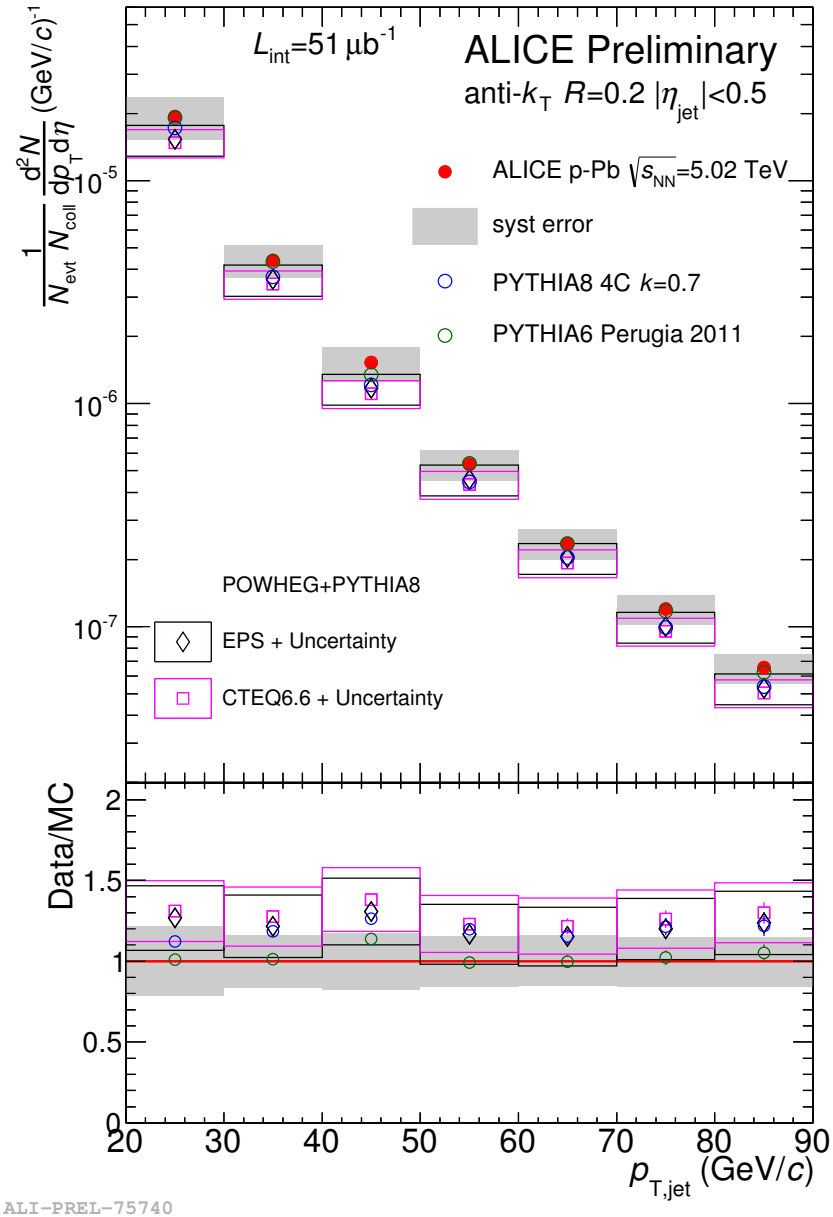
- Motivation: Quantify CNM effects in Pb-Pb jet quenching observation

$$R_{pPb} = \frac{1}{\langle N_{coll} \rangle} \frac{dN_{pPb}/dp_T}{dN_{pp}/dp_T}$$

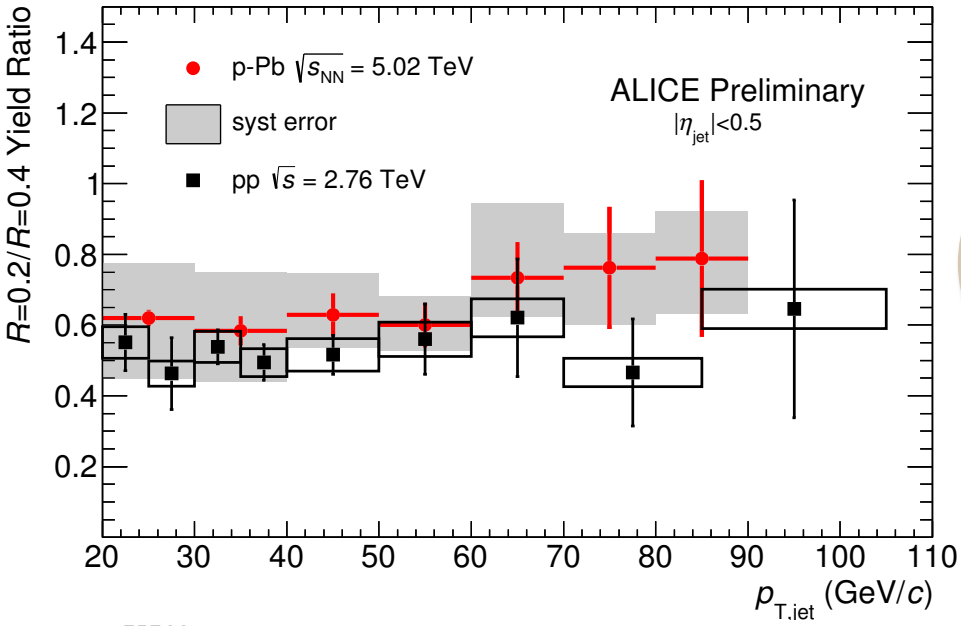
No pp data at 5 TeV
Compare to MC

$$\langle N_{coll} \rangle = A \cdot \frac{\sigma_{pN}}{\sigma_{pA}} = 208 \cdot \frac{70\ mb}{2100\ mb} = 6.9$$

- Spread of results from MC references shows uncertainty on pp reference
- Consistent with no CNM effects
  - Suppression in Pb-Pb not a CNM effect
  - Need to reduce uncertainties with pp data
  - Baseline for Run II Pb-Pb



Fragmentation Properties in p-Pb



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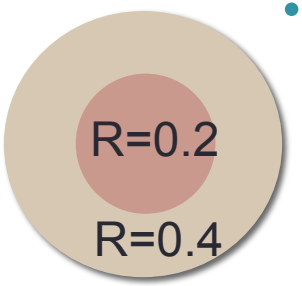

- p-Pb ratio consistent with pp collisions at 2.76 TeV

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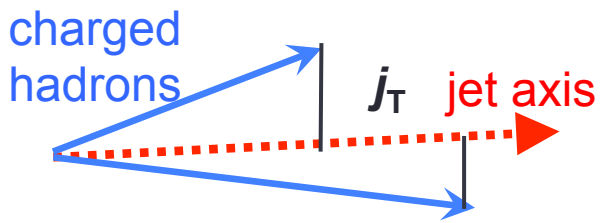
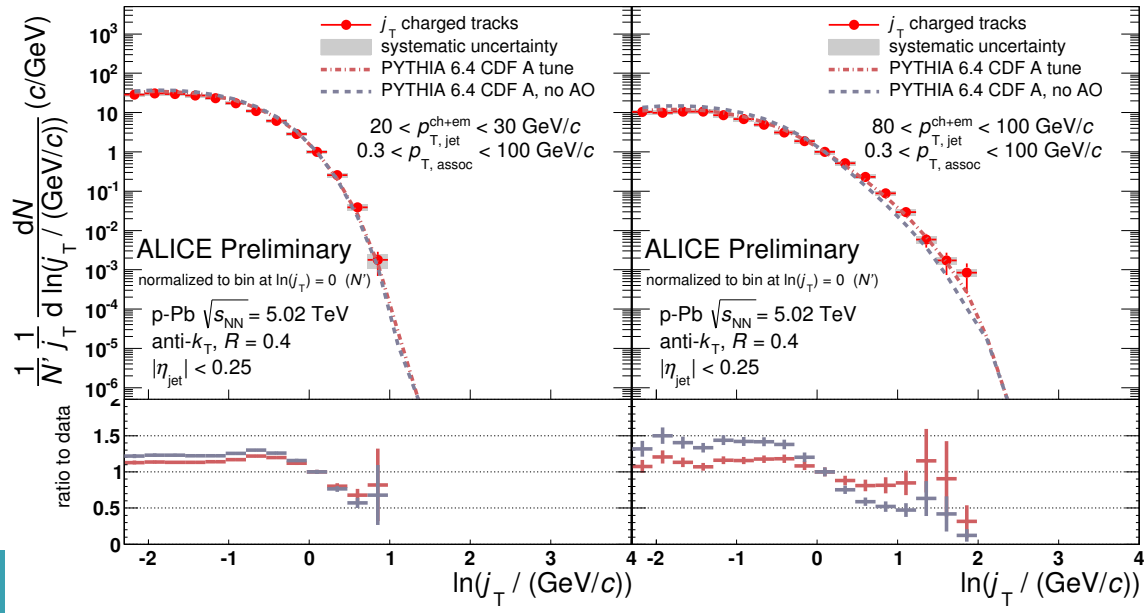
- No modification of the jet sub-structure observed



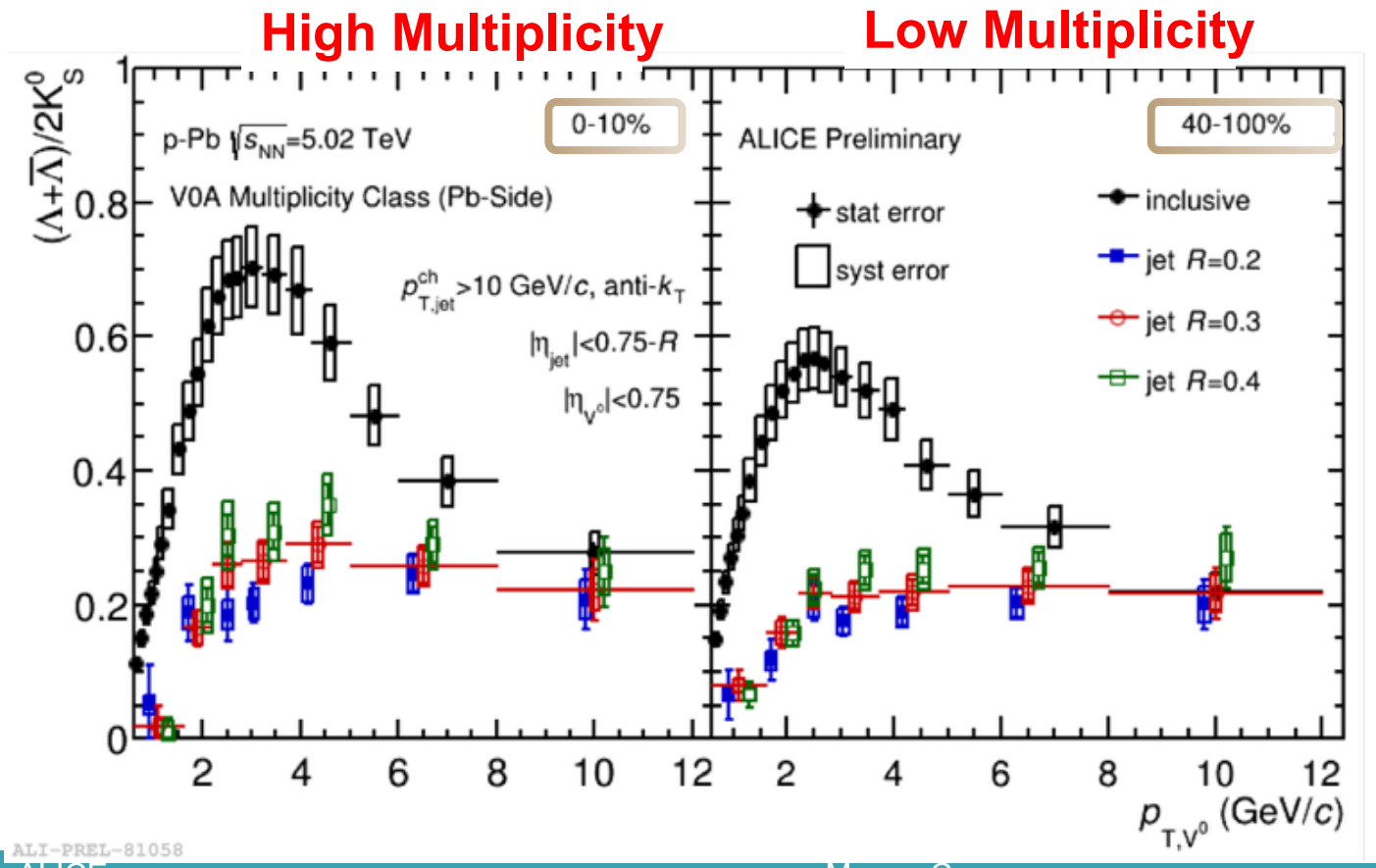
- Data is best described by PYTHIA with angular ordering



ALI-DER-85290

Λ/K^0_s Multiplicity Dependence in p-Pb

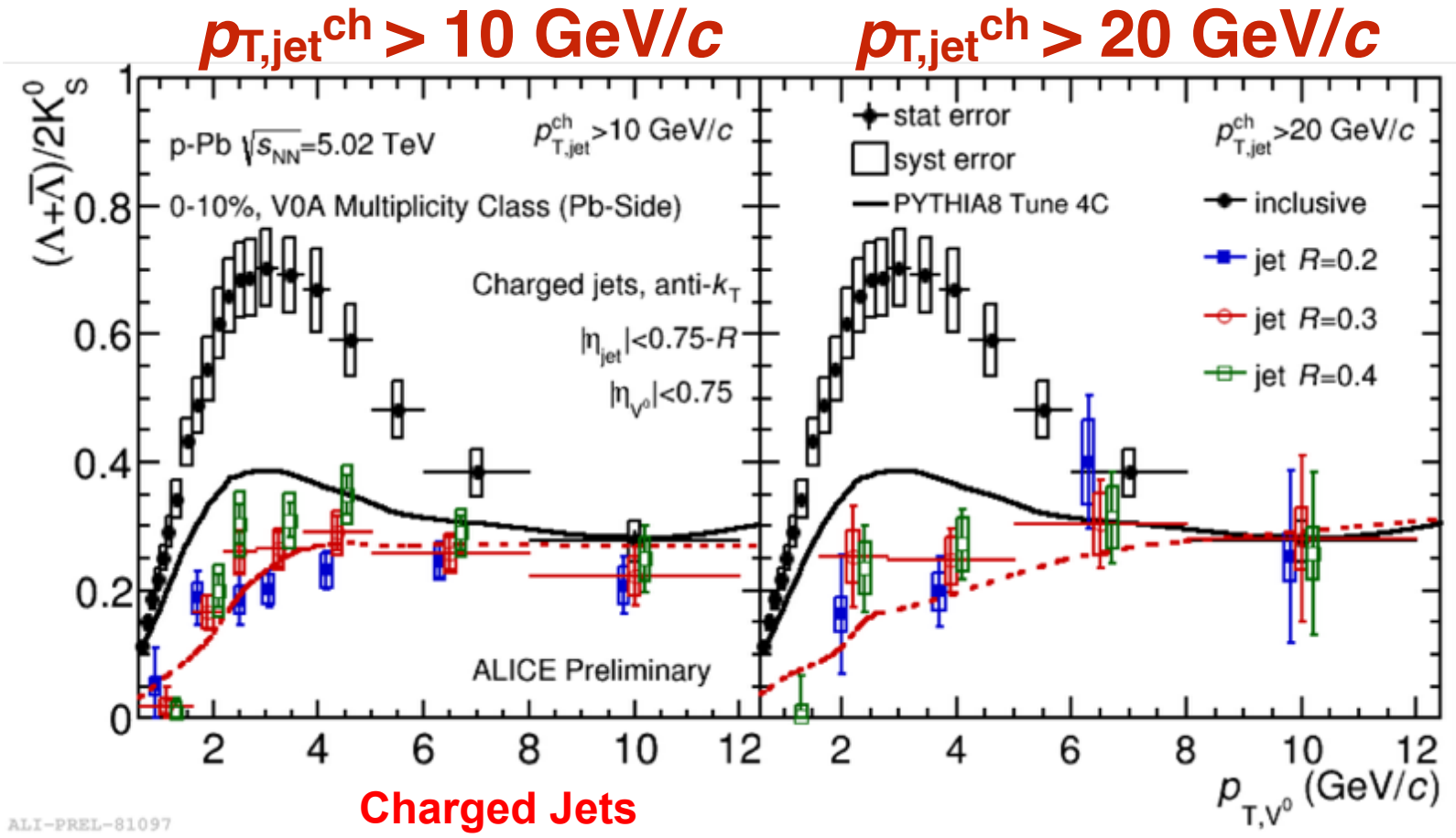
- Multiplicity dependence observed for inclusive Λ/K^0_s
- No multiplicity dependence for Λ/K^0_s ratio in jets
- Ratio within the jet lower than inclusive ratio



Charged Jets

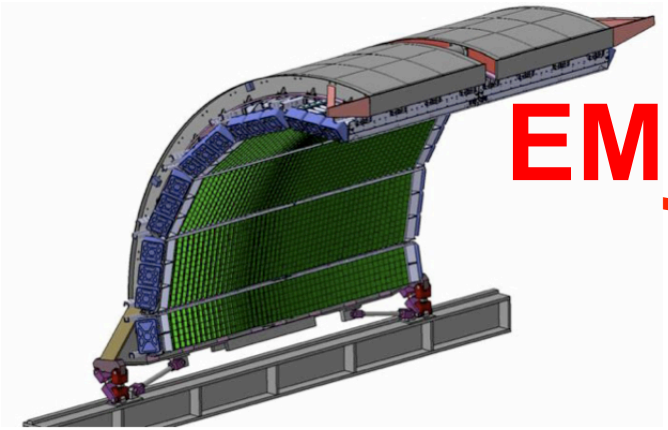
Λ/K^0_s Ratio Compared to PYTHIA

- Ratio within the jet consistent with PYTHIA
- Increased inclusive Λ/K^0_s ratio due to UE

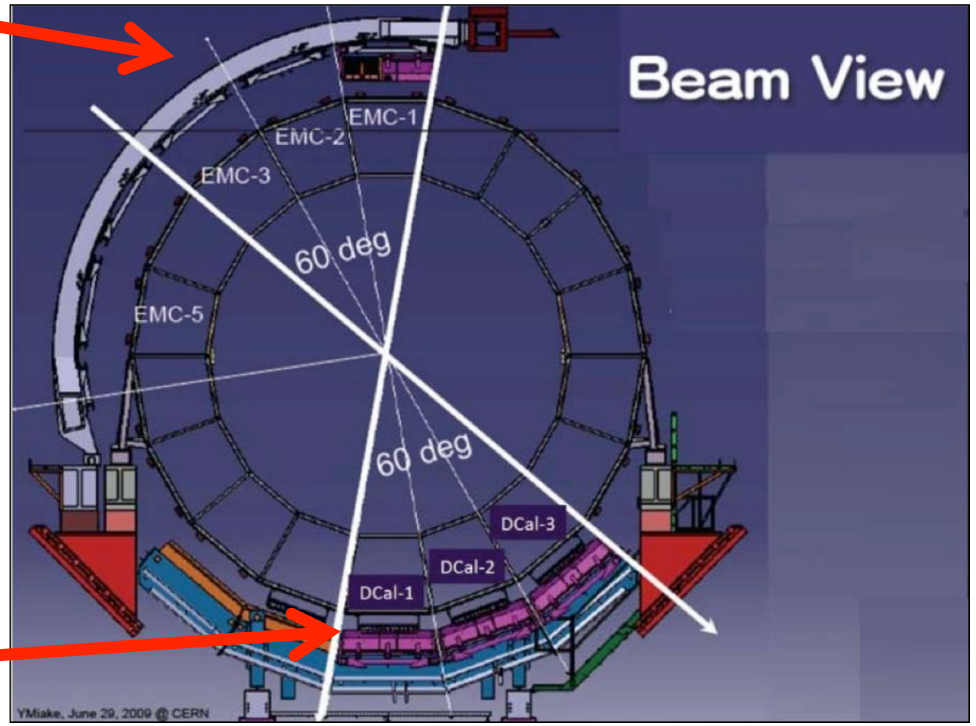


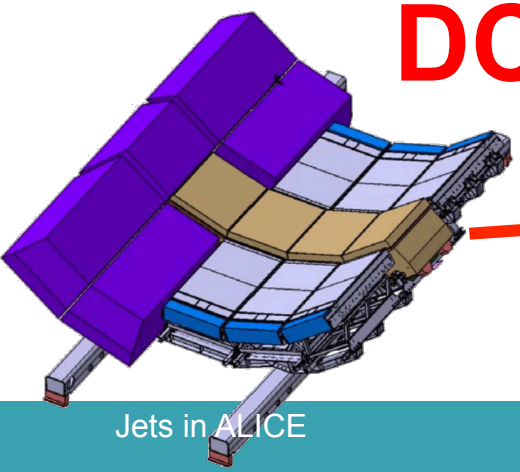
New ALICE Capabilities in Run II

- New DCal calorimeter
  - Increased acceptance for jets
  - Allows for di-jet observables



EMCal





DCal

$\Delta\eta=1.4, \Delta\varphi=60^{o}$

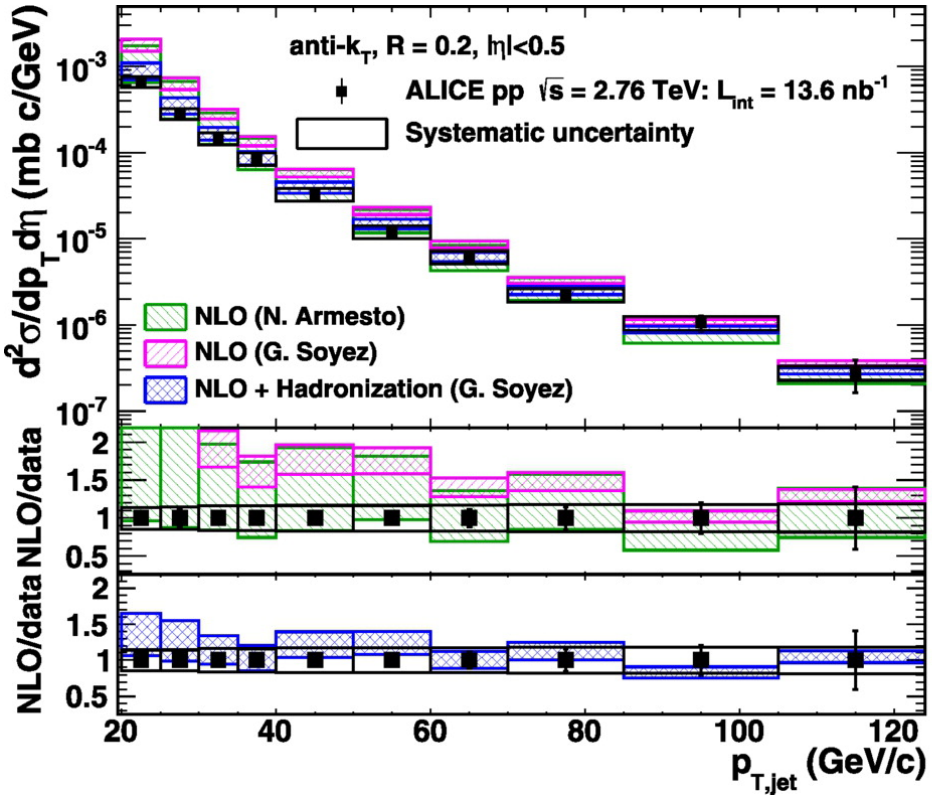
Ready for Run II

Summary

- Jet quenching observed in central Pb-Pb collisions
- p-Pb consistent with model calculations for 5.02 TeV pp
  - Need 5.02 TeV pp data to reduce uncertainties
  - CNM effects cannot account for strong suppression of Pb-Pb
- Jet substructure or particle ratios in p-Pb collisions consistent with pp expectations
- Energy loss models reproduce Pb-Pb suppression
  - Additional observables will provide more constraints to energy loss models
- Looking forward to measuring jets in Run II
  - Increased energy and statistics
  - New (di-)jet capabilities with the DCal

Jet Cross-Section (pp)
$\sqrt{s}$ = 2.76 TeV, R = 0.2

arXiv:1301.3475
PLB: 10.1016/j.physletb.2013.04.026



Hadronization needed for theory-data agreement!

- **Important reference** for Pb-Pb collisions
- Good agreement between data and NLO calculations
  - Many orders of magnitude
  - Jets are a well **calibrated probe** for th QGP

Agreement with Models

- Good agreement with energy loss models

JEWEL: JHEP 1303 (2013) 080, Eur. Phys. J. C74 (2014) 2762

YaJEM: Phys. Rev. C78 (2008) 034908, Phys. Rev. C84 (2011) 067902