Jet fragmentation measurements in *p*+Pb collisions with ATLAS

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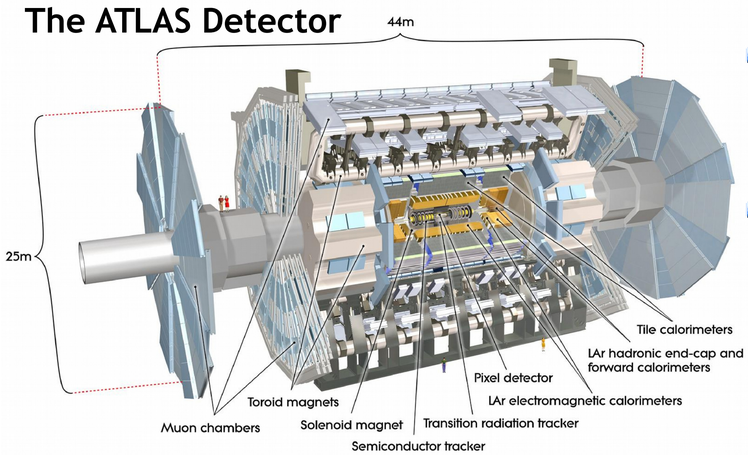
The ATLAS Detector



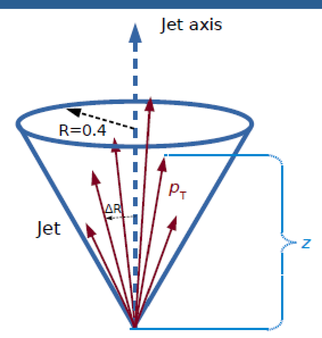
- ATLAS is a general-purpose p-p experiment, but the detector can be very well used for heavy ion physics!
- The analysis utilizes:
  - p+Pb data at 5.02 TeV with integrated luminosity of 28 nb^{-1}.
  - p+p data at 2.76 TeV with integrated luminosity of 4 pb^{-1}.
  - PYTHIA 6 (embedded into real MB p+Pb), PYTHIA 8 and HERWIG++ MC samples.

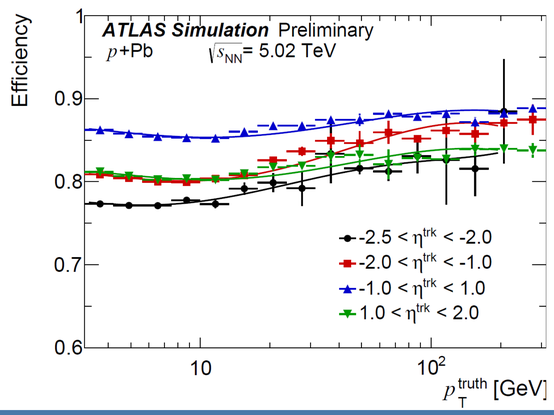
Fragmentation functions measurement [4]

- Fragmentation distribution defined as:

$$D(z) \equiv \frac{1}{N_{\rm jet}} \frac{1}{\varepsilon} \frac{\Delta N_{\rm ch}(z)}{\Delta z} \;;\; z = p_{\rm T}^{\rm ch}/p_{\rm T}^{\rm jet} \cos\Delta R$$

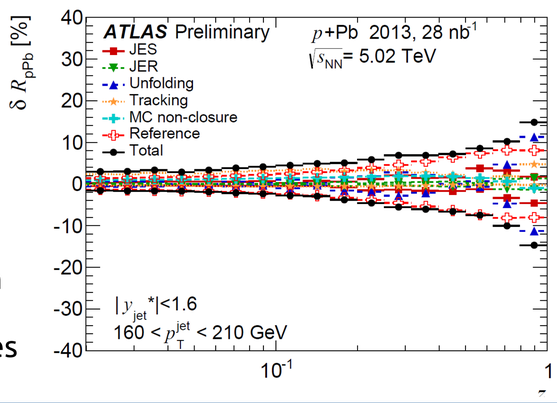
- Jets are reconstructed with the anti-k_t algorithm with radius R = 0.4 and with the underlying event subtraction procedure described in Ref. [5].
- Six jet p_T bins in region: 45-260 GeV and $|y^*|$<1.6 are used.
- Jets are selected by high-level jet trigger and are required to be isolated.
- To minimize the contribution from the UE only tracks with p_T > 3.5 GeV are used.
- Tracking efficiency is parametrized as a function of track p_T and track η.
- 2D Bayesian unfolding in z and jet p_T is used to correct for detector effects.





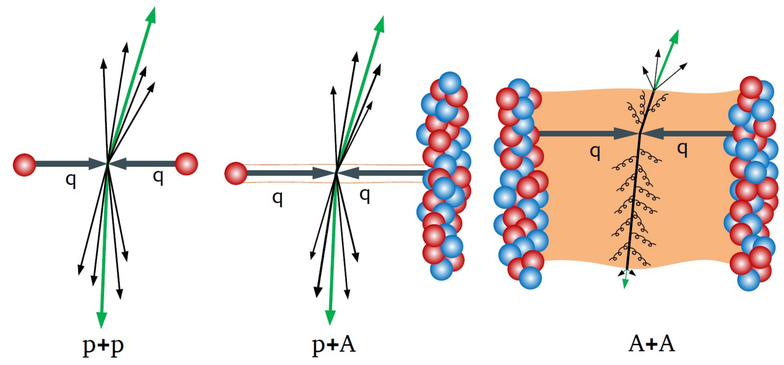
Systematics Uncertainties

- The following systematic uncertainties were taken in to account:
  - Jet Energy Scale
  - Jet Energy Resolution
  - Unfolding
  - Track reconstruction
  - MC non-closure
  - Reference
- The dominant systematic uncertainty on the *D(z)* is from the jet energy scale.
- Many jet-related systematic uncertainties cancels in the ratio.

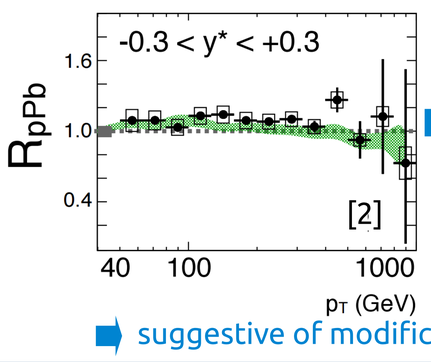


Jets in *pp*, *p*+Pb and Pb+Pb collisions

- Jets provide a powerful tool to probe the medium created in HI collisions and to test the QCD.
- Study of jet internal structure shows a modification of fragmentation functions in central HI collisions [1].

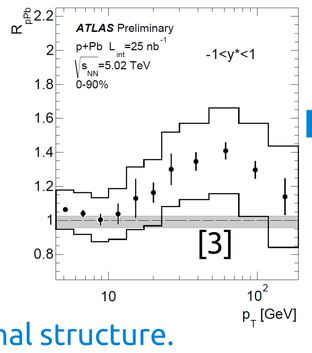


- Can we use *p*+Pb collisions as a reference for Pb+Pb collisions?
- How much modification is coming from initial nPDF effects?



Inclusive jet rate in *p*+Pb collisions is only slightly enhanced.

Consistent with nPDF expectations.

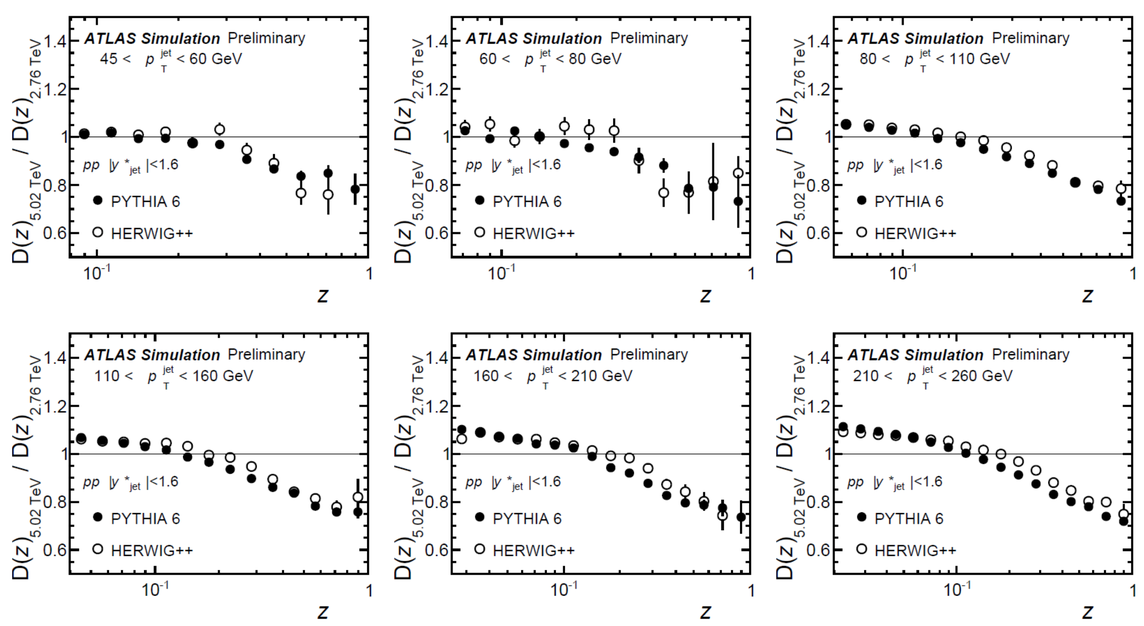


Enhancement of charged spectra at high p_T.

suggestive of modification of jet internal structure.

Reference

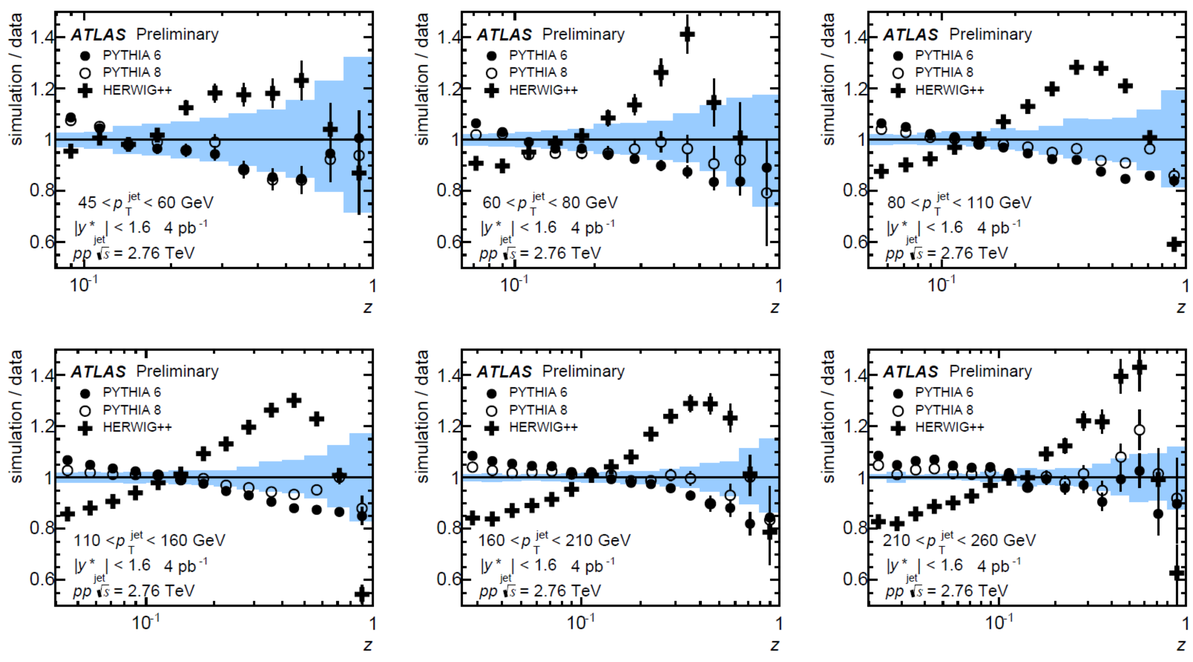
- In the absence of *pp* data at 5.02 TeV pp the reference was built by extrapolation of the measured *D*(*z*) in 2.76 TeV *pp* using PYTHIA 6.
- The same procedure was repeated using HERWIG++ MC generator.



Size of the extrapolation factors.

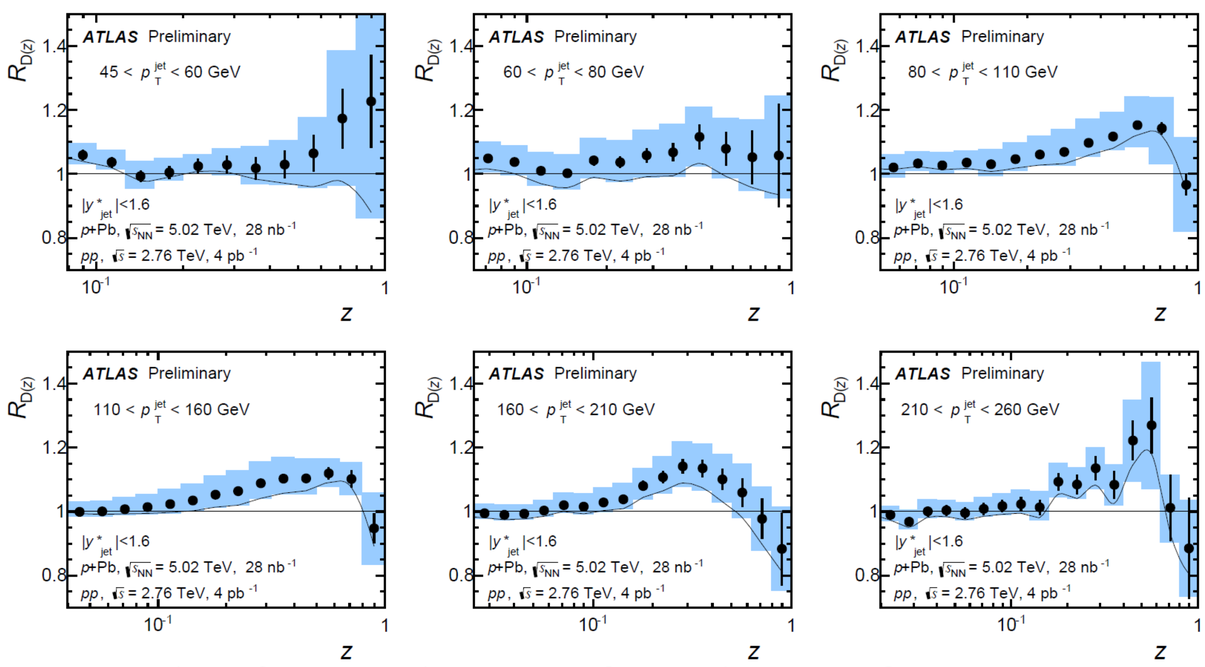
Results

Comparison of *pp* data and MC generators



- The MC generators show deviations from the *pp* data of up to approximately 30%.
- Significant differences between different MC models are observed.
- Different MC models have similar $\sqrt{s}$ evolution.

Comparison of *p*+Pb data to extrapolated *pp* reference



- An evidence for ~15% enhancement of $R_{D(z)}$ in the *z* region from 0.3 to 0.8.
- Correspond to the same range in p_T where the inclusive charged particle spectrum in *p*+Pb collisions is enhanced.
- The ratio is reduced when HERWIG++ is used for the extrapolation (black line).

References:
[1] ATLAS Collaboration, Phys. Lett. B739 (2014) 320-342.
[2] ATLAS Collaboration, Phys. Lett. B748 (2015) 392-413.
[3] ATLAS Collaboration, ATLAS-CONF-2014-029 (2014).
[4] ATLAS Collaboration, ATLAS-CONF-2015-022 (2015).
[5] ATLAS Collaboration, Phys. Lett. B719 (2013) 220-241.