In Situ Measurements of Jet Energy Scale in ATLAS
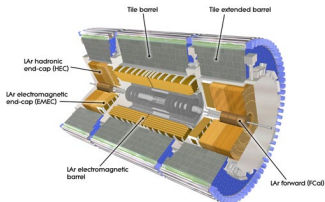
Doug Schouten[a,b], for the ATLAS Collaboration

[a]Simon Fraser University, [b]now at TRIUMF

Physics in Collisions 2011 - Vancouver

Introduction

- the jet energy scale strongly dependent on details of ATLAS calorimetry, but these will not be discussed here
- see *2008 JINST 3 S08003* for details of the ATLAS detector, if interested
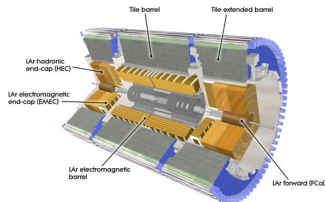
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- ▶ this presentation: **jet energy scale derived from 7 TeV collision data**, also using input from 2004 combined testbeam (CTB) and 900 GeV data

- ▶ **focus for the scale is on robustness**
  - ▶ resolution improvements with offline compensation techniques have recently arrived in ATLAS
  - ▶ overall uncertainty will continue to shrink as $\gamma + $ jet, multi-jet and track-jet *in situ* techniques mature, and as data accumulates

EM+JES Scheme
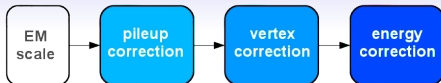
The EM scale correctly measures the energy of EM
showers. This is validated in $Z \to e^+ e^-$ events for the
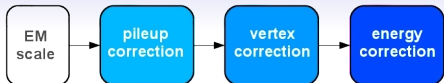EM LAr, and using MIP μ's for the Tile.

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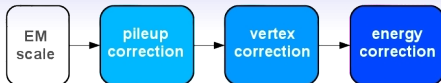
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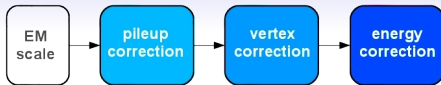
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Finally, a Monte Carlo based **energy correction**, $C(E, \eta)$, is applied that corrects to the particle level, within $\pm 2\%$[a]

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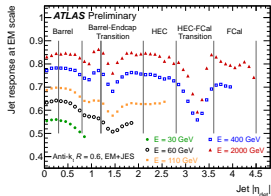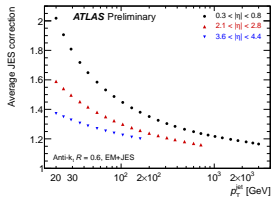
[a]See extra slides for more details on the procedure for extracting these corrections from the Monte Carlo.

Evaluating the EM+JES

▶ **overall strategy**: evaluate the JES by roughly factorizing the components of EM+JES, and verifying that the Monte Carlo description of each feature in the data is correct
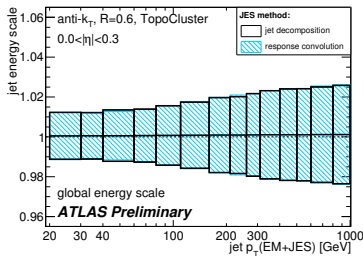
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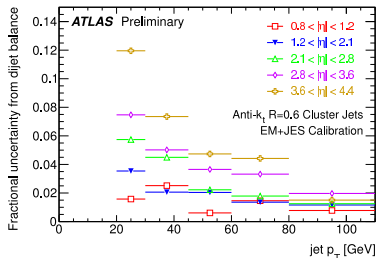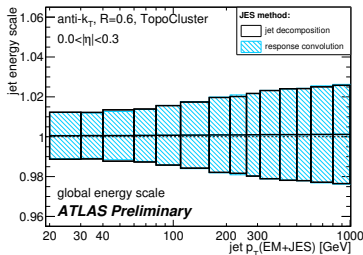| in situ measurement	JES uncertainty component
E/p **single particle response**	**central calorimeter response**
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$\langle E \rangle_{tower}$ & track-jets	multiple interactions

In Situ Results:

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In Situ Results:

JES Summary
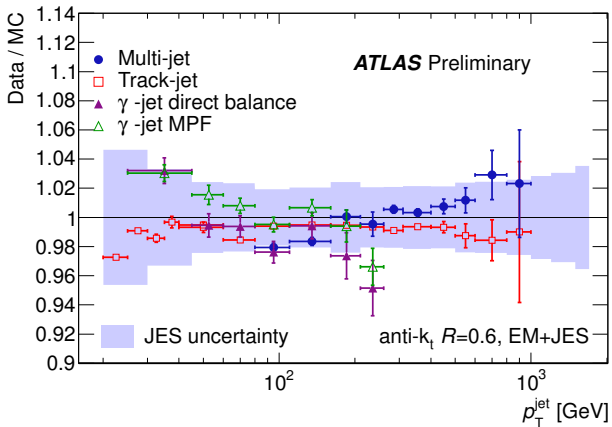
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3. local calibration scheme has been commissioned
   - results for local and sequential schemes already tested at jet level, and show good resolution improvement

EXTRA SLIDES

References

1. *Jet energy scale and its systematic uncertainty in proton-proton collisions at sqrt(s)=7 TeV in ATLAS 2010 data*, **ATLAS-CONF-2011-032**, 22 March 2011

2. *Determination of the ATLAS jet energy measurement uncertainty using photon-jet events in proton-proton collisions at sqrt(s) = 7 TeV*, **ATLAS-CONF-2011-031**, 18 March 2011

3. *In-situ jet energy scale and jet shape corrections for multiple interactions in the first ATLAS data at the LHC*, **ATLAS-CONF-2011-030**, 22 March 2011

4. *Probing the jet energy measurement at the TeV-scale with the multi-jet balance technique in proton-proton collisions at sqrt(s)=7 TeV with the ATLAS detector*, **ATLAS-CONF-2011-029**, 16 March 2011

5. *ATLAS Calorimeter Response to Single Isolated Hadrons and Estimation of the Calorimeter Jet Scale Uncertainty*, **ATLAS-CONF-2011-028**, 20 March 2011

6. *In-situ pseudorapidity intercalibration for evaluation of jet energy scale uncertainty using dijet events in proton-proton collisions at sqrt(s) = 7 TeV*, **ATLAS-CONF-2011-014**, 10 March 2011

Ingredients & Definitions

The goal of the JES calibration is to correct E and $\vec{p}$ of jets measured in the calorimeter to the corresponding truth reference jets.

Ingredients

- ▶ response non-compensation ($e/h > 1.3$ in ATLAS)
- ▶ inactive regions, leakage, and punch through
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Definitions

- ▶ the JES is defined for a particular class of "nominal" jets[a]:
  - ▶ in QCD dijet events (mostly jets from gluons)
  - ▶ isolated jets: $\Delta R(jet_i, jet_{j \neq i}) > 2.0$
  - ▶ nominal pileup scenario: $N_{PV} = 1$
- ▶ and with respect to a particular truth reference:
  - ▶ jets from final state, stable particles[b] excepting μ's and ν's
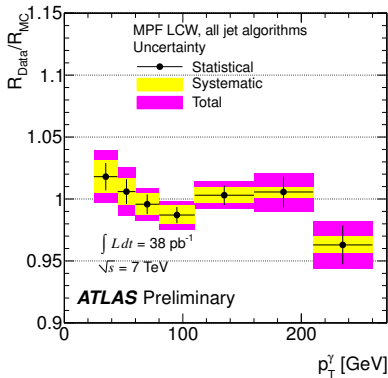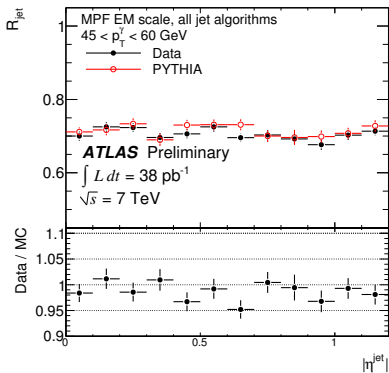 - ▶ matched to measured jets in $\Delta R < 0.3$

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[a]unless otherwise specified, all results shown are for jets defined with the anti-k_T algorithm[?], with a width parameter $D = 0.6$, built from 4/2/0 topological clusters

[b]stable is defined as $\tau > 10$ ps

Components of JES Uncertainty from Single Particle Response
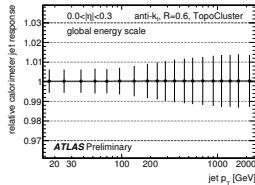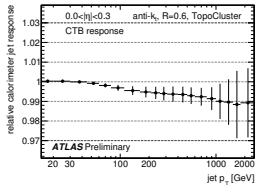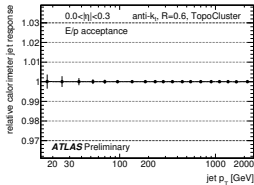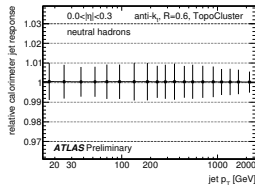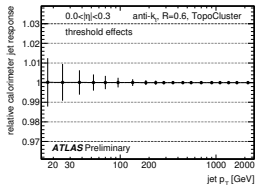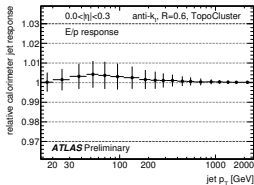
Extra Plots

Validating JES in η with MPF (left) and other calibration scheme, based on local hadronic response correction (right).