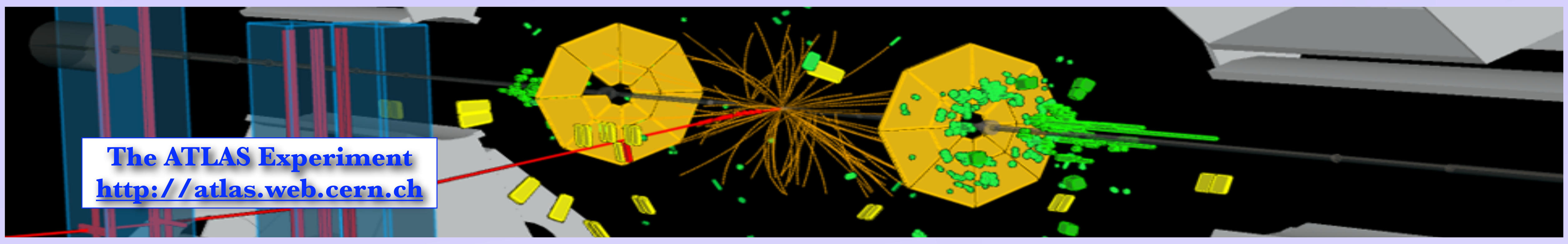

Single isolated hadron response and determination of the jet energy scale uncertainty with the ATLAS detector

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Introduction

The single charged hadron response has been measured for hadrons with momenta up to ~20 GeV using about 300 μb^{-1} of pp collisions at a cms energy $\sqrt{s}$=7 TeV up to $|\eta| < 2.3$. The track selection is discussed in [1].

The uncertainty on the response of the ATLAS calorimeter to single particles is convoluted using the Monte Carlo simulation to obtain the uncertainty on the calorimeter jet energy scale (JES).

Jet composition

On average [2]:

1) about 60% of the jet transverse momentum is carried by charged hadrons.

2) photons (produced in the $\pi^0 \to \gamma\gamma$ decay) carry 25% of the jet transverse momentum .

3) 15% of the jet transverse momentum is carried by neutral hadrons (neutrons and K^0_L)

Uncertainties

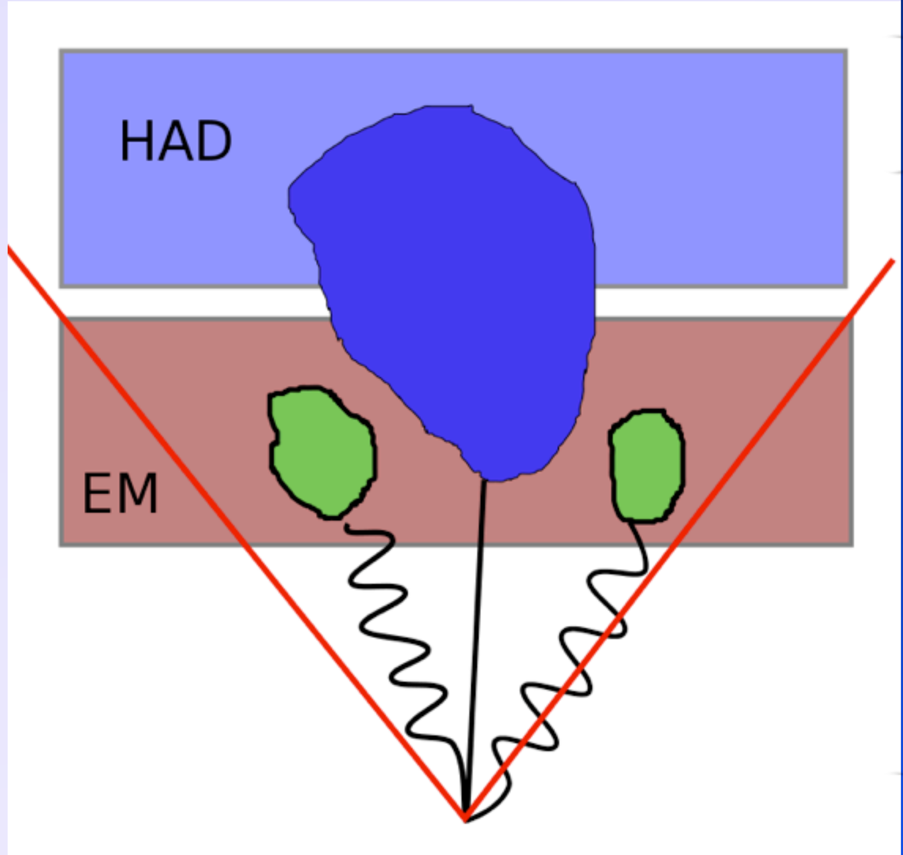
- Charged hadrons: uncertainty determined by the MC/data ratio value up to a momentum of 20 GeV with the E/P in situ measurement. Above 20 GeV the test beam results are used.
- Photons ($\pi^0 \to \gamma\gamma$ decay) 3% uncertainty coming from the level of knowledge of the absolute EM calorimeter scale (determined with a test beam) [3].
- Neutral hadrons (n, K_L^0): no experimental constraint exist on the calorimeter response to primary low energy hadron. 20% assumed.

Results

- The convoluted uncertainty on charged hadrons is about 1% and slightly dependent on momentum.
- The total uncertainty due to the absolute calorimeter scale is about 2%
- The calorimeter jet uncertainty is estimated to be about 3%.
- It is totally dominated by the uncertainty assumed on the neutral hadrons.

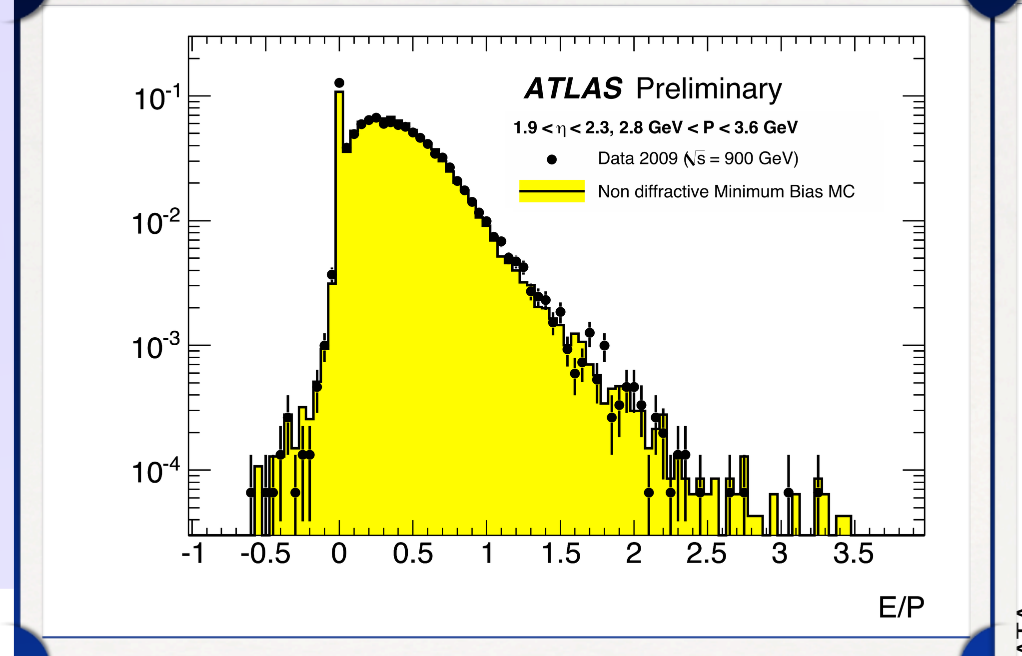
E/p - charged hadron response

The energy deposited by an isolated charged hadron in the calorimeter in a cone ΔR = 0.2 is divided by the associated track momentum (track isolation requirement ΔR = 0.4). Possible residual shower contamination (mainly from $\pi^0 \to \gamma\gamma$) is subtracted making use of events with late showering hadrons, where almost all the energy in the EM calorimeter is due to background [1]

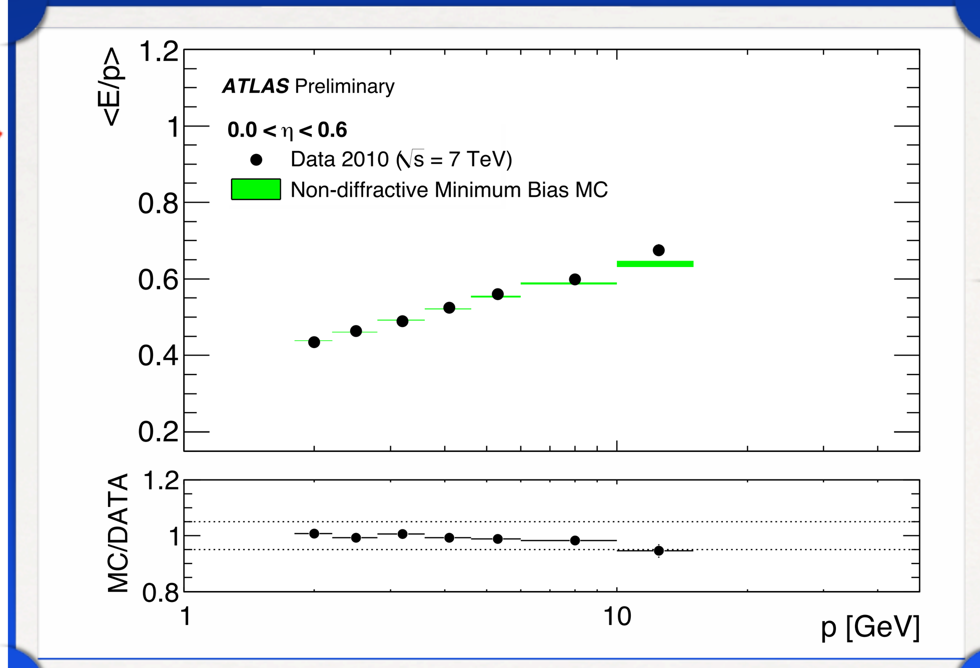


E/p - results

The mean value and RMS of the E/p distribution in bins of momentum and pseudorapidity obtained from pp collisions at $\sqrt{s}$=7 TeV is compared to that predicted by the Monte Carlo simulation. The agreement is within 5% for both quantities



a)



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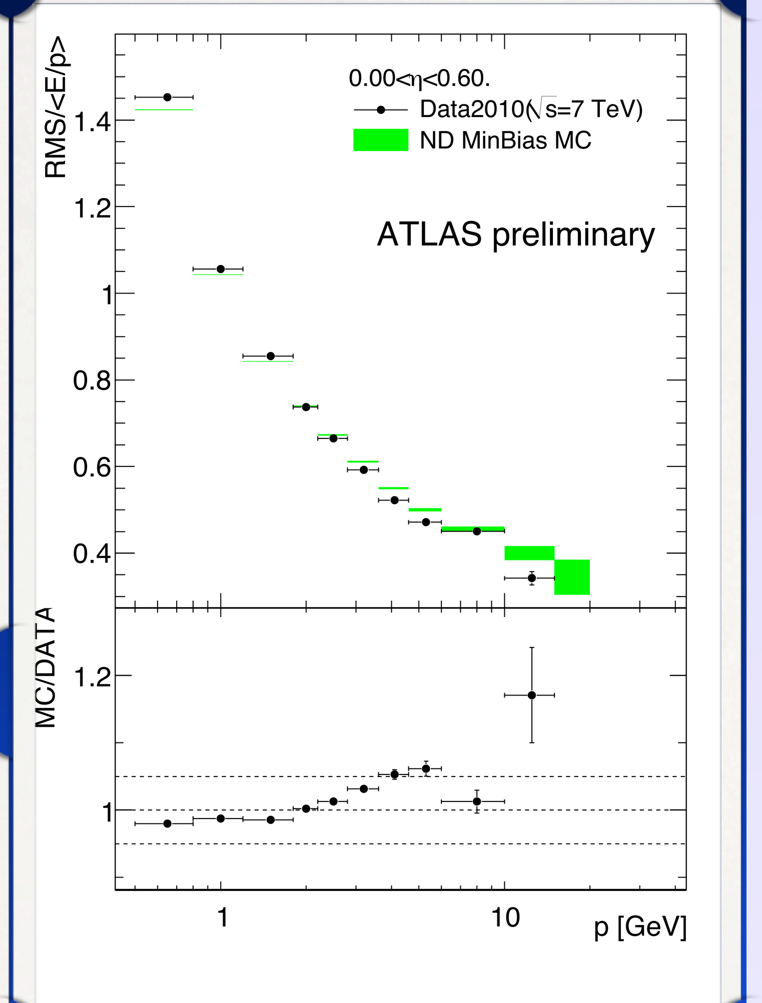


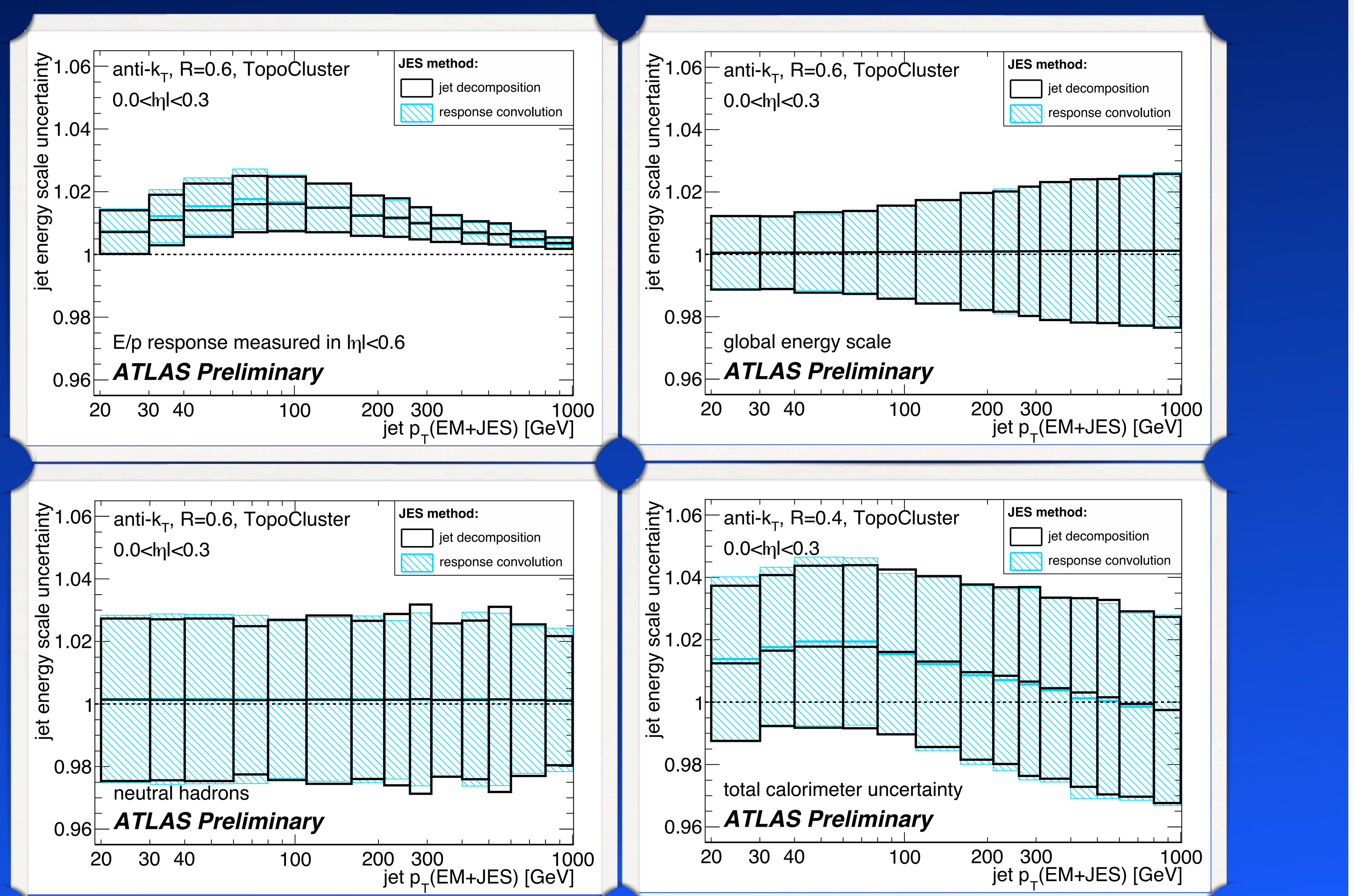
c)

a) Example of the E/P distribution.
b) <E/p> as a function of the track momentum in the central region of the detector
c) RMS(E/P) as a function of the track momentum in the central region of the detector

Calorimeter jet energy scale uncertainty

Using simulated QCD events, the event generator final state particles can be associated to jets. Two methods to make this association have been performed in ATLAS:

- Jet decomposition: Particles that contributed to the jet energy deposit in the calorimeter are identified using the Geant4 truth and associated to the jet.
- Response convolution: Truth jets are reconstructed from the event generator final state particles and associated to the calorimeter jets with a geometrical matching. Particles forming the truth jet are then associated to the calorimeter jet.



Conclusions

The ATLAS calorimeter response to single hadrons is reproduced by the simulation within 5%.

Single particle uncertainities have been propagated to jets using the Monte Carlo truth information.

The global calorimeter jet energy scale is estimated to be 3-4%.

References

[1] ATLAS Collaboration, *ATLAS Calorimeter Response to Single Isolated Hadrons and Estimation of the Calorimeter Jet Scale Uncertainty,* ATLAS-CONF-2010-052 (2010)

[2] ATLAS Collaboration, Expected Performance of the ATLAS Experiment, CERN-OPEN-2008-020 (2008)

[3] *ATLAS Electromagnetic Barrel Calorimeter Collaboration, M.Aharrouche et al., Energy linearity and resolution of the ATLAS electromagnetic barrel calorimeter in an electron test- beam,* Nucl. Instrum. Meth. **A568** (2006) arXiv:physics/0608012.