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Mean Charge Multiplicity and Transverse Structure of Hadronic Jets in pp Collisions at 7 TeV

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We present a study of the jet transverse structure based on a 78nb^{-1} integrated luminosity sample collected by the CMS experiment from pp collisions at $\sqrt{s} = 7$ TeV. The jet transverse structure is measured using the second moment of the charged hadron transverse jet profile. A comparison with predictions from different Monte Carlo generators is presented.

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1. Introduction

High energy partons (quarks and gluons) produced in hard hadron collisions are fragmented into hadrons and, thus, detected as bunches of high energy particles clustered into jets. In hadron-hadron collisions the jet shape provides a good test for different models of the hadronization. The current models of hadronisation (string scheme and the cluster model [1]) are implemented in PYTHIA [2] and HERWIG++ [3] Monte Carlo generators. The CMS detector is described elsewere [4]. This note is devoted to the analysis of the mean charge multiplicity and the jet transverse structure with a 78 nb^{-1} integrated luminosity sample of proton-proton collisions recorded by the CMS detector at a $\sqrt{s} = 7$ TeV.

2. Jet observables

The following observables are used to characterize the structure of jets [5]: N_{ch} and $\langle \delta R^2 \rangle$. The charged particle multiplicity in a jet, N_{ch}, is defined by the JetPlusTrack (JPT) algorithm [6]. The charged particle transverse jet shape variable was proposed in [7]: $\langle \delta R^2 \rangle = \langle \delta \phi^2 \rangle + \langle \delta \eta^2 \rangle$. The averages are defined as second moments using the transverse momenta $p_{T,i}$ of charged particles associated to a jet by the JPT algorithm:

$$\langle \delta\phi^2 \rangle = \sum_{i\in \text{jet}} (\phi_i - \phi_C)^2 \cdot p_{\text{T,i}} / \sum_{i\in \text{jet}} p_{\text{T,i}} \qquad \langle \delta\eta^2 \rangle = \sum_{i\in \text{jet}} (\eta_i - \eta_C)^2 \cdot p_{\text{T,i}} / \sum_{i\in \text{jet}} p_{\text{T,i}} \tag{2.1}$$

Here the means ϕ_C and η_C are defined as

$$\phi_C = \langle \phi \rangle = \sum_{i\in \text{jet}} \phi_i \cdot p_{\text{T,i}} / \sum_{i\in \text{jet}} p_{\text{T,i}} \qquad \eta_C = \langle \eta \rangle = \sum_{i\in \text{jet}} \eta_i \cdot p_{\text{T,i}} / \sum_{i\in \text{jet}} p_{\text{T,i}} \tag{2.2}$$

3. Charged Particle Momenta in Jets

Jets are reconstructed from calorimeter towers using the anti-k$_T$ clustering algorithm (R=0.5) [8] and corrected through the JPT algorithm [6] for the response to charged tracks as measured by the tracker. Tracks with $p_{T,ch} > 0.5$ GeV as selected by the JPT algorithm are used. The data are shown for a dijet sample of 6.7×10^5 events with a leading (second leading) jet $p_T > 20$ (10) GeV and $|\eta| < 1$. Jets with $p_T > 20$ GeV and $|\eta| < 1$ are included in the figures.

The sensitivity to parton radiation of the mean charged particle multiplicity N_{ch} and the charged particle transverse jet shape δR^2 is illustrated in Fig. 1 with a Monte Carlo (MC) simulation of QCD processes. The events are generated using Pythia6 and are subject to a detailed Monte Carlo simulation of the CMS detector and the same reconstruction that is used for data.

Figure 2 shows the measured averages of N_{ch} and δR^2 as a function of p_T^{jet}. Systematic uncertainties include a variation of the jet energy scale within the quoted uncertainty of 5% for JPT jets.

4. Conclusions

The charged particle multiplicity within jets, the transverse jet shape for charged particles have been measured at CMS using a first data set corresponding to an integrated luminosity of 78 nb^{-1}.

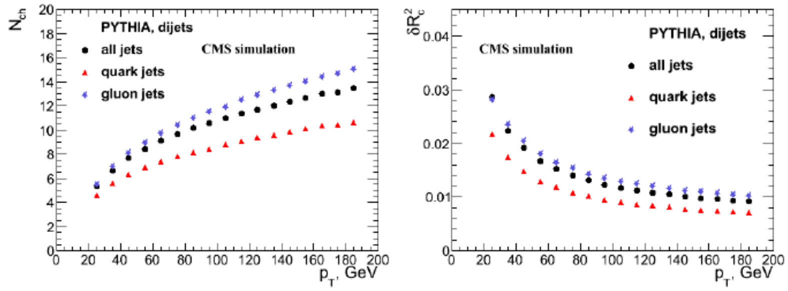

Figure 1: Simulated N_{ch} (left) and δR^2 (right) as a function of the jet $p_T$corrected with the JPT algorithm for quark, gluon and all jets for a dijet sample using the PYTHIA event generator.

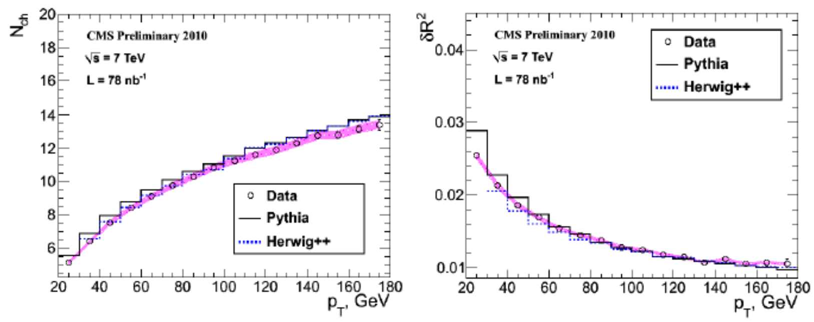

Figure 2: N_{ch} (left) and δR^2 (right) as function of JPT corrected jet p_T for a dijet sample. Data (cross symbols) are shown with statistical error bars and a band denoting systematic errors. Also shown are predictions based on the PYTHIA 6.401 tune D6T (filled histogram) and HERWIG 2.2.0 (solid line).

In the p_T range accessible at the moment, the measured data are described by the leading order QCD Pythia and Herwig predictions within the uncertainty of the measurement represented by the pink band in Fig. 2. At low jet transverse momentum ($20 < p_T < 50$ GeV) the predicted transverse jet shape as measured from charged particles differs from the measured data, with Pythia 6.401 and tune D6T predicting too narrow and Herwig 2.2.0 predicting too broad jets.

References

[1] B. R. Webber, arXiv:hep-ph/9912292 (1999).

[2] T. Sjostrand, S. Mrenna and P. Skands, hep-ph/0603175.

[3] M. Bahr et al., arXiv:0804.3053.

[4] CMS Collaboration, JINST 3:S08004,2008.

[5] CMS Collaboration, CMS PAS **QCD-10-014** (2010).

[6] CMS Collaboration, CMS PAS **JME-09-002** (2009).

[7] CMS Collaboration, CMS PAS **QCD-08-002** (2009).

[8] Cacciari M. and Salam G. and Soyez G, JHEP 0804:063 (2008).