The Compact Muon Solenoid Experiment

Conference Report

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Measurement of the inclusive jet cross section with the first data at 13 TeV at CMS

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Abstract

A measurement of the double-differential cross-section of inclusive jet as a function of jet transverse momentum p_T and absolute jet rapidity $|y|$ is presented. Data used for the analysis is obtained by the CMS experiment from proton-proton collisions at a centre-of-mass energy of 13 TeV at the LHC. The data samples correspond to integrated luminosities of 71 and 44 pb^{-1} for $|y| < 3$ and $3.2 < |y| < 4.7$, respectively. Jets are reconstructed with the anti- k_t clustering algorithm for two jet sizes, R , of 0.7 and 0.4, in a phase space region covering jet p_T up to 2 TeV and jet rapidity up to $|y| = 4.7$. Monte Carlo event generators can describe the difference in cross-section with the change of R parameter if parton showering, hadronization and multiple parton interactions are incorporated to the generator. In the new energy regime, this measurement confirms that jet physics is well understood as good as at a smaller centre-of-mass energy.

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Measurement of the double-differential inclusive jet cross section in proton-proton collisions at 13 TeV centre-of-mass energy with the Compact Muon Solenoid Detector

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Abstract. A measurement of the double-differential cross-section of inclusive jet as a function of jet transverse momentum p_T and absolute jet rapidity $|y|$ is presented. Data used for the analysis is obtained by the CMS experiment from proton-proton collisions at a centre-of-mass energy of 13 TeV at the LHC. The data samples correspond to integrated luminosities of 71 and 44 pb^{-1} for $|y| < 3$ and $3.2 < |y| < 4.7$, respectively. Jets are reconstructed with the anti- k_t clustering algorithm for two jet sizes, R , of 0.7 and 0.4, in a phase space region covering jet p_T up to 2 TeV and jet rapidity up to $|y| = 4.7$. Monte Carlo event generators can describe the difference in cross-section with the change of R parameter if parton showering, hadronization and multiple parton interactions are incorporated to the generator. In the new energy regime, this measurement confirms that jet physics is well understood as good as at a smaller centre-of-mass energy.

Keywords: QCD, jet physics, CMS

1 Introduction

Inclusive jet production ($p + p \rightarrow jet + X$) is a key process to test predictions of perturbative QCD (pQCD). To compare with measurements, the parton-level calculations must be complemented with corrections for nonperturbative effects with proper modeling of hadronisation and multiparton interactions. Results from previous measurements by CMS Collaborations[2] at centre-of-mass energies $\sqrt{s} = 2.76$ TeV and 7 TeV are described in [3] and [4], respectively. Here, a measurement of the double-differential inclusive jet cross section is presented as a function of the jet p_T and absolute jet rapidity $|y|$. A detailed description of the analysis is provided in [1]. The jets are clustered with the anti- k_t jet algorithm [5] as implemented in the Fast-Jet library [6]. Two jet sizes R are used: $R = 0.7$ and $R = 0.4$. The proton-proton collision data were recorded by the CMS experiment at a centre-of-mass energy of 13 TeV in 2015. The data samples correspond to integrated luminosities of 71 and 44 pb^{-1} for ranges in rapidity of $|y| < 3$ and $3.2 < |y| < 4.7$, respectively.

2 Event selection, jet reconstruction and measurement of the double-differential inclusive jet cross section

The measurement is based on data samples collected with eight single-jet high-level triggers (HLT) [7] with $p_T > 60, 80, 140, 200, 260, 300, 400$, or 450 GeV. Events are required to have at least one primary vertex.

The double-differential inclusive jet cross section is defined as:

$$\frac{d^2\sigma}{dp_T dy} = \frac{1}{\epsilon \mathcal{L}} \frac{N_j}{\Delta p_T \Delta y} \quad (1)$$

where $\mathcal{L}$ is the integrated luminosity, N_j is the number of jets in a bin of a width p_T in transverse momentum and y in rapidity, and ϵ is the product of the trigger and jet selection efficiencies, which is greater than 99%. The phase space in rapidity is subdivided into six bins from $y = 0$ to $|y| = 3$ with $|y| = 0.5$, and one bin from $|y| = 3.2$ to 4.7 , the forward rapidity region. The bin width in p_T is chosen in such a way that bin-to-bin migrations due to detector resolution are less than 50%. Figures 1 and 2 show the double-differential inclusive jet cross

Fig. 1. Double-differential inclusive jet cross section as function of jet p_T [1]. On the left, data (points) and predictions from NLOJet++ based on the CT14 PDF set corrected for the non-perturbative and electroweak effects (line) are shown. On the right, data (points) and predictions from Powheg (PH)[9] + Pythia8 (P8)[8] with tune CUETM1 (line) are shown. Jets are clustered with the anti- k_t algorithm ($R = 0.7$)

section measurements, presented as a function of p_T for seven $|y|$ ranges, after unfolding for detector effects, using the anti- k_t algorithm with $R = 0.7$ and 0.4 , respectively. The measurements are compared to the NLOJet++ predictions based on the CT14 PDF set, corrected for non-perturbative and electroweak effects (left), and to the predictions from Powheg + Pythia8 with tune CUETM1

Fig. 2. Double-differential inclusive jet cross section as function of jet p_T [1]. On the left, data (points) and predictions from NLOJet++ based on the CT14 PDF set corrected for the non-perturbative and electroweak effects (line) are shown. On the right, data (points) and predictions from Powheg (PH) + Pythia8 (P8) with tune CUETM1 (line) are shown. Jets are clustered with the anti- k_t algorithm ($R = 0.4$)

(right). The data are consistent with the predictions over a wide range of jet p_T from 114 GeV up to 2 TeV.

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