Available online at www.sciencedirect.com

ScienceDirect

Nuclear and Particle Physics Proceedings 270–272 (2016) 8–12

www.elsevier.com/locate/nppp

Jet production and α_s measurement at CMS. *

Giannis Flouris [1]

Department of Physics, University of Ioannina, Greece

Abstract

The measurements of inclusive jet, dijet and trijet cross sections, of the dijet azimuthal decorrelations, the ratio of the inclusive 3-jet to 2-jet cross sections are presented. The measurements use the samples of proton-proton collisions collected with the CMS detector at the LHC at a center-of-mass energy of 7 and 8 TeV.

Keywords: QCD, Jets, Strong coupling constant, CMS

1. Introduction

Jets are streams of particles clustered together; they are signatures of quarks and gluons in the detector. Despite the fact that jets are long-distance objects unlike constrained quarks, the factorization theorem can isolate the long distance contributions and render perturbative quantum chromodynamics (pQCD) into a useful tool for predictions and comparisons to experiment. QCD can be treated as a perturbative theory as long as the asymptotic freedom assumption is valid.

LHC produces jets in galore in high scales, allowing the study of the pQCD validity and measure the strong coupling constant and its running. This proceeding present five CMS measurements, two of them measured the strong coupling constant at mass of Z boson, $\alpha_s(M_Z)$. The inclusive jet differential cross section at 8 TeV [1][2], the dijet cross section at 8 TeV [3], the dijet azimuthal decorrelations at 8 TeV [4], the ratio of the inclusive 3-jet to the inclusive 2-jet cross setion and the extraction of the strong coupling constant at 7 TeV[5], and the measurement of the 3-jet mass cross section at 7 TeV and determination of $\alpha_s(M_Z)$ [6].

2. The Measurements

CMS measured the double differential cross section on transverse momentum, p_T, and rapidity, $|y|$, as a function of p_T in bins of $|y|$.

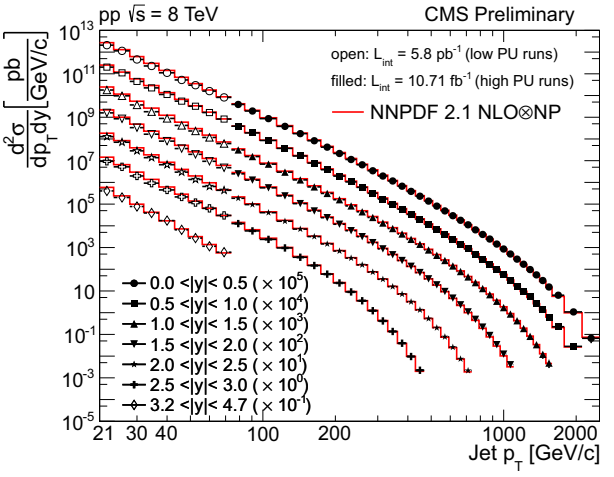

Figure 1: Double differential inclusive jet cross section measurement at 8 TeV compared to theory (red) using NNPDF2.1 and corrected for NP effects.

Figure 1 shows the measurement compared to theory (red line). The measurement consists of two datasets, one low pile-up (PU) and one high PU, corresponding to

*Talk given at 18th International Conference in Quantum Chromodynamics (QCD 15, 30th anniversary), 29 june - 3 july 2015, Montpellier - FR

[1] Speaker, on behalf of the CMS Collaboration.

http://dx.doi.org/10.1016/j.nuclphysbps.2016.02.003

low and high p_T region respectively. The cross section has been measured in six bins of $\Delta|y| = 0.5$ up to $|y| < 3.0$ and in one additional bin in the forward region $3.2 < |y| < 4.7$.

The theory in fig.1 has been calculated at next to leading order (NLO) using the NLOJet++[7, 8] parton generator within the fastNLO [9] framework. The parton density function (PDF) set used is the NNPDF2.1[10] and the theory is corrected for non-perturbative (NP) effects calculated from monte-carlo (MC) generators that simulate parton shower (PS) and multi-parton interactions (MPI). Theoretical calculations repeated with five different PDF sets, ABM11[11], CT10[12], HERAPDF1.5[13], and MSTW2008 [14]. Figure 2 shows the ratio of data over theory using CT10 of the innermost rapidity bin $|y| < 0.5$. Theoretical uncertainties consist of three sources, PDF, scale and $\alpha_s(M_Z)$ uncertainty. Most of the PDF sets describe data within uncertainties.

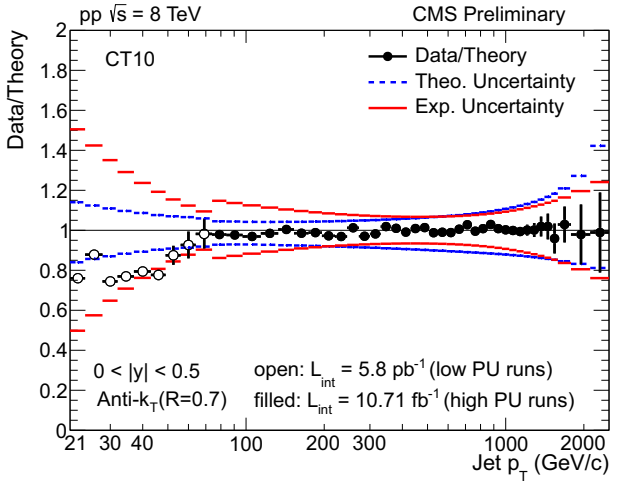

Figure 2: Ratio of data over theory using CT10 for the innermost rapidity bin $|y| < 0.5$. Error bars represent the statistical uncertainty.

Double differential cross section on dijet mass, M_{jj} and $|y|_{max}$ as a function of M_{jj} has also been measured by CMS at 8 TeV. The $|y|_{max}$ is defined by the maximum rapidity of the two leading jets $|y|_{max} = max(|y_1|, |y_2|)$. The measurement is performed in five bins of $\Delta|y|_{max} = 0.5$ and it recorded events with dijet invariant mass up to $M_{jj} = 5.5$ TeV. Figure 3 shows the comparison of data with NLO theoretical calculations using NNPDF2.1 and corrected for NP and electroweak (EWK) effects. Figure 4 shows the comparisons of data with theory using various PDF sets in the $|y|_{max} < 0.5$ region. The data are well described by most of the PDF sets within

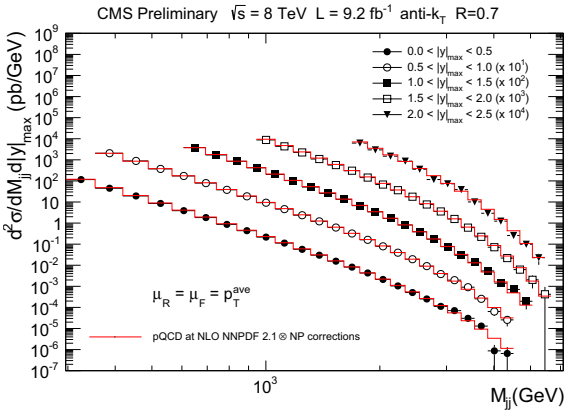

Figure 3: Dijet cross section measurement at 8 TeV compared to NLO theoretical calculations using NNPDF2.1.

uncertainties.

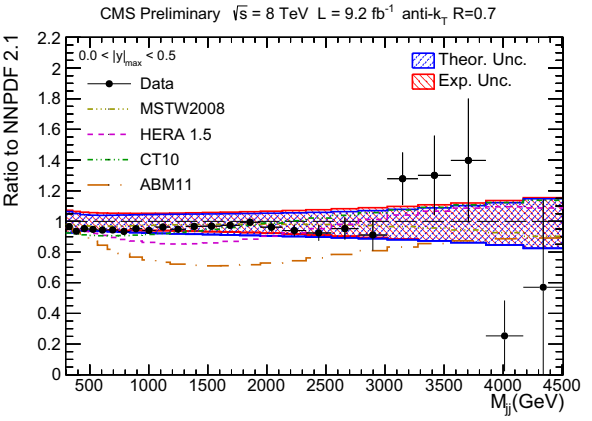

Figure 4: Dijet cross section measurement at 8 TeV compared to NLO theoretical calculations using NNPDF2.1.

The measurement of the dijet azimuthal decorrelations between the two leading jets at 8 TeV was studied in [4]. The analysis measured the normalized differential cross section on $\Delta\phi_{Dijet}$ as a function of $\Delta\phi_{Dijet}$ in bins of p_T^{max}. The $\Delta\phi_{Dijet}$ is defined as the azimuthal angle between the two leading jets and the p_T^{max} is the p_T of the leading jet. It is performed in seven p_T^{max} regions and it recorded jets up to $p_T = 2.2$ TeV. The measurement of the dijet azimuthal decorrelations probes multijet events by measuring only the azimuthal separation of the two leading jets. It is compared with 3-jet calculation at NLO and with various Monte Carlo event generators matched to PS. Figure 5 shows the measurement compared to the 3-jet NLO calculation