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Original Citation:
Measurements of differential jet cross sections in proton-proton collisions at root s=7 TeV with the CMS detector /

Availability:
This version is available at http://hdl.handle.net/11589/3378 since:

Published version
DOI:10.1103/PhysRevD.87.112002

Publisher:

Terms of use:
(Article begins on next page)

12 October 2024

Chatrchyan, S; Khachatryan, V; Sirunyan, Am; Tumasyan, A; Adam, W; Aguilo, E; Bergauer, T; Dragicevic, M; Ero, J; Fabjan, C; Friedl, M; Fruwirth, R; Ghete, Vm; Hammer, J; Hormann, N; Hrubec, J; Jeitler, M; Kiesenhofer, W; Knunz, V; Krammer, M; Kratschmer, I; Liko, D; Mikulec, I; Pernicka, M; Rahbaran, B; Rohringer, C; Rohringer, H; Schofbeck, R; Strauss, J; Taurok, A; Waltenberger, W; Wulz, Ce; Mossolov, V; Shumeiko, N; Gonzalez, Js; Bansal, M; Bansal, S; Cornelis, T; De Wolf, Ea; Janssen, X; Luyckx, S; Mucibello, L; Ochesanu, S; Roland, B; Rougny, R; Selvaggi, M; Van Haevermaet, H; Van Mechelen, P; Van Remortel, N; Van Spilbeeck, A; Blekman, F; Blyweert, S; D'Hondt, J; Suarez, Rg; Kalogeropoulos, A; Maes, M; Olbrechts, A; Van Doninck, W; Van Mulders, P; Van Onsem, Gp; Villella, I; Clerbaux, B; De Lentdecker, G; Dero, V; Gay, Apr; Hreus, T; Leonard, A; Marage, Pe; Mohammadi, A; Reis, T; Thomas, L; Vander Velde, C; Vanlaer, P; Wang, J; Adler, V; Beernaert, K; Cimmino, A; Costantini, S; Garcia, G; Grunewald, M; Klein, B; Lellouch, J; Marinov, A; Mccartin, J; Rios, Aao; Ryckbosch, D; Strobbe, N; Thyssen, F; Tytgat, M; Walsh, S; Yazgan, E; Zaganidis, N; Basegmez, S; Bruno, G; Castello, R; Ceard, L; Delaere, C; du Pree, T; Favart, D; Forthomme, L; Giammanco, A; Hollar, J; Lemaitre, V; Liao, J; Militaru, O; Nuttens, C; Pagano, D; Pin, A; Piotrzkowski, K; Garcia, Jmv; Beliy, N; Caebergs, T; Daubie, E; Hammad, Gh; Alves, Ga; Martins, Mc; Martins, T; Pol, Me; Souza, Mhg; Alda, Wl; Carvalho, W; Custodio, A; Da Costa, Em; Damiao, Dd; Martins, Cd; De Souza, Sf; Malbouisson, H; Malek, M; Figueiredo, Dm; Mundim, L; Nogima, H; Da Silva, Wlp; Santoro, A; Jorge, Ls; Sznajder, A; Pereira, Av; Anjos, Ts; Bernardes, Ca; Dias, Fa; Tomei, Tr; Gregores, Emfp; Lagana, C; Marinho, F; Mercadante, Pg; Novaes, Sf; Padula, Ss; Genchev, V; Iaydjiev, P; Piperov, S; Rodozov, M; Stoykova, S; Sultanov, G; Tcholakov, V; Trayanov, R; Vutova, M; Dimitrov, A; Hadjiiska, R; Kozhuharov, V; Litov, L; Pavlov, B; Petkov, P; Bian, Jg; Chen, Gm; Chen, Hs; Jiang, Ch; Liang, D; Liang, S; Meng, X; Tao, J; Wang, J; Wang, X; Wang, Z; Xiao, H; Xu, M; Zang, J; Zhang, Z; Asawatangtrakuldee, C; Ban, Y; Guo, Y; Li, W; Liu, S; Mao, Y; Qian, Sj; Teng, H; Wang, D; Zhang, L; Zou, W; Avila, C; Gomez, Jp; Moreno, Bg; Oliveros, Afo; Sanabria, Jc; Godinovic, N; Lelas, D; Plestina, R; Polic, D; Puljak, I; Antunovic, Z; Kovac, M; Brigljevic, V; Duric, S; Kadija, K; Luetic, J; Mekterovic, D; Morovic, S; Attikis, A; Galanti, M; Mavromanolakis, G; Mousa, J; Nicolaou, C; Ptochos, F; Razis, Pa; Finger, M; Finger, M; Assran, Y; Elgammal, S; Kamel, Ae; Mahmoud, Ma; Radi, A; Kadastik, M; Muntel, M; Raidal, M; Rebane, L; Tiko, A; Eerola, P; Fedi, G; Voutilainen, M; Harkonen, J; Heikkinen, A; Karimaki, V; Kinnunen, R; Kortelainen, Mj; Lampen, T; Lassila Perini, K; Lehti, S; Linden, T; Luukka, P; Maenpaa, T; Peltola, T; Tuominen, E; Tuominiemi, J; Tuovinen, E; Ungaro, D; Wendland, L; Banzuzi, K; Korpela, A; Tuuva, T; Besancon, M; Choudhury, S; Dejardin, M; Denegri, D; Fabbro, B; Faure, Jl; Ferri, F; Ganjour, S; Givernaud, A; Gras, P; de Monchenault, Gh; Jarry, P; Locci, E; Malcles, J; Millischer, L; Nayak, A; Rander, J; Rosowsky, A; Titov, M; Baffioni, S; Beaudette, F; Benhabib, L; Bianchini, L; Bluj, M; Busson, P; Charlot, C; Daci, N; Dahms, T; Dalchenko, M; Dobrzynski, L; Florent, A; de Cassagnac, Rg; Haguenauer, M; Mine, P; Mironov, C; Naranjo, In; Nguyen, M; Ochando, C; Paganini, P; Sabes, D; Salerno, R; Sirois, Y; Veelken, C; Zabi, A; Agram, Jl; Andrea, J; Bloch, D; Bodin, D; Brom, Jm; Cardaci, M; Chabert, Ec; Collard, C; Conte, E; Drouhin, F; Fontaine, Jc; Gele, D; Goerlach, U; Juillot, P; Le Bihan, Ac; Van Hove, P; Fassi, F; Mercier, D; Beauceron, S; Beaupere, N; Bondu, O; Boudoul, G; Chasserat, J; Chierici, R; Contardo, D; Depasse, P; El Mamouni, H; Fay, J; Gascon, S; Gouzevitch, M; Ille, B; Kurca, T; Lethuillier, M; Mirabito, L; Perries, S; Sgandurra, L; Sordini, V; Tschudi, Y; Verdier, P; Viret, S; Tsamalaidze, Z; Autermann, C; Beranek, S; Calpas, B; Edelhoff, M; Feld, L; Heracleous, N; Hindrichs, O; Jussen, R; Klein, K; Merz, J; Ostapchuk, A;

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12 October 2024

Measurements of differential jet cross sections in proton-proton collisions at $\sqrt{s} = 7$ TeV with the CMS detector

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(Received 29 December 2012; published 3 June 2013; publisher error corrected 12 June 2013)

Measurements of inclusive jet and dijet production cross sections are presented. Data from LHC proton-proton collisions at $\sqrt{s} = 7$ TeV, corresponding to 5.0 fb^{-1} of integrated luminosity, have been collected with the CMS detector. Jets are reconstructed up to rapidity 2.5, transverse momentum 2 TeV, and dijet invariant mass 5 TeV, using the anti-k_{T} clustering algorithm with distance parameter $R = 0.7$. The measured cross sections are corrected for detector effects and compared to perturbative QCD predictions at next-to-leading order, using five sets of parton distribution functions.

DOI: 10.1103/PhysRevD.87.112002 PACS numbers: 13.87.Ce, 12.38.Qk

I. INTRODUCTION

Events with high transverse momentum jets in proton-proton collisions are described by quantum chromodynamics (QCD) in terms of parton-parton scattering, where the outgoing scattered partons manifest themselves as hadronic jets. Measurements of the inclusive jet and dijet cross sections can be used to test the predictions of perturbative QCD, constrain parton distribution functions (PDFs) of the proton, differentiate among PDF sets, and look for possible deviations from the standard model.

In this paper, measurements of the double-differential inclusive jet ($p + p \to \text{jet} + X$) and dijet ($p + p \to \text{jet} + \text{jet} + X$) production cross sections are reported as functions of jet rapidity y and either jet transverse momentum p_{T} or dijet invariant mass M_{jj}, at $\sqrt{s} = 7$ TeV. The data were collected with the Compact Muon Solenoid (CMS) detector at the CERN Large Hadron Collider (LHC) during the 2011 run and correspond to an integrated luminosity of 5.0 fb^{-1}, 2 orders of magnitude larger than the published LHC results from the 2010 run [1–3]. Jets are reconstructed up to rapidity 2.5, transverse momentum 2 TeV, and dijet invariant mass 5 TeV. The measured cross sections are corrected for detector effects and compared to the next-to-leading-order QCD predictions.

II. APPARATUS

The CMS coordinate system has its origin at the center of the detector, with the z axis pointing along the direction of the counterclockwise beam. The azimuthal angle is denoted as ϕ, the polar angle as θ, and the pseudorapidity is defined as $\eta = -\ln[\tan(\theta/2)]$. The central feature of the CMS detector is a superconducting solenoid, of 6 m internal diameter, that produces an axial magnetic field of 3.8 T. Within the field volume are a silicon pixel and strip tracker, a lead tungstate crystal electromagnetic calorimeter (ECAL), and a brass/plastic scintillator hadronic calorimeter. Outside the field volume and in the forward region ($3 < |\eta| < 5$) is an iron/quartz-fiber hadronic calorimeter. Muons are measured in gas ionization detectors embedded in the steel return yoke outside the solenoid, in the pseudorapidity range $|\eta| < 2.4$. A detailed description of the CMS apparatus can be found in Ref. [4].

III. JET RECONSTRUCTION

The rapidity y and the transverse momentum p_{T} of a jet with energy E and momentum $\vec{p} = (p_x, p_y, p_z)$ are defined as $y = (1/2)\ln[(E + p_z)/(E - p_z)]$ and $p_{\mathrm{T}} = \sqrt{p_x^2 + p_y^2}$. The inputs to the jet clustering algorithm are the four-momentum vectors of the reconstructed particle candidates. Each such candidate is constructed using the particle-flow technique [5], which combines the information from several subdetectors and is calibrated to account for the nonlinear and nonuniform response of the CMS calorimetric system to hadrons. Jets are reconstructed using the anti-k_{T} clustering algorithm [6] with distance parameter $R = 0.7$. The clustering is performed using four-momentum summation with the FASTJET package [7], where the chosen distance parameter allows for the capture of most of the parton shower and improves the dijet mass resolution with respect to smaller sizes. The total transverse energy ΣE_{T} and missing transverse energy $\vec{E}_{\mathrm{T}}^{\mathrm{miss}}$ are used in the event selection and are derived from the reconstructed particle-flow objects. They are defined as $\Sigma E_{\mathrm{T}} = \sum_i E_{\mathrm{T}i}$, with $E_{\mathrm{T}i} = E_i \sin\theta_i$, and $\vec{E}_{\mathrm{T}}^{\mathrm{miss}} = -\sum_i (E_i \sin\theta_i \cos\phi_i \hat{\mathbf{x}} + E_i \sin\theta_i \sin\phi_i \hat{\mathbf{y}})$, where the sum refers to all particle candidates and $\hat{\mathbf{x}}, \hat{\mathbf{y}}$ are the unit vectors in the direction of the x and y axes.

The reconstructed jets require a small additional energy correction, mostly due to thresholds on reconstructed tracks and clusters in the particle-flow algorithm, and

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various reconstruction inefficiencies. These jet energy corrections are derived using simulated events, generated by PYTHIA6 (version 6.4.22) [8] and processed through the CMS detector simulation based on GEANT4 [9], and *in situ* measurements with dijet, photon + jet, and Z + jet events [10]. These jet energy corrections correct reconstructed jets to the hadron level, as opposed to the parton level. An offset correction is also applied to account for the extra energy from additional proton-proton interactions within the same or neighboring bunch crossings (in-time and out-of-time pileup) [10]. The pileup effects are important for the lowest-p_T jets (10% jet energy scale correction and 1% systematic uncertainty [11] for jets with $p_T \sim$ 100 GeV) and progressively decrease with jet p_T. For jets with $p_T > 200$ GeV the pileup effects are negligible. The jet energy correction depends on η and p_T of the jet, and is applied as a multiplicative factor to the jet four-momentum vector. The factor is typically between 1.0 and 1.2 and is approximately uniform in η. For a jet $p_T = 100$ GeV the factor is 1.1, decreasing towards 1.0 with increasing p_T. The typical jet p_T resolution is 10% at $p_T = 100$ GeV. The dijet mass M_{jj} is calculated from the corrected four-momentum vectors of the two jets with the highest p_T (leading jets). The relative dijet mass resolution, estimated from the simulation, ranges from 7% at $M_{jj} =$ 0.2 TeV to 3% at $M_{jj} = 3$ TeV.

IV. DATA SAMPLES AND EVENT SELECTION

The data samples used for this measurement were collected with single-jet high-level triggers (HLT) [12] that require at least one jet in the event to have $p_T > 60$, 110, 190, 240, or 370 GeV, respectively, in corrected jet transverse momentum. The online jet reconstruction uses only calorimetric information and the resulting HLT jets typically have worse energy resolution than the offline particle-flow jets. The lower-p_T triggers were prescaled and the corresponding integrated luminosity of each trigger sample, $\mathcal{L}_{eff}$, is listed in Table I. In the offline analysis, events are required to have at least one well-reconstructed proton-proton interaction vertex [13]. In order to suppress nonphysical jets, i.e., jets resulting from noise in the electromagnetic and/or hadronic calorimeters, the jets are required to satisfy the following identification criteria. Each jet should contain at least two particles, one of which is a charged hadron, and the jet energy fraction carried by neutral hadrons and photons should be less than 90%. These criteria have an efficiency of greater than 99% for physical jets, while the probability for a nonphysical jet to pass the criteria is less than 10^{-6}.

TABLE I. The integrated luminosity for each of the data samples.

Min. jet trigger p_T (GeV)	60	110	190	240	370
Jet trigger name	Jet60	Jet110	Jet190	Jet240	Jet370
$\mathcal{L}_{eff}$ (pb^{-1})	0.41	7.3	152	512	4980

The inclusive single-jet cross section measurements are made in five rapidity regions of size $\Delta|y| = 0.5$ over the range 0.0–2.5. Jets that do not satisfy the jet identification criteria are discarded and events are required to contain at least one jet that satisfies these criteria. In order to avoid any trigger bias, the jets are additionally required to have $p_T > 110$, 200, 300, 360, and 510 Gev for the five single-jet HLT triggers used, respectively. Figure 1 (top) shows the trigger efficiency as a function of the jet p_T, for the central rapidity bin $|y| < 0.5$ and for the highest trigger threshold. The efficiency of each trigger path has been measured using events collected with a lower threshold single-jet trigger and confirmed with events collected with single-muon triggers.

Background events due to instrumental noise, beam halo effects, or proton-proton collisions with leptons in the final state that might survive the jet identification criteria are further suppressed by requiring $E_T^{miss}/\Sigma E_T < 0.3$. Hard QCD processes do not generate true E_T^{miss} and because of the good energy resolution the measured values of E_T^{miss} in such events are small compared to the total transverse energy. Hence, the distribution of the variable $E_T^{miss}/\Sigma E_T$ peaks close to zero for QCD events, while some background events give larger values. Figure 2 (top) shows a

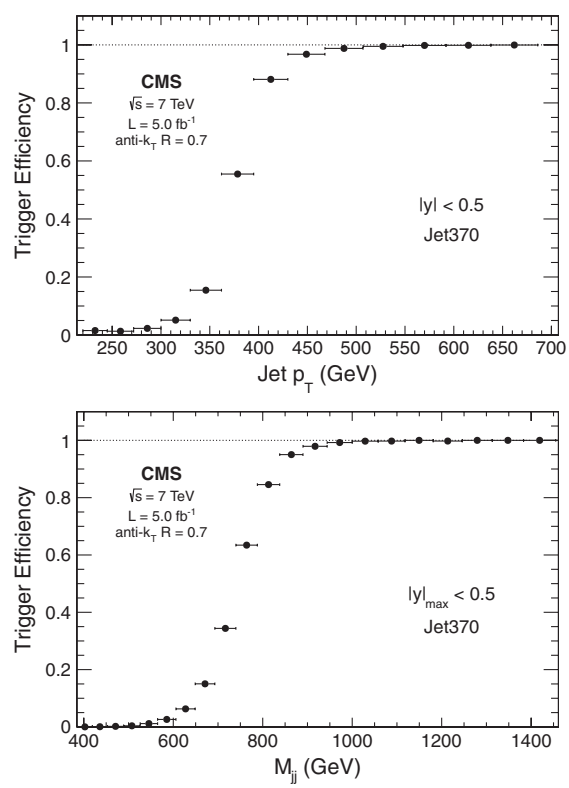

FIG. 1. Trigger efficiency as a function of the jet p_T (top) and dijet mass M_{jj} (bottom) for the 370 GeV single-jet trigger and for the central rapidity bins.

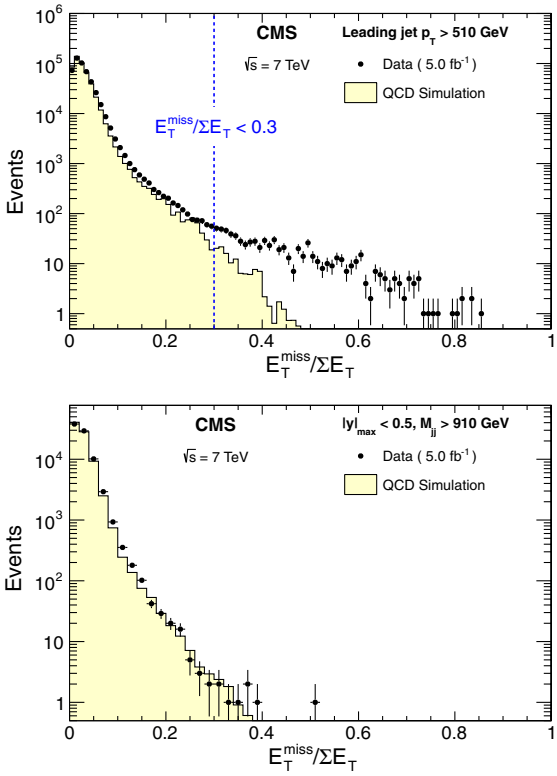

FIG. 2 (color online). Distribution of $E_T^{miss}/\Sigma E_T$ for data events (black points) and simulated QCD events (continuous line) with at least one jet with $p_T > 510$ GeV (top) and for dijet events with $|y|_{max} < 2.5$ and $M_{jj} > 910$ GeV (bottom), collected with the 370 GeV single-jet trigger. The distribution from the inclusive jet selection is shown before the offline selection $E_T^{miss}/\Sigma E_T < 0.3$. The larger tail in the data is caused by other processes with true E_T^{miss} [such as Z + jet(s), where the Z boson decays to neutrinos, and W + jet(s), where the W boson decays to leptons].

typical distribution of the variable $E_T^{miss}/\Sigma E_T$ for events with at least one jet with $p_T > 510$ GeV, collected with the 370 GeV single-jet trigger. The data points exceed the QCD predictions at large values of E_T^{miss}. This tail is dominated by processes such as Z + jet(s), where the Z boson decays to neutrinos, and W + jet(s), where the W boson decays to leptons. No events from instrumental and beam halo effects were found to survive the jet identification criteria, and therefore the additional $E_T^{miss}/\Sigma E_T$ selection only removes events from processes that produce true E_T^{miss}.

For the dijet measurement, at least two jets with $p_{T1} > 60$ GeV and $p_{T2} > 30$ GeV and satisfying the tight identification criteria are required. If either of the two leading jets fails the identification criteria, the event is discarded. The dijet measurement is performed in five rapidity regions of size $\Delta|y_{max}| = 0.5$, defined by the maximum absolute rapidity $y_{max} = \mathrm{sign}(|\max(y_1, y_2)| - |\min(y_1, y_2)|) \cdot \max(|y_1|, |y_2|)$ of the two leading jets in the event. The use of the variable $|y|_{max} \equiv |y_{max}|$ divides the phase space of the dijet system into exclusive rapidity bins, which correspond to different scattering angles in the center-of-mass frame.

Low values of $|y|_{max}$ probe s-channel scattering at large angles, while large values of $|y|_{max}$ probe t-channel scattering at small angles. For each rapidity bin the trigger efficiency is expressed as a function of M_{jj}, and the events are required to satisfy a minimum mass threshold, which increases with $|y|_{max}$. Figure 1 (bottom) shows the trigger efficiency for the central rapidity bin and for the highest trigger threshold. Because of the dijet topology, no further cut is needed on the $E_T^{miss}/\Sigma E_T$ variable, as can be seen in Fig. 2 (bottom).

V. MEASUREMENT OF THE DIFFERENTIAL JET AND DIJET CROSS SECTIONS

In this section the reconstruction of the jet transverse momentum and dijet mass spectra from the different samples is presented. Then the unfolding procedure, which translates the reconstructed spectra into true spectra, is described. Finally, the experimental uncertainties related to the measurements are described and discussed.

A. Determination of transverse momentum and dijet mass spectra

The jet p_T (dijet invariant mass) spectrum is obtained by populating each bin with the number of jets (events) collected using the highest threshold trigger which gives more than 99% trigger efficiency. Then, the yields from each trigger path are scaled according to the corresponding prescale value for this path (effective luminosity), as shown in Table I. Figure 3 shows the reconstructed spectra for inclusive jets (top) and dijets (bottom), in the central rapidity bin, decomposed into the five contributing trigger paths.

The observed inclusive jet yields are transformed into double-differential cross sections as follows:

$$\frac{d^2\sigma}{dp_T dy} = \frac{1}{\epsilon \cdot \mathcal{L}_{eff}} \frac{N_{jets}}{\Delta p_T (2 \cdot \Delta|y|)}, \tag{1}$$

where N_{jets} is the number of jets in the bin, $\mathcal{L}_{eff}$ is the integrated luminosity of the data sample from which the events are taken, ϵ is the product of the trigger and event selection efficiencies, both of which are greater than 99%, and Δp_T and $\Delta|y|$ are the transverse momentum and rapidity bin widths, respectively. The width of the p_T bins is proportional to the p_T resolution and so increases with p_T. The statistical uncertainty assigned to each p_T bin takes into account the number of independent events that contribute at least one jet in the bin. The largest fraction (more than 90%) of the observed jets in each p_T bin originates from different events; however, a small fraction of events contributes more than one jet. Such events are

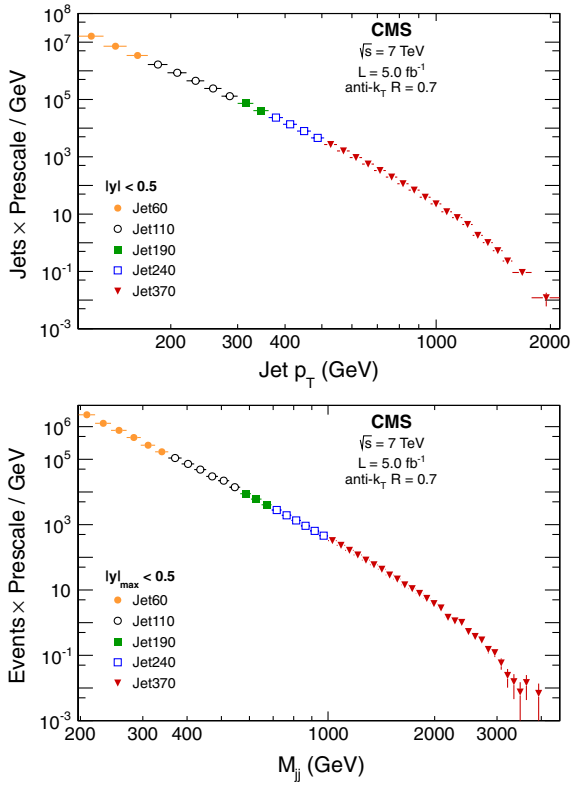

FIG. 3 (color online). Spectrum construction from individual trigger paths. Top: inclusive jet p_T spectrum for $|y| < 0.5$. Bottom: dijet mass spectrum for $|y|_{max} < 0.5$. The different markers indicate different trigger paths.

typically back-to-back dijet events, so closely balanced in p_T that both jets end up in the same $|y|$ and p_T bin.

The statistical uncertainty in the number of jets in a bin is $e_{stat} = \sqrt{(4-3f)/(2-f)} \cdot \sqrt{N_{jets}}$, where $f = N_1/N_{ev}$ is the fraction of events that contribute one jet in the given bin. The formula is valid under the assumption that the number of events that contribute more than two jets in each bin is negligible, which has been verified for the current measurement.

The observed dijet yields are transformed into double-differential cross sections as follows:

$$\frac{d^2\sigma}{dM_{jj}dy_{max}} = \frac{1}{\epsilon \cdot \mathcal{L}_{eff}} \cdot \frac{N}{\Delta M_{jj}(2 \cdot \Delta|y|_{max})}, \qquad (2)$$

where ΔM_{jj} and $\Delta|y|_{max}$ are the mass and rapidity bin widths, respectively. The size of the dijet mass bins is approximately equal to or larger than the mass resolution at the bin center, while the bins at the edge of the spectrum have been merged to assure a minimal number of events in each bin.

B. Unfolding

Because of the detector resolution and the steeply falling spectra, the measured differential cross sections are smeared with respect to the particle-level cross sections. Each p_T and mass bin contains events that have migrated in from neighboring bins and is missing events that have migrated out. For a steeply falling spectrum more events migrate into a bin than out. In order to allow for a direct comparison of experimental measurements with corresponding results from other experiments and with QCD predictions, the spectra are unfolded in order to correct for detector effects. The response matrix is obtained from the detector simulation and corrected for the measured differences in the resolution between data and simulation [10]. Figure 4 shows the response matrices for the jet p_T (top) and the dijet mass (bottom) in the central rapidity bins. The unfolding is done with the RooUnfold package [14] using the D'Agostini method [15].

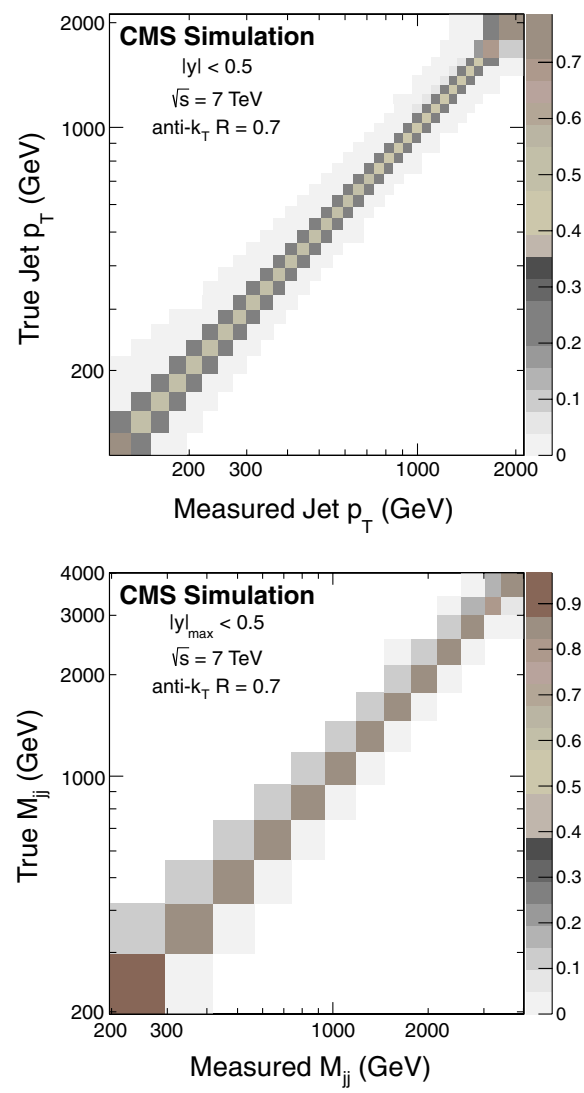

FIG. 4 (color online). Response matrices for the inclusive jet p_T spectrum (top) and the dijet mass spectrum (bottom) in the central rapidity bins.

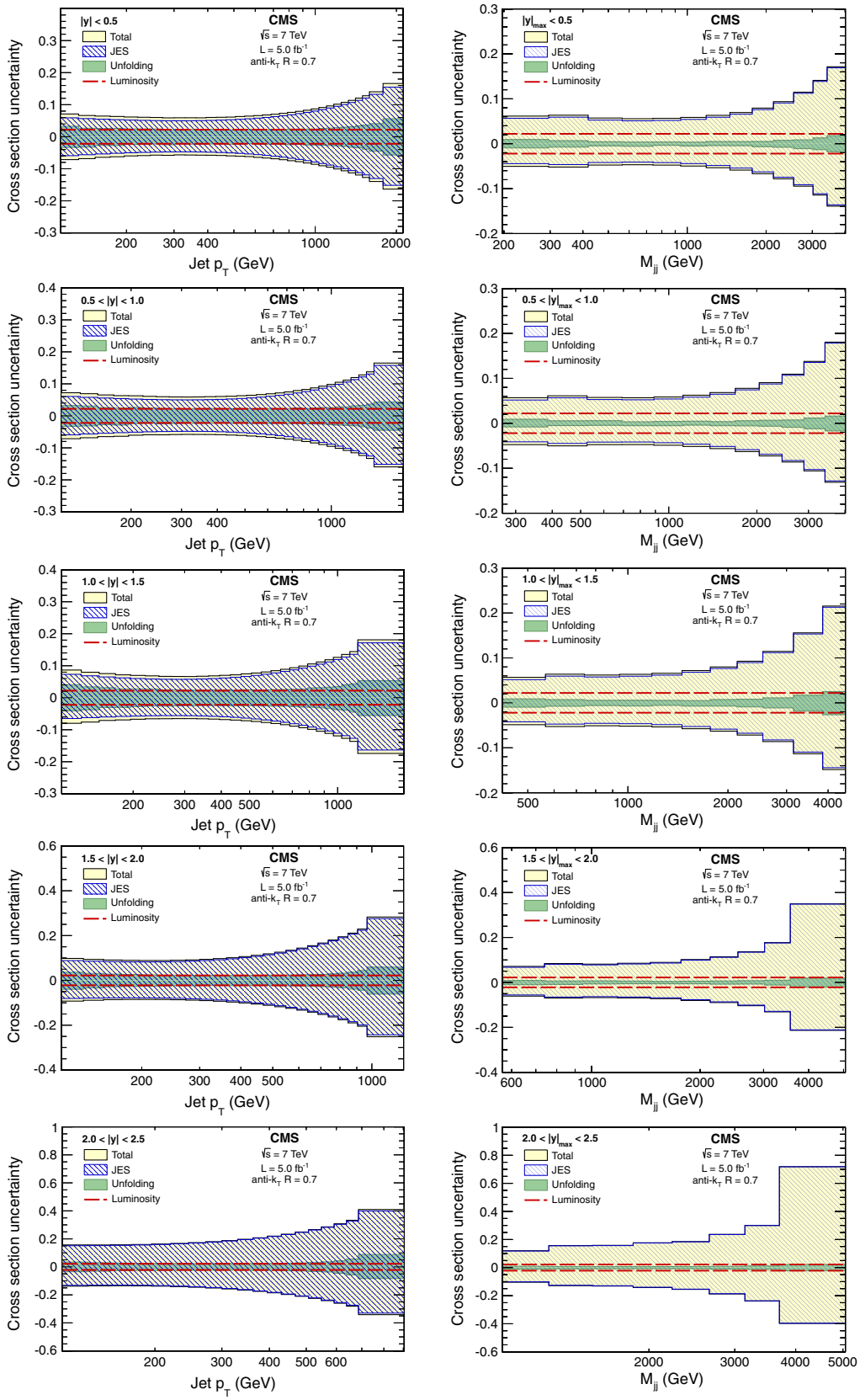

FIG. 5 (color online). Effect of the relative experimental uncertainties for the inclusive jet (left column) and dijet (right column) cross section measurements, and for all five $|y|$ and $|y|_{\max}$ bins, respectively. The upward and downward uncertainties are estimated separately.

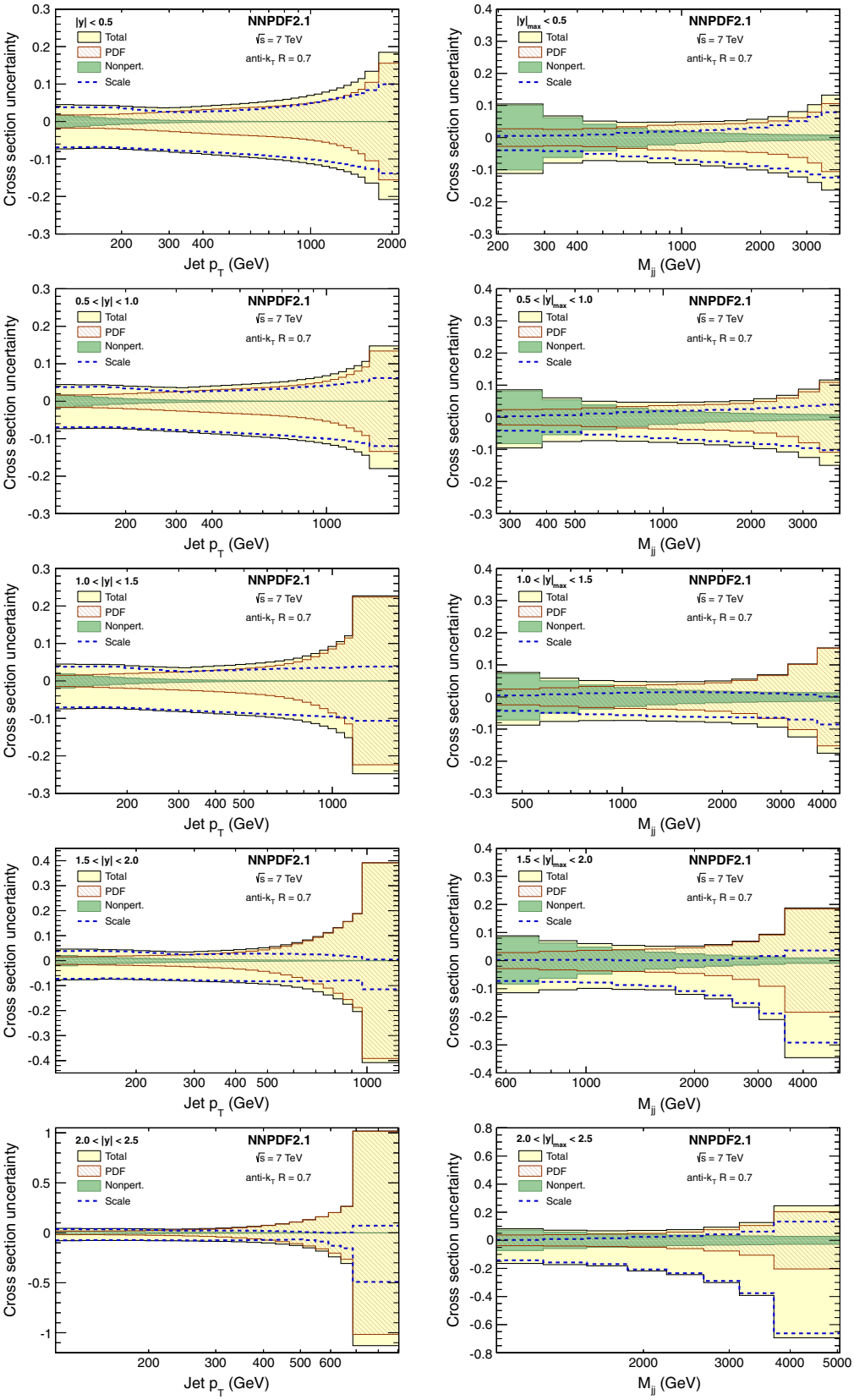

FIG. 6 (color online). Effect of the relative theoretical uncertainties for the inclusive jet (left column) and dijet (right column) cross section measurements for all five $|y|$ and $|y|_{\max}$ bins, respectively. The upward and downward uncertainties are estimated separately.

C. Experimental uncertainties

The dominant experimental uncertainties are related to the jet energy scale (JES), the luminosity, and the jet p_T resolution. Other sources of systematic uncertainty, such as the jet angular resolution, are negligible. The agreement of the results for positive and negative rapidities has also been confirmed. Figure 5 shows the effects of the experimental uncertainties in all rapidity bins for the cross section measurements. For rapidities up to $|y| = 1.5$ the total uncertainty of both cross sections ranges from 5% at low p_T or M_{jj} to 20% at high p_T or M_{jj}, respectively. For higher rapidities the total uncertainty increases to 10%–30% in both cases, with the exception of the highest dijet mass bin in the outer rapidity region of $2.0 < |y|_{max} < 2.5$, where the uncertainty is substantially larger. A discussion of the individual contributions to the uncertainty follows.

1. Jet energy scale uncertainty

The jet energy scale is the dominant source of systematic uncertainty. Because of the steep slope of the p_T spectrum, a small uncertainty in the p_T scale translates into a large uncertainty in the cross section for a given value of p_T. The jet energy scale uncertainty is dependent on p_T and η and has been estimated to be 2.0%–2.5% [11]. The individual, uncorrelated contributions to the JES uncertainty have been estimated and are discussed below.

The JES uncertainty sources account for the p_T and η dependence of the JES within the total uncertainty. For the phase space of jets considered here, 16 mutually uncorrelated sources contribute to the total uncertainty, where each such source represents a signed 1σ variation from a given systematic effect for each point in (p_T, η). Summing up separately the positive or negative variations of the sources in quadrature will reproduce the total upward and downward JES uncertainties at each point. The uncertainties from all 16 independent sources are included in the Supplemental Material [16] and in the HEPDATA record for this paper; the cross section measurements and other details are also tabulated therein.

The uncertainty sources are divided into four broad categories: pileup effects, relative calibration of jet energy scale versus η, absolute energy scale including p_T dependence, and differences in quark- and gluon-initiated jets. The first category, containing pileup effects, has relatively little impact on the analyses presented in this paper.

The second category, containing η-dependent effects, parametrizes the possible relative variations in JES, which for the dijet and inclusive jet analyses lead to correlations between rapidity bins. In principle these effects could also have a p_T dependence, but systematic studies on data and Monte Carlo (MC) events indicate that the p_T and η dependence of the uncertainties factorize to a good approximation.

The third category deals with the uncertainty in the absolute energy scale and its p_T dependence and is the most relevant one for these analyses. The photon + jet and Z + jet events only constrain the JES directly in a limited jet p_T range of about 30–600 GeV, and the response at higher (and lower) p_T is estimated by MC simulation. The p_T-dependent uncertainty arising from modeling of the underlying event and jet fragmentation is obtained by comparing predictions from PYTHIA6 and HERWIG++. Most studies show that both generators agree with the data with differences comparable to those seen between data and MC. The uncertainty arising from the calorimeter response to single hadrons is estimated by varying the response parametrization by ±3% around the central value. The final uncertainty arises from differences in the JES for quark- and gluon-initiated jets and is determined from MC studies.

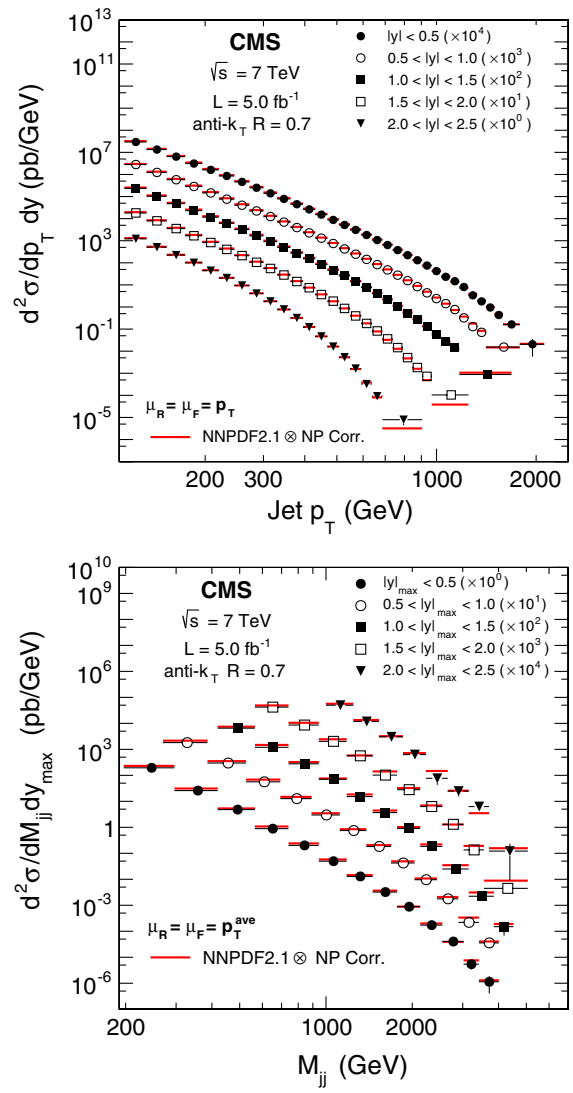

FIG. 7 (color online). Inclusive jet (top) and dijet (bottom) cross sections for the five different rapidity bins, for data (markers) and theory (thick lines) using the NNPDF2.1 PDF set.

2. Luminosity uncertainty

The luminosity uncertainty is estimated to be 2.2% [17], which can be directly translated into a 2.2% uncertainty on the cross section normalization. It is fully correlated across all p_T and mass bins.

3. Unfolding uncertainty

The unfolding correction is closely related to the dependence on the p_T and M_{jj} resolution and the spectrum slope. For the inclusive jet p_T spectrum it varies between 5% and 10%, while for the dijet mass spectrum it ranges between 2% and 5%. The shape of the unfolding correction and uncertainty as displayed in Fig. 5 is understood as follows: the resolution in the observable, p_T or M_{jj}, improves when going from low to high values. As a consequence the effect of smearing is more pronounced in the lower p_T or M_{jj} region. On the other hand the p_T and M_{jj} spectra become steeper when approaching the kinematic limit at high p_T or M_{jj}, leading again to a larger smearing effect than observed at medium values.

The uncertainty introduced by the unfolding is caused by the modeling of the jet p_T (dijet mass) resolution and the jet p_T (dijet mass) spectrum in the simulation. In order to estimate the sensitivity of the correction to these inputs, the

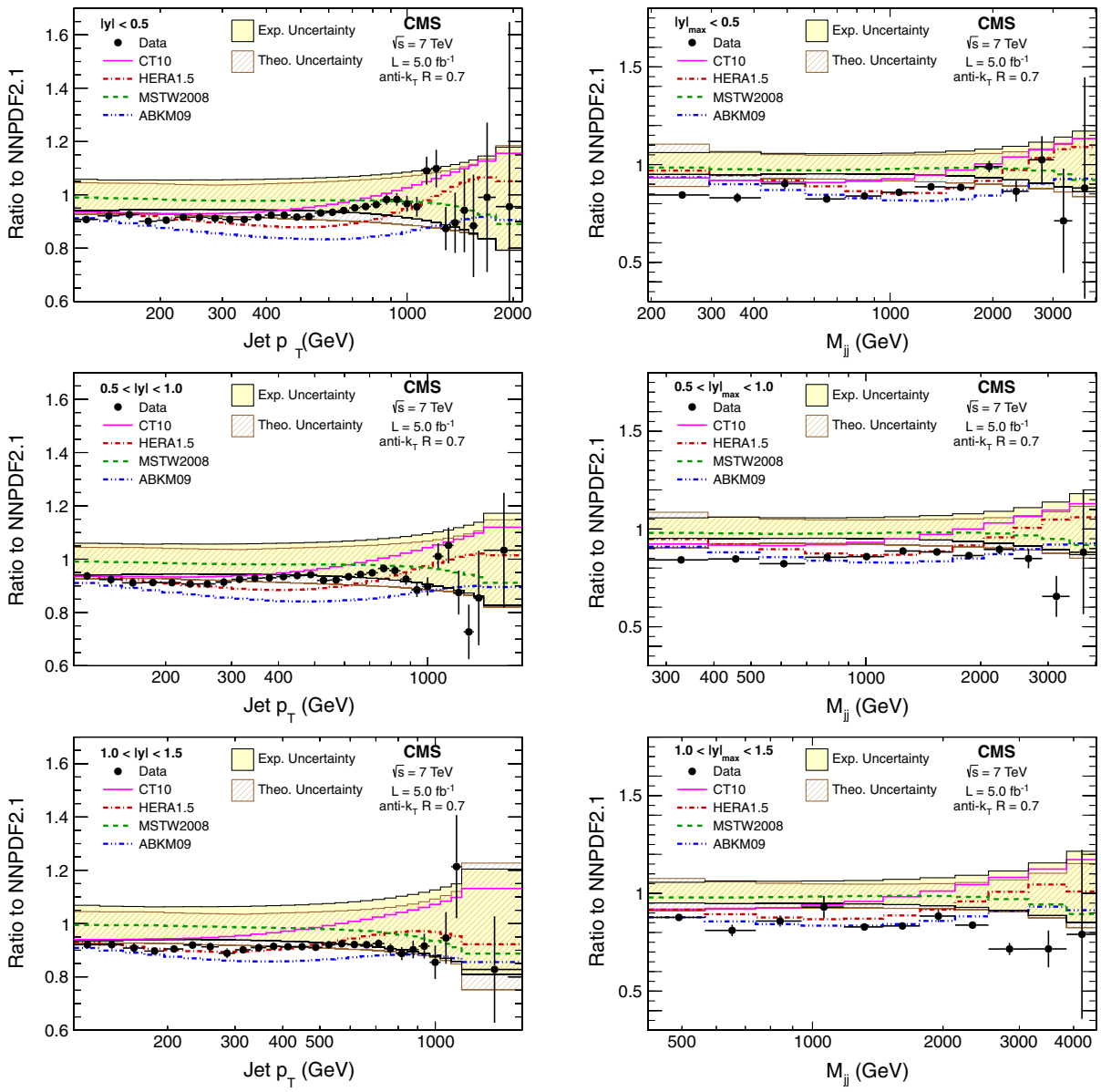

FIG. 8 (color online). Ratio of inclusive jet (left) and dijet (right) cross sections to the theoretical prediction using the central value of the NNPDF2.1 PDF set for the first three $|y|$ and $|y|_{max}$ bins, respectively. The solid histograms show the ratio of the cross sections calculated with the other PDF sets to that calculated with NNPDF2.1. The experimental and theoretical systematic uncertainties are represented by the continuous and hatched bands, respectively.

jet p_T resolution is varied by $\pm 10\%$ and the jet (dijet mass) spectrum slope by $\pm 5\%$. The former is motivated by the observed difference between data and simulation in the jet energy resolution [10], and the latter is a conservative estimate based on comparisons of the theoretical and measured spectrum shapes. An additional constant 2% uncertainty is assigned to the dependence on the unfolding method. Overall, the unfolding uncertainty is of the order of 3%–4%, and is fully correlated across the p_T and mass bins.

4. Other uncertainty sources

The contributions from small trigger and jet identification inefficiencies, time dependence of the jet p_T resolution, and uncertainty on the trigger prescale factor have been shown to be much smaller than 1%. To account for these residual effects a conservative uncertainty of 1% is assigned to each jet p_T and dijet mass bin, uncorrelated across the bins.

VI. THEORETICAL PREDICTIONS

The theoretical predictions for the jet cross sections consist of a next-to-leading-order (NLO) QCD calculation and a nonperturbative correction to account for the multiparton interactions (MPI) and hadronization effects.

A. NLO calculations

The NLO calculations are performed using the NLO-Jet + + program (v2.0.1) [18] within the framework of the fastNLO package (v1.4) [19]. The renormalization and factorization scales (μ_R and μ_F) for the inclusive and dijet measurements are identified with the jet p_T and the average transverse momentum p_T^{ave} of the two jets, respectively. The NLO calculation is performed using five different PDF sets: CT10 [20], MSTW2008NLO [21], NNPDF2.1 [22], HERAPDF1.5 [23], and ABKM09 [24] at the corresponding default values of the strong coupling constant $\alpha s(M_Z) = 0.1180$, 0.120, 0.119, 0.1176, and 0.1179, respectively.

B. Systematic uncertainties

The PDF variation introduces uncertainties in the theoretical prediction of up to 30%, while the variation of $\alpha s(M_Z)$ by ± 0.001 introduces an additional 1%–2% uncertainty. The uncertainty due to the choice of factorization and renormalization scales is estimated as the maximum deviation at the six points $(\mu_F/\mu, \mu_R/\mu) = (0.5, 0.5)$, (2, 2), (1, 0.5), (1, 2), (0.5, 1), (2, 1), where $\mu = p_T$ (inclusive) or $\mu = p_T^{ave}$ (dijet). An additional uncertainty of at most 10% is caused by the nonperturbative correction. The scale

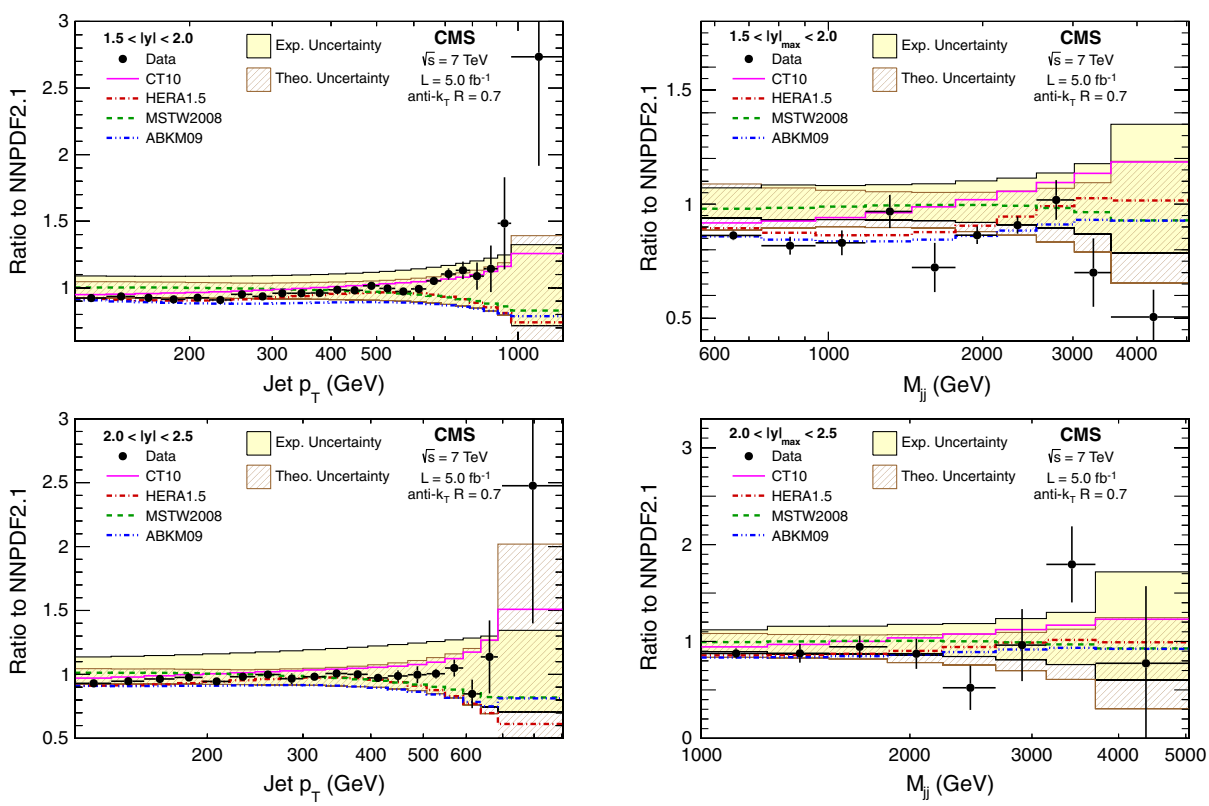

FIG. 9 (color online). Ratio of inclusive jet (left) and dijet (right) cross sections to the theoretical prediction using the central value of the NNPDF2.1 PDF set for the last two $|y|$ and $|y|_{max}$ bins, respectively. The solid histograms show the ratio of the cross sections calculated with the other PDF sets to that calculated with NNPDF2.1. The experimental and theoretical systematic uncertainties are represented by the continuous and hatched bands, respectively.

uncertainty ranges from 5% to 10% for $|y| < 1.5$ but increases to 40% for the outer $|y|$ bins and for high dijet masses and jet p_T. Overall, the PDF uncertainty is dominant for the high p_T and high dijet mass regions. Figure 6 shows the effect of the systematic uncertainties for the two observables in all rapidity bins and for the NNPDF2.1 PDF set.

C. Nonperturbative corrections

The nonperturbative effects are estimated from the simulation, using the event generators PYTHIA6 (tune Z2) and HERWIG++ 2.4.2 [25]. (The PYTHIA6 Z2 tune is identical to the Z1 tune described in [26] except that Z2 uses the CTEQ6L PDF while Z1 uses CTEQ5L.) These models are representative of the possible values of the nonperturbative corrections, due to their different physics descriptions. The nonperturbative correction is defined as the ratio of the cross section predicted with the nominal generator settings divided by the cross section predicted with the MPI and hadronization switched off. The central value of the nonperturbative correction is calculated from the average of the two models considered, and ranges from 1% to 20%, being larger in the dijet spectrum because of the involvement of lower p_T jets.

VII. RESULTS

The unfolded inclusive jet and dijet spectra are shown in Fig. 7, compared to the theoretical predictions.

To compare the CMS data and the theoretical prediction, the ratio of the two is taken. Figures 8 and 9 show this ratio using the central value of the NNPDF2.1 PDF set, accompanied by the total experimental and theoretical uncertainties. The theoretical uncertainties vary considerably among the different PDF sets, and, in particular, in the high-p_T and high-M_{jj} region. The experimental uncertainty is comparable to the theoretical uncertainty. The additional curves represent the ratio of the central values of the other PDF sets to NNPDF2.1. Agreement is observed between data and theory in all rapidity bins, given the statistical and systematic uncertainties, with the various theoretical predictions showing differences of the order of 10%.

VIII. SUMMARY

Measurements of the double-differential inclusive jet and dijet cross sections are presented using 5.0 fb^{-1} of data collected with the CMS detector in proton-proton collisions at $\sqrt{s} = 7$ TeV. The measurements cover the jet p_T range from 0.1 to 2 TeV, and the dijet mass range from 0.3 to 5 TeV in five rapidity bins up to $|y| = 2.5$. The measured cross sections agree with the predictions of perturbative QCD at next-to-leading order obtained with five different PDF sets. Theoretical and experimental uncertainties are comparable, even at the limits of the experimental phase space, so these results may be used to constrain global PDF fits.

ACKNOWLEDGMENTS

We congratulate our colleagues in the CERN accelerator departments for the excellent performance of the LHC and thank the technical and administrative staffs at CERN and at other CMS institutes for their contributions to the success of the CMS effort. In addition, we gratefully acknowledge the computing centers and personnel of the Worldwide LHC Computing Grid for delivering so effectively the computing infrastructure essential to our analyses. Finally, we acknowledge the enduring support for the construction and operation of the LHC and the CMS detector provided by the following funding agencies: the Austrian Federal Ministry of Science and Research; the Belgian Fonds de la Recherche Scientifique, and Fonds voor Wetenschappelijk Onderzoek; the Brazilian Funding Agencies (CNPq, CAPES, FAPERJ, and FAPESP); the Bulgarian Ministry of Education, Youth and Science; CERN; the Chinese Academy of Sciences, Ministry of Science and Technology, and National Natural Science Foundation of China; the Colombian Funding Agency (COLCIENCIAS); the Croatian Ministry of Science, Education and Sport; the Research Promotion Foundation, Cyprus; the Ministry of Education and Research, Recurrent financing contract SF0690030s09 and European Regional Development Fund, Estonia; the Academy of Finland, Finnish Ministry of Education and Culture, and Helsinki Institute of Physics; the Institut National de Physique Nucléaire et de Physique des Particules/CNRS, and Commissariat à l'Énergie Atomique et aux Énergies Alternatives/CEA, France; the Bundesministerium für Bildung und Forschung, Deutsche Forschungsgemeinschaft, and Helmholtz-Gemeinschaft Deutscher Forschungszentren, Germany; the General Secretariat for Research and Technology, Greece; the National Scientific Research Foundation, and National Office for Research and Technology, Hungary; the Department of Atomic Energy and the Department of Science and Technology, India; the Institute for Studies in Theoretical Physics and Mathematics, Iran; the Science Foundation, Ireland; the Istituto Nazionale di Fisica Nucleare, Italy; the Korean Ministry of Education, Science and Technology and the World Class University program of NRF, Republic of Korea; the Lithuanian Academy of Sciences; the Mexican Funding Agencies (CINVESTAV, CONACYT, SEP, and UASLP-FAI); the Ministry of Science and Innovation, New Zealand; the Pakistan Atomic Energy Commission; the Ministry of Science and Higher Education and the National Science Centre, Poland; the Fundação para a Ciência e a Tecnologia, Portugal; JINR (Armenia, Belarus, Georgia, Ukraine, Uzbekistan); the Ministry of Education and Science of the Russian Federation, the Federal Agency of Atomic Energy of the Russian Federation, Russian Academy of Sciences, and the Russian Foundation for Basic Research; the Ministry of Science and

Technological Development of Serbia; the Secretaría de Estado de Investigación, Desarrollo e Innovación and Programa Consolider-Ingenio 2010, Spain; the Swiss Funding Agencies (ETH Board, ETH Zurich, PSI, SNF, UniZH, Canton Zurich, and SER); the National Science Council, Taipei; the Thailand Center of Excellence in Physics, the Institute for the Promotion of Teaching Science and Technology of Thailand and the National Science and Technology Development Agency of Thailand; the Scientific and Technical Research Council of Turkey, and Turkish Atomic Energy Authority; the Science and Technology Facilities Council, U.K.; the U.S. Department of Energy, and the U.S. National Science Foundation. Individuals have received support from the Marie-Curie program and the European Research Council (European Union); the Leventis Foundation; the A. P. Sloan Foundation; the Alexander von Humboldt Foundation; the Belgian Federal Science Policy Office; the Fonds pour la Formation à la Recherche dans l'Industrie et dans l'Agriculture (FRIA-Belgium); the Agentschap voor Innovatie door Wetenschap en Technologie (IWT-Belgium); the Ministry of Education, Youth and Sports (MEYS) of Czech Republic; the Council of Science and Industrial Research, India; the Compagnia di San Paolo (Torino); and the HOMING PLUS program of Foundation for Polish Science, cofinanced from European Union, Regional Development Fund.

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