LATEST JET RESULTS FROM THE TEVATRON AT $\sqrt{s} = 1.96$ TeV

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ON BEHALF OF THE CDF AND DØ COLLABORATIONS

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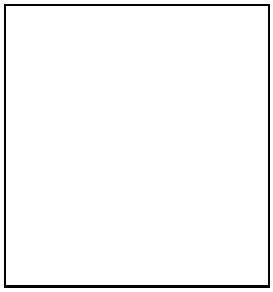

Inclusive jet and dijet production measurements based on high luminosity data samples at the Fermilab Tevatron $p\bar{p}$ collider are presented. Next-to-leading order predictions within the framework of perturbative QCD describe the data.

1 Introduction

Measurements of inclusive and exclusive jet production represent particularly important tests of perturbative QCD (pQCD). In addition to probing the dynamics of underlying QCD partonic scattering subprocesses, jet measurements are also used to constrain the parton density functions (PDFs) within the proton and antiproton. The most precise determination of the PDFs will be a pre-requisite for many future new physics searches, and large transverse momentum jet production measurements at the Tevatron also provide a sensitivity to new physics scenarios.

2 Theoretical Framework

Predictions for jet production rely both on perturbative as well as non-perturbative contributions. At next-to-leading order (NLO) in perturbative QCD jet production arises both as a direct consequence of the hard scatter as well as through additional initial or final state emissions. The large transverse momentum of the jets provides a relevant hard scale and cross section predictions are obtained by convoluting the initial state partons with proton / antiproton parton density function inputs. Predictions at the hadron level are obtained by applying a jet-finding algorithm to the final state partons after they have been fragmented according to a hadronization model input and an additional contribution for spectator parton rescattering (underlying event correction) has been applied.

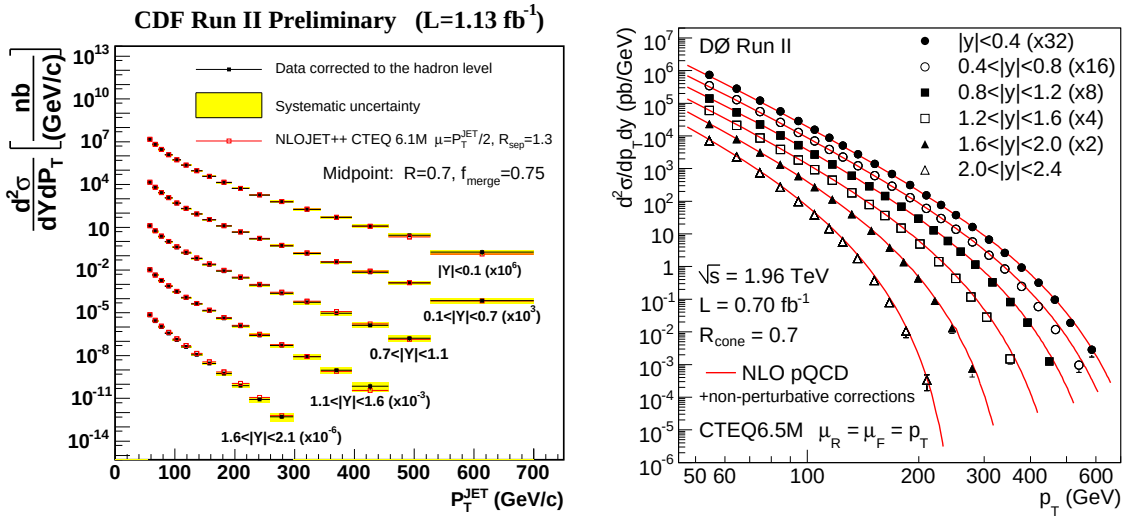

Figure 1: The inclusive jet production cross section measured as a function of jet transverse momentum, separately for different regions of jet rapidity y. NLO pQCD theoretical predictions are compared to the data.

3 Inclusive Jet Production

Inclusive jet production measurements at large jet p_T are important to constrain the gluon PDF contribution at large x. The inclusive jet production cross sections measured by the CDF and DØ Collaborations are shown as a function of jet transverse momentum p_T, in different regions of jet rapidity y, in Figure 1. Both measurements are based on integrated luminosities of about 1 fb^{-1}, extending out to forward jet rapidities. Jets are selected using midpoint iterative cone jet algorithms and the data are corrected to hadron level by applying a jet energy scale correction. NLO pQCD predictions using PDF inputs from the CTEQ Collaboration are compared to the data. In Figure 2 the ratio of the DØ result in each measurement interval to the predicted cross section is presented. The shaded region shows significantly reduced measurement systematic uncertainties. The NLO pQCD prediction with the CTEQ6.5M PDF input is able to describe the data across the whole measured range, however the data favor the lower edge of the PDF uncertainty region at large jet p_T. The data are also well described when using the MRST2004 PDF input (long-dashed line).

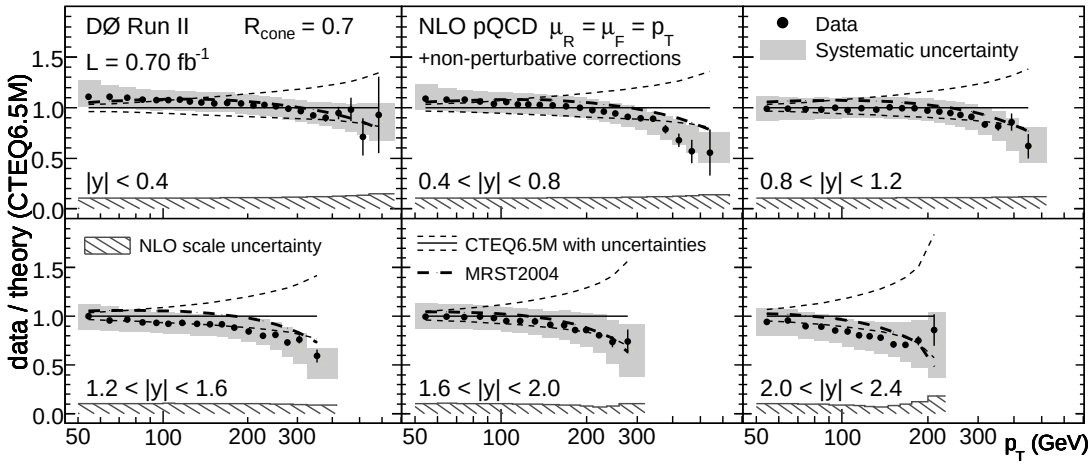

Figure 2: Data to Theory comparison of the DØ inclusive jet production measurement to NLO pQCD prediction using the CTEQ6.5M and MRST2004 PDF inputs.

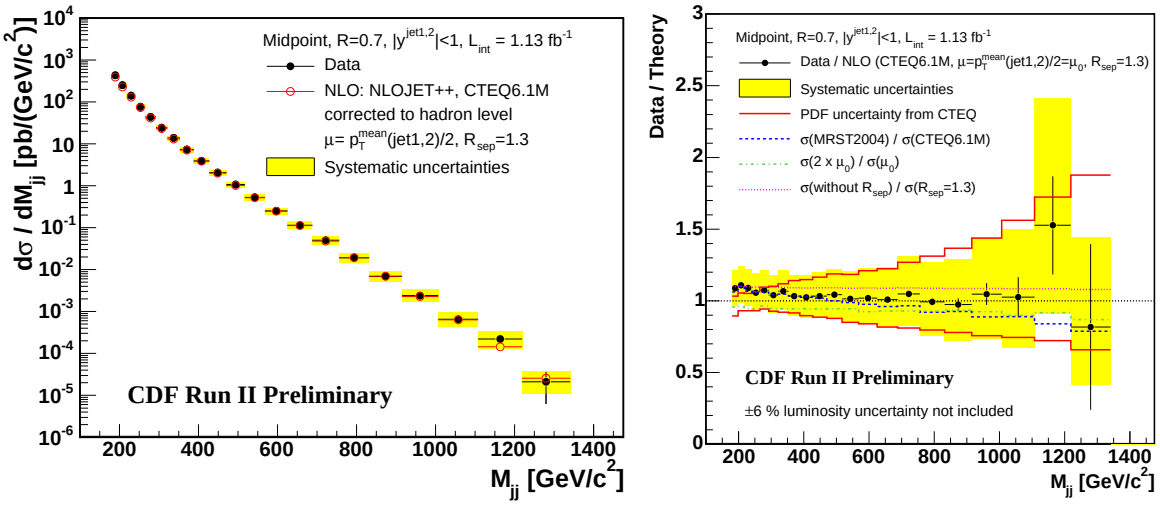

Figure 3: Dijet production differential cross section as a function of the invariant mass of the leading pair of centrally produced jets.

4 Dijet Production Measurements

The production of very large p_T (central) jets is of particular interest in terms of new physics scenarios. Figure 3 shows the CDF differential cross section measurement of the invariant mass dependence of the two leading (largest p_T) jets in centrally produced $|y^{jet1,jet2}| < 1$ events. NLO pQCD predictions using CTEQ 6.1M and MRST2004 PDF inputs give a good description of the data across the full measured range, setting limits on excited quark, massive gluon and Z'/W' production scenarios.

At lower jet p_T exclusive dijet production via colour singlet exchange is expected to lead to events with only two jets in the final state. In Figure 4 the CDF measured distribution of the invariant mass ratio between two low p_T selected jets and the total event reconstructed mass is shown for events in which regions devoid of significant energy deposits (rapidity gaps) are required at pseudorapidities $3.6 < |\eta| < 5.9$. The exclusive and single diffractive contributions are fitted using the Monte Carlo event generators EXHUME and POMWIG respectively, to extract the exclusive diffractive cross section as a function of M_{jj}.

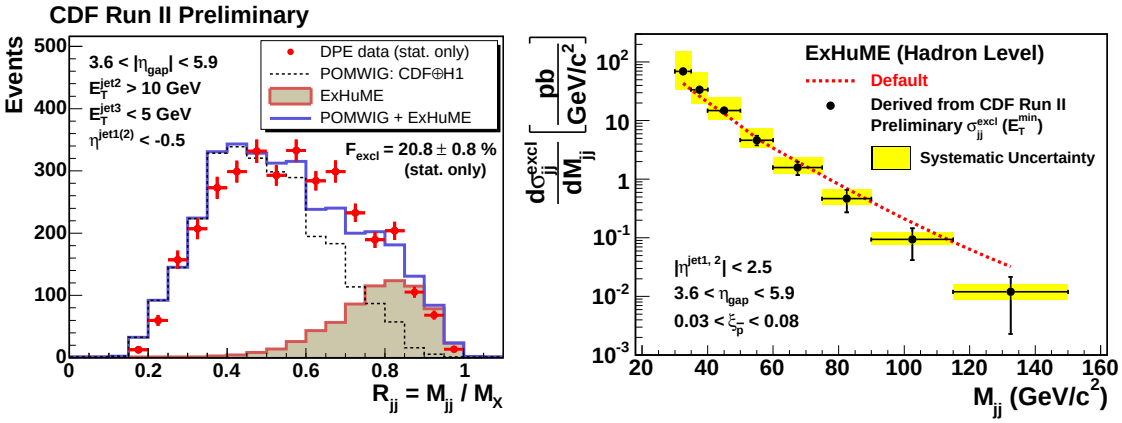

Figure 4: The dijet invariant mass to total event mass ratio.

Dijet azimuthal distributions probe the transistion from additional soft radiation to additional jet production (which would lead to strong dijet azimuthal decorrelation values). The normalized differential cross section (DØ Collaboration) is presented as a function of the sepa-

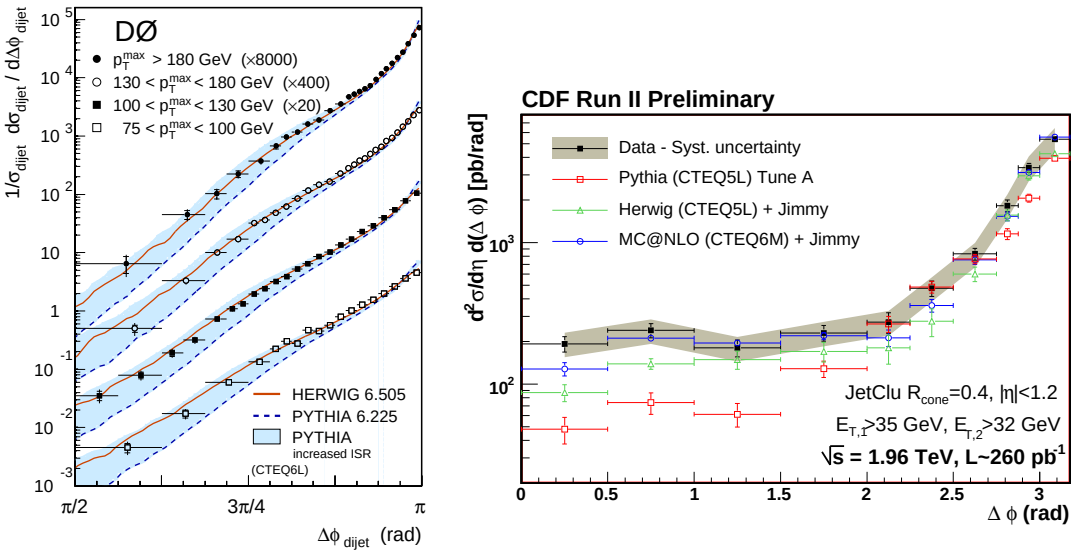

Figure 5: Dijet Angular Decorrelations in dijet and $b\bar{b}$ dijet production.

ration $\Delta\phi$ between two leading jets, separately for four leading jet p_T regions, in Figure 5. The data are well described by the HERWIG and also PYTHIA event generators when the available phase space for initial state radiation in PYTHIA is varied by a factor 4 (blue shaded region).

The CDF Collaboration has measured the $b\bar{b}$ dijet production rate using a dedicated silicon vertex triggered dataset, corresponding to an integrated luminosity $L = 260$ pb^{-1}. Heavy flavour jets are tagged by requiring a displaced secondary vertex > 120 μm. Monte Carlo templates are used to fit and extract the b-jet contribution as a function of the separation $\Delta\phi$ between the two b-tagged jets.structed mass is shown for events in which regions devoid of significant energ The region of large di-jet decorrelation demonstrates the importance of higher order multiple interaction contributions.

5 Summary

The increased luminosity and experimental precision at the Tevatron are providing stronger tests of perturbative QCD jet production predictions, further constraining theoretical inputs and new physics models. NLO QCD predictions describe the jet data in both the inclusive and dijet production channels.

Acknowledgments

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References

1. V.M. Abazov, *et al* [DØ Collaboration], arXiv:0802.2400v1 [hep-ex].