# DIJET ANGULAR DISTRIBUTIONS AT DØ

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Measurements of the dijet angular distributions are relatively insensitive to parton distribution functions and thus offer an excellent method of testing the LO and NLO predictions of perturbative QCD. We present measurements of the dijet angular distributions for $|\eta| < 3.0$ in $p\bar{p}$ collisions at $\sqrt{s} = 1.8$ TeV.

## 1 Introduction

The dijet angular distribution allows us to measure the properties of parton-parton scattering without strong dependence on the details of the parton distribution functions. At small center of mass scattering angles, the dijet angular distribution predicted by leading order QCD is proportional to the Rutherford cross section: $d\hat{\sigma}_{\mathrm{ij}}/d\cos\theta^\star \sim 1/\sin^4(\frac{\theta^\star}{2})$, where $\theta^\star$ is the center of mass scattering angle. It is useful to measure the angular distribution in the variable $\chi$, rather than $cos\theta^\star$, where $\chi = (1+\cos\theta^\star)/(1-\cos\theta^\star) = e^{|\eta_1-\eta_2|}$. The dijet angular distribution is plotted in the variable $\chi$ in order to flatten out the distribution and facilitate an easier comparison to the predictions of QCD [1]. In addition, the dijet angular distribution provides a test for possible quark compositeness.

The quantity measured in this analysis is $1/N(dN/d\chi)$, in bins of the dijet mass $M_{jj}$. The other variables of interest are the center-of-mass pseudorapidity of the dijet pair, $\eta^\star = \frac{1}{2}(\eta_1 - \eta_2)$, and the pseudorapidity boost: $\eta_{\mathrm{boost}} = \frac{1}{2}(\eta_1 + \eta_2)$.

## 2 Event Selection

The DØ detector is described elsewhere [2]. An inclusive two-jet sample was used. The two leading $E_T$ jets were required to have a pseudorapidity less than 3.0. Four mass bins were then chosen so that the trigger was fully efficient whilst maximizing the statistics and $\chi$ reach ($\chi_{\mathrm{max}}$). A cut was then made on the $\eta_{\mathrm{boost}}$ of the dijet system so that there was uniform acceptance for the $\chi$ range being examined. The mass, $\chi$, and $\eta_{\mathrm{boost}}$ ranges are described in Table 1.

| Min $E_{T1}$ | Mass | $\chi_{\max}$ | $\lvert\eta_{\mathrm{boost\_max}}\rvert$ |
|---|---|---|---|
| 55 | 260 – 425 | 20 | 1.5 |
| 120 | 475 – 635 | 13 | 1.5 |
| 120 | $> 550$ | 18 | 1.5 |
| 175 | $> 635$ | 11 | 1.5 |

Table 1: The mass bins and their $\chi$ and $\eta_{\mathrm{boost}}$ ranges.

## 3 Results

QCD predictions at leading order (LO) and next to leading order (NLO) were calculated using JETRAD[3]. In this calculation, the CTEQ3M parton distribution functions were used with a renormalization scale equal to the transverse energy of the leading jet. The theoretical prediction was smeared in $E_T$ and $\eta$ in order to compare it to data. The data are compared to the LO and NLO predictions of QCD in Fig 1. Fig 2 illustrates the effect on the highest mass bin of adding a contact term for quark compositeness. Since an added contact term is not yet available at NLO, its effect was calculated using LO Papageno[4]. The NLO JETRAD was then multiplied by the ratio of LO with and without the contact term, to produce the curves shown.

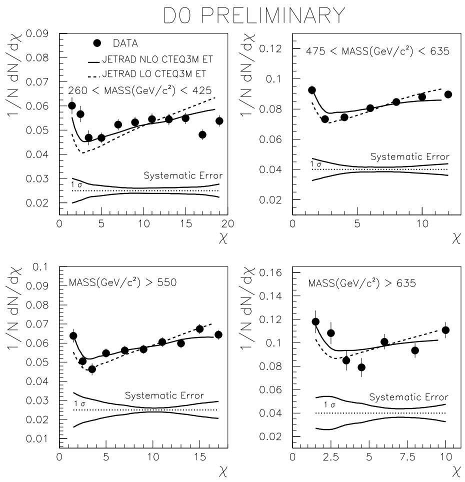


Figure 1: Comparisons of data to NLO and LO predictions of QCD using JETRAD with CTEQ3M and a renormalization scale of $E_T$. The errors bars are statistical. Shown at the bottom of each plot is the plus and minus $1\sigma$ systematic error band.

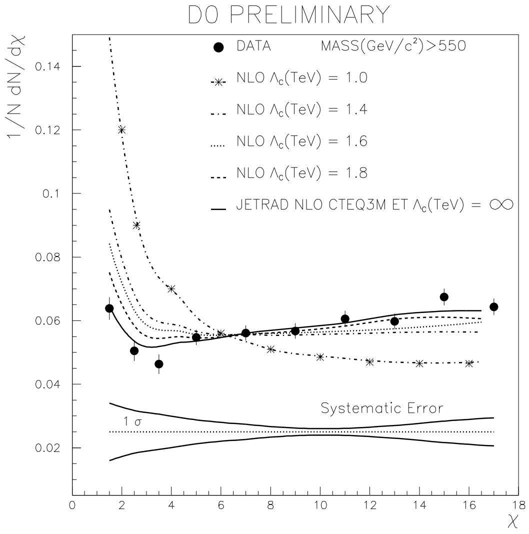


Figure 2: Comparison of data to NLO prediction of QCD using JETRAD with CTEQ3M and a renormalization scale of $E_T$ with an added contact term for quark compositeness.The errors bars are statistical. Shown at the bottom of the plot is the plus and minus $1\sigma$ systematic error band.

## 4 Conclusion

The NLO predictions of QCD agree well with the measured dijet angular distributions in all mass bins, including those which would be affected by the addition of a contact term for quark compositeness.

## References


1. R. K. Ellis and W. J. Stirling, 'QCD and Collider Physics', FERMILAB-Conf-90/164-T, August 1990, p. 66-69.
2. S. Abachi *et al.*, (DØ Collaboration), *Nucl. Instrum. Methods*, **A338**, 185 (1994).
3. W.T. Giele, E.W. Glover, and D.A.Kosower, *Phys. Rev. Lett.*, **73**, 2019 (1994) and private communications.
4. I. Hinchliffe, 'The Papageno Partonic Monte-Carlo Program', LBL-34372, July 1993.