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AZIMUTHAL DECORRELATION OF JETS WIDELY SEPARATED IN RAPIDITY AT DØ

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We present preliminary results from an analysis of the azimuthal decorrelation of dijet events as a function of their separation in pseudorapidity using the data collected during the 1994-1995 collider run. These results are compared to a parton shower Monte Carlo (HERWIG) and a theoretical prediction using BFKL resummation.

1 Introduction

The exponential growth of the dijet inclusive cross section with increasing rapidity interval between the tagging jets at the extremes of rapidity was originally proposed as a signature of the QCD perturbative pomeron. This is the prediction of the color singlet solution of the Balitsky, Fadin, Kuraev, and Lipatov (BFKL) equation obtained by resuming the leading logarithmic contributions to the radiative corrections to parton scattering in the high-energy limit. At a fixed collider energy, the azimuthal angle decorrelation of jets widely separated in rapidity was suggested as an alternative approach to search for the effect. The broadening of distribution in the azimuthal angle difference with increasing dijet rapidity interval is a characteristic feature of BFKL dynamics. The first measurement of the azimuthal decorrelation between jets with pseudorapidity separation up to five units was previously reported by the DØ collaboration.

We have extended this measurement of the azimuthal decorrelation by employing a lower, symmetric \( P_T \) threshold cut (20 GeV) and allowing a pseudorapidity separation up to six units with a substantial amount of new data collected by the DØ detector during the 1994-1995 collider run. We report preliminary results for the \( \Delta \phi \) distribution and for \( \langle \cos(\pi - \Delta \phi) \rangle \) as a function of \( \Delta \eta \), where \( \Delta \phi = \phi_1 - \phi_2 \) is the difference in azimuth of the two tagging jets and \( \Delta \eta = \eta_1 - \eta_2 \) is the difference in pseudorapidity. The \( \langle \cos(\pi - \Delta \phi) \rangle \) distribution as a quantitative measurement would vary from unity for complete correlation to zero for complete decorrelation. Results from data are compared to an analytical prediction based on BFKL resummation and the parton showering Monte Carlo HERWIG in which higher order effects are approximated by a parton shower superimposed on a leading order 2 to 2 parton process.
Event Selection and Analysis Cuts

The DØ detector is particularly suited for this measurement owing to its uniform calorimetric coverage to $|\eta| \leq 4.0$. The uranium-liquid argon sampling calorimeter facilitates jet identification with its fine transverse segmentation ($0.1 \times 0.1$ in $\Delta \eta \times \Delta \phi$) and good jet energy and position resolution.

The trigger consists of three levels. The first (L0) requires hits in beam-beam scintillation counters signalling the presence of an inelastic collision. The second level (L1) looks for localized energy deposits in $0.2 \times 0.2$ ($\Delta \eta \times \Delta \phi$) towers in the calorimeter. The third level (L2) implements a cone based jet-finding algorithm ($R = 0.7$) using calorimeter cell information. Jets were triggered on out to $|\eta| = 4.0$. We used two triggers specialized for this analysis. One (inclusive) required a single interaction at L0, one trigger tower above 2GeV at L1, and one jet above 12GeV at L2. The other (forward) trigger had the additional pseudorapidity constraints $|\eta| > 2.0$ at L1 and $|\eta| > 1.6$ at L2.

Jet energy scale corrections were applied offline and spurious jets were removed before a minimum $E_T$ cut of 20GeV was applied. Selecting events having at least two jets, we tagged the two jets at the extremes of rapidity and required their boost ($|\eta| = \frac{1}{2}|\eta_1 + \eta_2|$) to be less than 0.5 to avoid any trigger bias. Events were removed if either of the tagging jets were located in less well understood detector regions ($1.0 \leq |\eta| \leq 1.4$). For the forward trigger, one of the two tagging jets was required to be at $|\eta| > 2.25$ to ensure full trigger efficiency, and events from this trigger were used only for $\Delta \eta \geq 4.5$.

Results

The azimuthal angular separation, $|1 - \Delta \phi/\pi|$, is plotted for the average of $\Delta \eta$ with unit bins centered at $\Delta \eta = 1$ and 5 in Fig. 1. Since each distribution is normalized to unity, the decorrelation between the two most widely separated jets can be seen in either the relative decline near the peak or the relative increase in width as $\Delta \eta$ increases. Figure 2 shows $\langle \cos(\pi - \Delta \phi) \rangle$ as a function of $\langle \Delta \eta \rangle$. For the data, the error bars represent the statistical and uncorrelated systematic errors added in quadrature. Uncorrelated systematic errors include the effects of the jet position and energy resolution and instrumental backgrounds. Corrections for trigger efficiencies and jet reconstruction efficiency have been also taken into account. Combined corrections are less than 0.01. In addition, the band at the bottom of the plot represents the correlated uncertainties due to the energy scale corrections. Also shown in Fig. 2 are the predictions from the BFKL resummation $^7$ and HERWIG $^8$ with statistical errors only.
4 Conclusion

We have measured the azimuthal decorrelation of two jets as a function of their rapidity difference using the DØ detector at the Tevatron. The decorrelation increases with increasing $\Delta \eta$. These effects are described well by HERWIG within the uncertainties of the measurement. A theoretical prediction based on BFKL resummation predicts too much decorrelation as the rapidity interval increases.

References

7. V. Del Duca and C.R. Schmidt, private communication.