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NEW EVIDENCE FOR RAPIDITY GAPS BETWEEN JETS AND DIFFRACTIVE W AND DIJET PRODUCTION AT CDF

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We present new evidence for events with a central rapidity gap between jets, and new results on diffractive W and dijet production in $p\bar{p}$ collisions at $\sqrt{s}=1.8$ TeV.

We report new evidence for dijet events with a central rapidity gap (RG) between jets and results on diffractive (tagged by a forward RG) W and dijet production in $p\bar{p}$ collisions at $\sqrt{s}=1.8$ TeV. The data were collected in Tevatron runs 1A (1992-93) and 1B (1993-95) with disabled beam-beam counters, to eliminate biasing against forward RGs, and an added forward dijet trigger selecting $E_T^{jet} > 20$ GeV and $|\eta^{jet}| > 1.8$. The results presented were obtained from 9492 (29496) dijets with $\eta_1\eta_2 > 1$ ($\eta_1\eta_2 < 1$), and 8246 (4593) $W \rightarrow e\nu(\mu\nu)$ events with a central $e^\pm$ ($|\eta| < 1.1$) or $\mu^\pm$ ($|\eta| < 0.6$).

The relevant CDF detector components are the central tracking chamber ($|\eta| < 1.2$) and the calorimeters: central ($|\eta| < 1.1$; $\Delta\eta \times \Delta\phi = 0.1 \times 15^\circ$), plug ($1.1 < |\eta| < 2.4$; $0.1 \times 5^\circ$) and forward ($2.4 < |\eta| < 4.2$; $0.1 \times 5^\circ$).

In a given $\Delta\eta$ RGs from color singlet exchange (CSE) appear as an excess over RGs from normal fluctuations in the underlying event multiplicity. In the dijet case, rather than using Monte Carlo simulations and/or fits to evaluate the excess, we determine it by comparing the multiplicity distribution with a template obtained from another process that is not expected to have CSE RGs. For opposite side (OS) dijets, $\eta_1\eta_2 < 0$, we use as a template the same side (SS) dijet distribution; for SS dijets, we use W events, which have a relatively small amount of CSE RGs, as determined by an independent analysis based on lepton-gap correlations. The template method has the added advantage of eliminating detector related systematic uncertainties.

In our search for CSE RGs, a "particle" is defined as a track of $P_T > 300$ MeV or a tower of $E_T(\text{corrected}) > 300$ MeV or $E > 1.5$ GeV (in W case).

In Fig. 1 we compare the track (left) and tower (right) OS (solid) multiplicity within $|\eta| < 1.0$ with the (normalized) SS distribution (dashed) for $|\eta| < 1.2$. The asymmetry is defined as $A = (N_{OS} - N_{SS})/(N_{OS} + N_{SS})$. The excess OS events in the $N_{track} = 0$ and $N_{tower} = 0, 1, 2$ bins are attributed to CSE. The spreading of the tower signal into the $N=1, 2$ bins is presumably

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due to calorimeter noise or due to γ s coming from decays of neutral particles at $|\eta| > 1$. The ratio of excess RG to all events is

$$R_{track} = [2.07 \pm 0.24(stat)]\% \quad R_{tower} = [2.03 \pm 0.24(stat)]\%$$

The average $R = [2.05 \pm 0.24]\%$ is larger than the CDF¹ and DØ² values of $R_{CDF}[0.85 \pm 0.12(stat)_{-0.12}^{+0.24}(syst)]\%$ & $R_{DØ}[1.07 \pm 0.10(stat)_{-0.13}^{+0.25}(syst)]\%$. We are currently investigating the dependence of the signal on $|\eta^{jet1} - \eta^{jet2}|$.

In the W sample we look for RGs within $2.4 < |\eta| < 4.2$. Because of the boosted cms, and the large W mass requiring *valence* quarks from the p or $\bar{p}$ to interact with the flavor symmetric pomeron, diffraction favors the (angle $\otimes$ charge)-gap correlated topology of $\eta \times C_l > 0$ with $\eta_l \times \eta_{gap} < 0$ over the anticorrelated, $\eta \times C_l > 0$ with $\eta_l \times \eta_{gap} > 0$, where C_l is the sign of the charge of the lepton. Fig. 2(*left*) shows the correlated and anticorrelated multiplicities and their asymmetry. From the excess in the zero bin, and assuming a hard-quark pomeron structure of the form $G(\beta) \sim \beta(1-\beta)$ in calculating the acceptance (where β is the momentum fraction of the parton in the pomeron), we find that the fraction of diffractive to non-diffractive (ND) W production is

$$R_W = [2.0 \pm 1.9(stat \oplus syst)]\%$$

The standard (renormalized) pomeron flux POMPYT prediction³ for a hard 3-flavor quark pomeron is $\sim 16\%(1.8\%)$.

In searching for diffractive dijets, we look for an excess zero bin multiplicity in $2.4 < |\eta| < 4.2$ opposite the dijets using W s as a template with two entries per event, one for each η -side, to reduce diffractive W RGs down to $\sim (0.2 \pm 0.2)\%$. Fig. 2(*right*) shows the SS dijet and W distributions and their asymmetry. From the excess in the zero bin we derive the diffractive to ND ratio $R = (0.46 \pm 0.09)\%$. Correcting for acceptance (assuming a hard pomeron structure), for calorimeter noise and for a possible RG signal in the W sample, and including systematic uncertainties, we obtain the (preliminary) ratio

$$R_{JJ} = [0.8 \pm 0.3(stat \oplus syst)]\%$$

The standard and renormalized pomeron flux POMPYT predictions³ for a hard gluon (quark) pomeron structure are $\sim 5\%$ (2%) and $\sim 0.56\%(0.22\%)$.

References

1. F. Abe *et al.*, CDF Collaboration, Phys. Rev. Lett. **74** (1995) 855.
2. S. Abachi *et al.*, DØ Collaboration, Phys. Rev. Lett. **76** (1996) 734.
3. K. Goulianos, Phys. Letters B358 (1995) 379.

Figure 1: Dijet track (left) and tower (right) multiplicities.

Figure 2: Multiplicity distributions within $2.4 < |\eta| < 4.2$: (left) for W events; (right) for SS dijet events compared to that of W events.