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Results on Hard Diffraction from CDF

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RESULTS ON HARD DIFFRACTION FROM CDF

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Results on diffractive W-boson and dijet production, selected with a rapidity gap in the forward detector region, are briefly summarized. The new sample of Run 1C data with a Roman Pot trigger has been analyzed for dijet production in single diffraction and double pomeron exchange. Comparisons of diffractive to non-diffractive dijet events are presented.

1 Introduction

A schematic diagram of diffractive dissociation in $p\,\bar{p}$ collisions is shown on the left side of figure 1. These diffractive interactions are assumed to be due to pomeron($I\!P$) exchange. A possible partonic structure of the virtual exchanged $I\!P$ can be probed in hard diffractive interactions with a hard scale given by a produced W-boson or jets with high p_T. In the following, factorization of the cross section for such hard reactions is assumed into a standard $I\!P$ flux (Donnachie and Landshoff[1] form with parameters as measured by CDF[2]) and the cross section for the hard partonic sub-process, weighted with the parton densities of the $\bar{p}$ and the $I\!P$ (see left side of fig. 1 for definition of ξ and t):

$$\frac{d\sigma(\bar{p}\,p \;\rightarrow\; p \;+\; X)}{d\xi\;dt\;dx_1\;dx_2} = f_{I\!P/p}(\xi,t)\;[f_{p1/\bar{p}}(x_1,Q^2)\;f_{p2/I\!P}(x_2,Q^2)\;\frac{d\hat{\sigma}}{d\hat{t}}] \qquad (1)$$

The CDF Collaboration used two techniques to select diffractive interactions: a) requiring a rapidity gap, which is due to the exchange of the color neutral $I\!P$, or b) measuring the recoil beam particle with Roman Pot detectors.

2 Diffractive W and Dijet Production with a Rapidity Gap

The diffractive production of W bosons and dijets was studied by requiring a rapidity gap in two components of the CDF detector[3], the Beam-Beam Counters (BBC: $3.2 < |\eta| < 5.9$) and the forward calorimeters ($2.4 < |\eta| < 4.2$). The ratio of diffractive to non-diffractive W-boson production was measured to be[4]: $R_W[\frac{\text{diffr.}}{\text{non-diffr.}}] = [1.15 \pm 0.51(\text{stat.}) \pm 0.20(\text{syst.})]\%$ for $\xi < 0.1$. Simulations with the standard flux predict $R_W = 24(16)\%$ for a pure hard quark

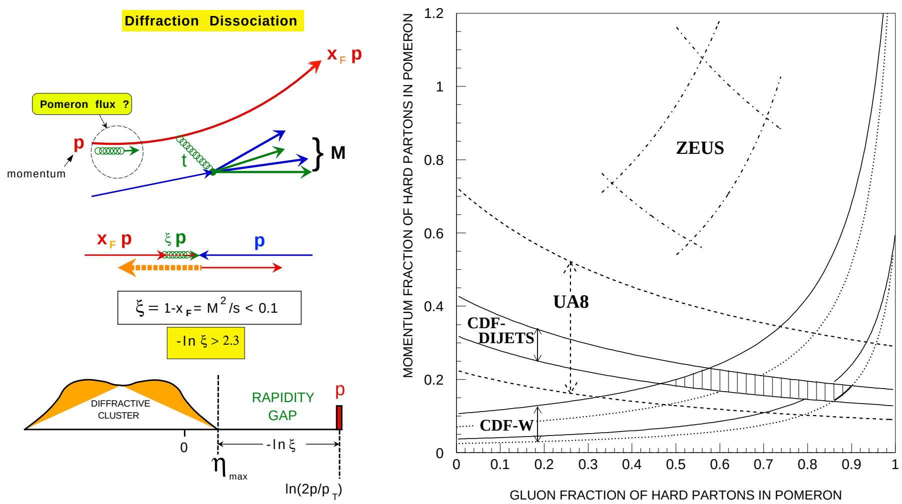

Figure 1: Diffr. dissociation in $p\,\bar{p}$ collisions(left), diffr. W and dijet production(right).

$I\!P$ structure with 2(3) flavors and $R_W = 1.1\%$ for a pure hard gluon structure. Although the measurement seems to be in agreement with the latter prediction, the extracted events show a very low fraction of jets in the final state, which means that diffractive W production occurs predominantly through quarks inside the $I\!P$. The quark/gluon content of the $I\!P$ can be estimated by combining diffractive W production with diffractive dijet production. The ratio of diffractive to non-diffractive dijet production with jets of $E_T > 20$GeV is measured to be[5]: $R_{JJ}[\frac{\text{diffr.}}{\text{non-diffr.}}] = [0.75 \pm 0.05(\text{stat.}) \pm 0.09(\text{syst.})]\%$ for $\xi < 0.1$, whereas simulations with the standard flux predict 2(5)% for a hard quark (gluon) $I\!P$. The common region for both measurements in the right plot of figure 1 determines a fraction of hard gluons in the $I\!P$ of $f_g = 0.7 \pm 0.2$. Comparing to the measurements from ZEUS[6] a discrepancy factor $D = 0.18 \pm 0.04$ to the momentum sum emerges, which is independent of the flux normalization and implies a breakdown of the factorization assumption. This discrepancy factor is predicted by the concept of the renormalized flux[7].

3 Dijets in Single Diffractive Events with a Roman Pot Track

In Run 1C the CDF detector was supplemented by three Roman Pot stations in the $\bar{p}$ direction. The following results on dijet production in single diffraction (SD) were achieved by requiring one good track in these stations, several cuts

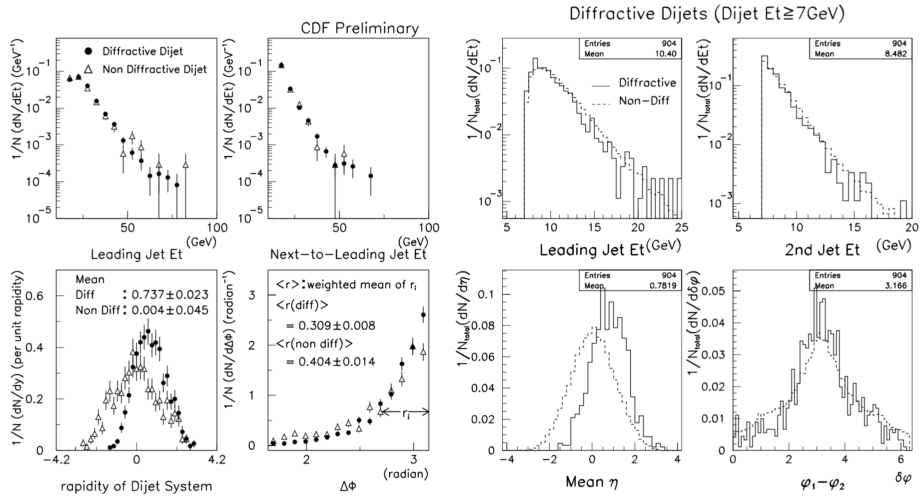

Figure 2: Comparison of SD to ND dijet events at $\sqrt{s} = 1800$GeV(left), 630GeV(right).

to ensure good dijet events and an $E_T^{jet} > 15(7)$GeV at $\sqrt{s} = 1800(630)$GeV. Comparisons to non-diffractive(ND) dijet events (fig. 2) show similar E_T^{jet} spectra, which indicates that the $I\!\!P$ has a hard partonic structure. The dijet-η shows the expected boost. The jets in diffractive events are more back to back, so less radiation occurs in the colorless exchange.

4 Dijets in Double Pomeron Exchange Events

By asking for a good Roman Pot track and an additional rapidity gap opposite to the Roman Pots, candidates for double pomeron exchange(DPE) were extracted. Figure 3 shows on the left side the number of calorimeter towers versus the number of hits in the BBC. In the signal region, the (0,0)-bin, 90 candidates were identified and the ratio of dijet production in DPE to SD interactions was calculated to be: $R[\frac{\mathrm{DPE}}{\mathrm{SD}}] = [0.26 \pm 0.05(\mathrm{stat.}) \pm 0.05(\mathrm{syst.})]\%$. The ratio derived from simulations for DPE and SD is in good agreement with this value, if for each $I\!\!P$ the flux is renormalized by the measured discrepancy D. The DPE simulation also predicts the kinematic properties of the dijets as measured. Figure 3 displays on the right side a comparison of dijets in DPE, SD and ND. All three show a similar E_T^{jet} spectrum: the lowering of $\sqrt{s}$ by the $\sqrt{\xi}$ when going from ND to SD and further to DPE is compensated, which hints to a hard structure for the $I\!\!P$. The dijet-η shows again the expected boost. The difference in the azimuthal angle between the jets, as a measure of

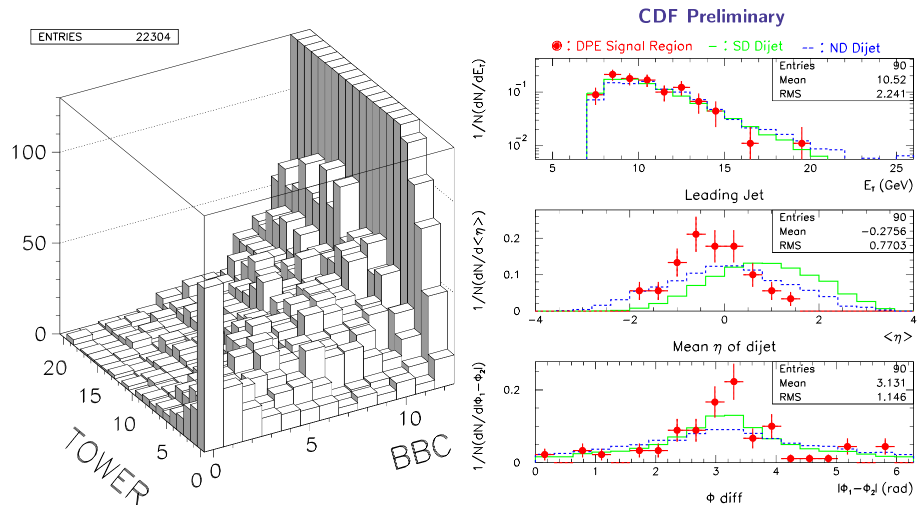

Figure 3: East side detector multiplicities in SD events(left) and comparisons of dijet events in DPE, SD and ND interactions.

the emitted radiation, decreases from ND to SD and even more to DPE.

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References

1. A. Donnachie and P. Landshoff, *Phys. Lett.* B **191**, 309 (1987), *Nucl. Phys.* B **303**, 634 (1988).
2. F. Abe *et al*, *Phys. Rev.* D **50**, 5518 (1994), *Phys. Rev.* D **50**, 5535 (1994), *Phys. Rev.* D **50**, 5550 (1994).
3. F. Abe *et al*, *Nucl. Instrum. Methods* A **271**, 387 (1988).
4. F. Abe *et al*, *Phys. Rev. Lett.* **78**, 2698 (1997).
5. F. Abe *et al*, *Phys. Rev. Lett.* **79**, 2636 (1997).
6. M. Derrick *et al*, *Phys. Lett.* B **356**, 129 (1995).
7. K. Goulianos in *DIS'97*, ed. J.Repond & D.Krakauer (AIP Conference Proceedings pp.527, Chicago, 1997), *Phys. Lett.* B **358**, 379 (1995).