The Diffractive Structure Function: ξ dependence

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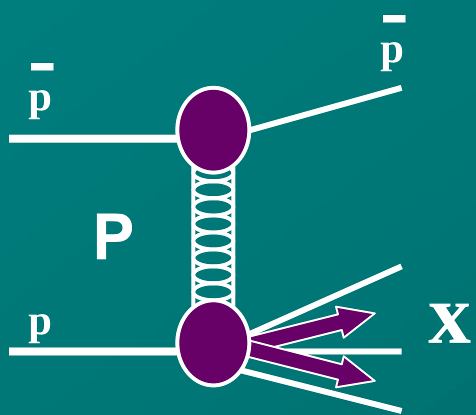
The Diffractive Structure Function

Single Diffractive dissociation



ξ - fractional momentum loss of $\bar{p}$

$\beta = \frac{x}{\xi}$ fraction of the **P** momentum carried by the struck parton

Subject of interest:

Hard diffraction process: production of high p_T dijets

Study the diffractive structure function

$$F_{jj}^{D}\left(x, Q^2, \xi\right) = x\left[g^{D}\left(x, Q^2, \xi\right) + \frac{4}{9} q^{D}\left(x, Q^2, \xi\right)\right]$$

Regge factorization:

$$F_{jj}^{D} = f_{\mathbf{P}}(\xi) \times F^{\mathbf{P}}(\beta, Q^2)$$

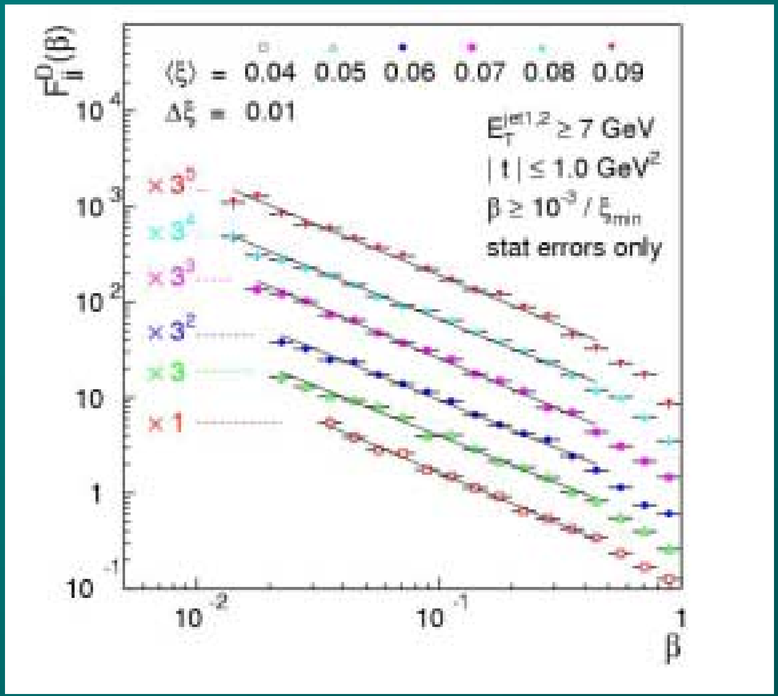
The Diffractive Structure Function

kinematic region

$|t| < 1\, GeV^2$

$0.035 < \xi < 0.095$

$E_T^{jet1,2} > 7\, GeV$



2 dijet samples:

SD: diffractive – leading $\bar{p}$

ND: non-diffractive

Measure ratio of SD to ND

$$R_{\frac{SD}{ND}}(x_{\bar{p}}, \xi)$$

then

$$F_{jj}^D(x_{\bar{p}}, Q^2, \xi) = R_{\frac{SD}{ND}}(x_{\bar{p}}, \xi) \times F_{jj}(x_{\bar{p}}, Q^2)$$

known ND structure function

The Diffractive Structure Function

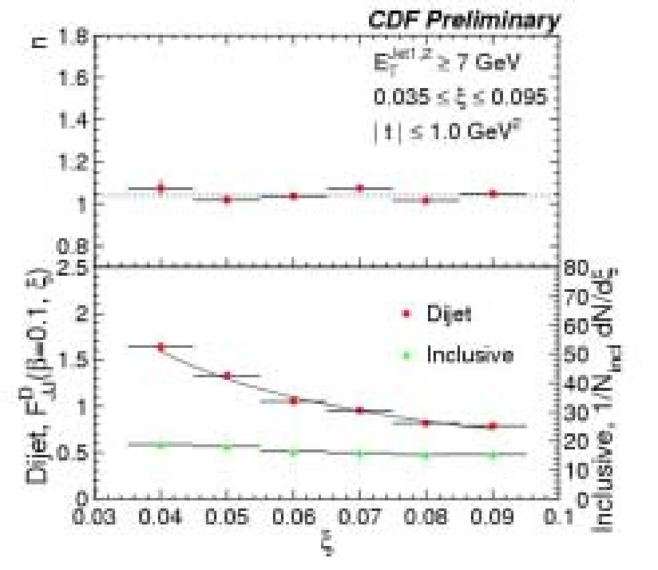
Power Law dependence

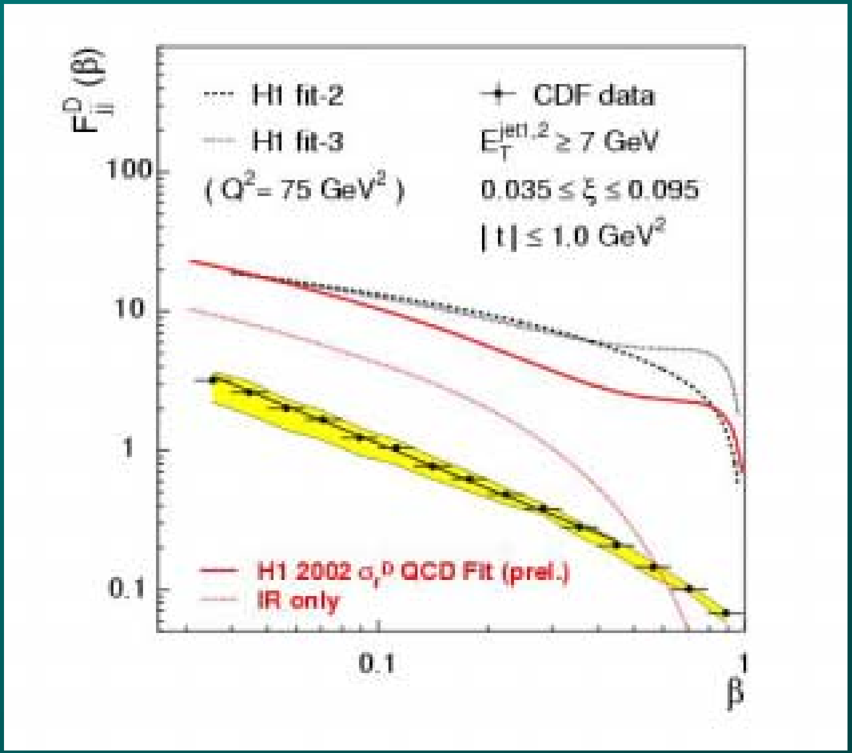
$$F_{jj}^{D} = C\left(\frac{1}{\beta^{n}}\right)\left(\frac{1}{\xi^{m}}\right)$$

for $\beta < 0.5$

$n = 1.0 \pm 0.1$

$m = 0.9 \pm 0.1$





discrepancy in normalization

↓

factorization breakdown

The Diffractive Structure Function: Run I

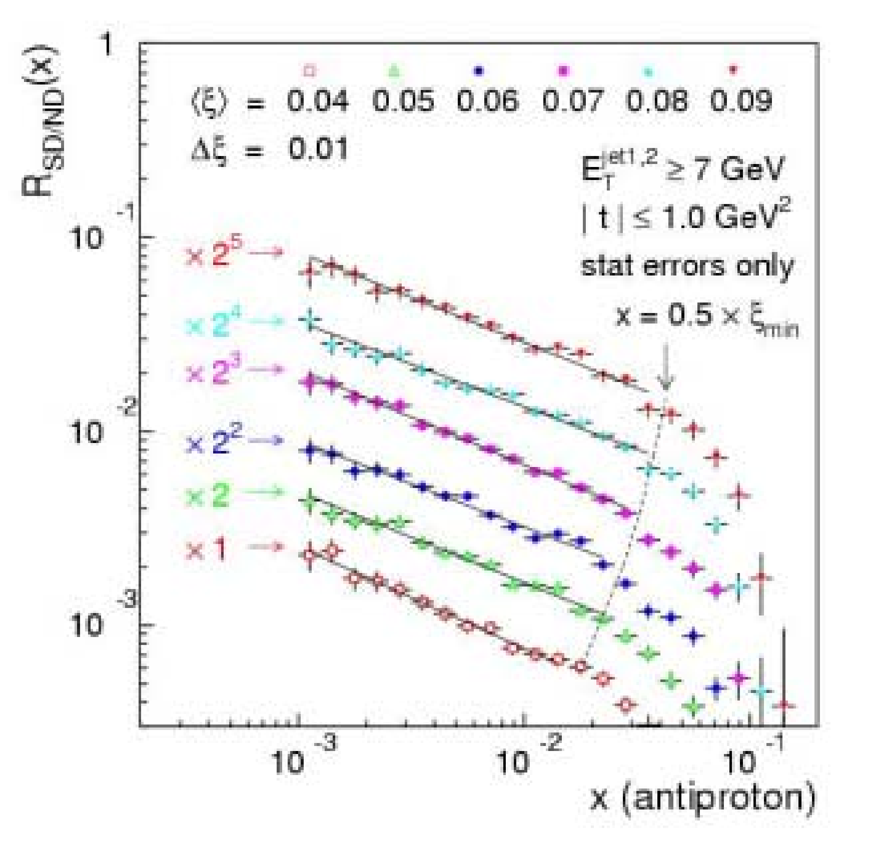
ξ dependence

contributions from reggeon exchange in $0.035<\xi<0.095$ range

if reggeon has different structure than pomeron

↓

change in shape for $R_{\frac{SD}{ND}}$ as a function of x



↓

no ξ dependence

The Diffractive Structure Function: Run 2:

Goals

to study ξ dependence
for low ξ (<0.035) values

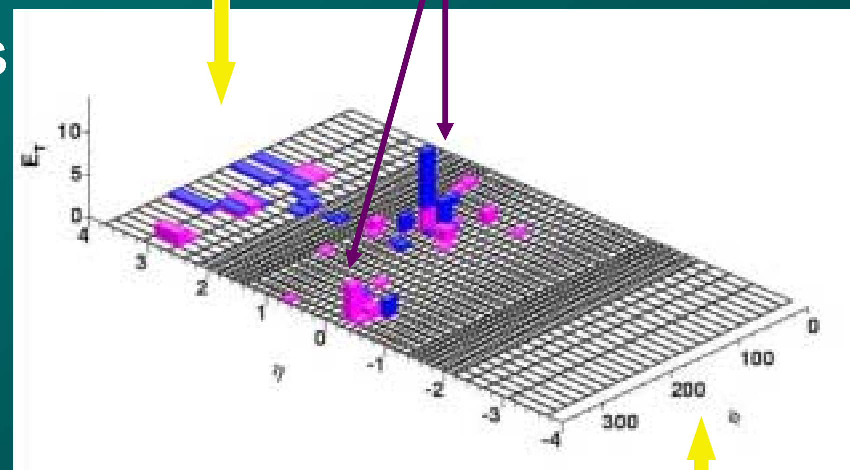
Means

rapidity gaps

events without hits in BSC
on the p or $\bar{p}$ side

East

dijets



West
BSC gap requirement

The Diffractive Structure Function: Run 2: Hardware

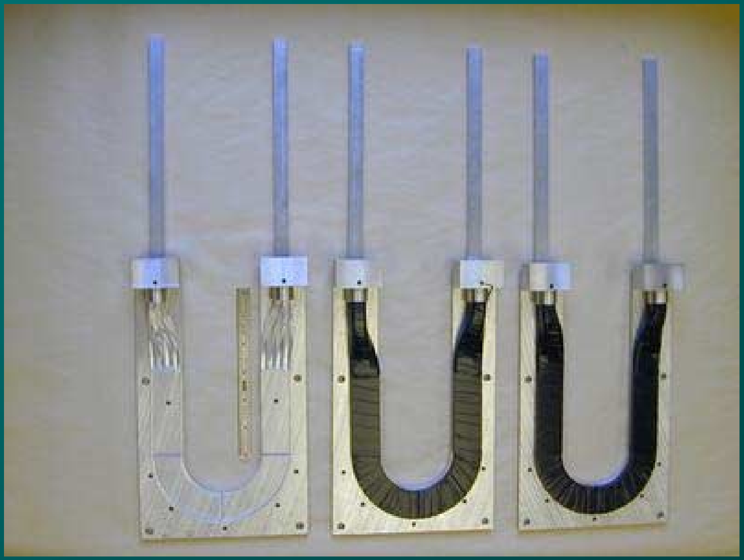
Beam Shower Counters:

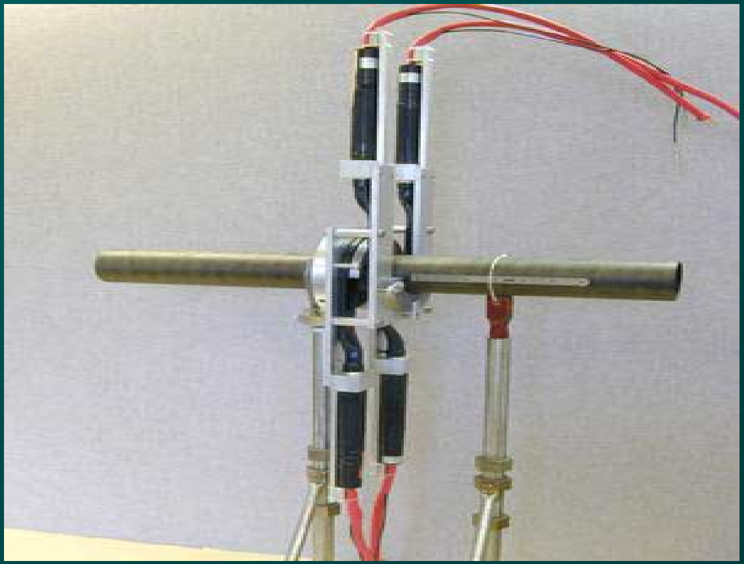
scintillation counters around
the beam pipe

detect particles traveling in direction
from interaction point along beam pipe

$5.5 < |\eta| < 7.5$ coverage

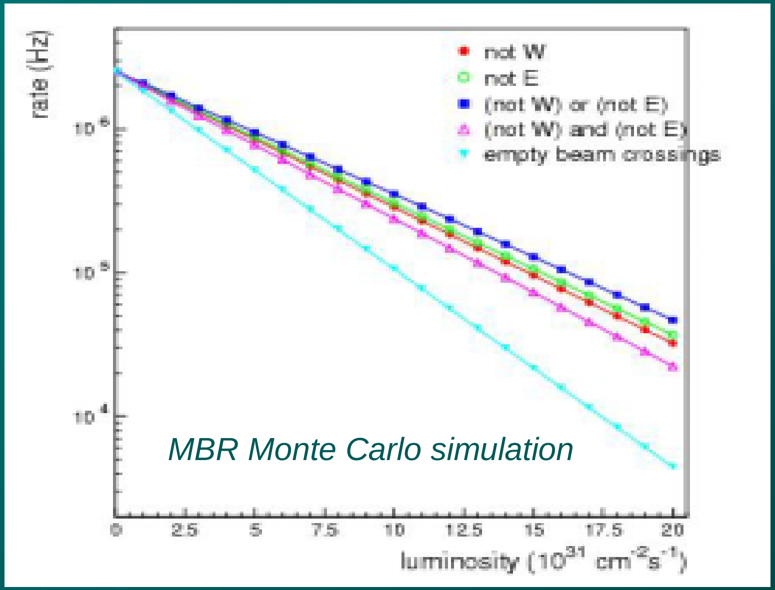
BSCs provide East and West gap triggers:



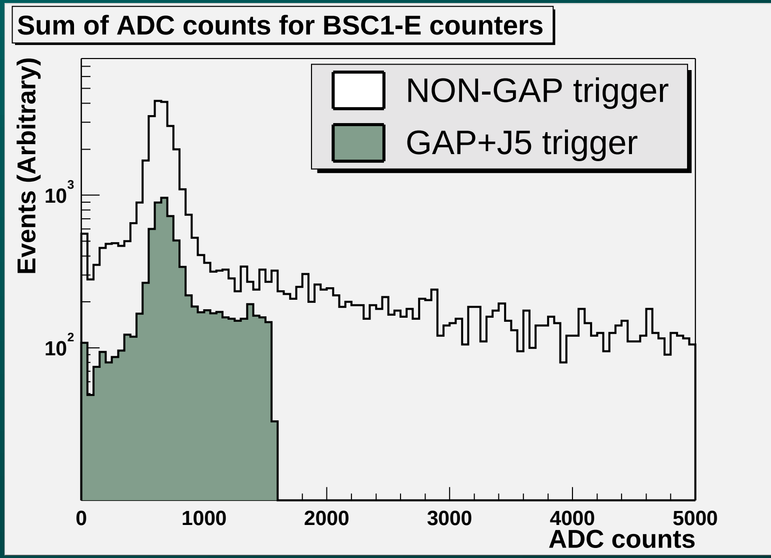


The Diffractive Structure Function: Run 2: Trigger

gap trigger rate decreases with increasing luminosity – additional interactions "kill" gap



Trigger name	PS	Rate (*Hz*)	Cross Section
Level 1			
L1_GAP_WEST_JET5	1	101.2	12.8 μb
Level 2			
L2_PS500_L1_GAP_WEST_&_JET5	500	0.20	27.6 nb
L2_JET15_&_L1_GAP_WEST_PS50	50	0.25	34.3 nb
L2_JET40_&_L1_GAP_WEST	1	1.63	223.0 nb
Level 3			
DIFF_GAPW_ST5	1	0.20	27.4 nb
DIFF_GAPW_JET20	1	0.11	15.3 nb
DIFF_GAPW_JET50	1	0.19	25.5 nb

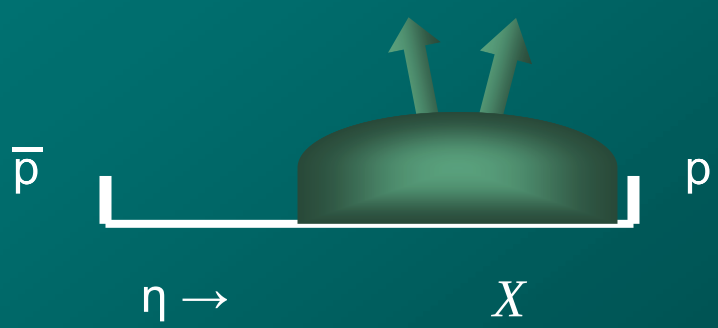


The Diffractive Structure Function: Run 2

determination of ξ:

from the information of
final state particles in
the diffractive mass system *X*

$$\xi_{\bar{p}} = \frac{1}{\sqrt{s}} \sum_i E_T^i e^{-\eta^i}$$



information from calorimeters:

forward calorimeters:

MiniPlugs: 3.5<|η|<5.1

$$\Delta\eta_{gap} \approx \ln \xi$$

low ξ values

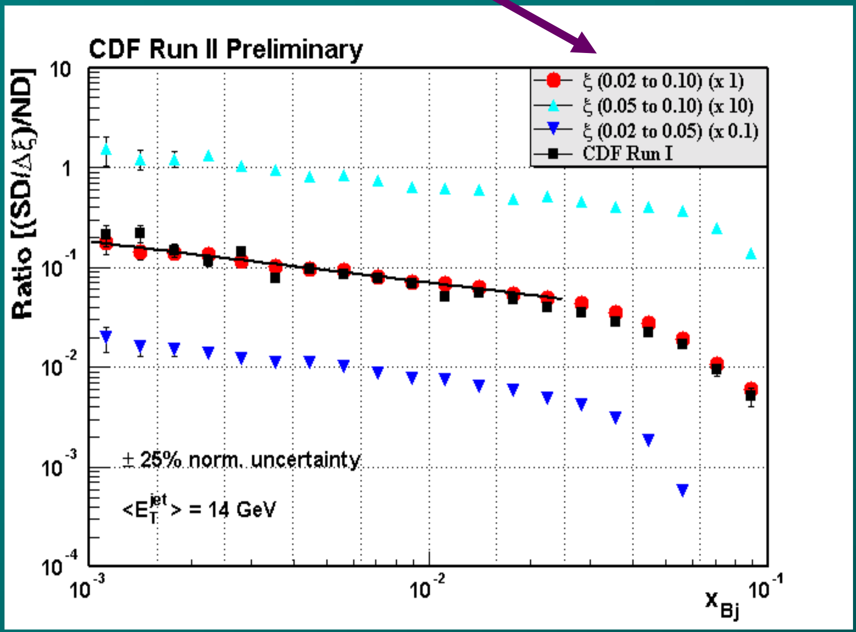
0.001 < ξ

possibly…

The Diffractive Structure Function: Run 2

Roman Pots + Jet Sample

0.002< ξ < 0.05



consistent with Run I

BSCW-Gap + Jet Sample

0.001 < ξ

Strategy for the analysis:

- calculate ξ for each event
- separate clean diffractive sample:
- calculate *x* for dijet system
- compare with ND *Jet5* sample
- cross checks with *RP+Jet5* sample
- different Q^2 samples for the same trigger…

Summary

FACT:

New possibility to extend ξ range down to 0.001 for Q^2 100 GeV^2

QUESTION:

Will the ξ distribution at the Tevatron be the same
as at HERA at very low ξ?

ANSWER:

New results from CDF Run 2 data coming soon!