Hard Diffraction at DØ

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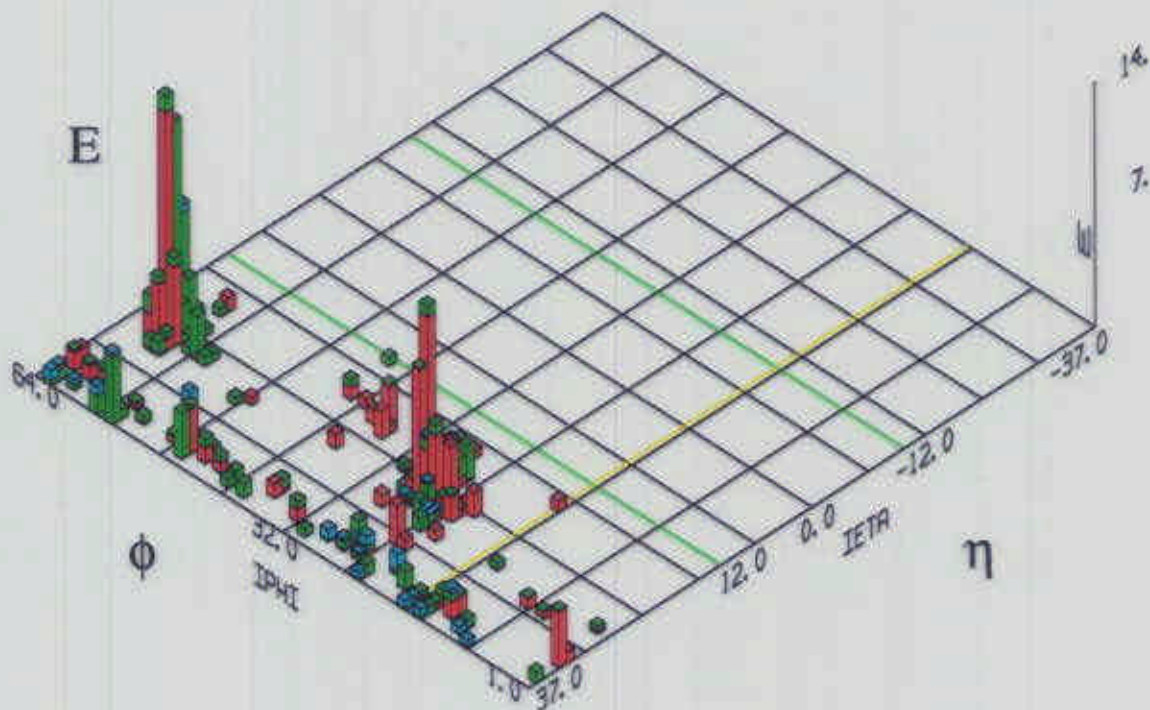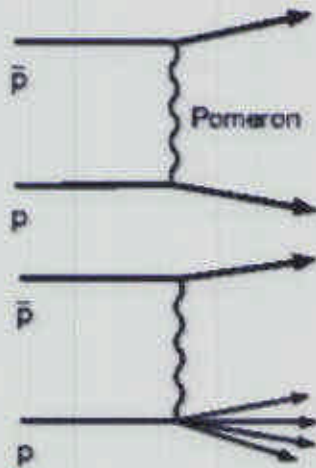
EVENT TOPOLOGIES

Soft Processes:

$\bar{p}$ Pomeron

ϕ (Rapidity Gap)   **Elastic Scattering**

$\bar{p}$ (Gap)   **Single Diffraction**

Hard Processes (jet production):

$\bar{p}$ (Gap)   **Hard Single Diffraction**
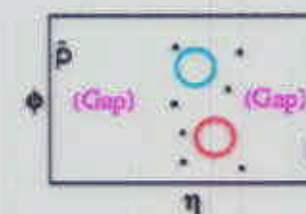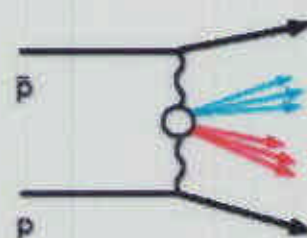
$\bar{p}$ (Gap) (Gap)   **Hard Double Pomeron**
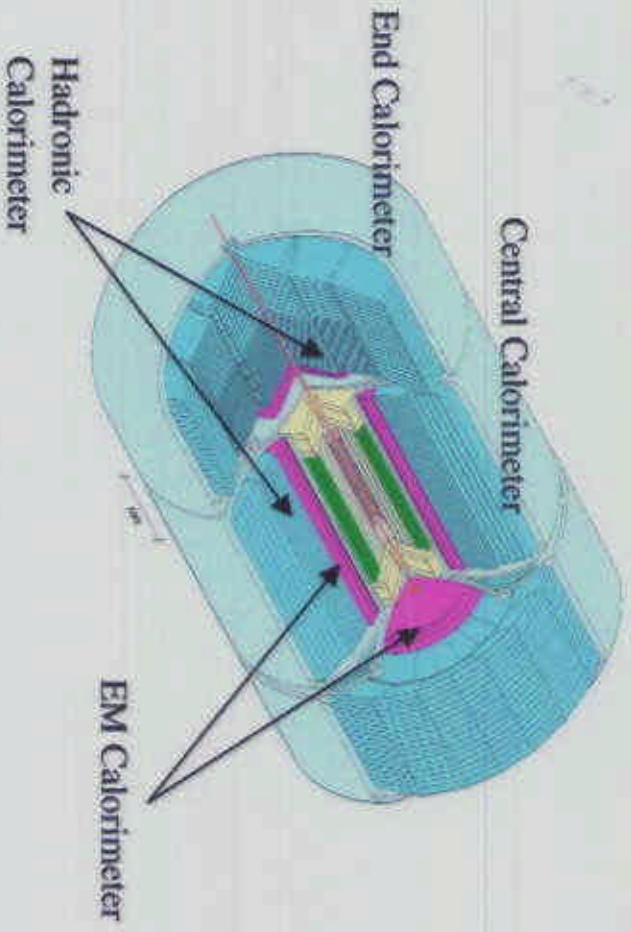
- Rapidity gaps => experimental signature for diffraction

- Hard diffraction(Jets+Rap.Gap) => probe structure of
  exchanged object

DØ Detector

- #n_{CAL} and #n_{L0} => identify rapidity gaps
- measure jets

DØ Calorimeter
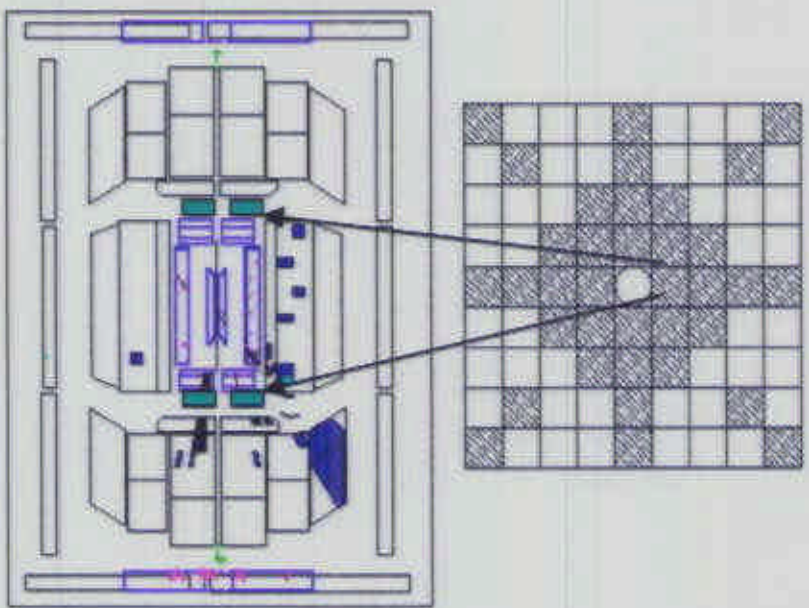
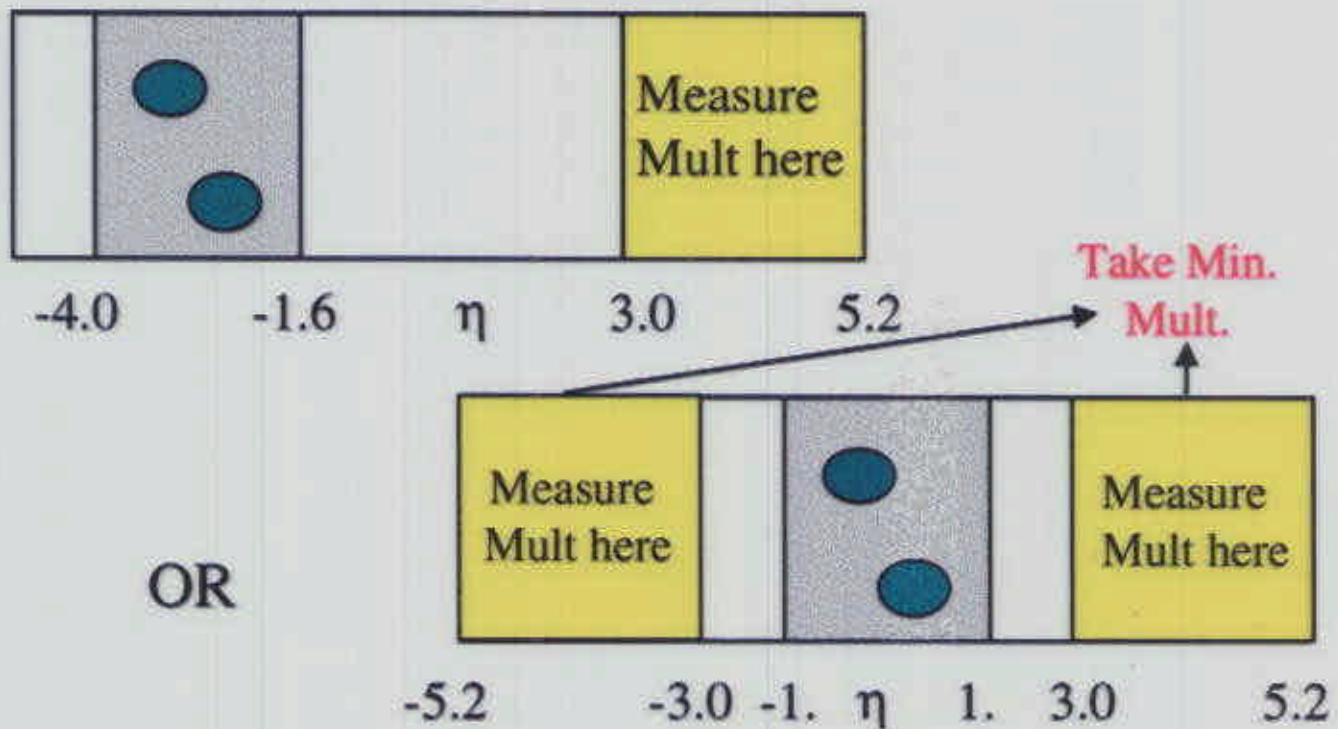Central Calorimeter

End Calorimeter

Hadronic
Calorimeter

EM Calorimeter

Calorimeter
n_{CAL} = # EM(HAD) towers with
E > 200(500) MeV
$3.0 < |\eta| < 5.2$

Level 0

Level 0
n_{L0} = # L0 tiles with hits
$2.3 < |\eta| < 4.3$

Hard Single Diffraction
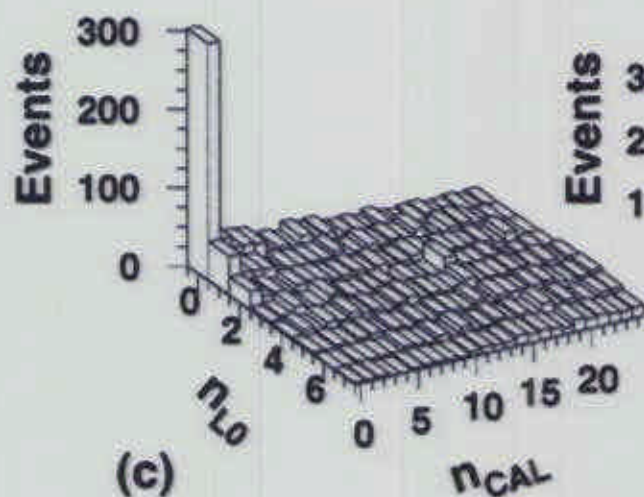
Measure Gap Fraction :
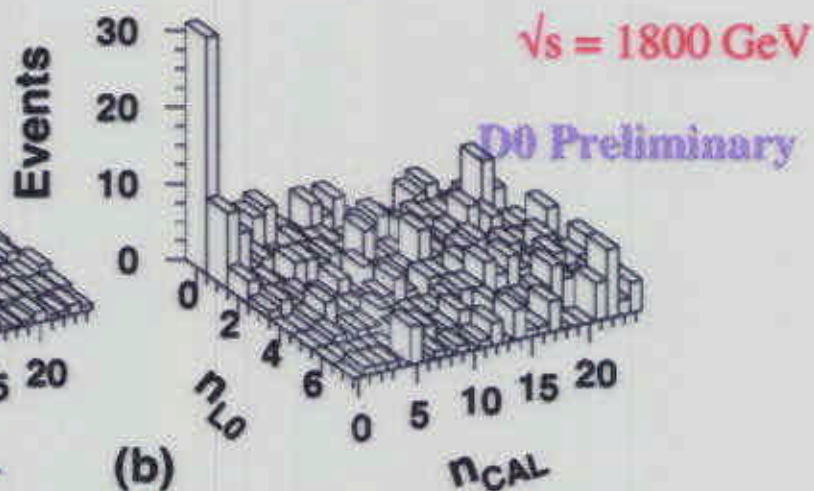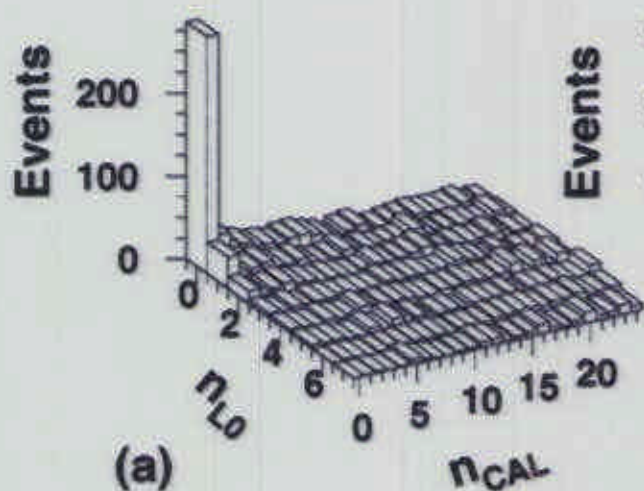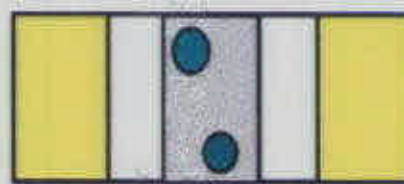
- Forward Jet Trigger
  two 12GeV Jets $|\eta| > 1.6$
- Inclusive Jet Trigger
  two 15(12)GeV Jets $|\eta| < 1.0$

Study SD Characteristics:
- Single Veto Trigger
  two 15(12)GeV Jets

1800 and 630 GeV Multiplicities

$\sqrt{s} = 1800$ GeV

D0 Preliminary

(a) (b)

$\sqrt{s} = 630$ GeV

(c) (d)
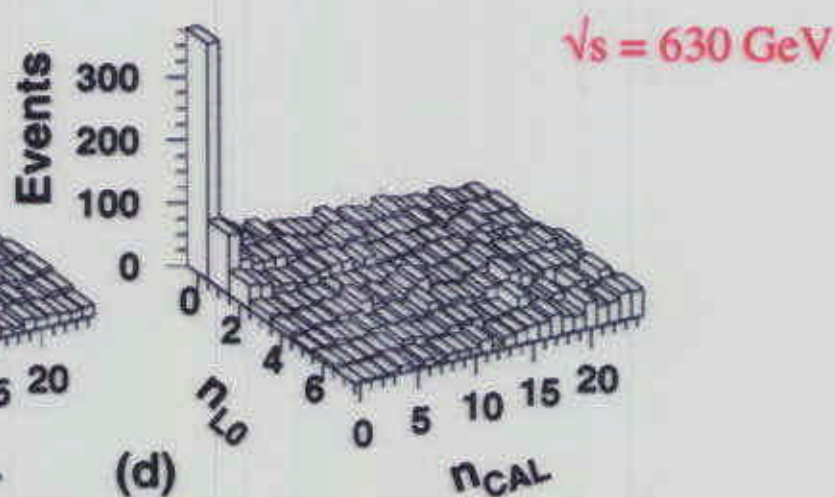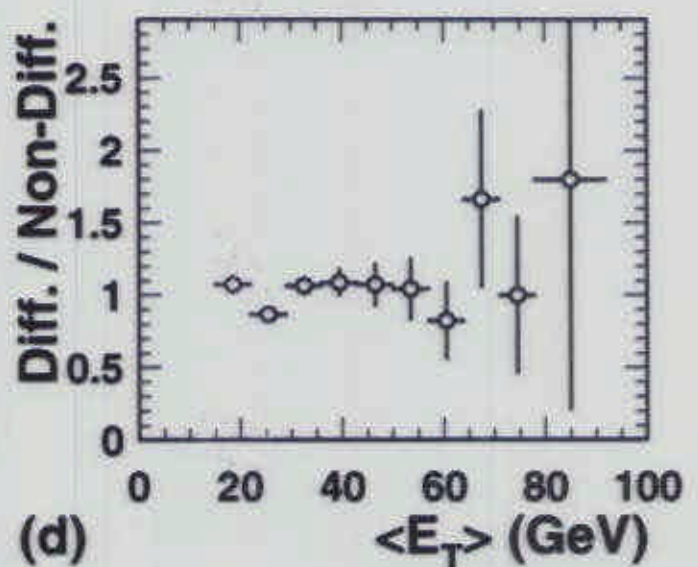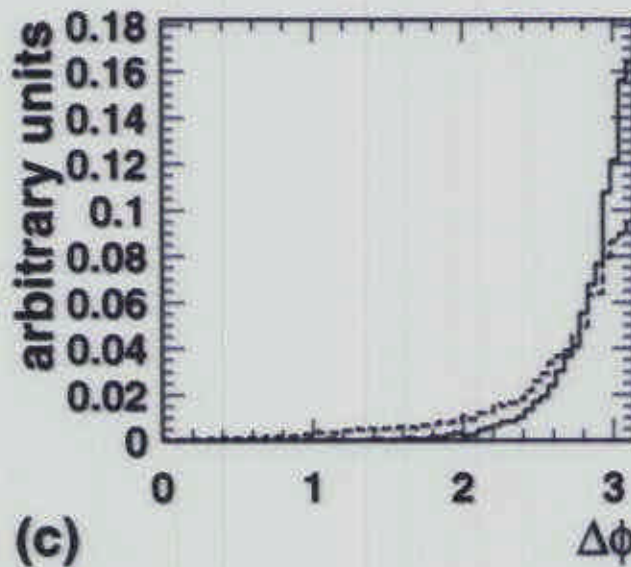
- Peak at $n_{CAL}=n_{L0}=0$ indicates that data has a diffractive   component

Event Characteristics(1800GeV)

.... $n_{L0}>1$ and $n_{CAL}>1$

———— $n_{L0}=n_{CAL}=0$

D0 Preliminary

(a) N_{jets} (b) jet width

(c) $\Delta\phi$ (d) $<E_T>$ (GeV)
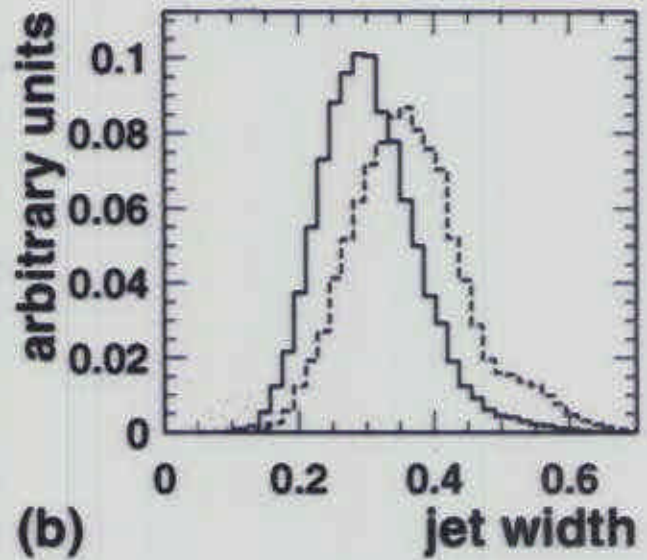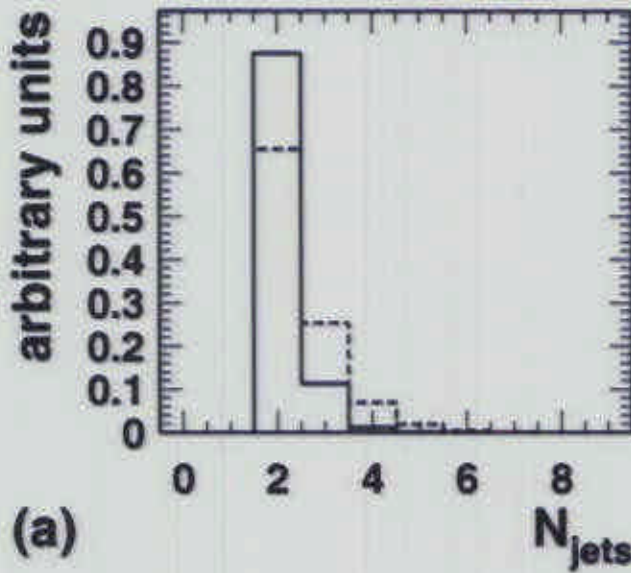
- Difractive events have less radiation (a-c)

- Gap fraction has little dependence on $<E_T>$ (d)

Single Diffractive ξ Distributions

ξ distribution for events in $n_{L0}=n_{CAL}=0$ bin

$$\xi = \sum_i \frac{E_{T_i} e^{\eta_i}}{\sqrt{s}} = \frac{\Delta p}{p}$$

D0 Preliminary

(a) $\sqrt{s}$ = 1800 GeV forward

(b) central

(c) $\sqrt{s}$ = 630 GeV forward
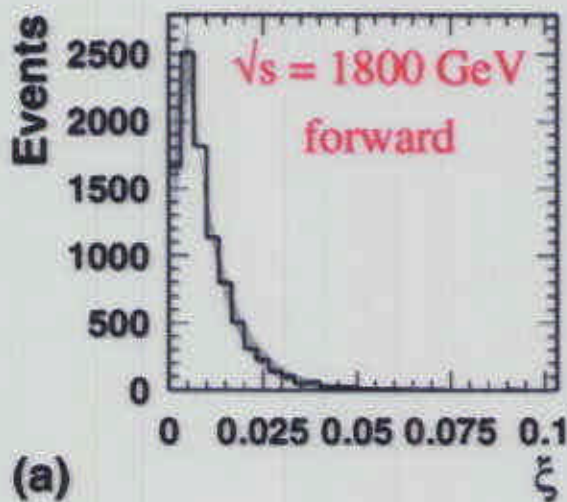
(d) central

$\xi \to 0.2$ for $\sqrt{s}$ = 630 GeV !

Gap Fraction Results

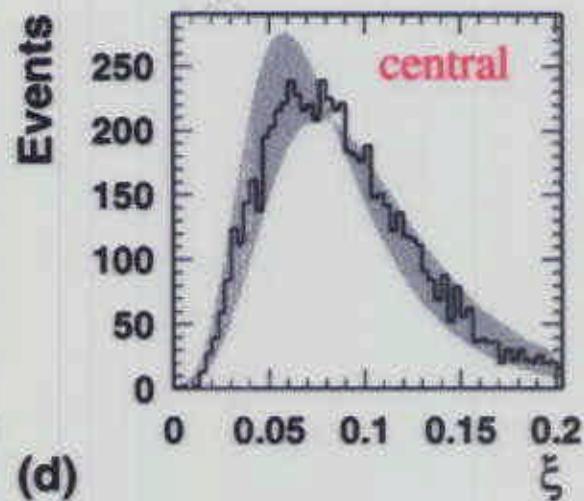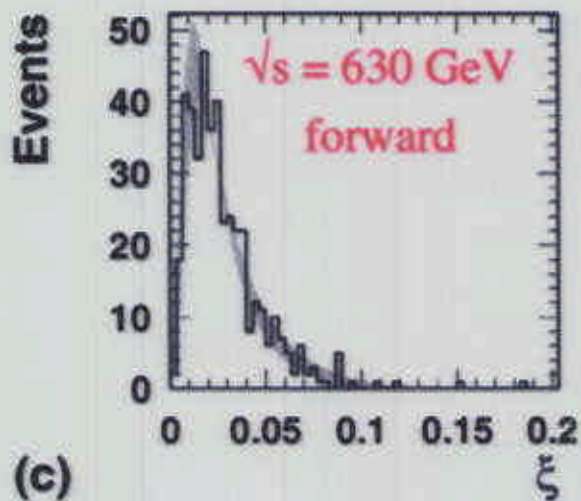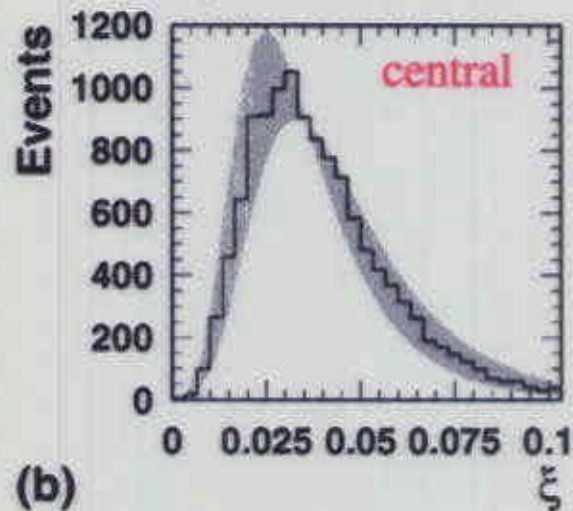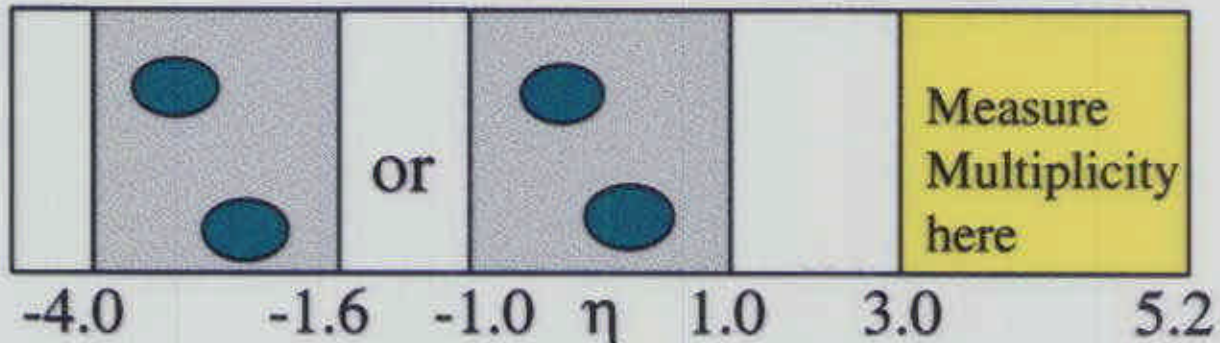| Data Sample	Measured Gap Fraction (#Diffractive Dijet / #All Dijets)
1800 Forward Jets	0.65% + 0.04% - 0.04%
1800 Central Jets	0.22% + 0.05% - 0.04%
630 Forward Jets	1.19% + 0.08% - 0.08%
630 Central Jets	0.90% + 0.06% - 0.06%

D0 Preliminary

Data Sample	Gap Fraction Ratios
630/1800 Forward Jets	1.8 + 0.2 - 0.2
630/1800 Central Jets	4.1 + 0.8 - 1.0
1800 Fwd/Cent Jets	3.0 + 0.7 - 0.7
630 Fwd/Cent Jets	1.3 + 0.1 - 0.1

- Forward Jets Gap Fraction > Central Jets Gap Fraction

- 630GeV Gap Fraction > 1800GeV Gap Fraction

MC Comparison(POMPYT/PYTHIA)

Gap Fraction

Evt Sample	Hard Gluon	Quark	Soft Gluon	DATA
1800 FWD JET	(2.2 ± 0.3)%	(0.8 ± 0.1)%	(1.9 ± 0.4)%	(1.19 ± 0.08)%
1800 CEN JET	(2.5 ± 0.4)%	(0.5 ± 0.1)%	(0.14 ± 0.04)%	(0.90 ± 0.06)%
630 FWD JET	(3.9 ± 0.9)%	(2.2 ± 0.5)%	(1.4 ± 0.2)%	(0.65 ± 0.04)%
630 CEN JET	(5.2 ± 0.7)%	(1.6 ± 0.2)%	(0.05 ± 0.01)%	(0.22 ± 0.05)%

Ratios

Event Sample	Hard Gluon	Quark	Soft Gluon	DATA
630/1800 FWD	1.7 ± 0.4	2.7 ± 0.6	1.4 ± 0.3	1.8 ± 0.2
630/1800 CEN	2.1 ± 0.4	3.2 ± 0.5	3.1 ± 1.1	4.1 ± 0.9
1800 FWD/CEN	0.9 ± 0.2	1.6 ± 0.3	$30. \pm 8.$	3.0 ± 0.7
630 FWD/CEN	0.8 ± 0.2	1.4 ± 0.3	$13. \pm 4.$	1.3 ± 0.1

- Within **Ingelman-Schlein** model, **DØ** data is reasonably described by a **pomeron** mainly composed of **quarks**

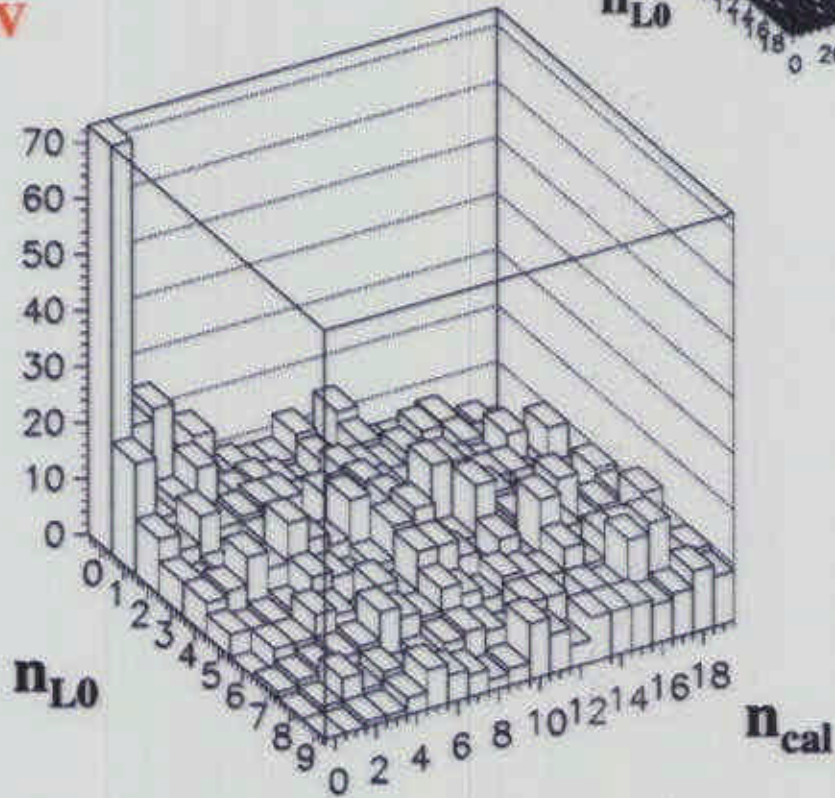- To describe **DØ** data & other measurements a **reduced flux factor** convoluted with a **pomeron** composed of **soft & hard gluon** is required

Diffractive W

Measure Mult. Here

Measure Mult. Here

η 1.1   3   5.2

$\sqrt{s} = 1800$ GeV

n_{L0}

n_{cal}

n_{L0}

n_{cal}
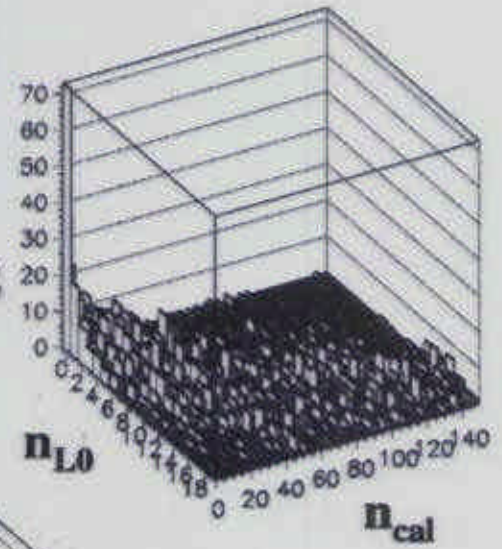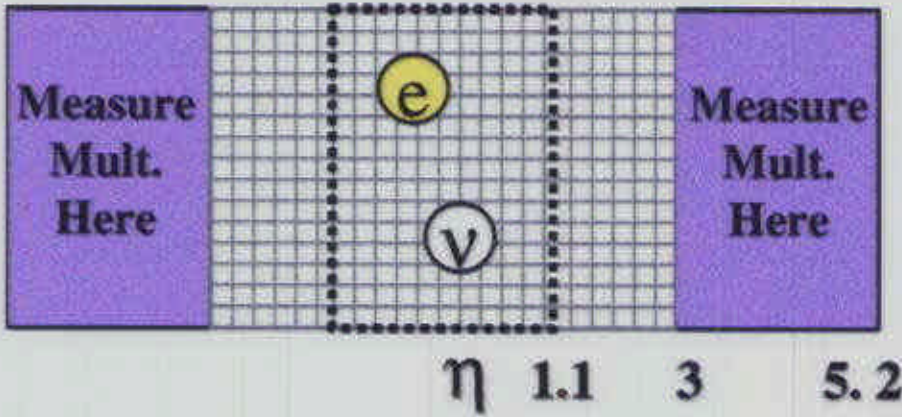
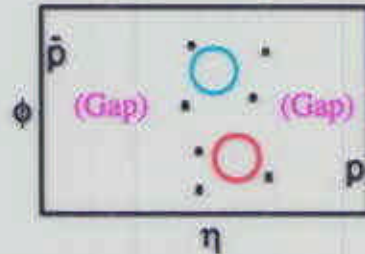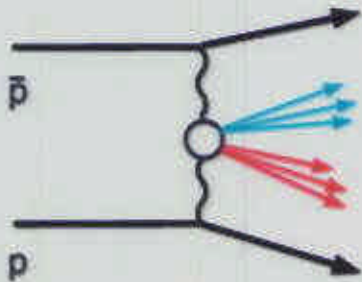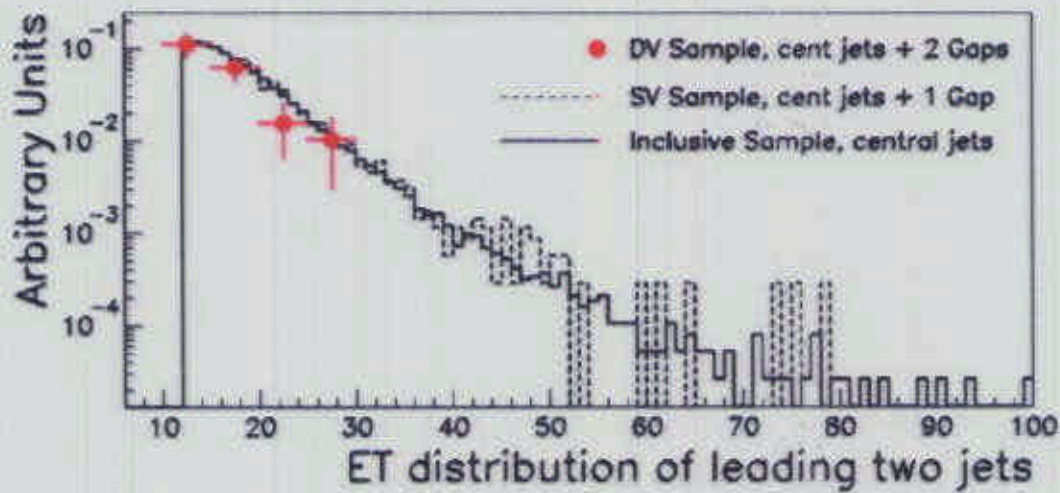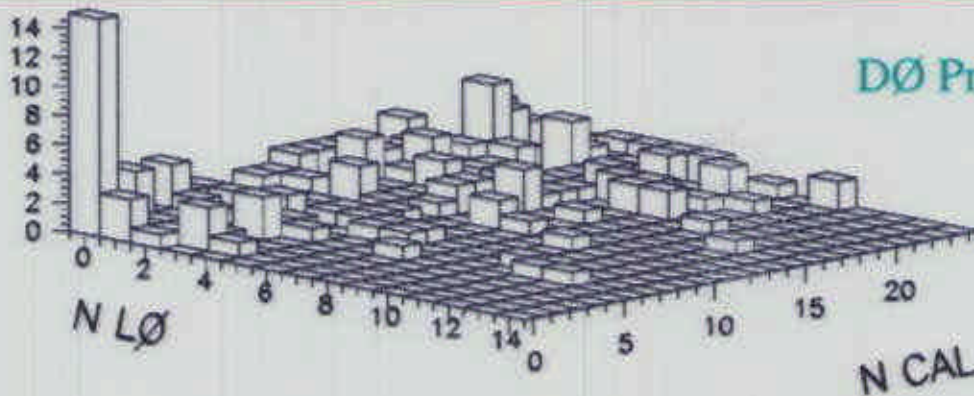**Peak at (0,0) indicates diffractive W with a signal on the 1% level**

Double Gaps at 630 GeV

$|Jet \ \eta| < 1.0, \ E_T > 12 \ GeV$

Gap Region
$2.5 < |\eta| < 5.2$

Demand gap on one side, measure multiplicity on opposite side

DØ Preliminary

N LØ

N CAL

- DV Sample, cent jets + 2 Gaps
- .... SV Sample, cent jets + 1 Gap
- —— Inclusive Sample, central jets

Arbitrary Units

ET distribution of leading two jets

Gap Summary

- **Observed and measured forward gaps in jet events at $\sqrt{s}$ = 630 and 1800 GeV.** Rates much smaller than expected from Ingelman-Schlein model.
=>Require a different normalization and significant soft component to describe data. Large fraction of proton momentum frequently involved in collision.

- **Observed jet events with forward/backward gaps at $\sqrt{s}$ = 630 and 1800 GeV**

- **Observed W and Z boson events with gaps**

- **Finalizing papers and attempting to combine results**
(hep-ex/9912061)

- **Adding FPD to improve diffractive physics capabilities of DØ in RunII**