Jet Production with Two Rapidity Gaps

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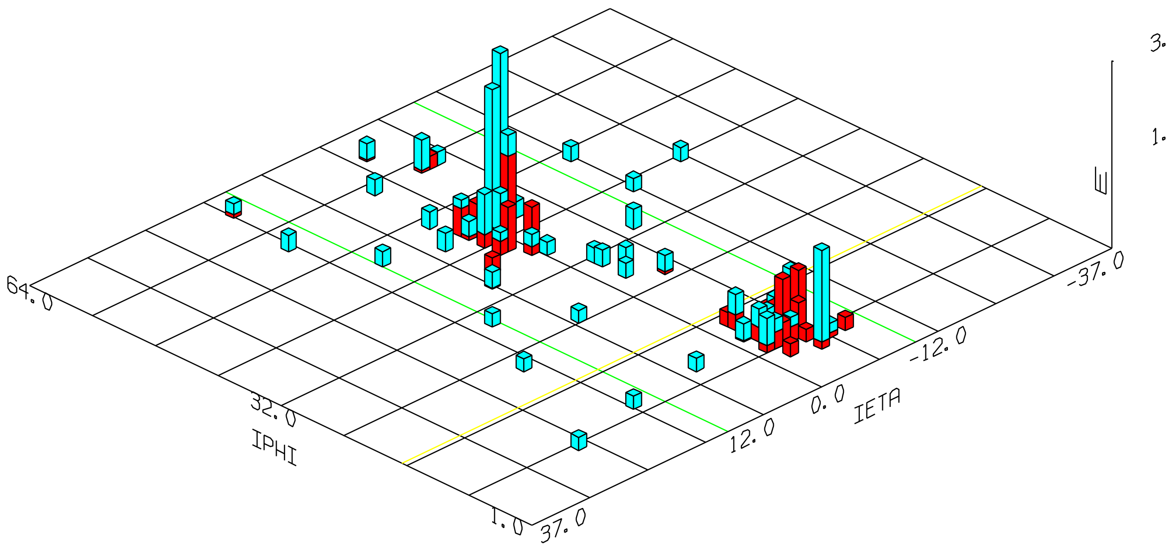
Lafex/CBPF
for the
D-Zero Collaboration

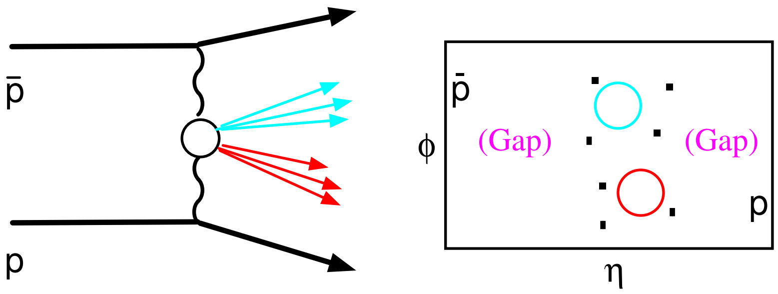


- Introduction
- Data Selection
- Event Characteristics for 1800/630 Data
- Monte Carlo
- Summary

Introduction

Motivations for Study Double Pomeron Exchange

$\bar{p}\, p \Rightarrow \bar{p}\, p + X$



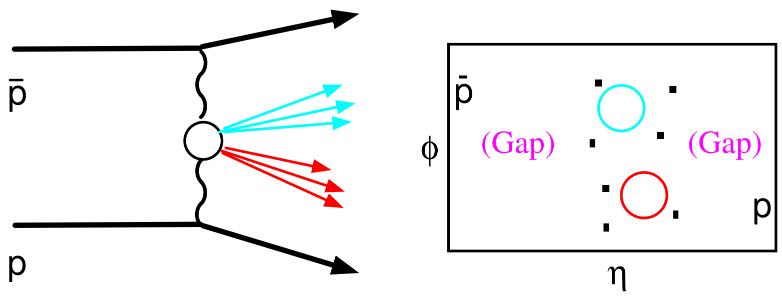
Pomeron-Pomeron collisions provide an extra process to gain insight into the nature of the pomeron.

Clean signature for new particle searches

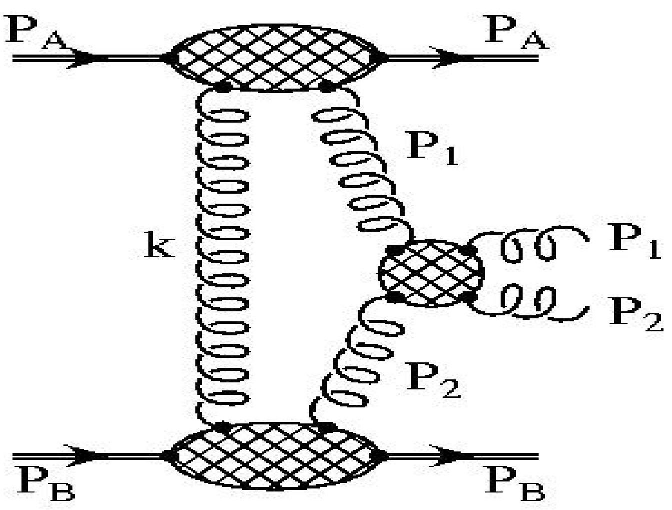
In this analysis we use a trigger that demands central jet production with a rapidity gap on one side (SD candidates) and study the multiplicity on the opposite side.

HDPE Models

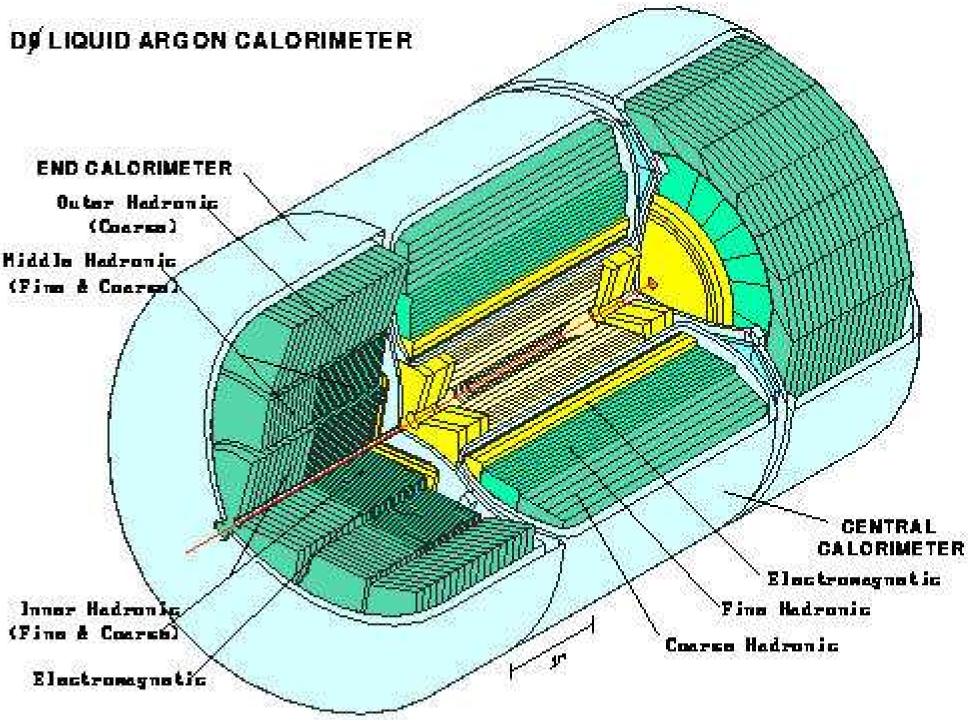
Factorizable Approach

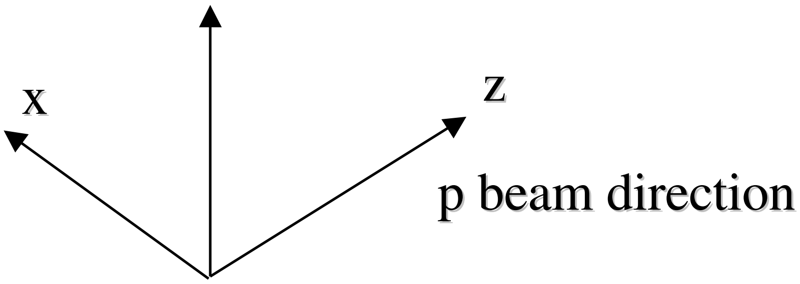


Non-Factorizable Approach



DØ Calorimeter

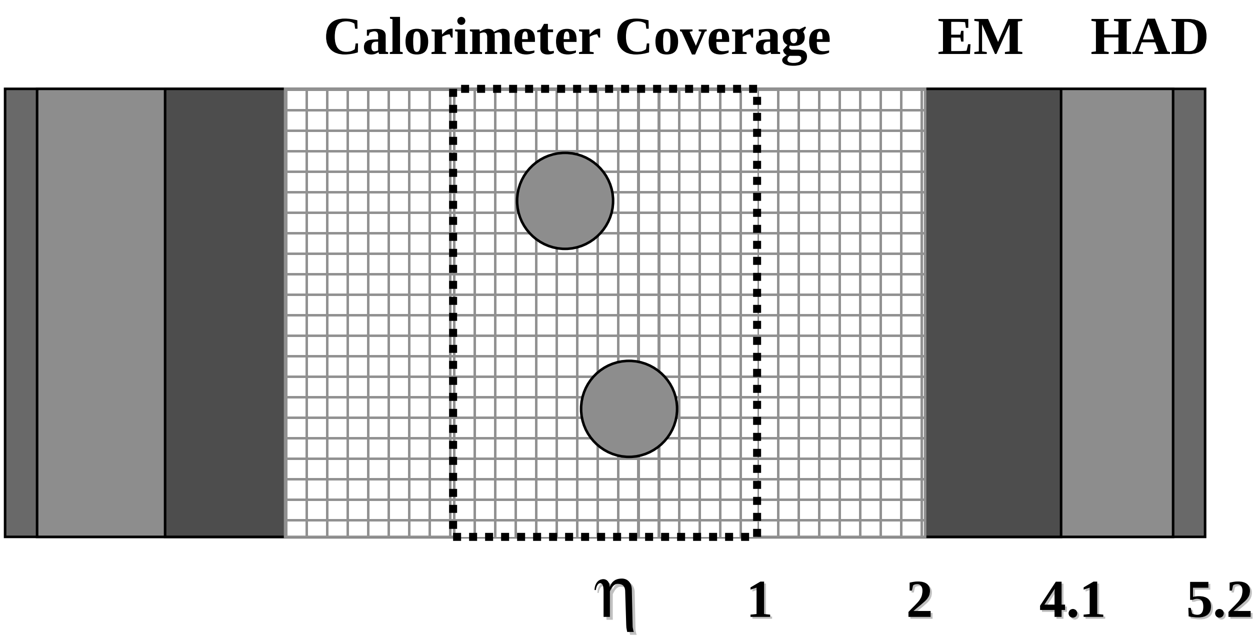




$$\eta = -\ln(\tan \theta/2)$$

Gap Definition

Detector coverage for gap definition



Thresholds:
EM: 125 MeV
HAD: 500 MeV
HAD END: 50 MeV

Level 0 coverage (scintillator array)

Gap definitions:

1) Ncal=0 in η (2.0,5.2)

2) Ncal=0 in η (2.5,5.2)

Data Selection

Data sample

• Three Triggers for Different Gap Requirements
  - Inclusive Trigger (2 jets > 15 GeV)
  - Single Veto Trg. (Add 1 Gap at L0)
  - Double Veto Trg. (Add 2 Gaps at L0)

• Event and jet quality cuts
  - single interaction cut
  - 1 central vertex
  - low missing ET < 25 GeV
  - remove events w/ spurious jets

Require 2 leading jets > 15 GeV , $|\eta_{jet}| < 1.0$

Restrict to low lum runs < 6×10^{30} cm^{-2} s^{-1}

To search for double gap events we use our enhanced sample of single gap events from the SV trigger.

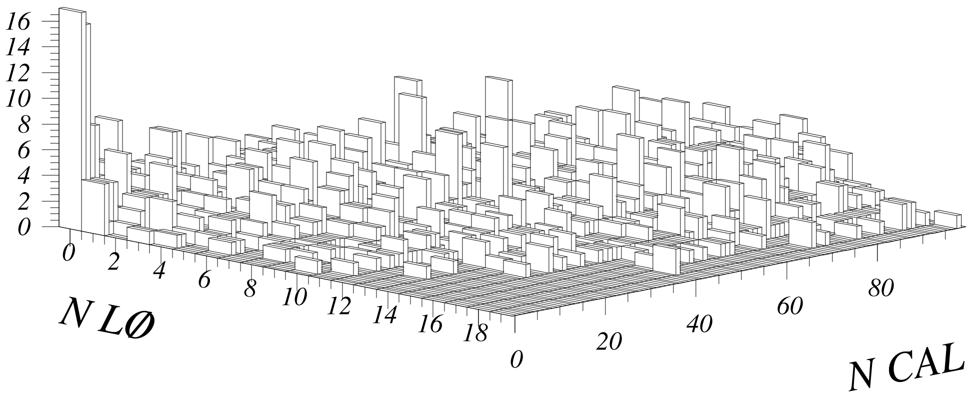
We re-enforce the gap at trigger level w/ calorimeter tag and plot L0/CAL multiplicities on opposing side...

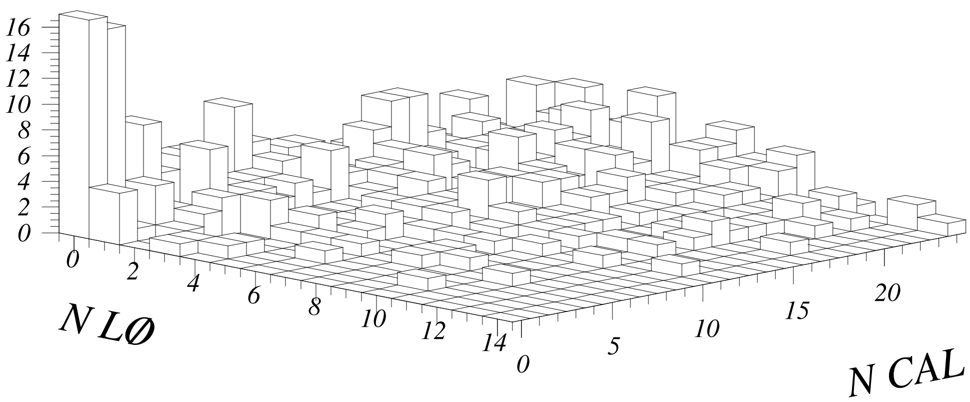
1800 GeV Multiplicities I

Require 1 gap w/ 2.5< |η|< 5.2; 2 jets ET> 15 GeV, |η_jet| < 1.0
Plot detector multiplicity in same region on opposite side

D0 Preliminary

Multiplicity in 2.5.lt.ETA.lt.5.2



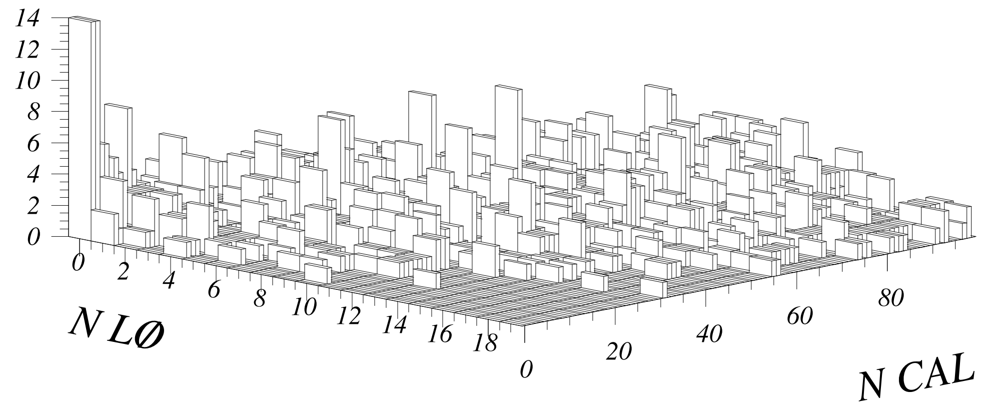


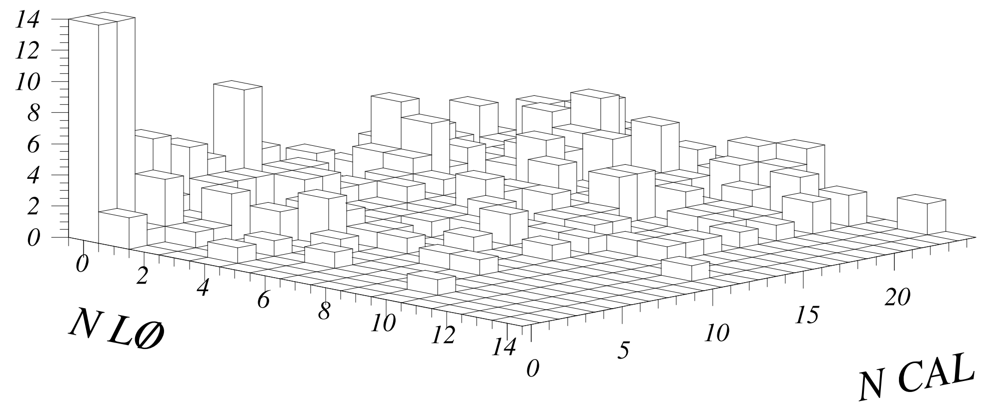
1800 GeV Multiplicities II

Require 1 gap w/ 2.0< |η|< 5.2; 2 jets ET> 15 GeV, |η_jet| < 1.0
Plot detector multiplicity in same region on opposite side

D0 Preliminary

Multiplicity in 2.0.lt.ETA.lt.5.2





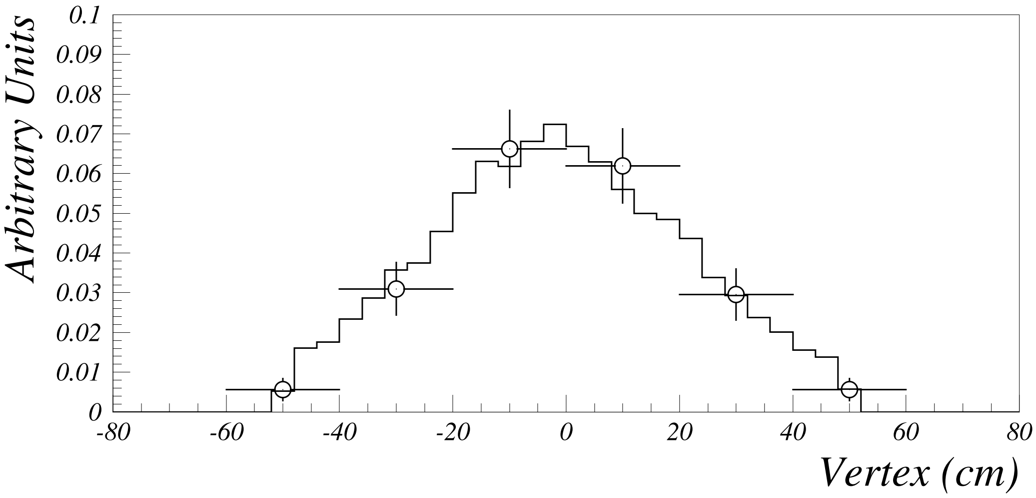
Little change w/ addition of 1/2 unit of rapidity in gap definition

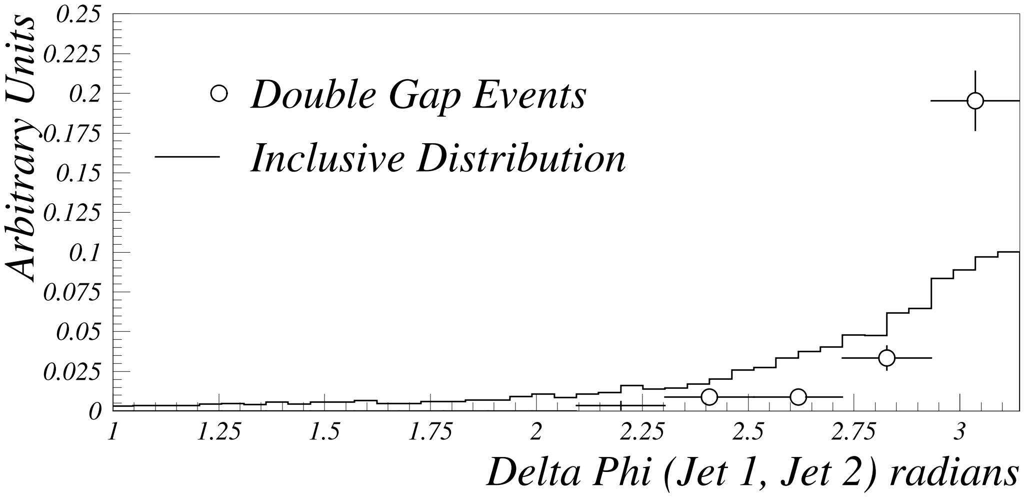
1800 Gev Event Characteristics I

Double gap events vs. inclusive events
w/ 2 leading jets > 15 GeV, |η_jet| < 1.0

D0 Preliminary

Select 'low background' double gap events
N_L0 + N_CAL = 0 on both sides (Use DV trig)





1800 Gev Event Characteristics II

Double gap events vs. inclusive events
w/ 2 leading jets > 15 GeV, |η_jet| < 1.0

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Select 'low background' double gap events
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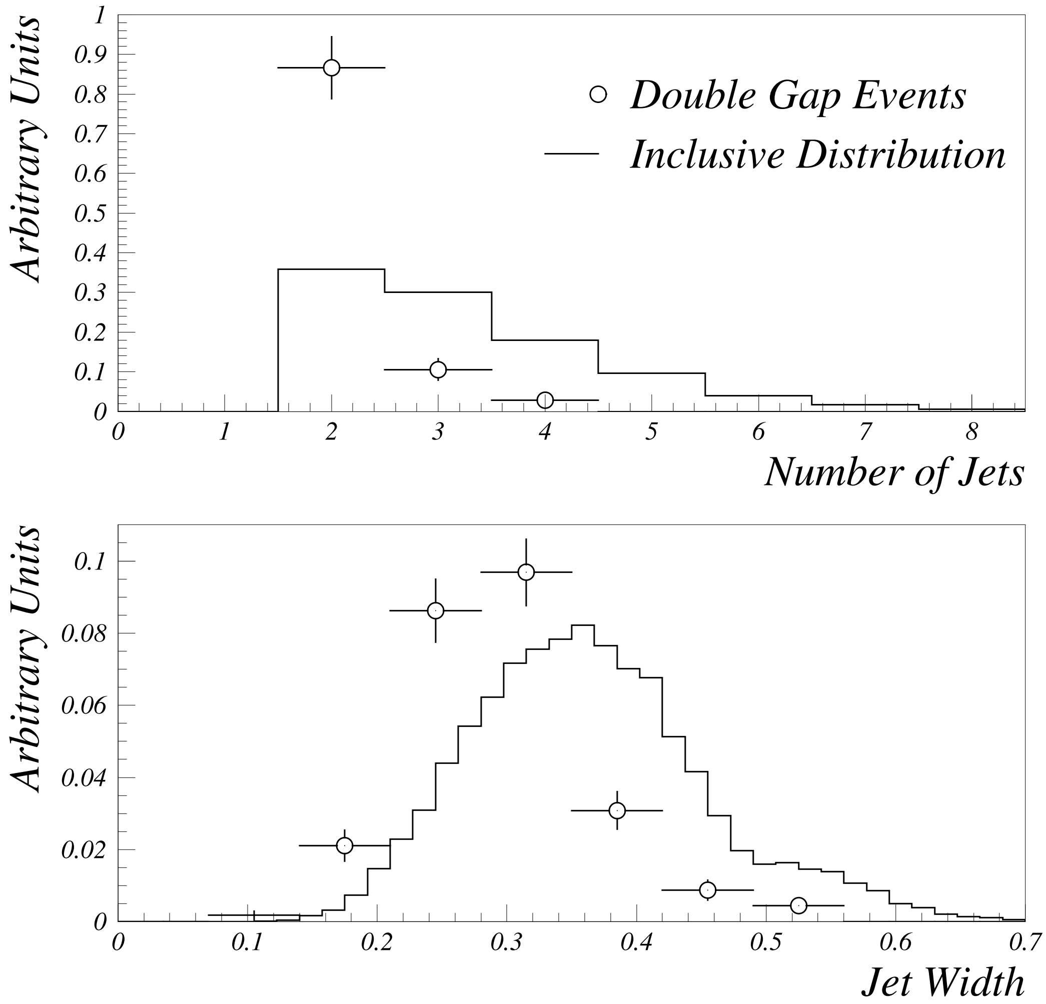


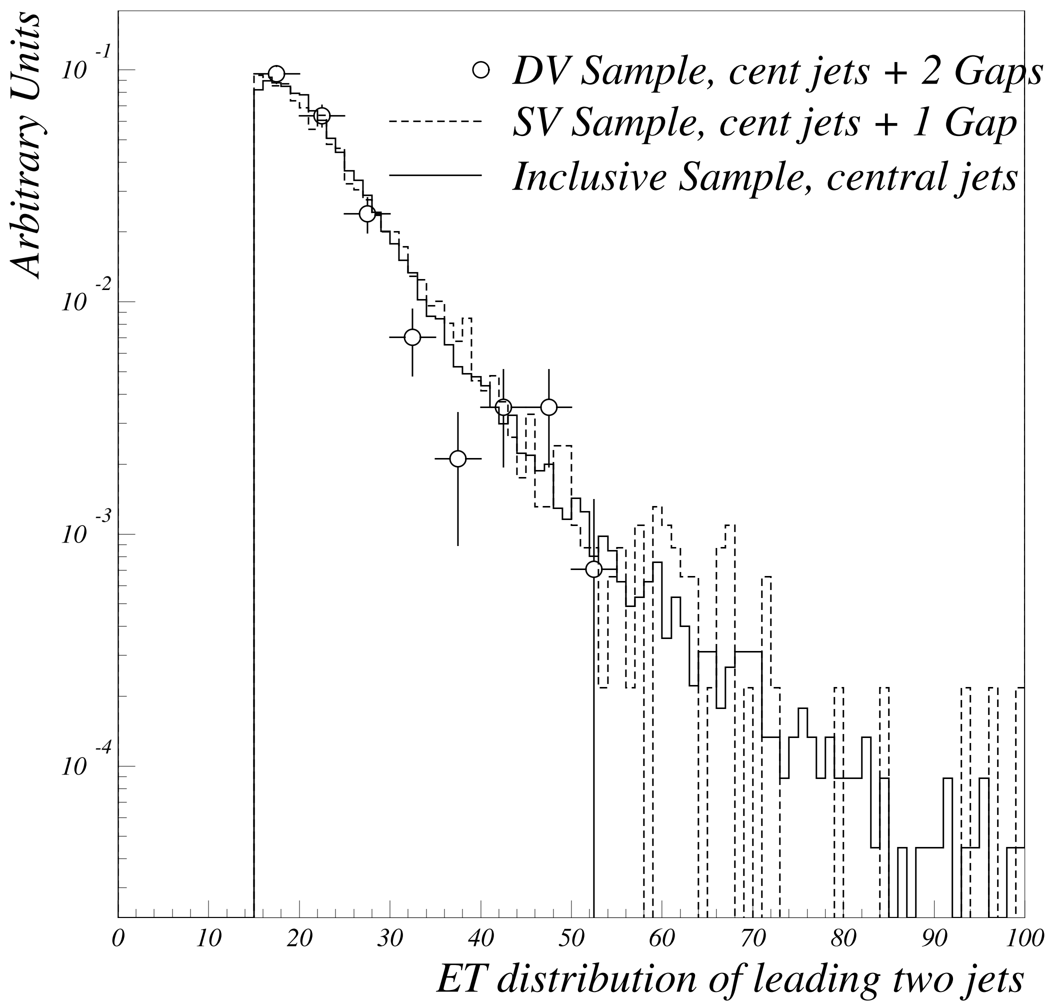
DG events more quiet, thinner jets

1800 Gev ET Distributions

Double gap events vs. single gap and inclusive events

D0 Preliminary

w/ 2 leading jets > 15 GeV, |η_jet| < 1.0



Similar ET spectra in each sample

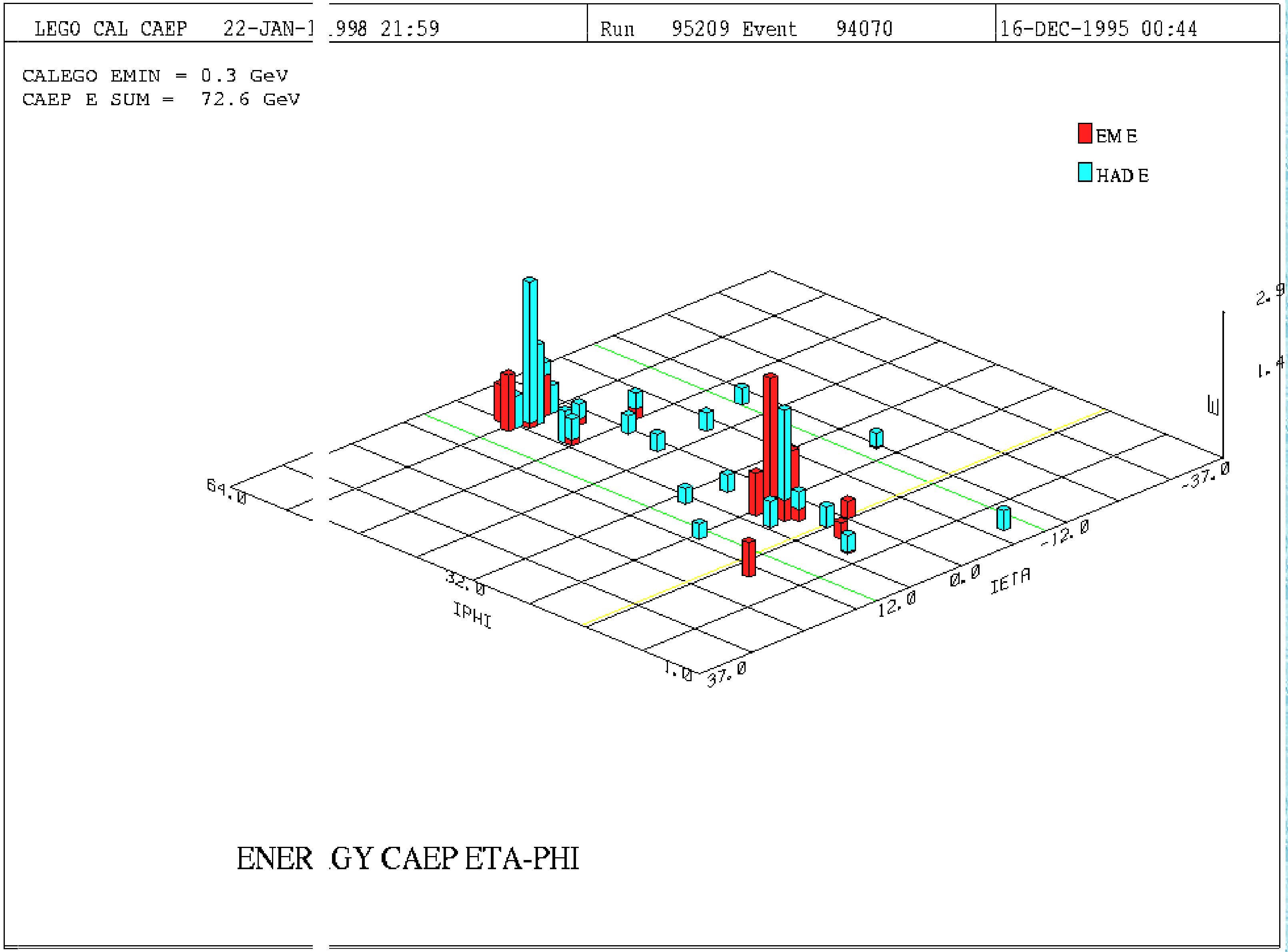
630 GeV Data

We have performed a parallel analysis with a sample of data taken during a 630 GeV running period.

Event cuts and gap definitions were similar to the 1800 GeV analysis

Except lower trigger thresholds were used and in this analysis we require 2 leading jets with $E_T > 12$ GeV

Event Display



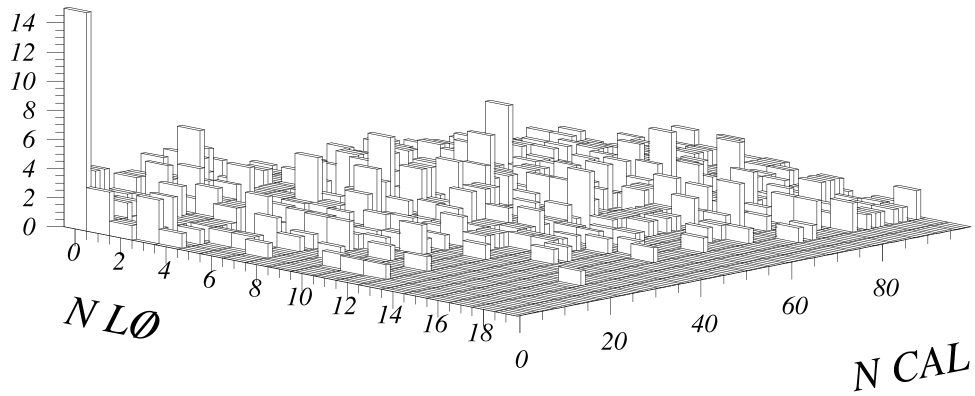
630 GeV Data

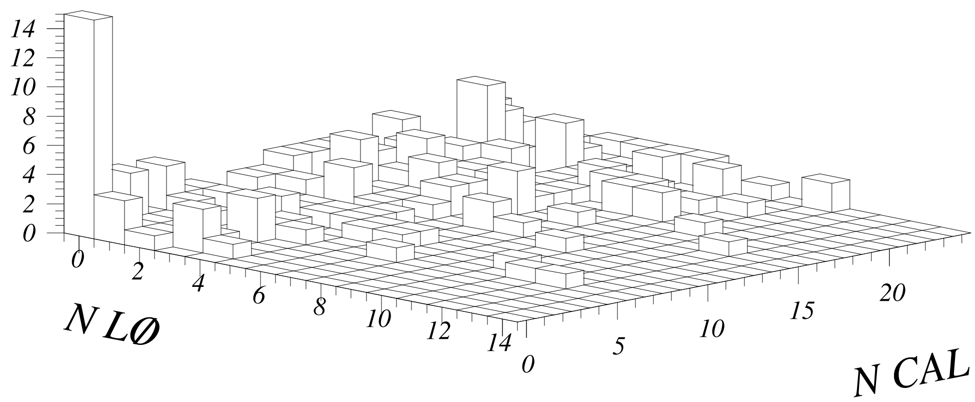
630 GeV Multiplicities

D0 Preliminary

Require 1 gap w/ 2.5 < |η| < 5.2
Plot detector multiplicity in same region on opposite side

Multiplicity in 2.5.lt.ETA.lt.5.2



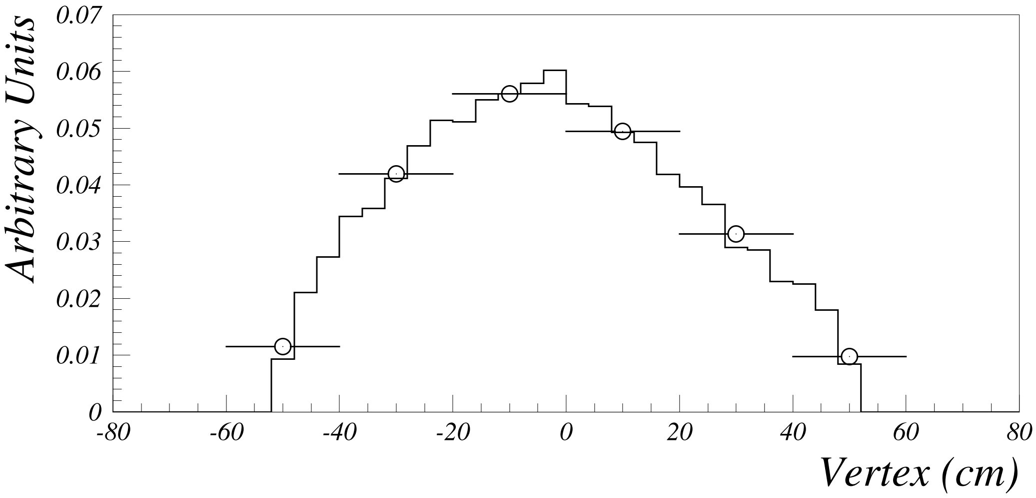


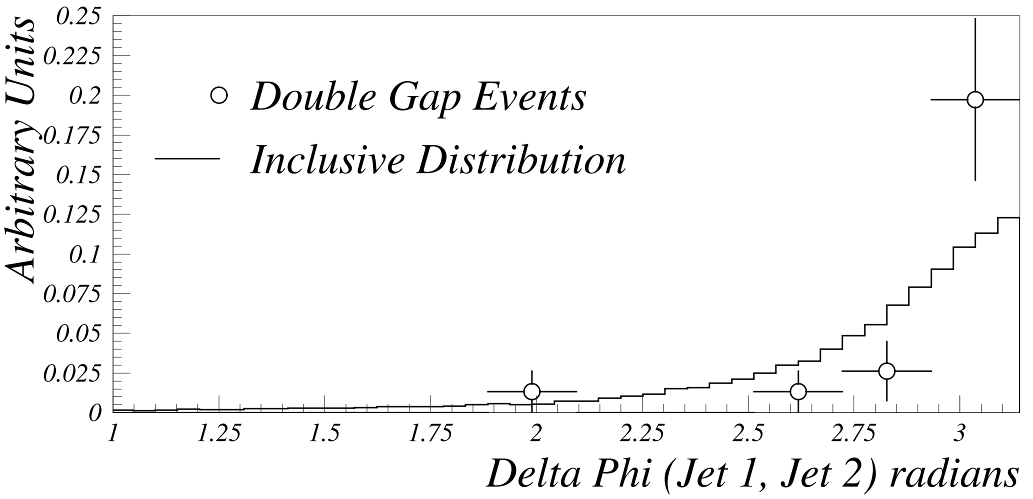
630 GeV Event Characteristics I

Double gap events vs. inclusive events
w/ 2 leading jets > 12 GeV, |η_jet| < 1.0

D0 Preliminary

Select 'low background' double gap events
N_L0 + N_CAL = 0 on both sides



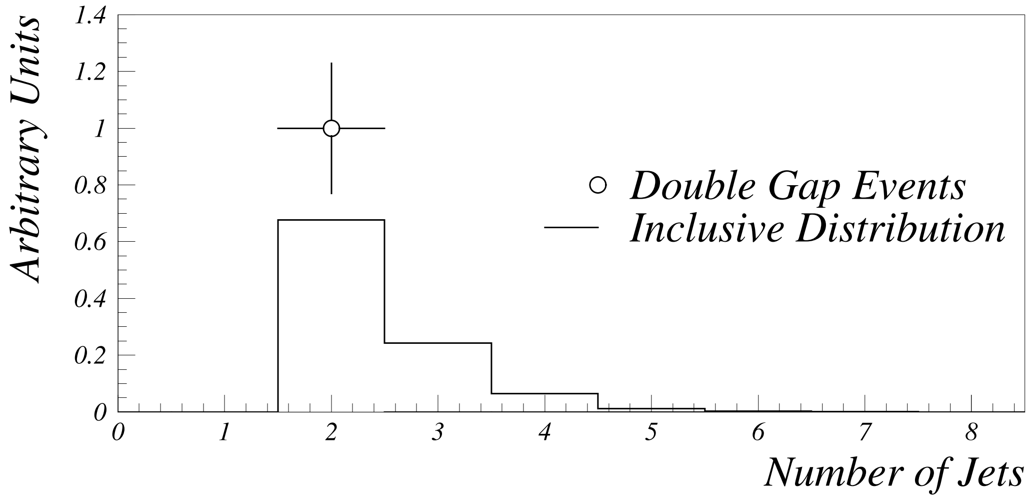


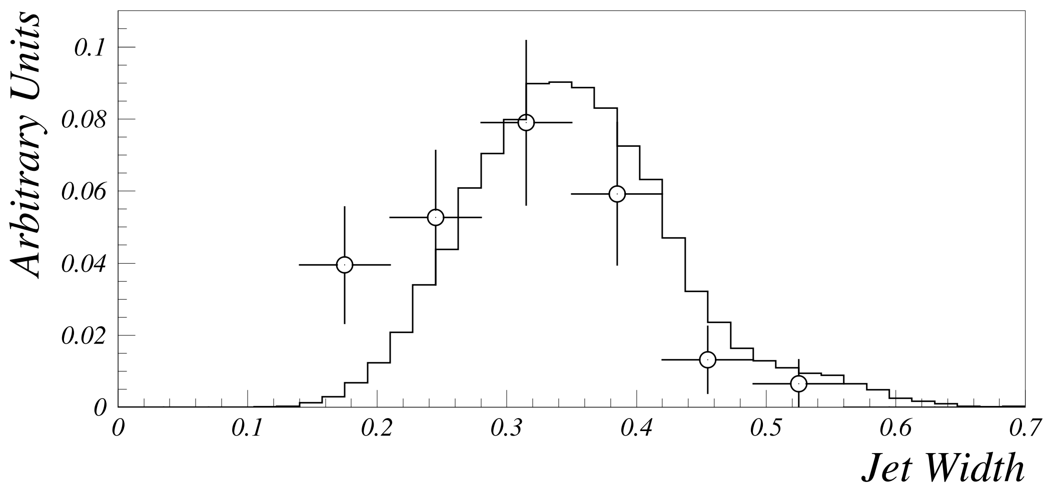
630 GeV Event Characteristics II

D0 Preliminary

Double gap events vs. inclusive events
w/ 2 leading jets > 12 GeV, |η_jet| < 1.0

Select 'low background' double gap events
N_L0 + N_CAL = 0 on both sides



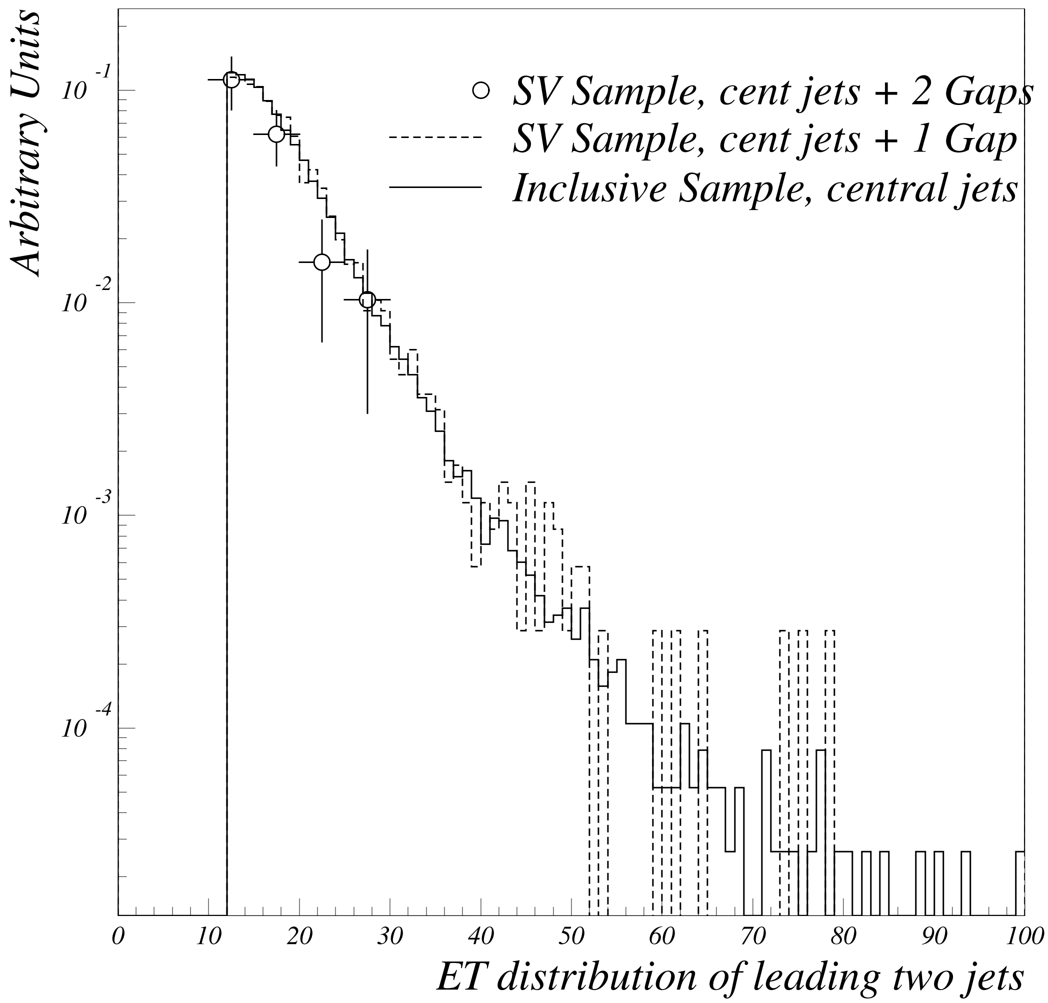


630 GeV ET Distributions

Double gap events vs. single gap and inclusive events

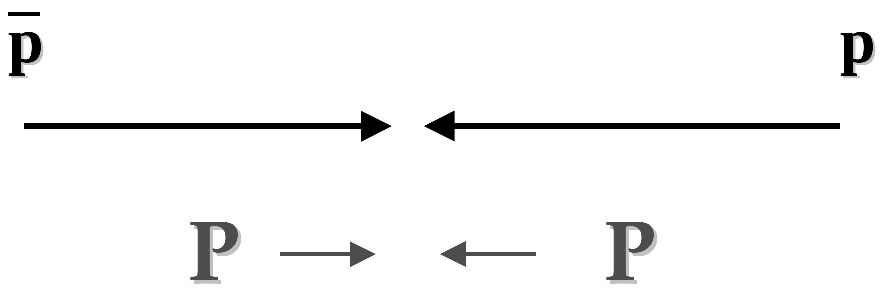
D0 Preliminary

w/ 2 leading jets > 12 GeV, |η_jet| < 1.0



DPE Monte Carlo

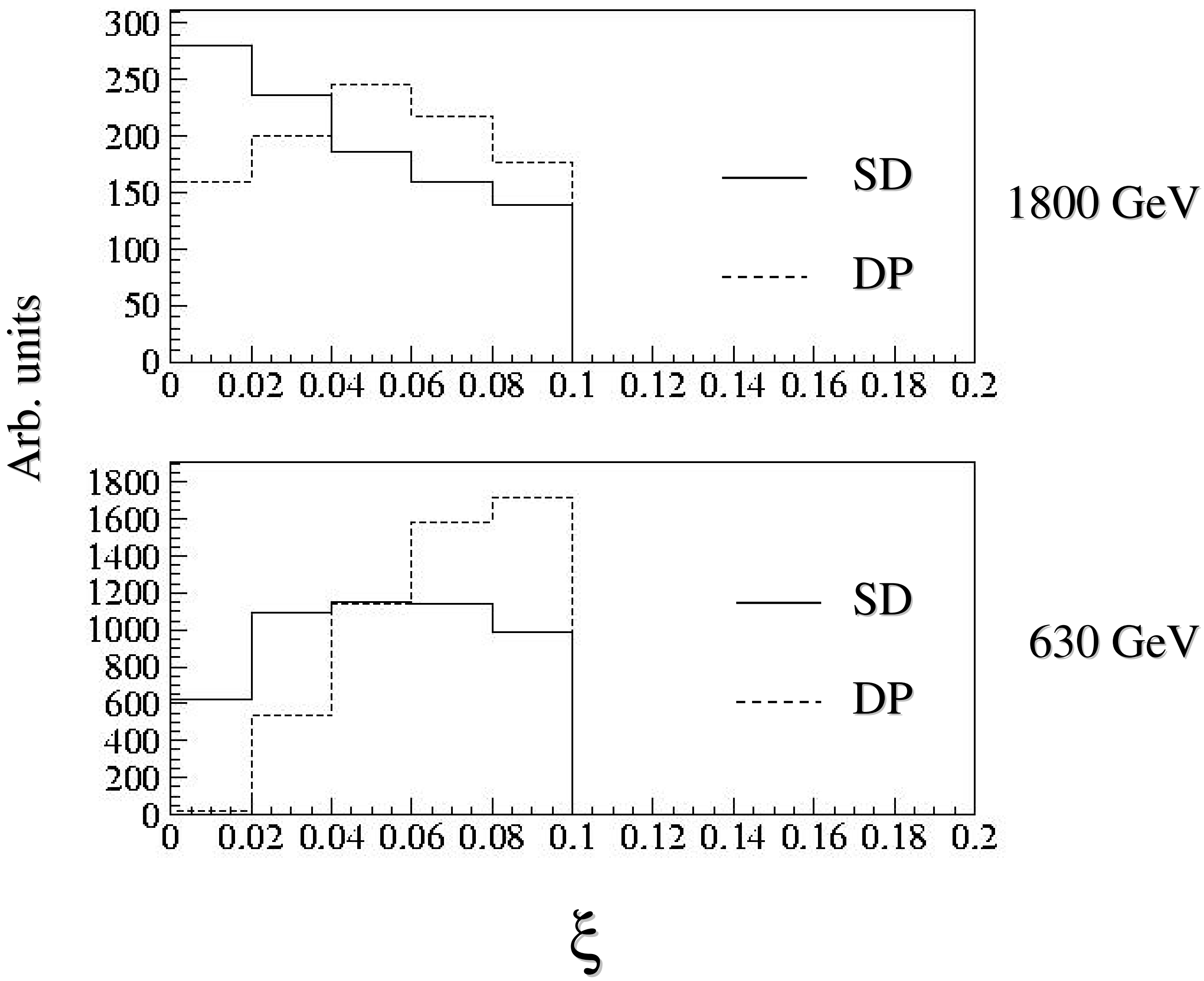
Modified Version of POMPYT
Allowing 2 pomerons as beam particles
in PYTHIA



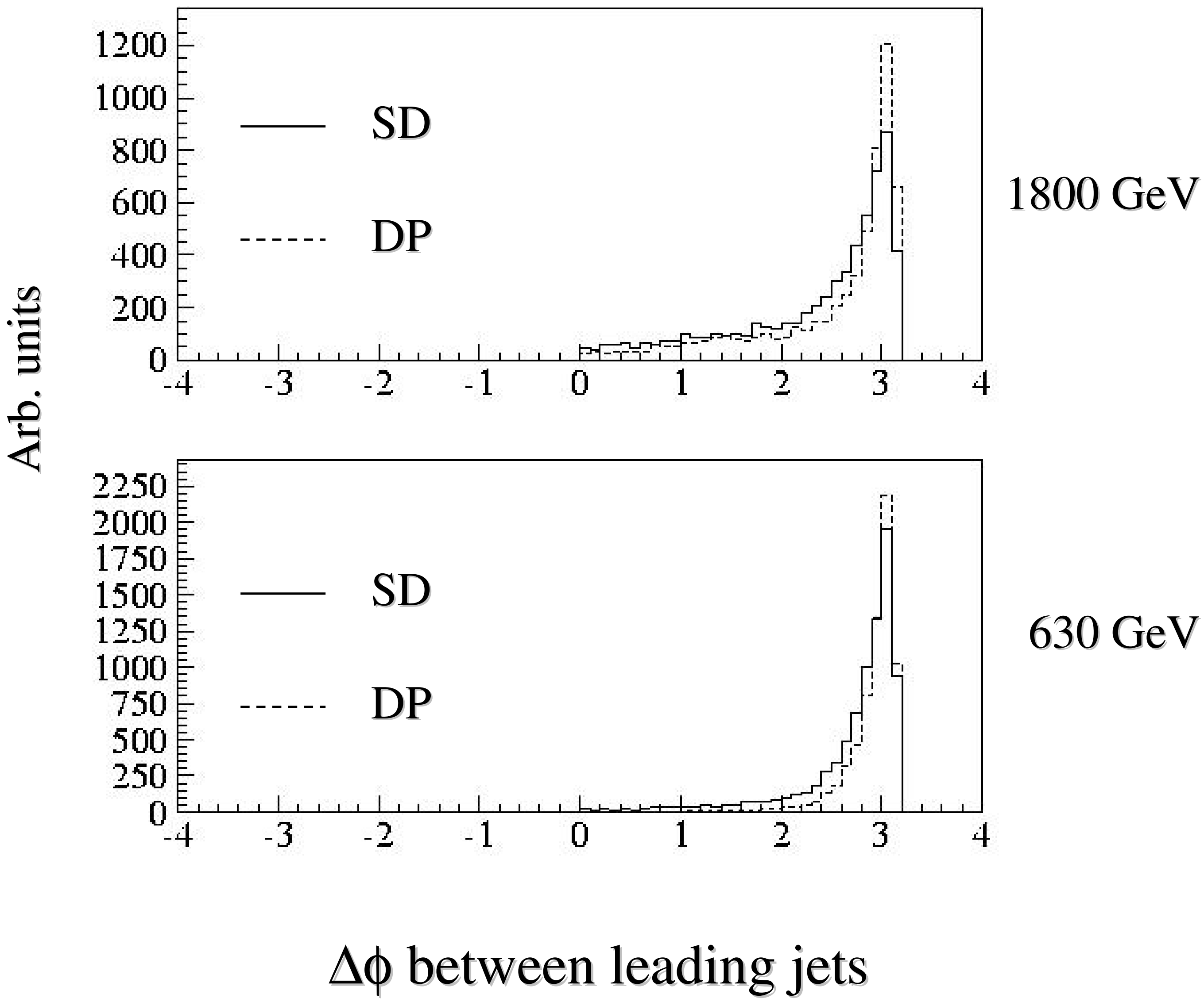
- Each pomeron has a probability for carrying a fraction ξ of the parent's momentum

DPE Monte Carlo

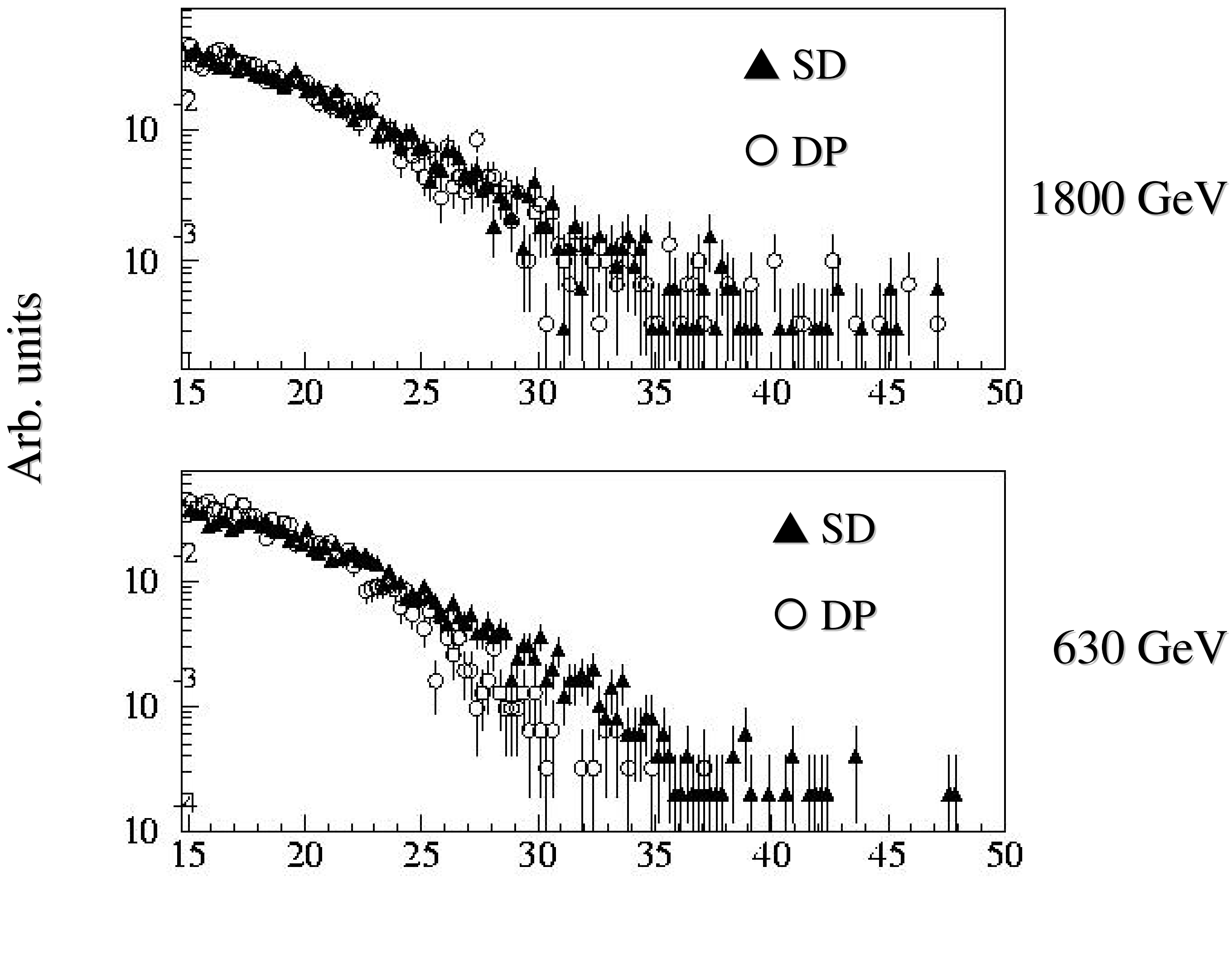
Distributions



DPE Monte Carlo
Distributions

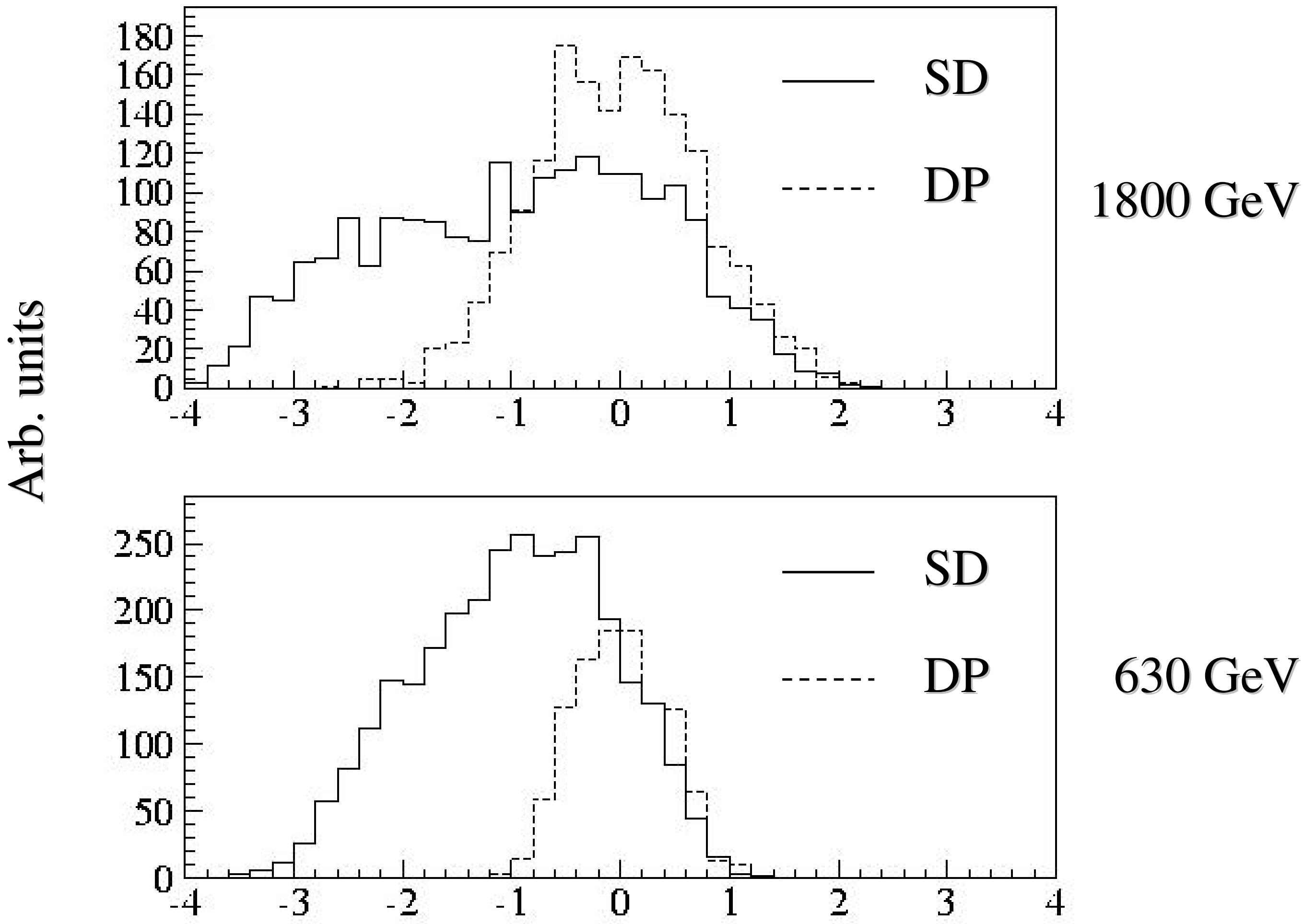


DPE Monte Carlo
Distributions



ET Distribution of leading 2 jets

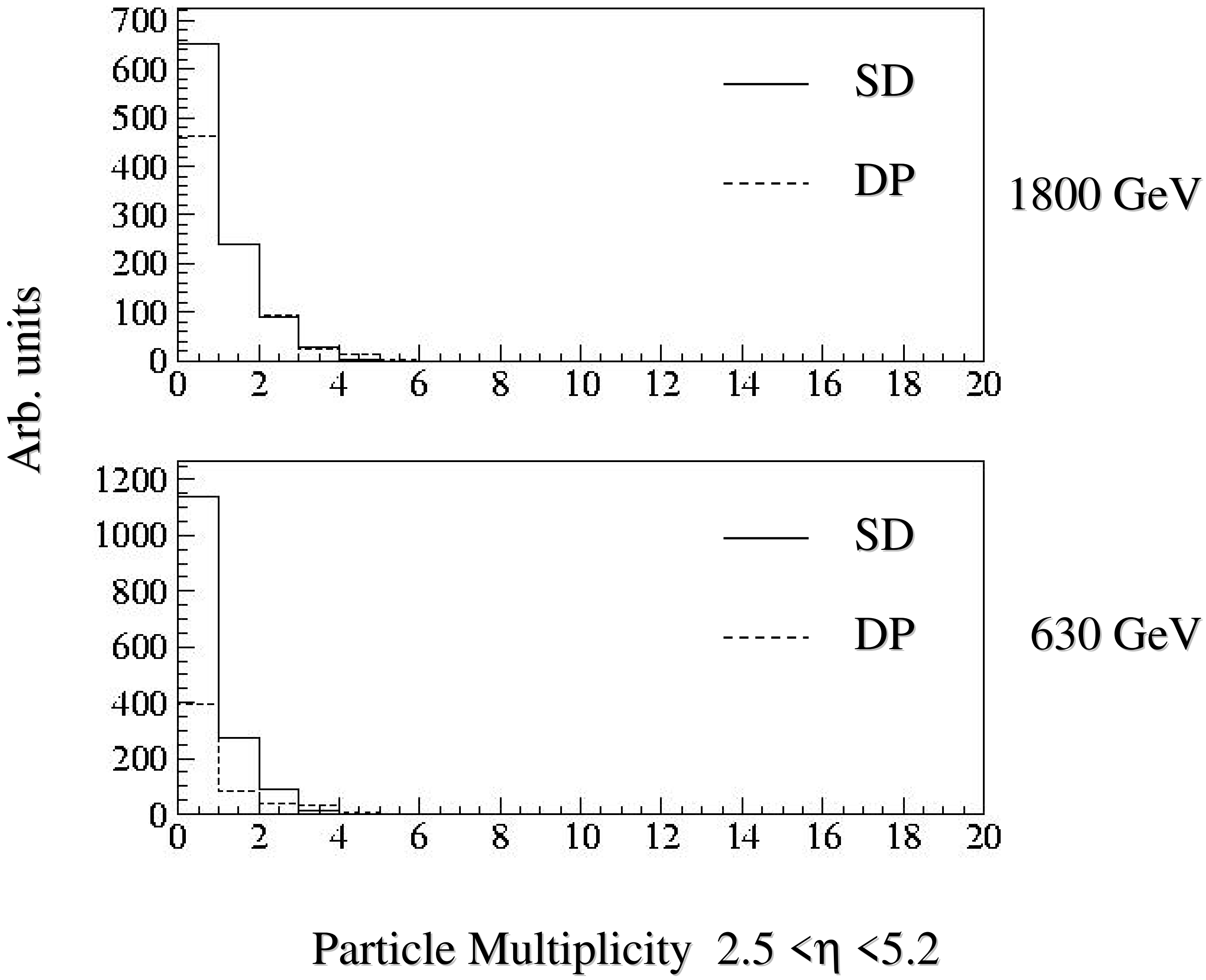
DPE Monte Carlo
Distributions



η distribution leading 2 jets

DPE Monte Carlo

Distributions



Summary

Qualitative Observations:

- We observe Double Gap signals at 1800 and 630 GeV CM energies in excess of a smooth background assumption

- Double Gap Signal has weak dependence on gap size (though gap range shown is quite limited)

- ET Spectrum of jets in Double Gap events looks a lot like inclusive $p\bar{p}$ scattering

(though events are quieter and jets tend to be narrower)

- First look at Monte Carlo Distributions at Generator Level.
- Fully Simulated Events will allow better understanding of data

MC Distributions for factorizable DPE model allow for Similar ET spectrum at BOTH CM energies. Rates 630/1800 should be the key to see if this picture holds.