Exclusive Dijets from CDF2LHC

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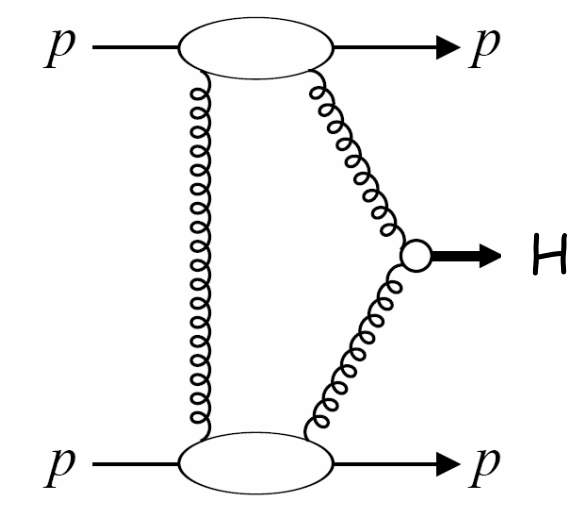
- ✓ Introduction
- ✓ Triggers and Data
- ✓ Results

Exclusive Higgs at LHC



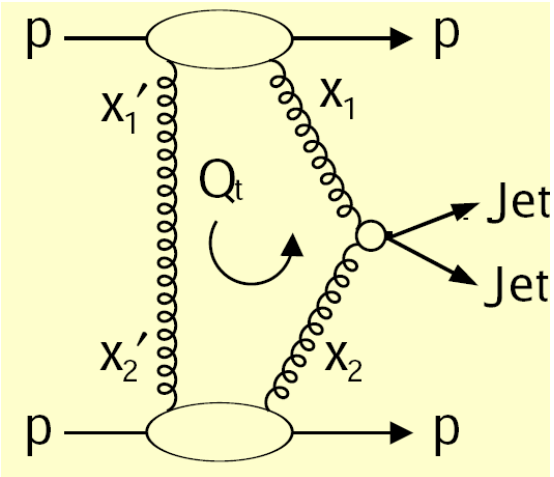
- hard $gg \rightarrow H$ process
- color neutral exchange
  - $\Rightarrow$ rapidity gap signature
- clean process
- M_H = "missing mass" = $(s\, \xi_1\, \xi_2)^{1/2}$

Bialas, Landshoff:
Phys.Lett.B 256,540 (1991)
Khoze, Martin, Ryskin:
Eur. Phys. J. C23, 311 (2002);C25,391 (2002);C26, 229 (2002)
C. Royon, hep-ph/0308283

Theory predictions:
$\Rightarrow \sigma_H$(LHC)~3 fb, signal/bkg~3 (if ΔM_{miss}=1 GeV)
Khoze, Martin, Ryskin

Attractive Higgs discovery channel at the LHC

Exclusive Dijets at Tevatron



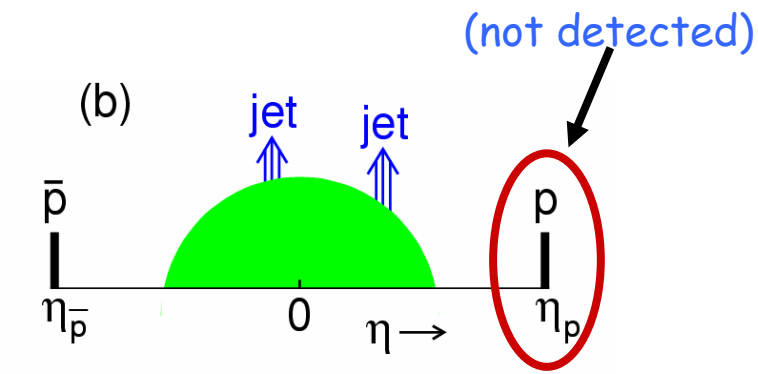
- similar to exclusive Higgs
- much larger cross section

...not observed yet...

Goal:

- find exclusive dijet production (if it exists)
- measure cross section/upper limit
- calibrate Higgs predictions at LHC

Exclusive Dijets in Run I

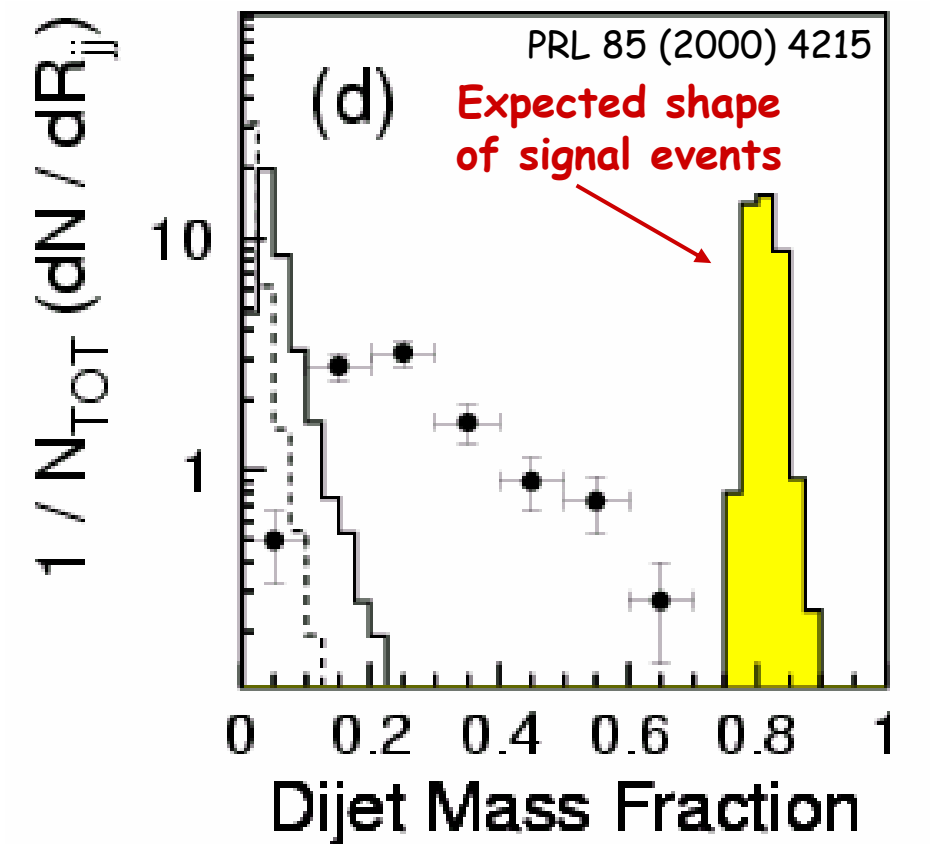


Mass fraction: $R_{jj} = \frac{M_{jj}}{M_x}$

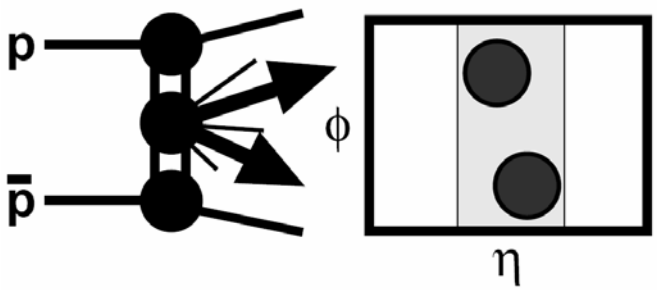
Exclusive dijet limit:
Run I: PRL 85 (2000) 4215

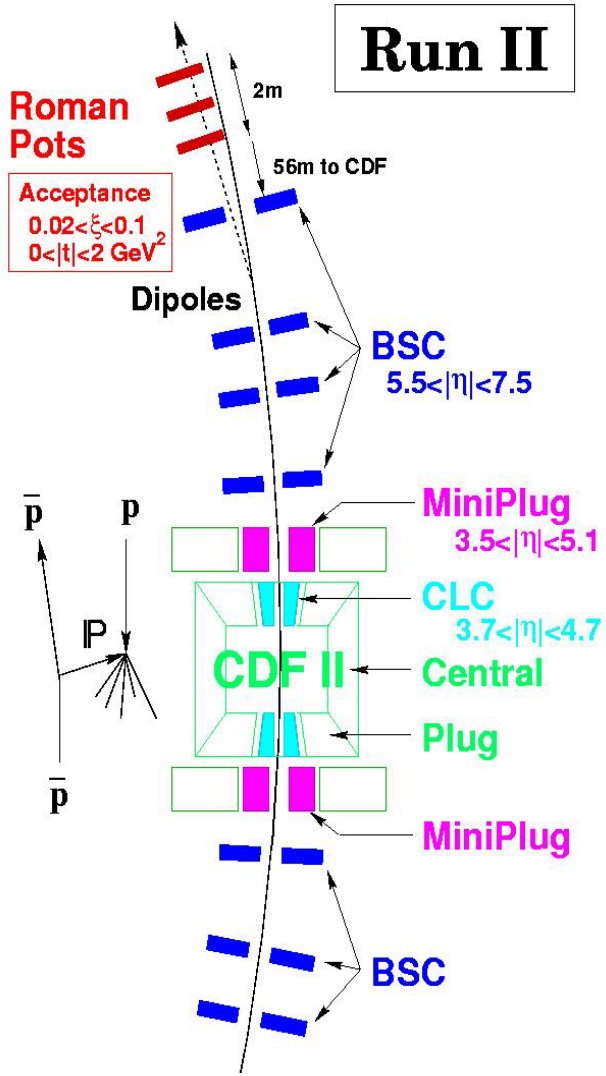
⇨ σ_{jj} (excl.) < 3.7 nb (95% CL)

theory expectns ~1 nb (Run I kinematics)



DPE Dijets in Run II



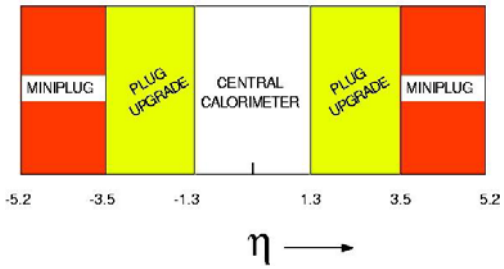


Dedicated DPE trigger:

- RP + Jet (E_T>5GeV) + Gap_P(BSC)
- ~110 pb^{-1} data collected

Control Sample:

- SD = RP + Jet (E_T>5GeV)
- ND = Jet (E_T>5GeV)

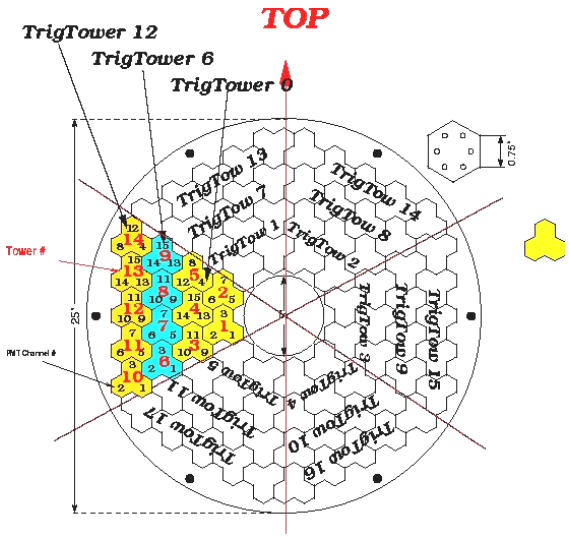


MiniPlug Calorimeters

- liquid scintillator + lead
- flexible tower geometry
- full coverage (no dead regions)
- detect charged/neutral

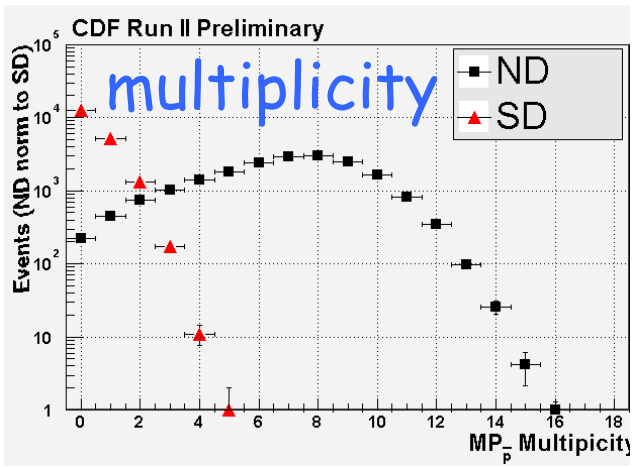
M.G. - hep-ph/0407255

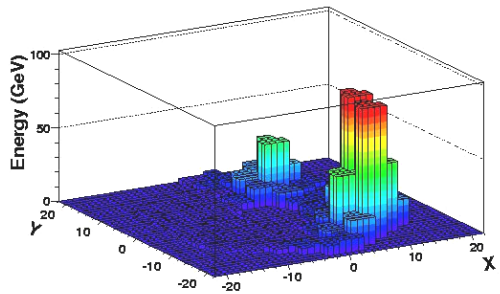
Group fibers to form "towers"

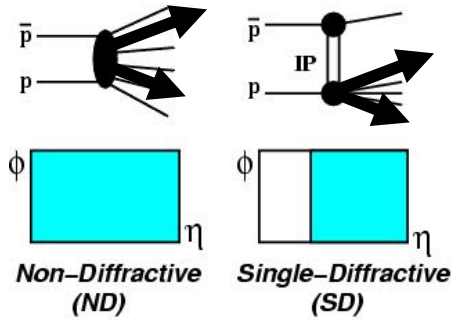


large hadronic shower fluct.
energy resolution ~40%
⇨ 32 rad. lengths , 1.3 int.l.

short "hadronic depth"
⇨ good position resolution







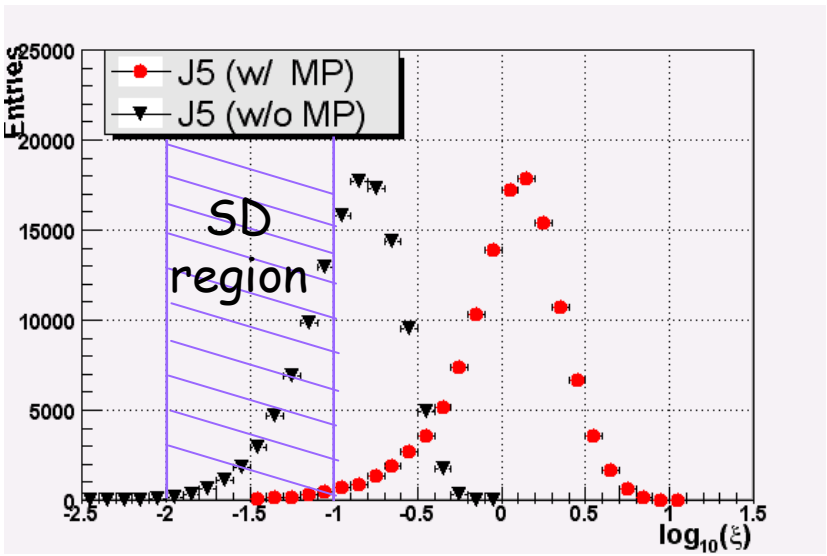
Non–Diffractive (ND)

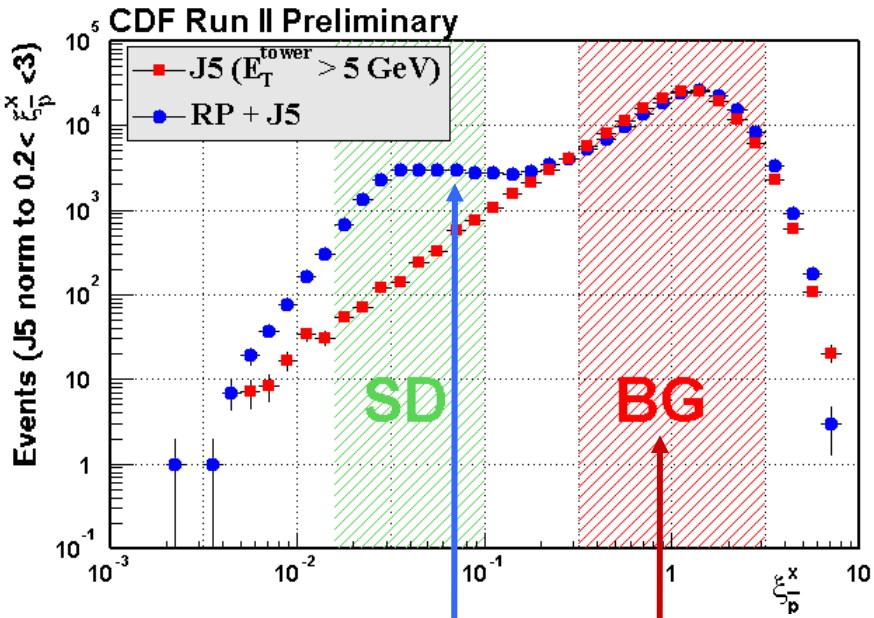
Single–Diffractive (SD)

Diffractive dijets

ξ : momentum loss fraction of pbar

$$\xi = \frac{\Sigma_{(\text{all towers})} E_T \, e^{-\eta}}{\sqrt{s}}$$





Approx. flat at ξ<0.1

$$\frac{d\sigma}{d\xi} \propto \frac{1}{\xi} \rightarrow \frac{d\sigma}{d(\log\xi)} = \text{const}$$

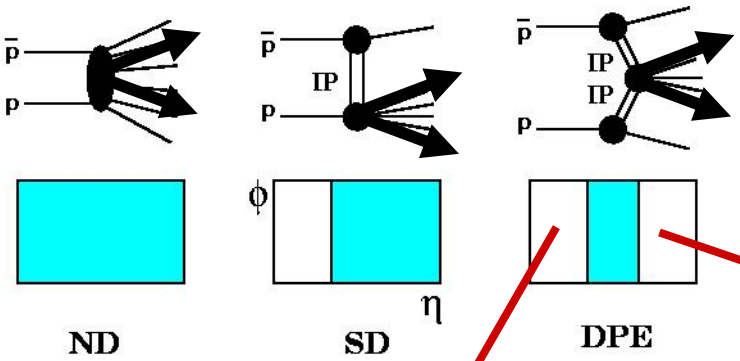
overlap events

MP energy scale: ±25% →Δlogξ = ±0.1

RP acceptance (0.03<ξ< 0.1) ~ 80% (Run I)

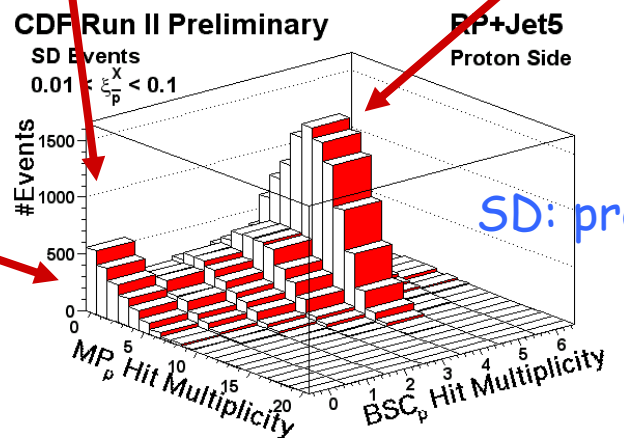
DPE Dijet Production

from SD data:

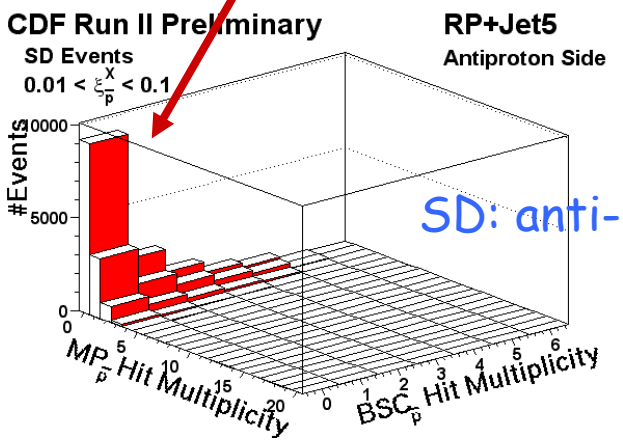


DPE

SD

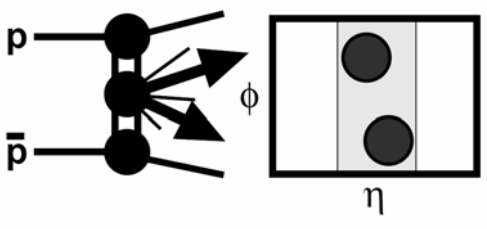


SD: proton side



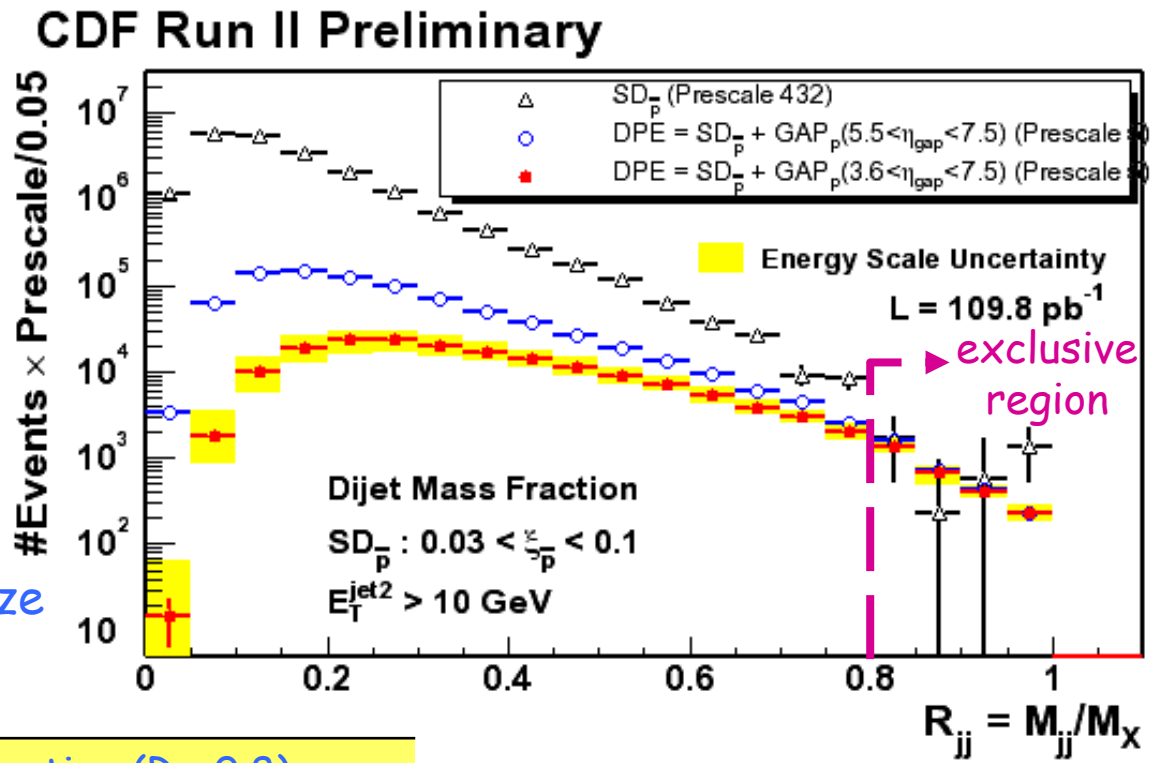
SD: anti-proton side

Dijet Mass Fraction



rate falls smoothly as $R_{jj} \rightarrow 1$
no excess at large R_{jj}

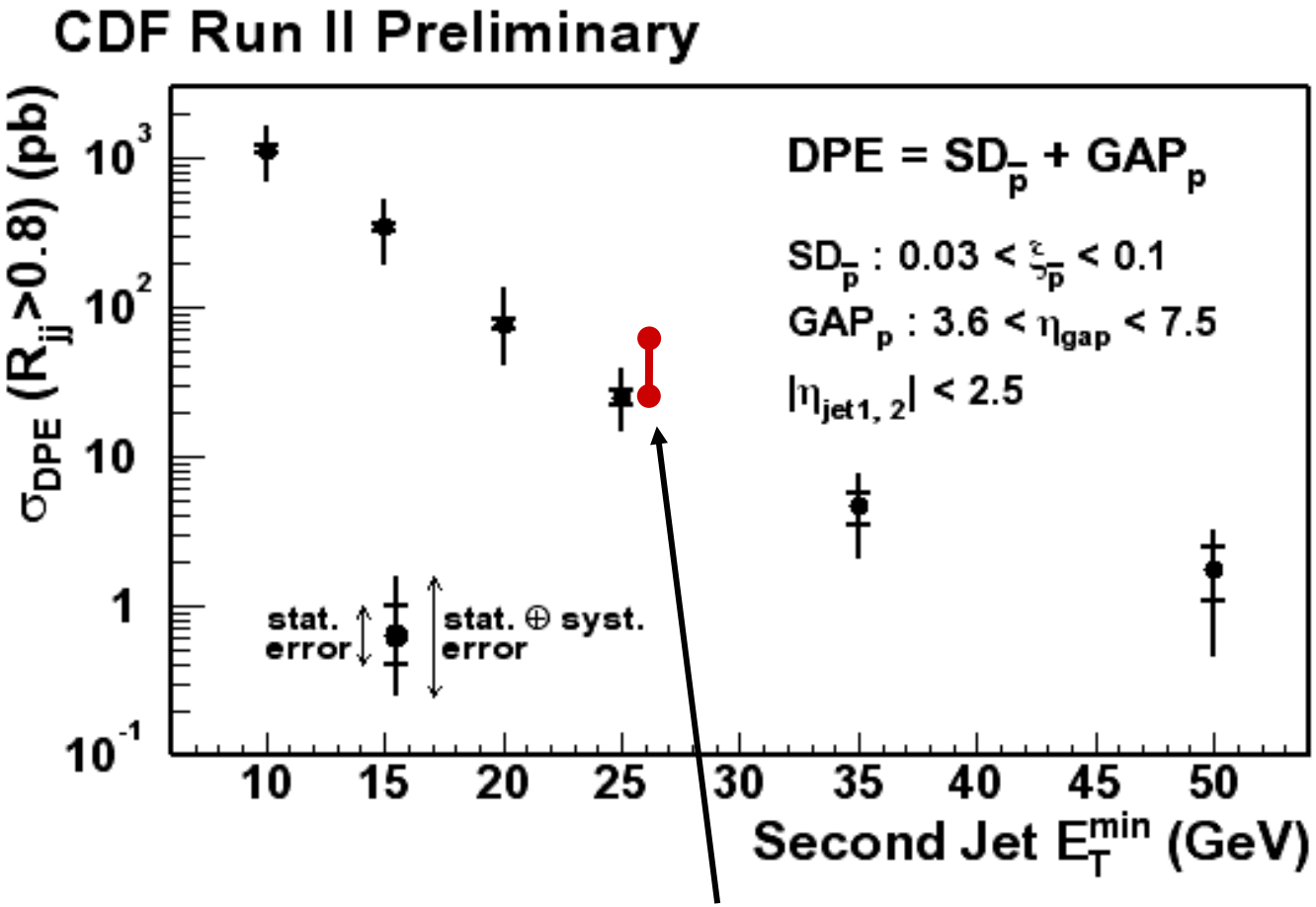
independent of rapidity gap size



Minimum E_T(Jet1)	Cross section (R_{jj}>0.8)
10 GeV	1.1 ± 0.1(stat) ± 0.5(syst) nb
25 GeV	25 ± 3(stat) ± 10(syst) pb

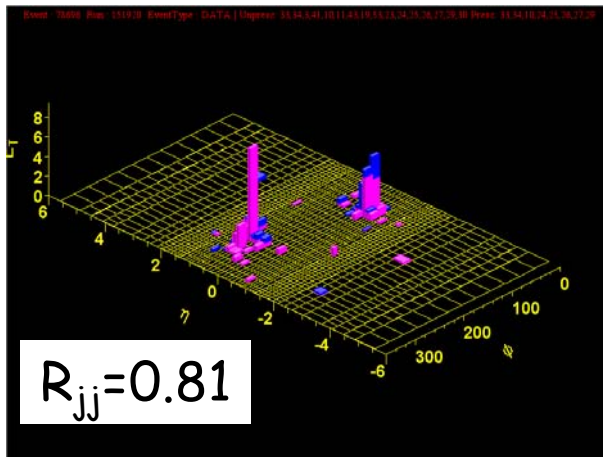
Khoze, Martin, Ryskin - Eur. Phys. J. C23, 311, 2002
~ 60 pb (factor of 2 uncertainty)

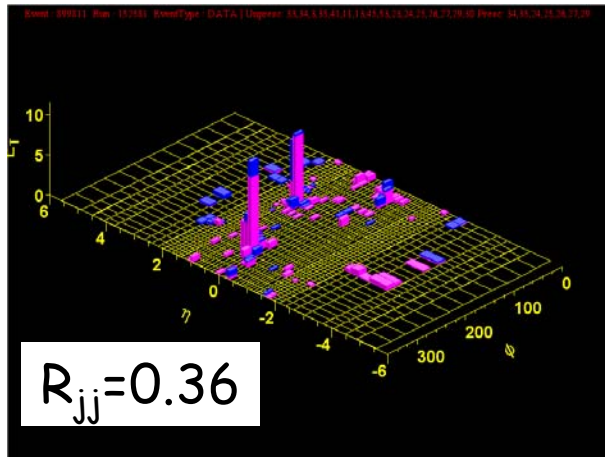
Limits on Exclusive production

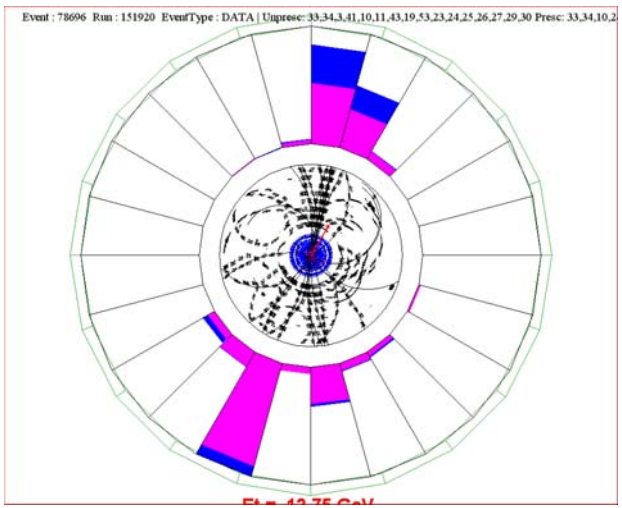


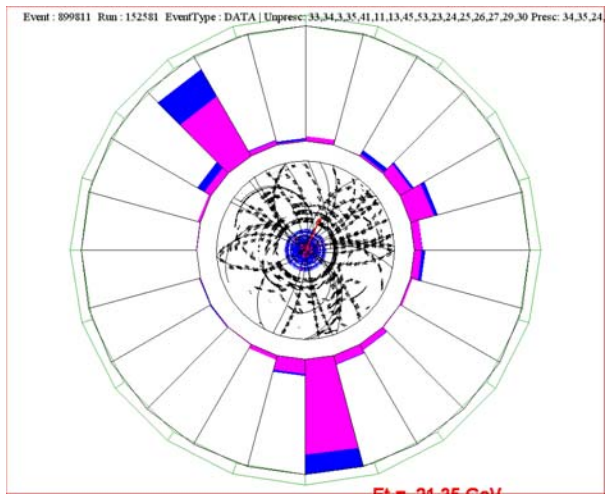
Martin, Kaidalov, Khoze, Ryskin, Stirling
(hep-ph/0409258): ~ 40 pb (E_T→25 GeV)

Exclusive Dijet Events ?









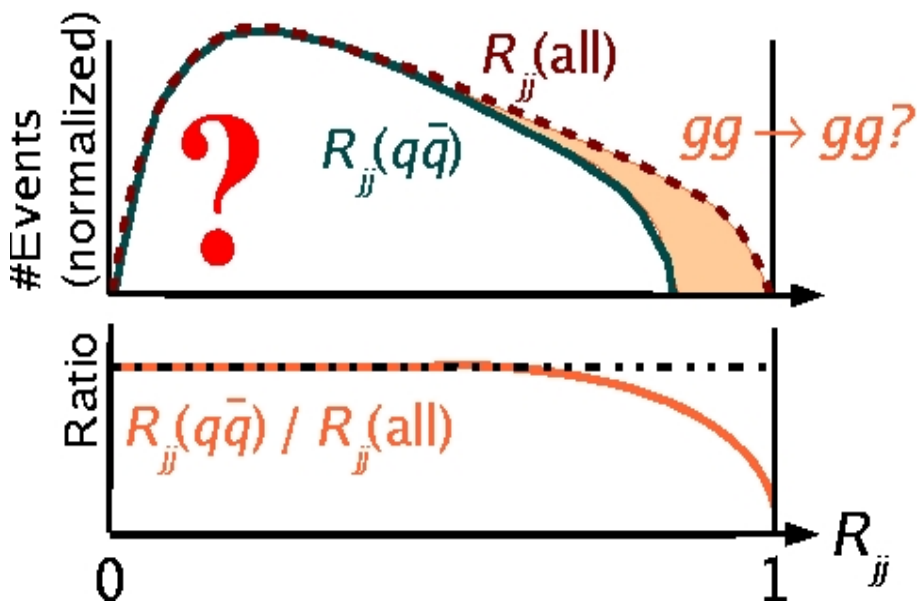
Heavy flavor exclusive dijets

Theory:
J_Z=0 spin selection rule
$gg \rightarrow gg$ dominant contribution at LO
$gg \rightarrow q\bar{q}$ suppressed when $M_{jj} \gg m_q$

Experimental method:
normalize R_{jj} for $q\bar{q}$ to R_{jj} for all jets
⇨look for event suppression at large R_{jj}

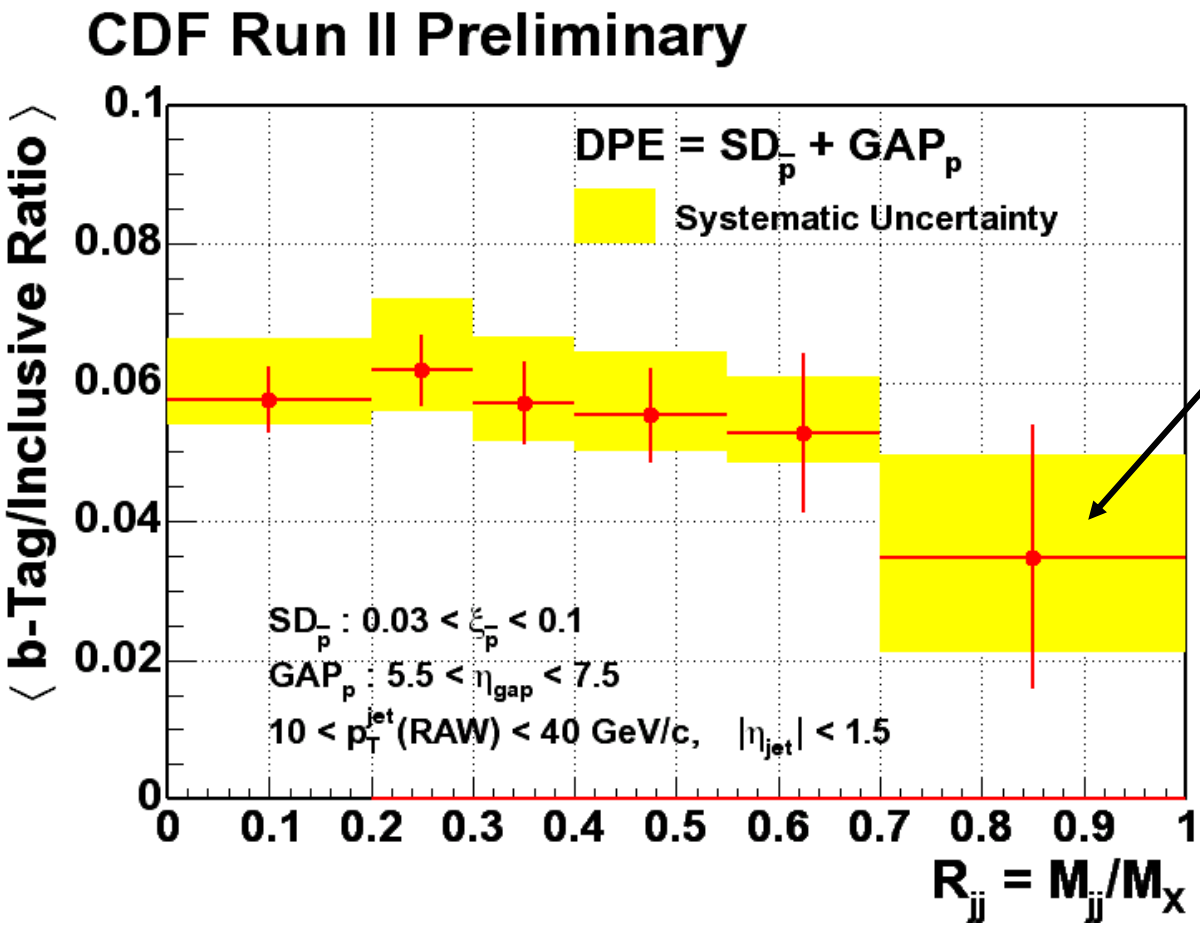
Pros: many systematics cancel out
good HF quarks id
small g mistag O(1%)

Cons: heavy quark mass:
contribution from exclusive b/c



⇨ using b-quark jets

b-tagged jet fraction



exclusive production?
need:
- to compare to MC
- more data!

$R_{btag}(>0.7)/R_{btag}(<0.4)=0.59 \pm 0.33\ (stat) \pm 0.23\ (syst)$

Future plans

Increase DPE b-jet data:

⇨new DPE b-jet trigger

- ~ 80% efficiency for SecVtx tagged jets
- expect 900 tagged b-jets in 300 pb^{-1} at $L=3x10^{31}cm^{-2}s^{-1}$

⇨How does $R_{btag}(>0.7)$ /$R_{btag}(<0.4)$ look like in $b\bar{b}$ events?

Summary

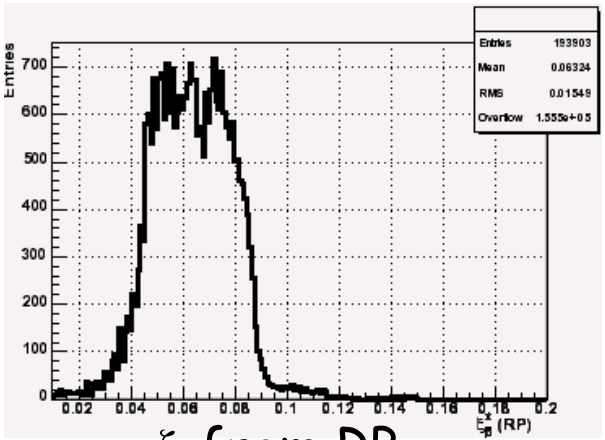
forward detectors working well
dedicated diffractive triggers

measurement of forward energy flow and particle momentum loss with Miniplug

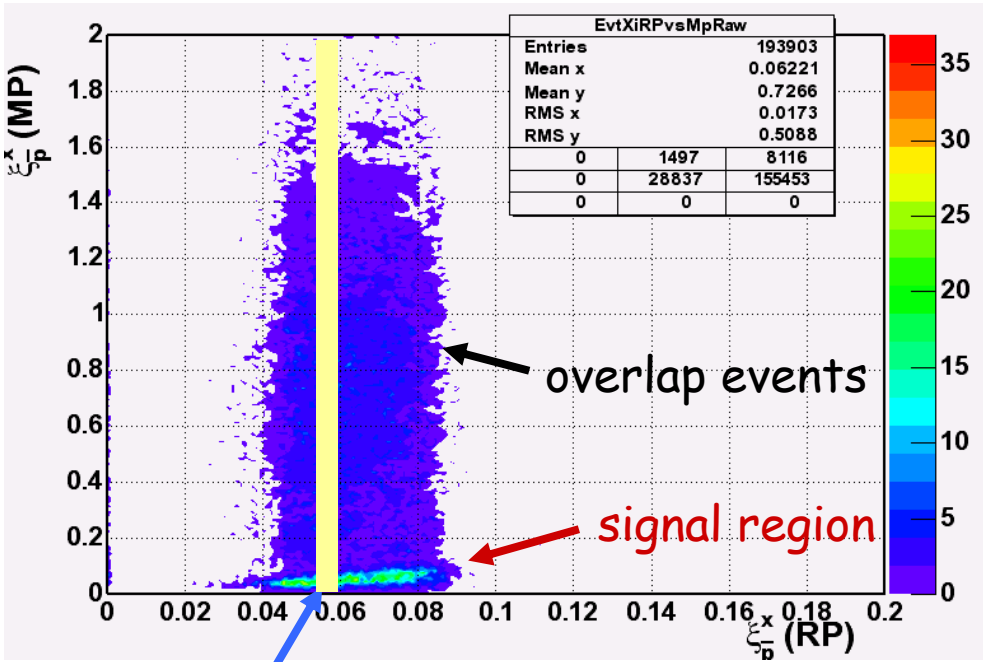
no exclusive dijet production
improved limits

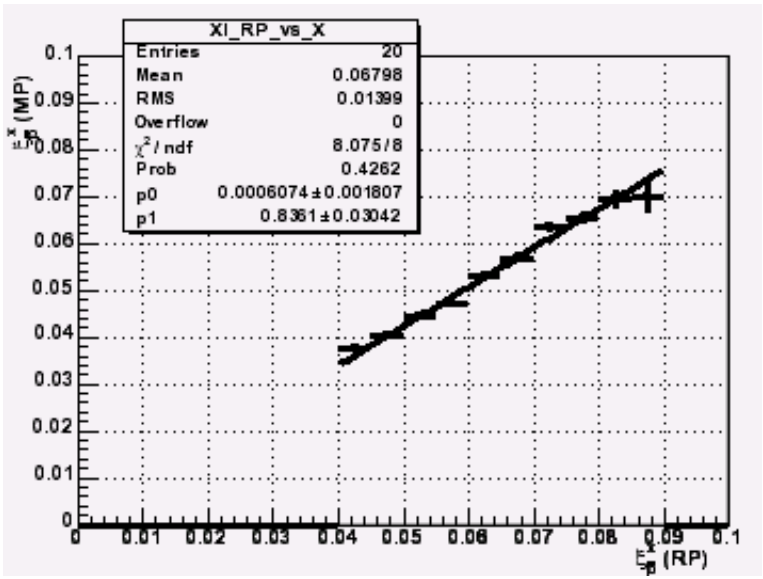
attempted to extract signal using b-quarks
new DPE b-trigger soon

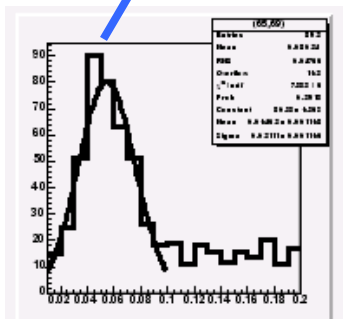
ξ: RP vs calorimeter



ξ from RP



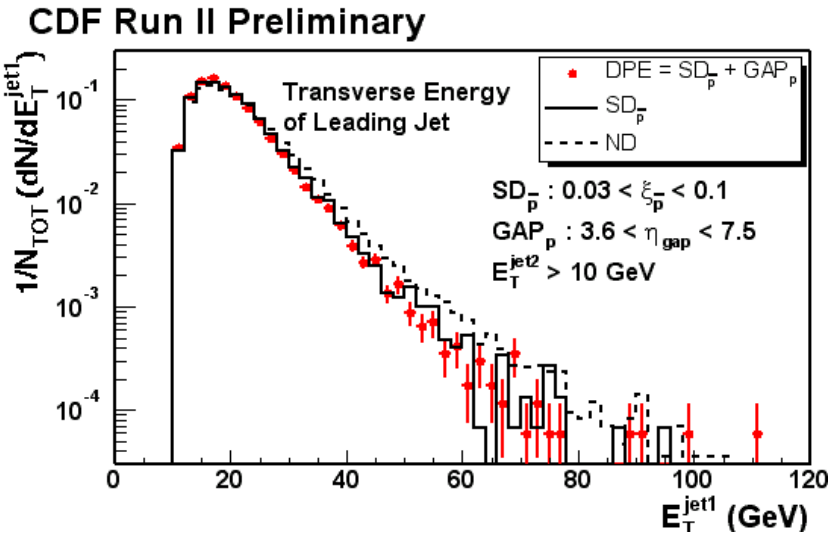


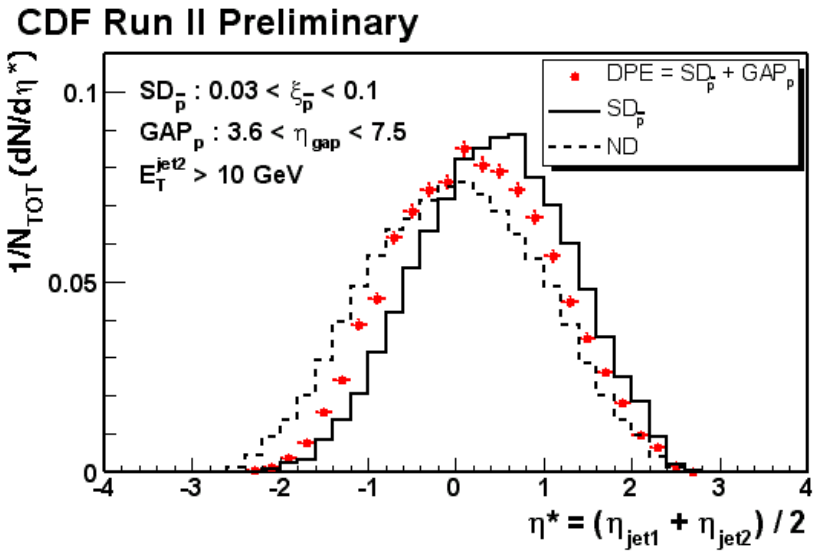


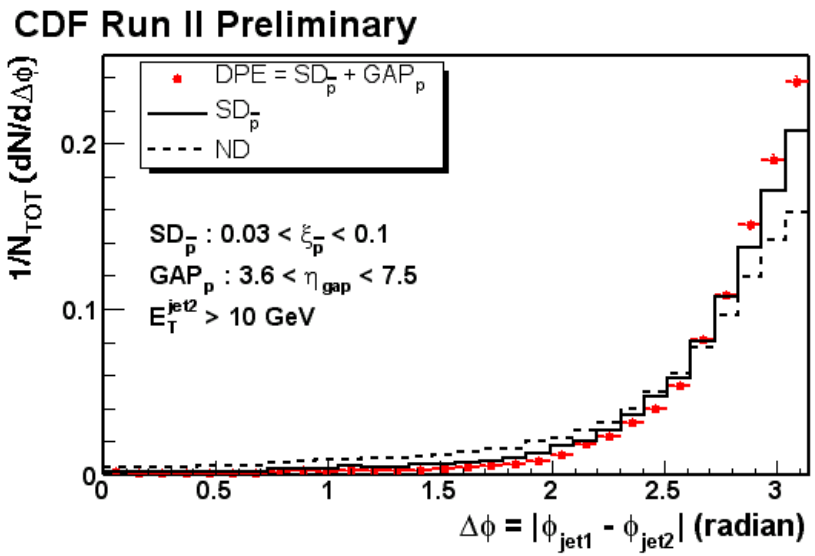
ξ^{cal} distribution for slice of ξ^{RP}

DPE: kinematics

Compare ND and SD and DPE





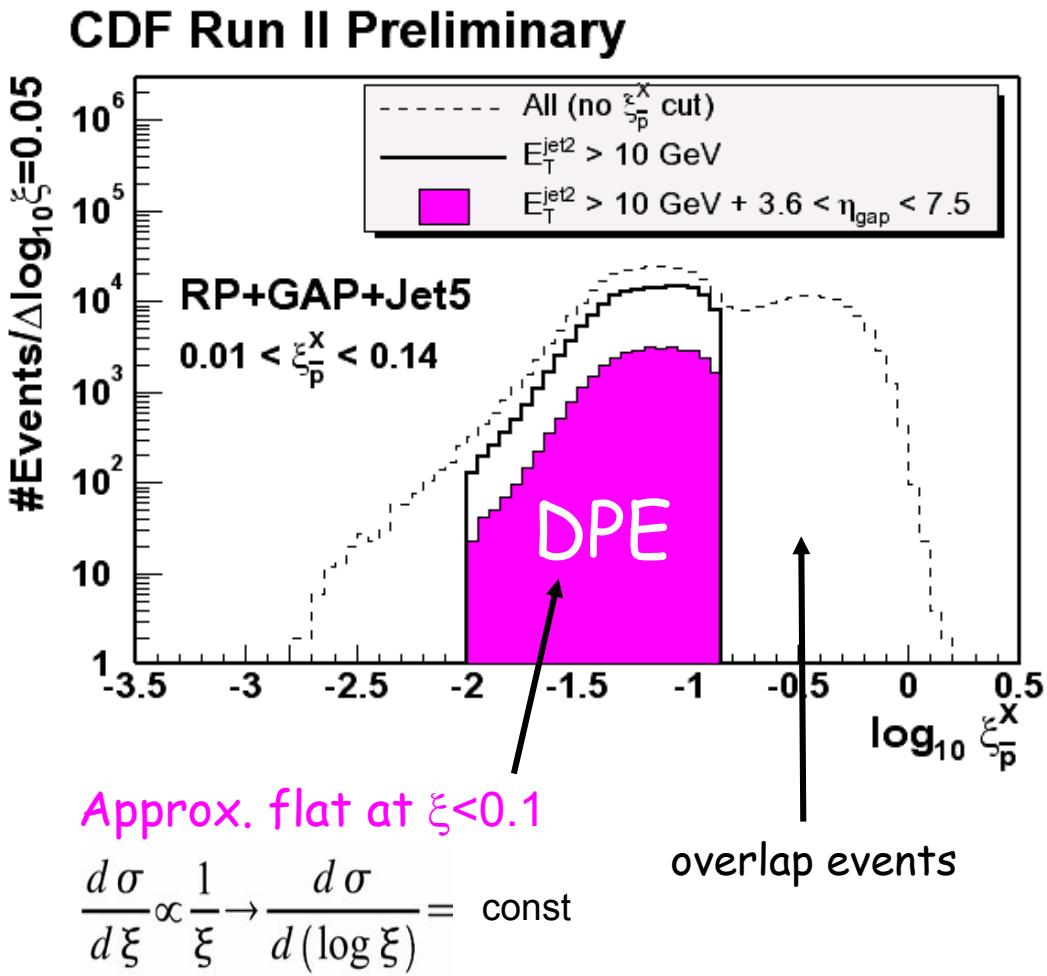


Data Selection

- ✓ Dedicated DPE trigger RP+Jet5+Gap(proton side)

⇨~110 pb^{-1} data collected

- ✓ Calculate ξ (pbar)
- ✓ RP acceptance: 80%



B tagging

Strategy:

✓displaced vertices (SecVtx)

✓use SecVtx mass (M>2 GeV)