

Dynamic Alignment τ of Roman Pots

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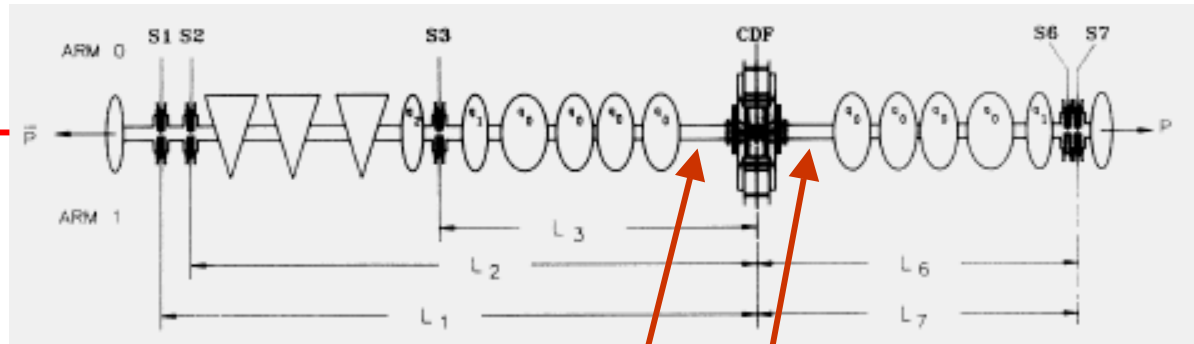
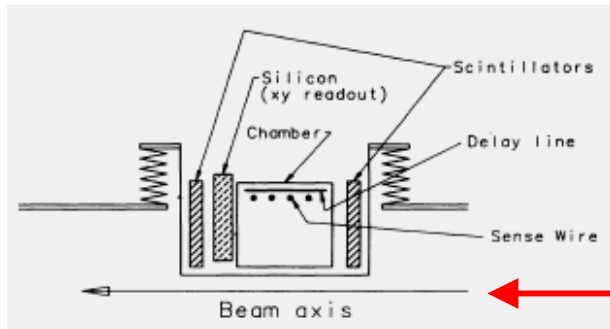
The Future of Forward Physics at the LHC
Manchester, UK, 11-13 Dec 2005



Run-I,0 (1988-89)

Elastic, single diffractive, and total cross sections
@ 546 and 1800 GeV

Roman Pot Spectrometers



Roman Pot Detectors

- Scintillation trigger counters
- Wire chamber
- Double-sided silicon strip detector

Trackers in Roman Pots out to $|\eta| = 7$

Alignment corrected by using elastic scattering

Results

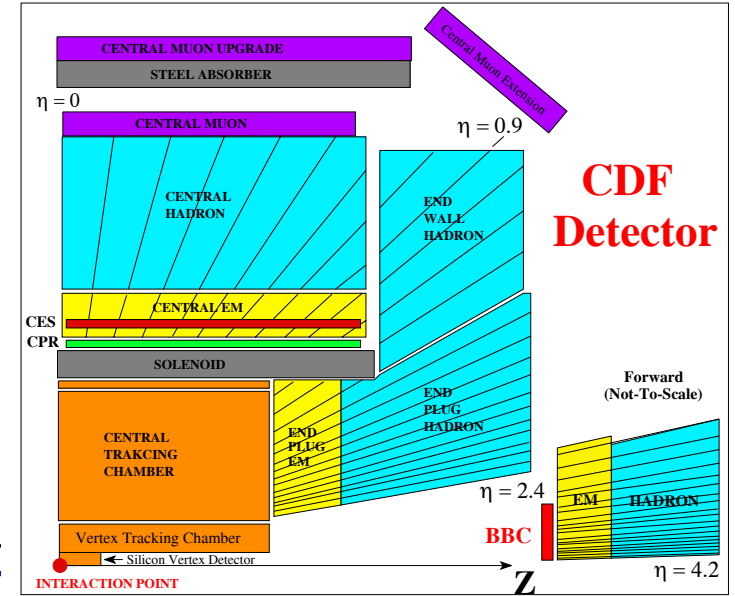
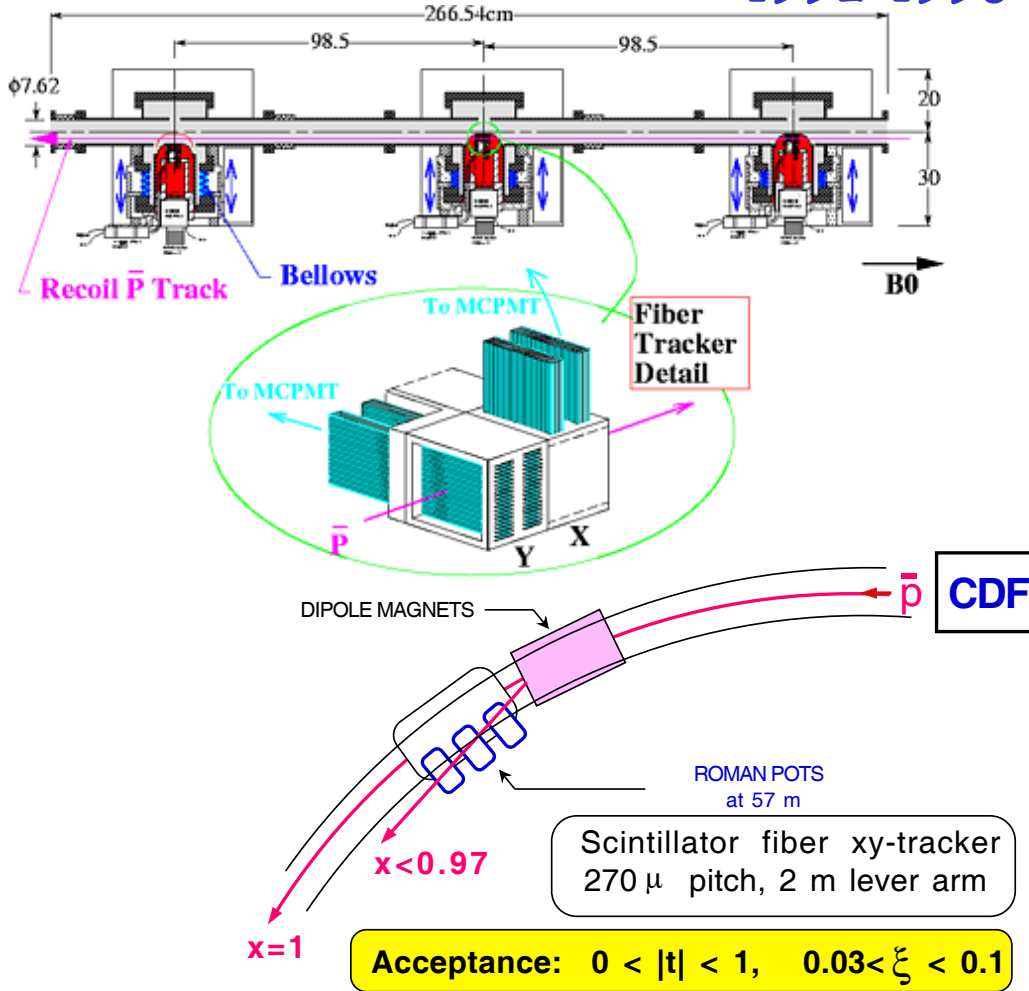
PRD 50 (2004) 5518; 5535; 5550

- | | |
|--|---|
| <ul style="list-style-type: none"> ➤ Total cross section ➤ Elastic cross section ➤ Single diffraction | $\sigma^{\text{tot}} \sim S^{\epsilon}$
$d\sigma/dt \sim \exp[2\alpha' \ln s] \rightarrow$ shrinking forward peak
Breakdown of Regge factorization |
|--|---|

Run-IC

CDF-I 1992-1996

Run-IA,B



Forward Detectors

BBC $3.2 < \eta < 5.9$

FCAL $2.4 < \eta < 4.2$

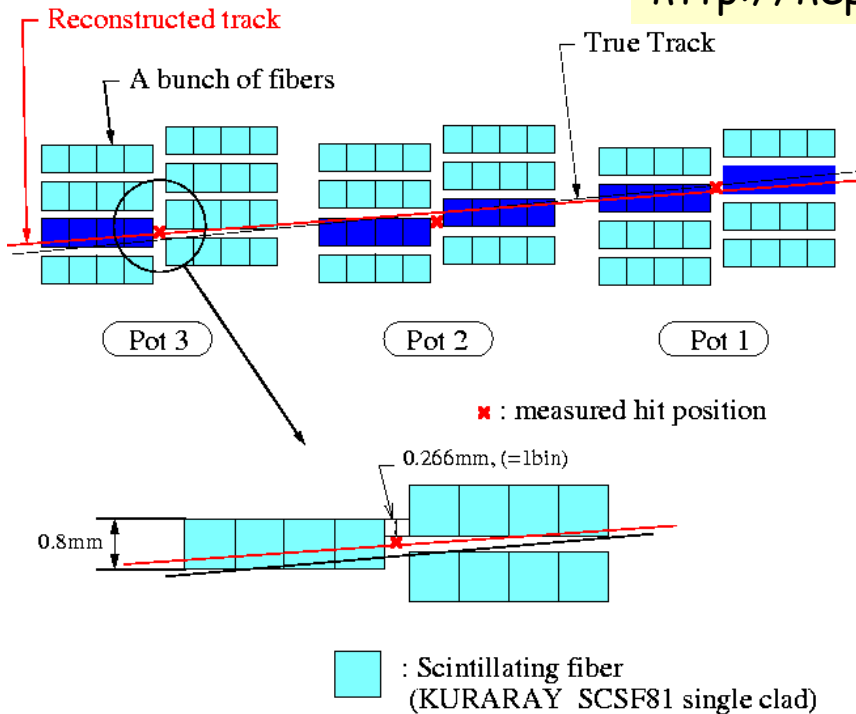
CDF-I Roman Pot Spectrometer

FIBER TRACKER

Alignment performed by surveying

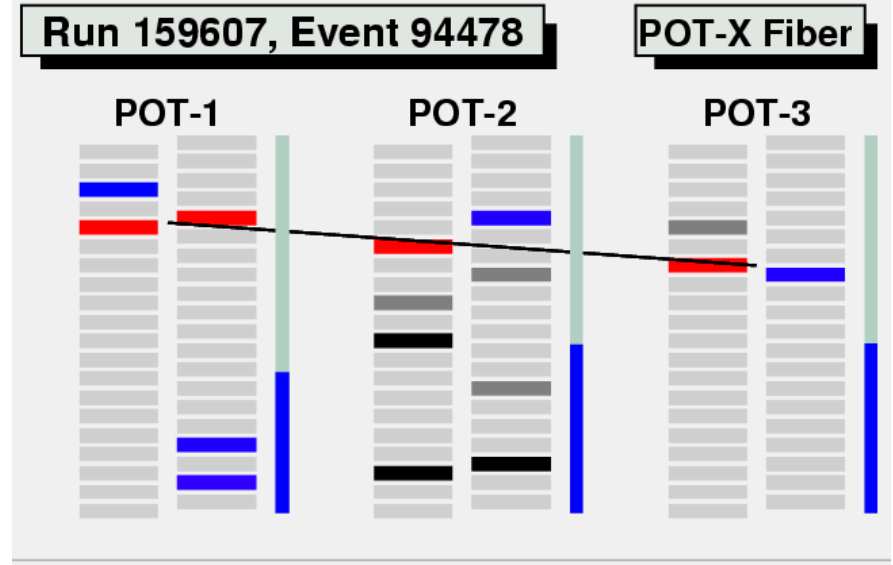
Hosai Nakada - thesis

http://hep-www.px.tsukuba.ac.jp/research/thesis_d.html



Fiber width: 800 μ

Expected position resolution	80 μ m
Expected angle resolution	60 μ rad



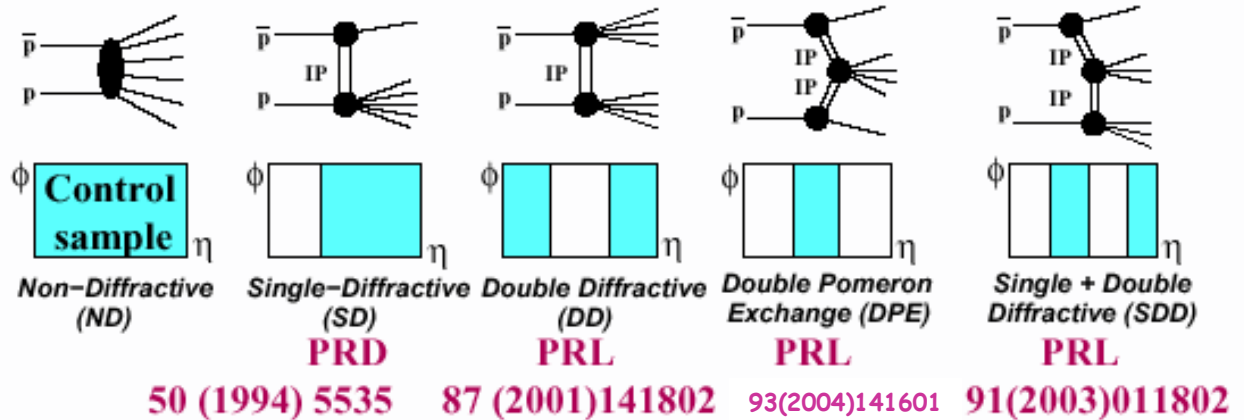
- 3 trigger counters
- $3 \times [2 \times (20 + 20)] = 240$ channels

Diffraction@CDF in Run I

16 papers

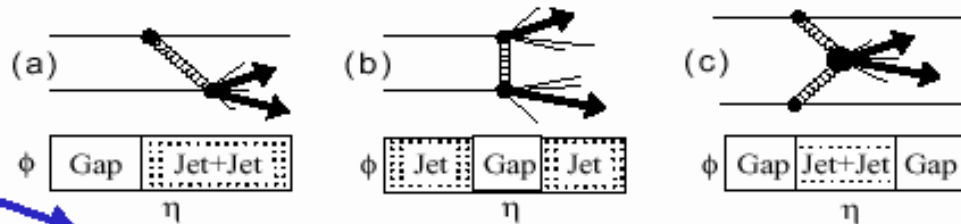
- Elastic scattering PRD 50 (1994) 5518
- Total cross section PRD 50 (1994) 5550
- Diffraction

SOFT diffraction



HARD diffraction

PRL references



with roman pots

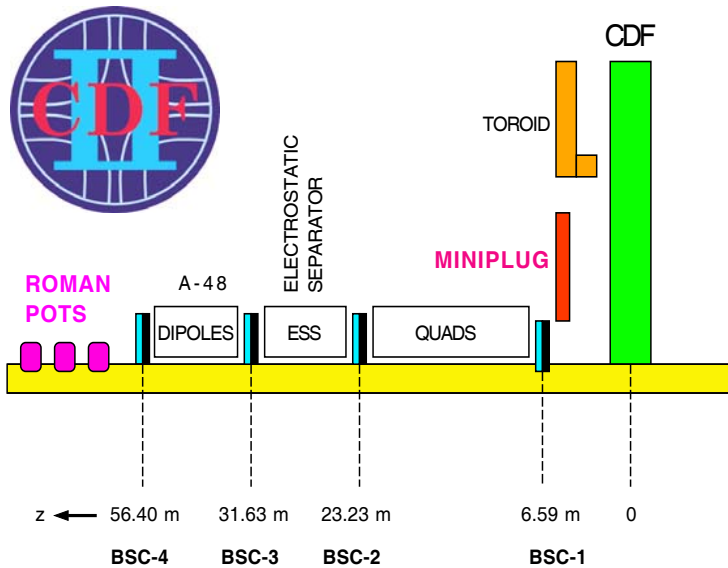
JJ	84 (2000) 5043
JJ	88 (2002) 151802

W	78 (1997) 2698	JJ	74 (1995) 855	JJ	85 (2000) 4217
JJ	79 (1997) 2636	JJ	80 (1998) 1156		
b-quark	84 (2000) 232	JJ	81 (1998) 5278		
J/ ψ	87 (2001) 241802				

Run-II Diffraction @ CDF

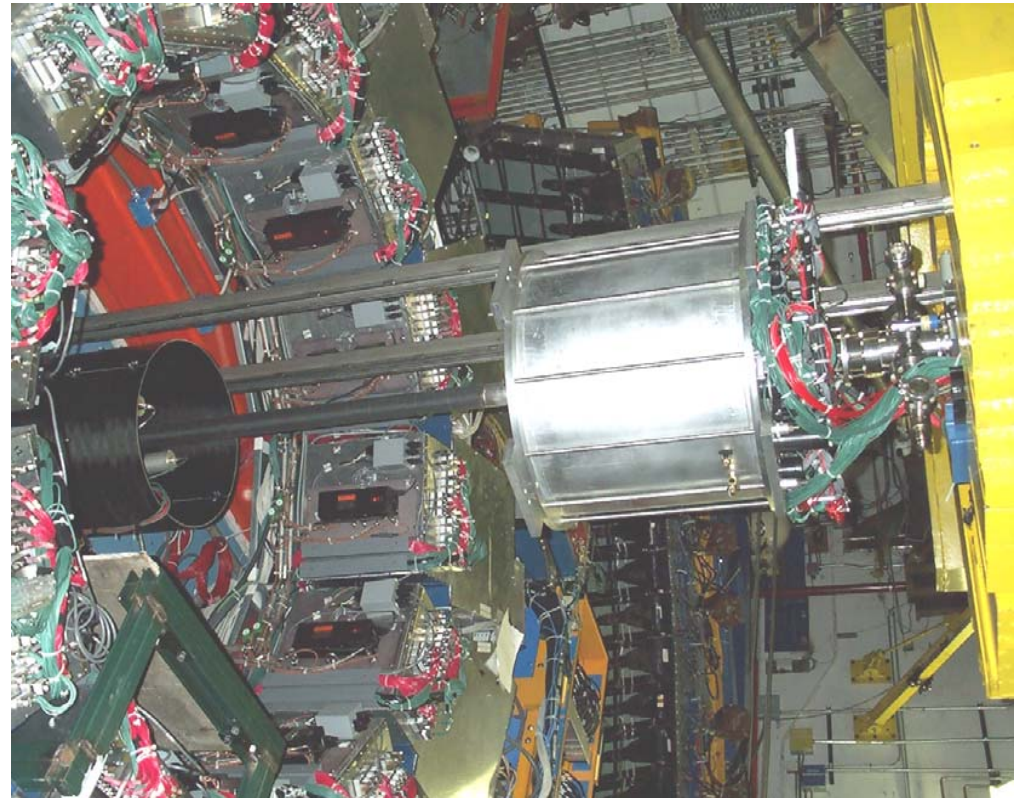
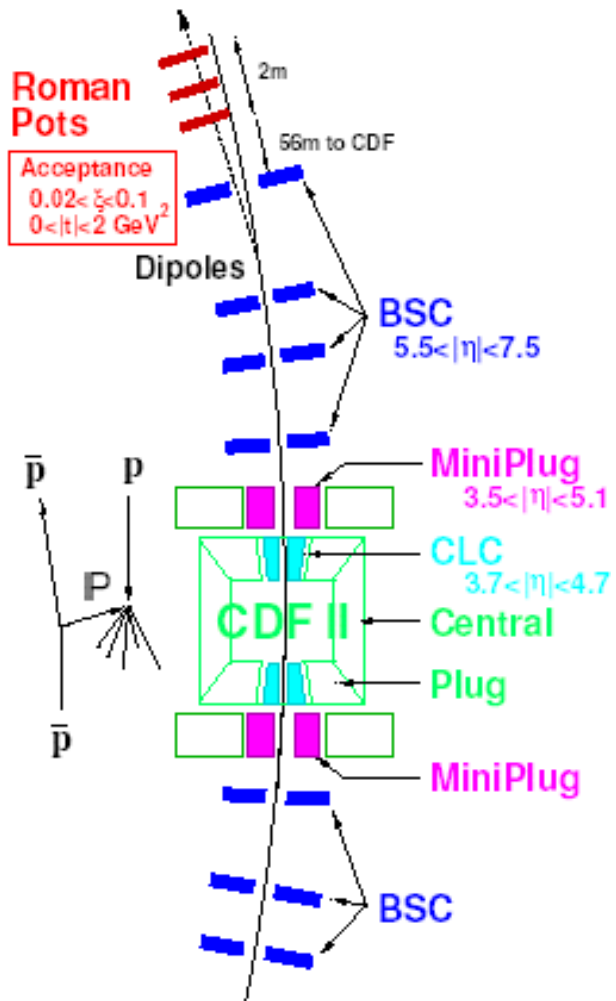
2001 -

CDF Forward Detectors

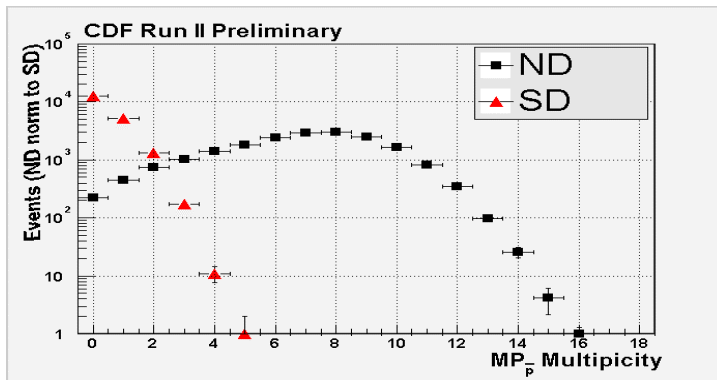
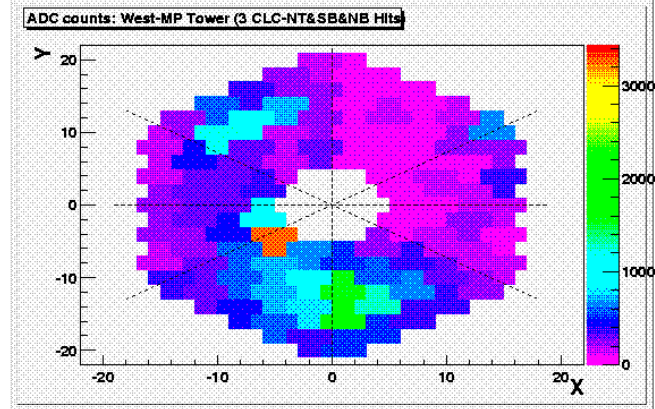
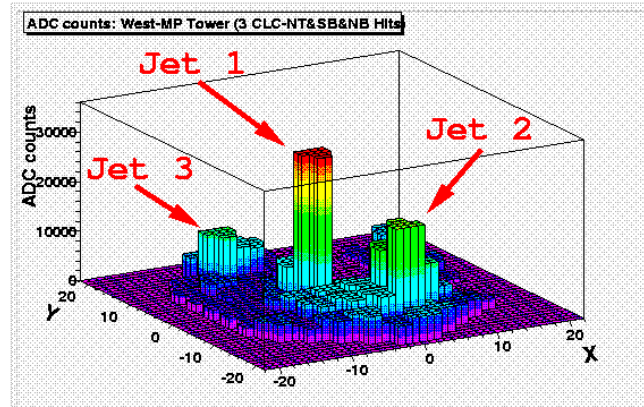
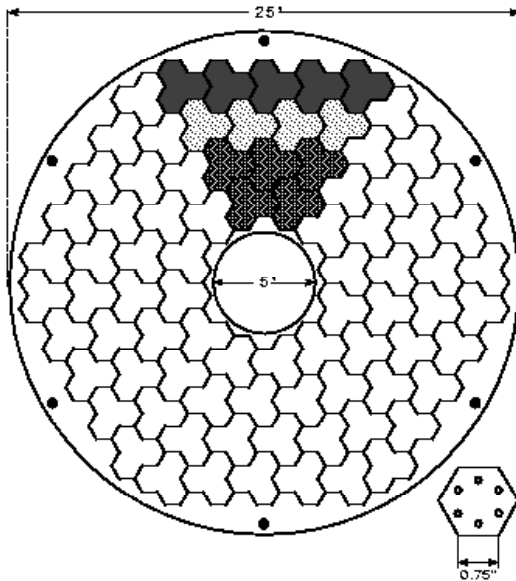


- ✓ **MiniPlug calorimeters ($3.5 < \eta < 5.5$)**
- ✓ **Beam Shower Counters ($5.5 < \eta < 7.5$)**
- ✓ **Antiproton Roman Pot Spectrometer**

Run-II Forward Detectors



MiniPlug Run -II Data



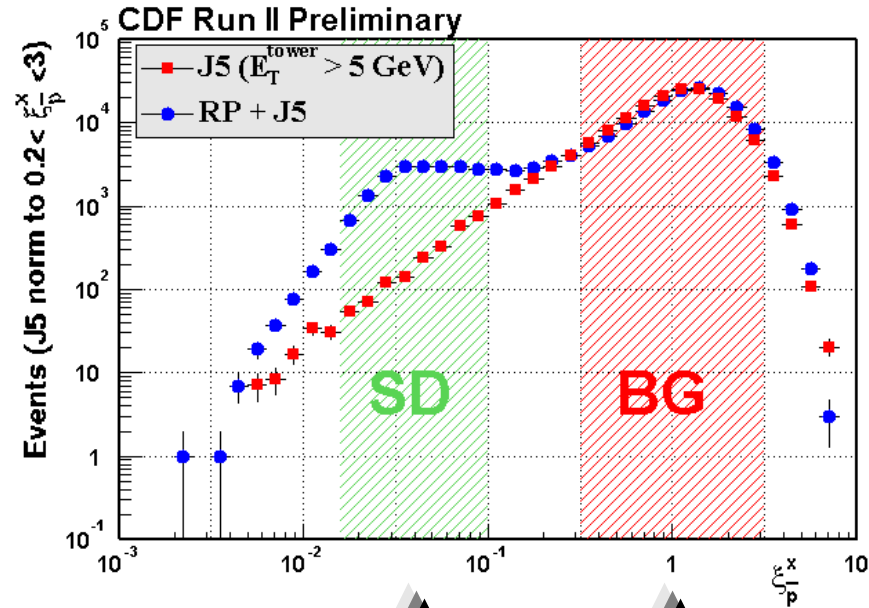
Multiplicity distribution in SD and ND events

ADC counts in MiniPlug towers in a $p\bar{p}$ event at 1960 GeV.

- “jet” indicates an energy cluster and may be just a hadron.
- Approximately 1000 counts = 1 GeV

Diffractive Dijets

$\xi_{\bar{p}}^X$ – distribution



$$\xi = \frac{\sum_i E_T^i e^{-\eta_i}}{\sqrt{s}}$$

SD
events

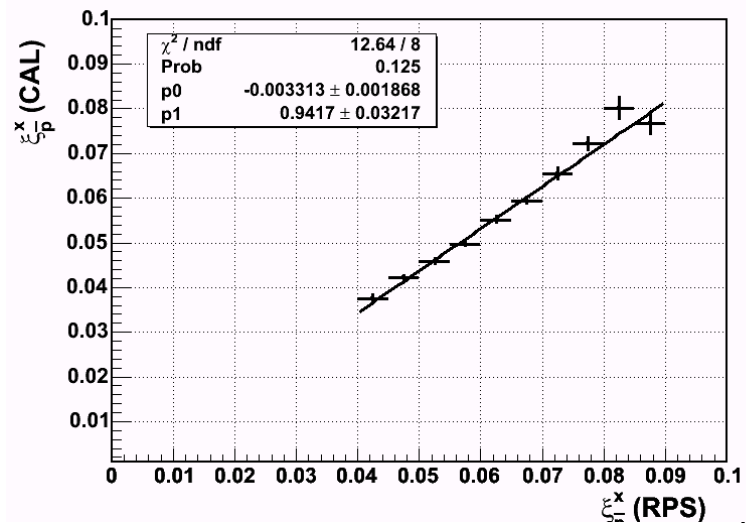
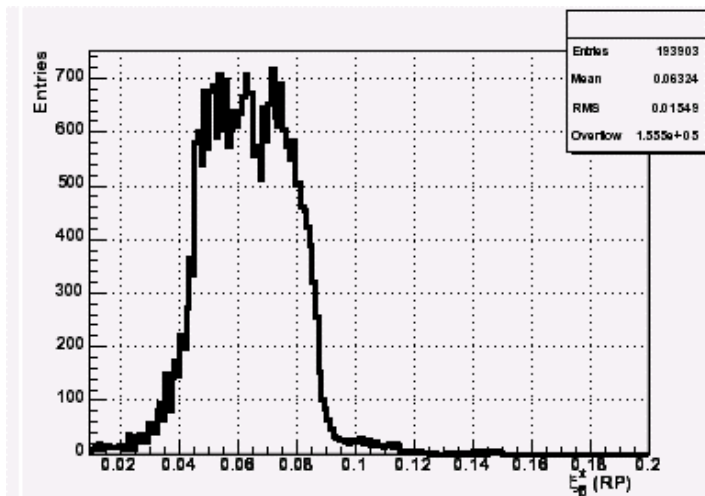
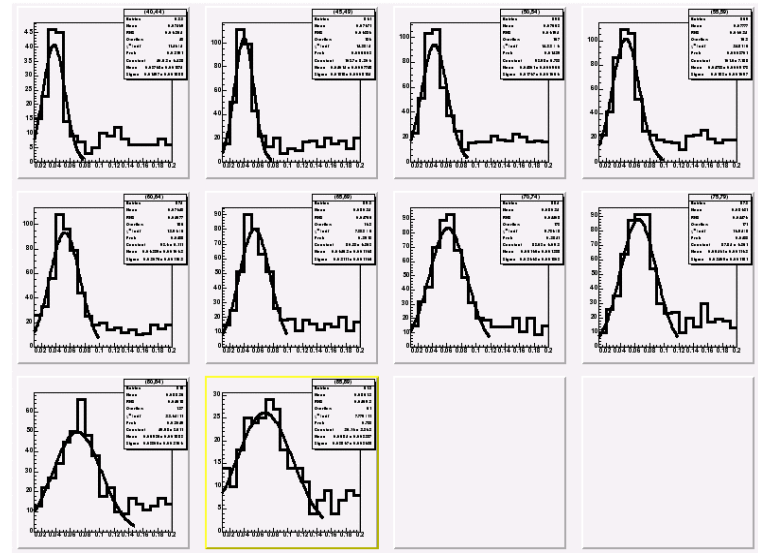
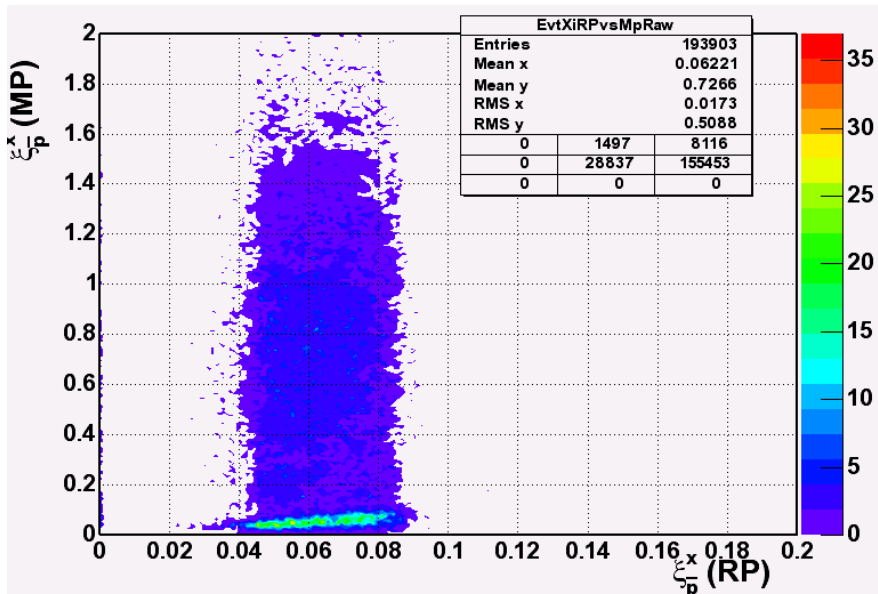
ND+SD & SD+MB
overlap events

$\xi \sim 1$

Flat region

$$\left\{ \begin{array}{l} \frac{d\sigma}{d\xi} \propto \frac{1}{\xi} \Rightarrow \frac{d\sigma}{d \log \xi} = \text{constant} \end{array} \right.$$

Run II Roman Pot Tracking

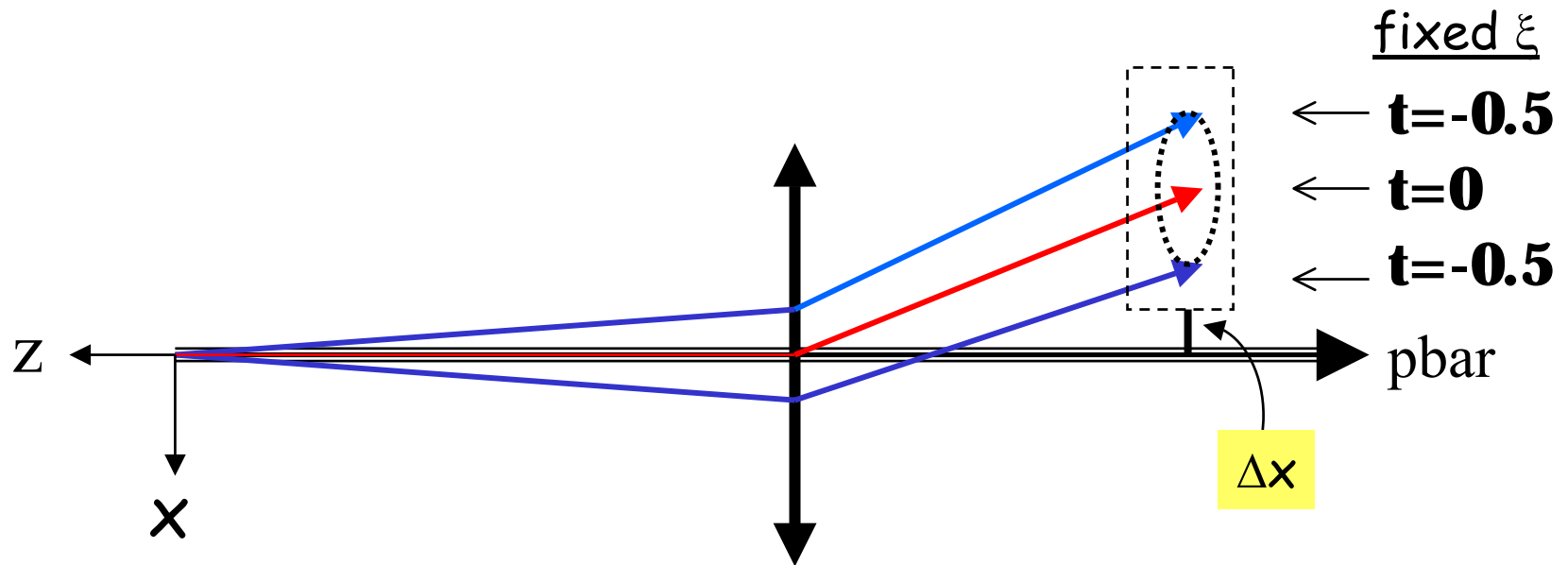


Calibration of RP position

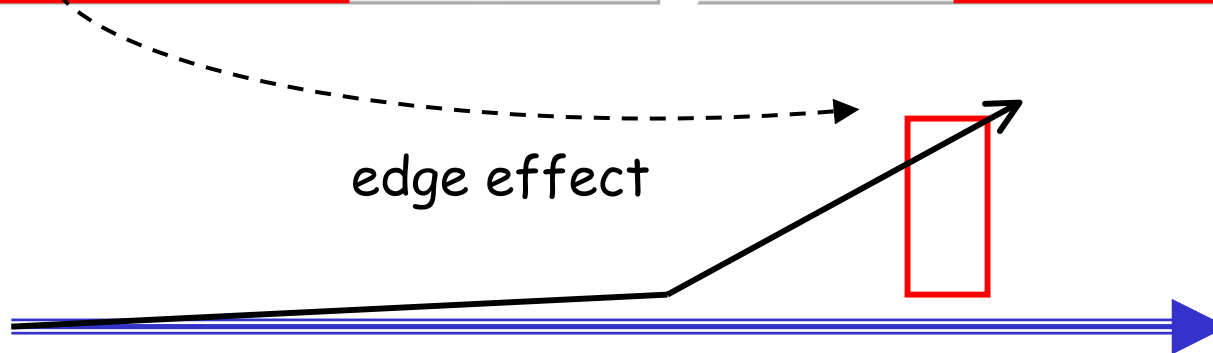
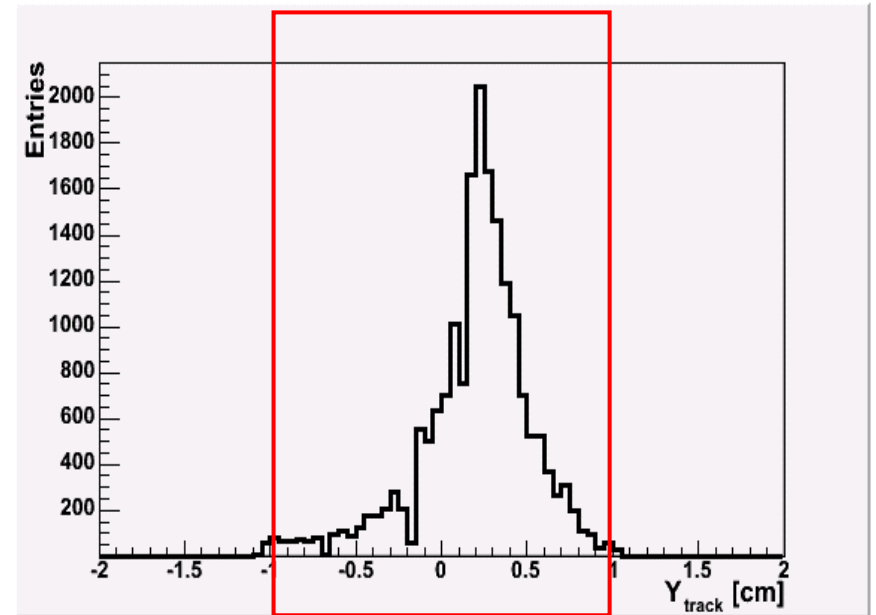
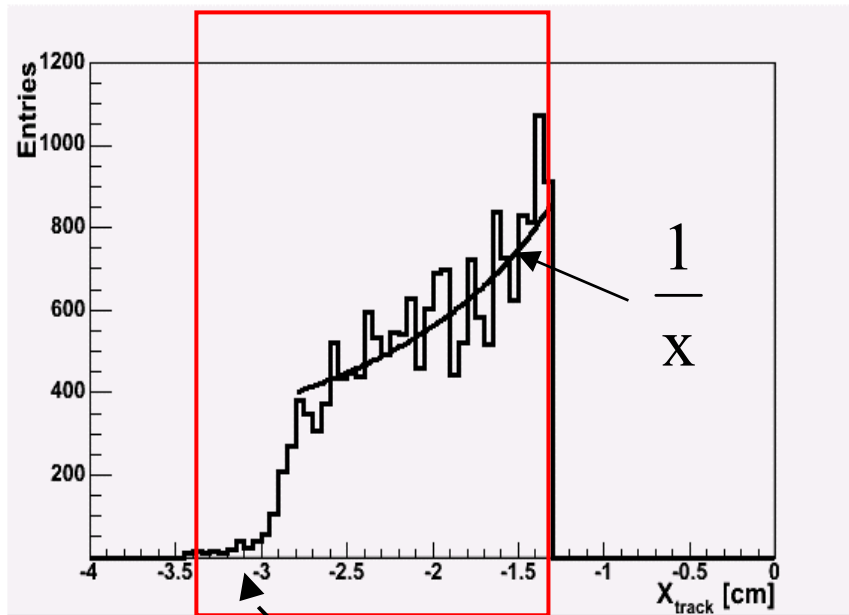
$$\frac{d\sigma}{dt} \sim e^{bt} \Rightarrow$$

Method

Adjust Δx to get the steepest t distribution

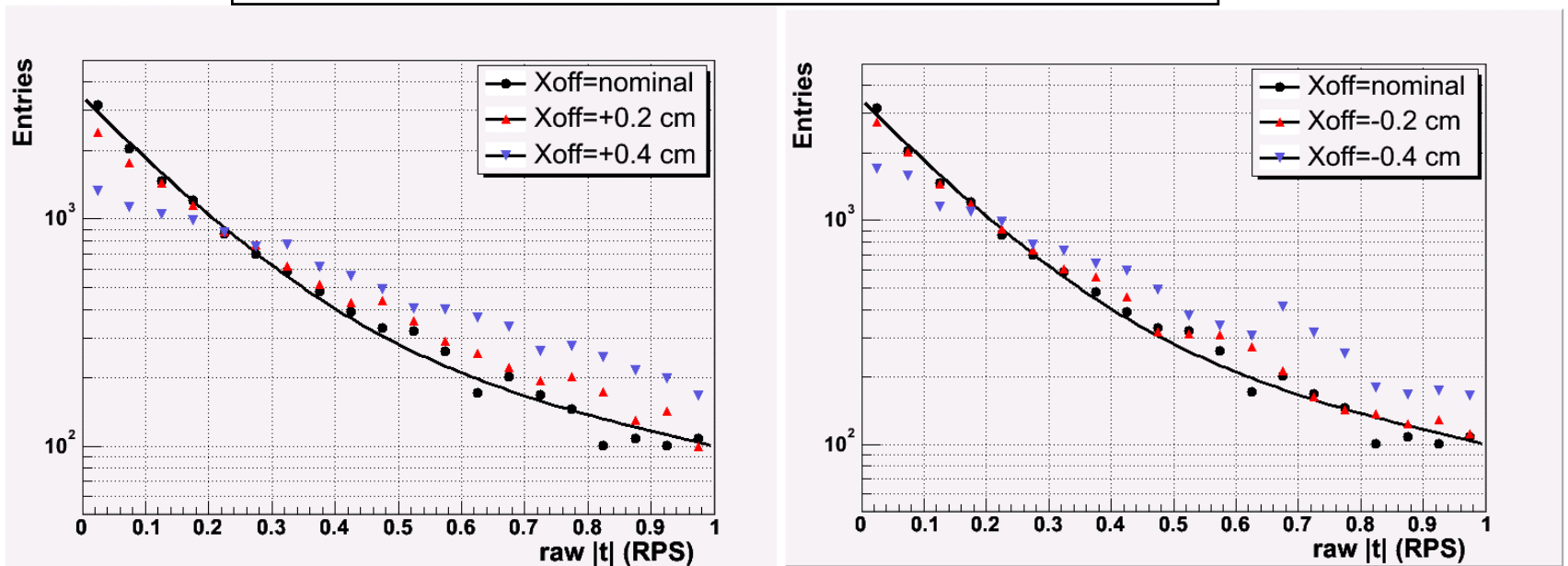


Roman Pot Distributions

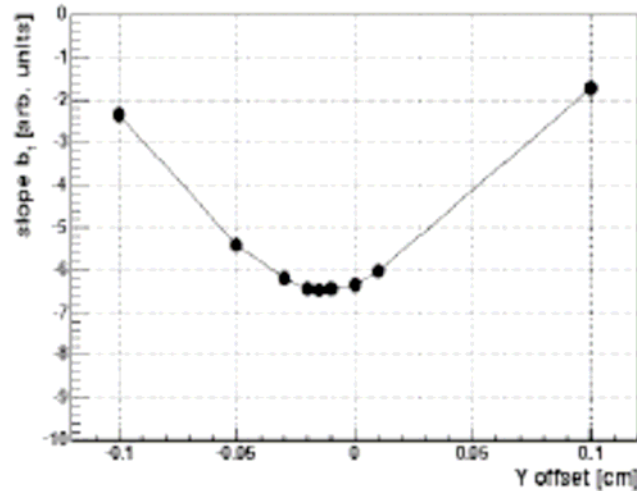


Determining Δx from data

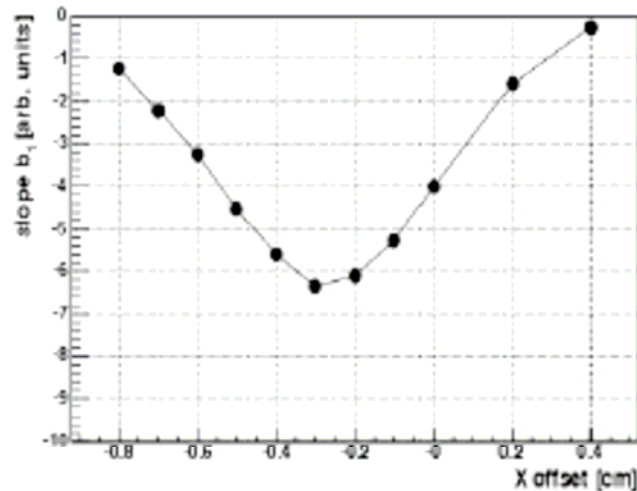
Method: maximize the $t=0$ value of $d\sigma/dt$



x and y Alignment



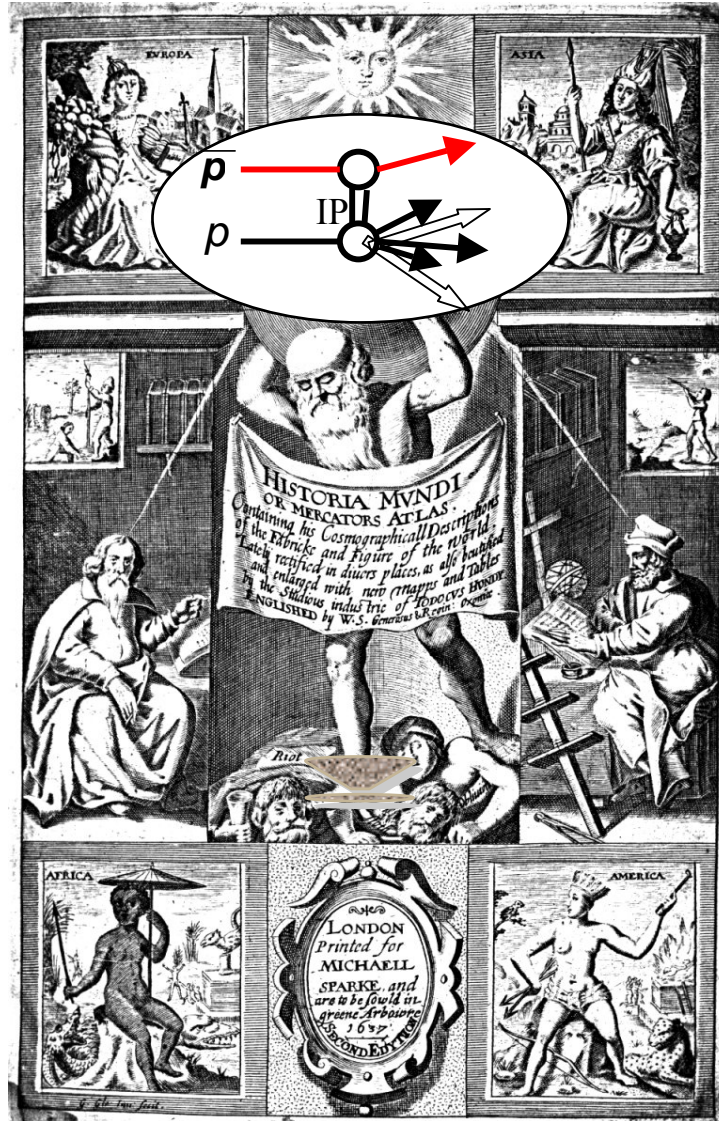
$$\frac{d\sigma}{dt} \sim e^{b|t|}$$



maximize the $|b|$ -slope
→ obtain x and y offsets

HERA & Tevatron → LHC

Difficult



Soft & Hard