Dynamic Alignment of Roman Pots

Konstantin Goulianos
The Rockefeller University
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

Alignment corrected by using elastic scattering

Results
- Total cross section: $\sigma^{\text{tot}} \sim S^E$
- Elastic cross section: $d\sigma/dt \sim \exp[2\alpha' \ln s]$ → shrinking forward peak
- Single diffraction: Breakdown of Regge factorization

PRD 50 (2004) 5518; 5535; 5550

Trackers in Roman Pots out to $|\eta| = 7$
**Run-IC**

**CDF-I**

1992-1996

- Dipole Magnets
- Roman Pots
- Scintillator fiber xy-tracker
  
  \[ x < 0.97 \]

Acceptance: \( 0 < |t| < 1, \quad 0.03 < \xi < 0.1 \)

**Run-IA,B**

**Central Muon Upgrade**

**Steel Absorber**

**Central Muon**

**Central Hadron**

**End Walk Hadron**

**End Plug EM**

**BBC**

**Forward Detectors**

- BBC: \( 3.2 < \eta < 5.9 \)
- FCAL: \( 2.4 < \eta < 4.2 \)

Manchester 11-13 Dec 2005
CDF-I Roman Pot Spectrometer

Alignment performed by surveying
Hosai Nakada - thesis

Fiber width: 800 μ

<table>
<thead>
<tr>
<th></th>
<th>POT-1</th>
<th>POT-2</th>
<th>POT-3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Run 159607, Event 94478</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- 3 trigger counters
- 3×[2×(20+20)]=240 channels

Manchester 11-13 Dec 2005
Diffraction@CDF in Run I

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

**SOFT diffraction**

- Control sample

**HARD diffraction**

**PRL references**

**with roman pots**

<table>
<thead>
<tr>
<th></th>
<th>W</th>
<th>JJ</th>
<th>JJ</th>
</tr>
</thead>
<tbody>
<tr>
<td>J/ψ</td>
<td>87 (2001) 241802</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Manchester 11-13 Dec 2005
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 pbar-p event at 1960 GeV.
- “jet” indicates an energy cluster and may be just a hadron.
- Approximately 1000 counts = 1 GeV
Diffractive Dijets

$$\xi^X/P - distribution$$

CDF Run II Preliminary

- J5 ($E_T > 5$ GeV)
- RP + J5

$$\xi = \sum_\xi E_T e^{-\eta_i} \sqrt{s}$$

SD & SD+MB overlap events

$$\xi \sim 1$$

Flat region

$$\frac{d\sigma}{d\xi} \propto \frac{1}{\xi} \Rightarrow \frac{d\sigma}{d\log\xi} = \text{constant}$$
Manchester 11-13 Dec 2005
Calibration of RP position

\[ \frac{d\sigma}{dt} \sim e^{bt} \quad \Rightarrow \quad \text{Method} \]

Adjust \( \Delta x \) to get the steepest \( t \) distribution

Fixed \( \xi \)

\[ t=-0.5 \]

\[ t=0 \]

\[ t=0.5 \]

\[ \Delta x \]
Roman Pot Distributions

\[ \frac{1}{x} \]

edge effect
Determining $\Delta x$ 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