No, it doesn’t work yet, but it will all be ready March 1 - July 1 Soon!
Event Topologies

**Soft Processes:**

- Elastic Scattering
- Single Diffraction

**Hard Processes (jet production):**

- Hard Single Diffraction
- Hard Double Pomeron
Series of 18 Roman Pots forms 9 independent momentum spectrometers allowing measurement of proton momentum and angle.

\[ \xi = 1 - x_p = \frac{\Delta P}{P} \quad t = (P_{\text{Beam}} - P_F)^2 \]

1 Dipole Spectrometer \( (\bar{p}) \) \( \xi > \xi_{\text{min}} \)
8 Quadrupole Spectrometers \( (p \text{ or } \bar{p}, \text{ up or down, left or right}) \) \( t > t_{\text{min}} \)
FPD Summary July 11, 2000

• Hard diffraction exists, but not well-understood: large data samples and precise measurements needed

• Large c.m. energy and luminosity of Tevatron necessary for these measurements

• FPD will be a completely integrated sub-detector of the DØ detector: Combination of quadrupole and dipole spectrometers gives ability to tag both p’s and \( \bar{p} \)’s over large kinematic range, allows alignment, understanding of backgrounds

• Beams Division work for installation of FPD complete

• Preparations underway for Engineering Run: all Roman pot castles will be installed, some arms instrumented

• Control of pots (motors) using DØ online system has been tested

• Detector production underway at UTA

• Funding still not secured for phototubes and trigger electronics
Photo of a quadrupole castles installed in Tevatron tunnel. All 6 FPD castles were installed in fall of 2000.
Engineering Run (9-10/00)

- Setup a standalone DAQ system close to D0CR.
- Cabling (PMT, HV, TV, 1553, etc) SCR to Tunnel.
- Installation of the castles in the beam line: Dipoles (fully equipped) + proton castles partially equipped
- Installation of two full detectors and some scint.
- Test of remote pot motion via a Python script.
- Data taking.

Some problems found:

- Everything takes longer than you think!
- Rack monitor heating (noise from switch, fixed).
- Flooding in the tunnel (need umbrellas).
- Loss of pot control (new procedures, safeguards).
Hit Reconstruction

• This event (from Engineering Run data) represents a hit in our detector at the location:
  \[ x_d = 5.6 \text{ mm} \]
  \[ y_d = 3.8 \text{ mm} \]
FPD Manpower

- **UTA**
  - Andrew Brandt
  - Mike Strang (grad student)
  - Pierrick Hanlet (post-doc)
  - Christophe Royon (Saclay faculty)
  - Victor Bodyagin (Moscow State faculty)
  - Jia Li (engineer/physicist)
  - Petra Krivkova (grad student – 8/31/01)
  - Lionel Peyrichoux (engineer – 8/31/01)

- **Brazil**
  - Alberto Santoro (faculty group leader)
  - Sergio Novaes (faculty at Fermi)
  - Jorge Molina (grad student at Fermi)
  - Gilvan Alves (faculty Oct at Fermi)
  - Helio da Motta (faculty Nov at Fermi)
  - Newton Oliveira (engineer Nov at Fermi)
  - Eduardo Gregores (post-doc Oct.-Nov. at Fermi)
  - Mario Vaz (engineer)
  - Jorge Barreto (faculty)
  - Vitor Oguri (faculty)
  - Andre Sznajder (post-doc)
  - Wagner Carvalho (post-doc)

- **Other**
  - Mike Martens (FNAL)
  - C. Avila (Bogata)
  - S. Ahmed (Nijmegen)
FPD Status 3/01/01

• All 6 castles with 18 Roman pots comprising the FPD have been installed in Tevatron

• Most cables and pot motion electronics installed (~full time work for 6 FTE from Dec-Mar)

• Electronic safety review completed

• Two complete detectors and four pseudodetectors (trigger scintillator only) installed and waiting for beam.

• Testing of all systems underway

• Work continues on trigger, software

• Some additional funds ($38,000) secured by Brazil, still need $67,000 to complete 10 detectors ($25,000 promised by DOE)
May Shutdown Plans

• Test upgraded pot motion program and obtained pot motion approval

• Continued cabling

• Installed new cameras

• Added a couple more pseudo-detectors

• Many miscellaneous tasks

At end of shutdown:

Prepared and approved for collisions

Tunnel work should essentially completed except for installation of additional detectors
Pot Motion: LVDT vs. Encoder

- **Graph 1**: LVDT vs. Position (mm)
  - Markers for $P_{1,\text{IN}}$

- **Graph 2**: LVDT/Position vs. Position (mm)
  - Markers for $P_{1,\text{IN}}$
Pot Motion Tests and Safeguards

• The pot motion software was upgraded and extensively tested during the May shutdown.

• The software is reliable and gives reproducible results. The pots always move to the desired position

• The software verifies the direction of the intended pot motion to make sure that it is correct before the pot is moved. If this is not the case the command is reissued, and if it is still wrong, the pot is returned home.

• The drivers are disabled with a switch in the SCR when the pots are not being moved.

• The pots are hooked to an emergency line which bypasses the software to send the pots back to the home position.
More Pot Motion

- Smoke detector alarms disable the pot motion (haven’t had any, but have tested).

- An alarm is given if contact with the IIB is interrupted. If this situation continues the emergency line could be used.

- The pot positions are in ACNET as well as variables which indicate all pots are in home position, which are checked by the MCR before beam injection.

- Halo rates are displayed, and after some experience is gained, alarms will be added if the halo rate changes significantly.

- A pot motion manual has been provided to all shifters and a copy is in the SCR.
Pot Motion Tests

Initially pot motion tests restricted to end of stores, so progress slow. Eventually gained confidence of BD, allowed to insert pots anytime.
Summer Run Plan

• Dedicated FPD shifts with pots inserted close to beam

• Used stand-alone DAQ/trigger in small control room

• Full system tests (excluding DØ trigger)

• Debugging, data-taking, algorithm development, pot insertion procedure, documentation, etc.
Goals for Oct. Shutdown

• Detector Upgrades
  – Install and test 8 new detectors

• Readout & Triggering
  – Installation of AFE interface and AFE and DFE boards
  – Commissioning readout chain
  – Commissioning trigger chain

• Pot Motion
  – Installation of multiplexors
  – Software upgrade, database update

• Veto Counters
  – Installation of new scintillation veto counters ($5.2 < |\eta| < 5.9$)
Detector Upgrades

Done:
• Test and bin MAPMT’s and L0 PMT’s
• Cartridge Assembly
• Cable tests
• Map detectors with optical scanner
• Installing detectors
• Detector tests
• Amplifier tests
• Low voltage tests
• Noise studies

To Do:
• Final low voltage purchase
Readout and Triggering

Done:
• Design and building of AFE cassette support
• Cabling in collision hall
• Design of Transition board

In Progress:
• Construction of Transition Board
• Final comb support

To Do:
• Tests with AFE boards

Prognosis:
• Progress slow, have been hampered by unavailability of LM/AFE boards, non FPD/AFE contact edict
• Full Integration with DØ will not happen for another couple months
AFE Cassette

- Cassette support design modified by Jia Li, built at UTA machine shop
Pot Motion

Done:
• Get Newton to Fermilab
• Multiplexor board construction

In Progress:
• Tests of Mux boards

To Do
• Upgrade pot motion software
• Switchover to mux

Prognosis:
• Need a magnet failure at some future date to install mux
Veto Counters

Done:
• Veto counter feasibility study
• Veto counter and support design (Jia Li and A.B.)
• Counter construction and support machining (Lab 6, Lab 8, DØ)
• Counter assembly

To Do:
• Install counters Nov. 18
Veto Counter
FPD Funding Status

Cost to complete FPD Stage I (10 pots):

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
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</thead>
<tbody>
<tr>
<td>63 MAPMT (@$1540)</td>
<td>$97,000*</td>
</tr>
<tr>
<td>AFE interface Multiplexor, misc</td>
<td>$8,000</td>
</tr>
<tr>
<td>Total</td>
<td>$105,000</td>
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Funds available:

<table>
<thead>
<tr>
<th>Source</th>
<th>Amount</th>
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</thead>
<tbody>
<tr>
<td>Fermilab</td>
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<tr>
<td>LAFEX</td>
<td>$38,000</td>
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<tr>
<td>DOE Sup.</td>
<td>$25,000</td>
</tr>
<tr>
<td>Total</td>
<td>$105,000</td>
</tr>
</tbody>
</table>

• Additional $97,000 needed for 18 pots ($30k of this just obtained from ARP)
## Software Effort

**Proton ID leaders:**  G. Alves, S. Novaes

<table>
<thead>
<tr>
<th>Level</th>
<th>Module</th>
<th>Leaders</th>
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<tbody>
<tr>
<td>L1</td>
<td>Proton Tracking</td>
<td>M. Martens, J. Barreto</td>
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<tr>
<td></td>
<td></td>
<td>M. Vaz, J. Molina - hardware equations</td>
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<td></td>
<td>MI and Halo Rejection</td>
<td>W. Carvalho</td>
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<td>Resolutions</td>
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<td>L2</td>
<td>Gap Tool</td>
<td>M. Strang</td>
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<td>L3</td>
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<td>ONLINE</td>
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<td>C. Royon, H. da Motta</td>
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<td>Alignment</td>
<td>C. Avila, M. Martens</td>
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<td>OFFLINE</td>
<td>Monte Carlo</td>
<td>G. Alves, Andre Sznadjer</td>
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<td>S. Novaes, E. Gregores</td>
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<td>TrigSim</td>
<td>W. Carvalho, G. Alves</td>
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<tr>
<td></td>
<td>Reco</td>
<td>J. Barreto, M. Martens</td>
</tr>
</tbody>
</table>
Halo and Multiple Interactions

Reject Halo fakes using trigger scint. timing info

Multiple Interactions pile-up

1) Using FPD tracks at L1; cut on $\xi < 0.01$
2) Cut at $\Delta T$ on L.M.

Low $\xi$ dominates pile-up

M.Martens Resolution

L.M.algo C.Miao
FPD W.Carvalho
MI Flag Studies

Signal - Hard Diffraction
Background - Soft Diff. + Dijets (Pythia)

W. Carvalho
Trigger Equations

The idea of cluster

This equation represents the idea of the picture above

J. Molina
Long Range Plan

• Begin data taking with improved system in November (still standalone)

• Use sDAQ to start integration in DØ

• Install AFE’s when available (mid-December? January?)

• Firmware and Trigger development

• Demonstrate working system, usefulness of horizontal plane, and secure funding for remaining MAPMT in 2002

• Early papers:
  NIM
  Elastic t-distribution
  Single diffraction distributions
  Diffractive jet production
  Double tagged double pomeron exchange
Conclusion

• Tremendous progress in installation and commissioning

• Entering a new phase of FPD:
  1) Installation almost complete
  2) We have funding for Phase I!

• Emphasis shifts to software and operations

• Trigger hardware and firmware a MAJOR concern

• Starting to think about physics a little!