

Tevatron - CDF/D0 exchange: A first look

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Disclaimer

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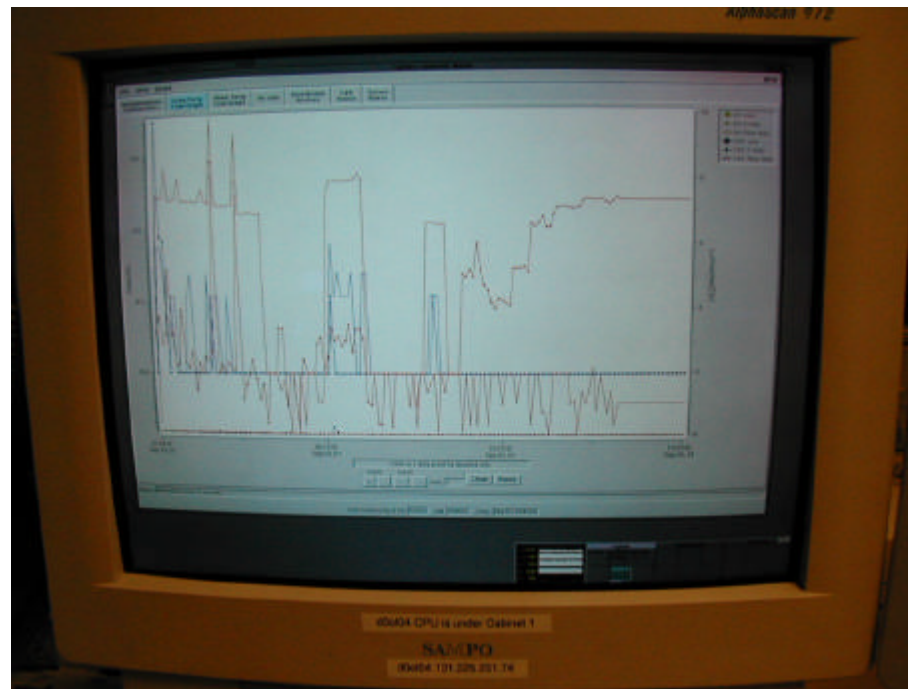
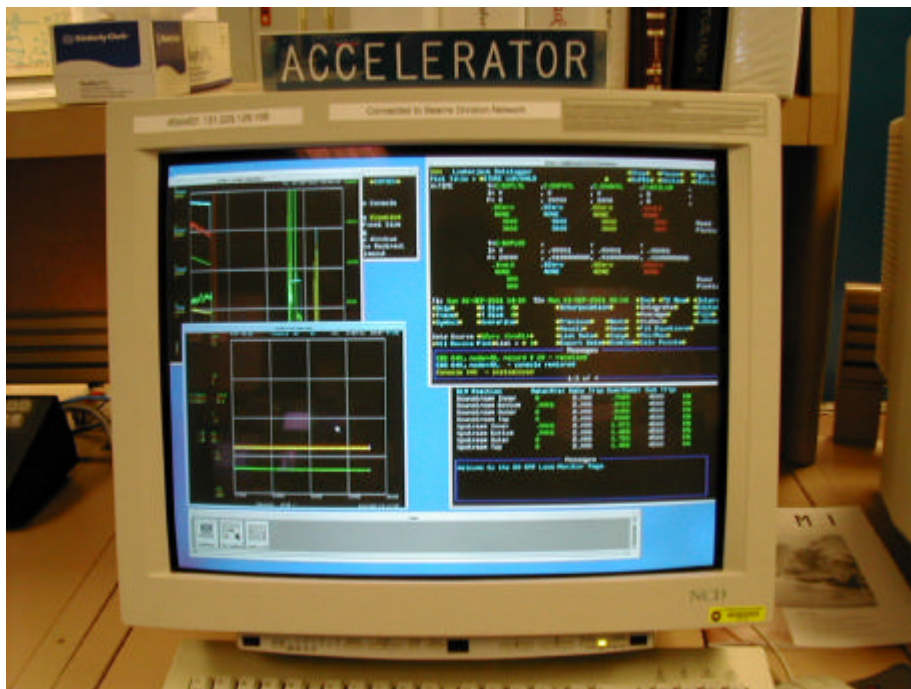
Disclaimer

- As the title states, this is a 'First look' only
 - Do not expect quantitative information nor a concise summary of the situation at FNAL
- Examples from CDF/D0 and Tevatron
 - Have been used in the context of an Academic Training Lecture series on the "LHC Machine / Experiment Interface"
 - Given together with O. Brüning and E. Tsesmelis in May 2002
 - These examples were used only as illustrations from the 'real life' world
- Propose to see this short talk as starting point
 - Offer to collect more concrete information
 - Based on your questions etc.

Inform. exchange: Tevatron CDF/D0

- Using the FNAL accelerator controls system
 - Architecture distinguishes
 - Front-ends (bridge to hardware)
 - Centrals (databases, alarm reporting, ...)
 - Consoles (end-user interface)
 - Networks (Ethernet and token ring)
- ACNET
 - Protocol to define the transport mechanism for data acquisition and client-server communication
 - Connectionless, peer-to-peer and proprietary
 - Task sends message to another ACNET task
 - Single request with one (many or no) reply expected
- In addition, several hardware links
 - Tevatron clock (10 MHz)
 - Tevatron Beam Synch timing link
 - Abort link

Example: D0 control room (Tevatron)

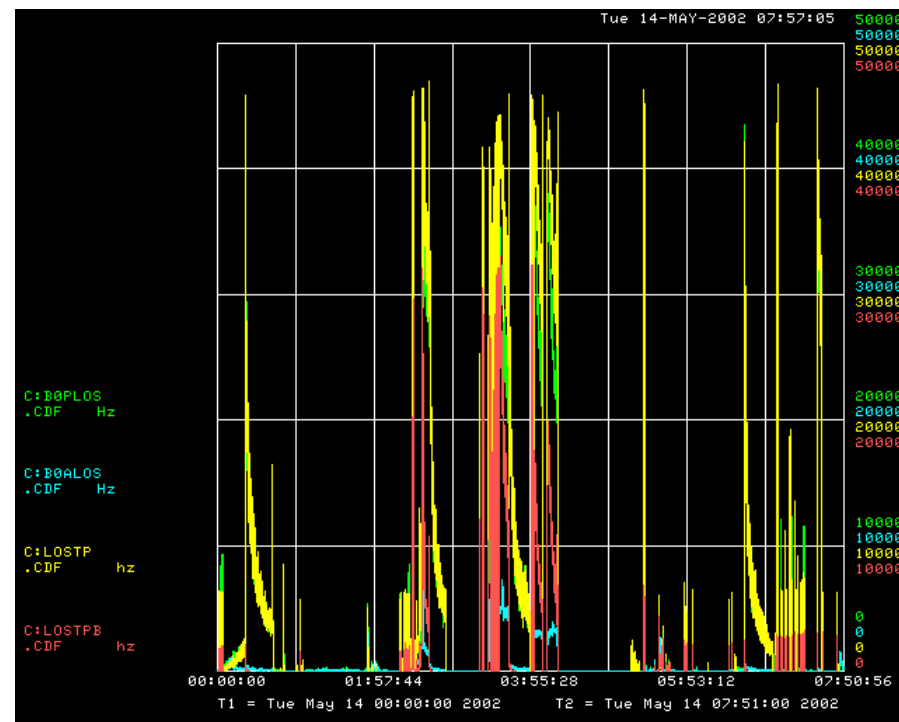
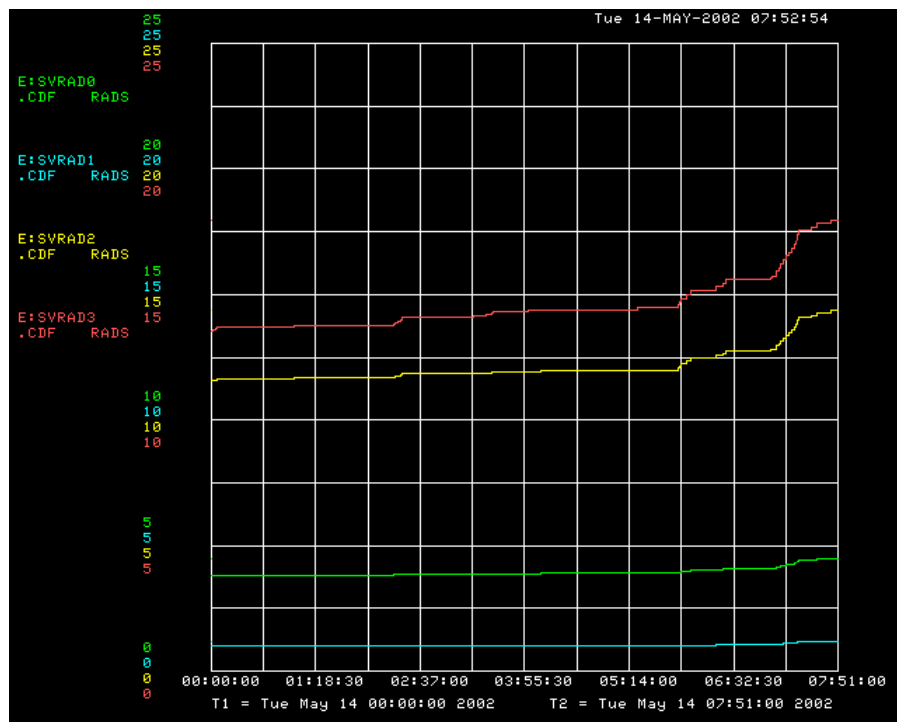


- 'Interface' to the accelerator operation
 - Time evolution of rates and luminosity
 - Status information and parameters

- Luminosity monitor display
 - Time evolution of the delivered luminosity
 - dedicated counters (L-R coincidence) for inelastic events

$$\rightarrow L = N_{L-R} / \sigma_{\text{tot}}^{\text{visible}}$$

Example: CDF (Tevatron)



- Monitoring of radiation dose in silicon detectors

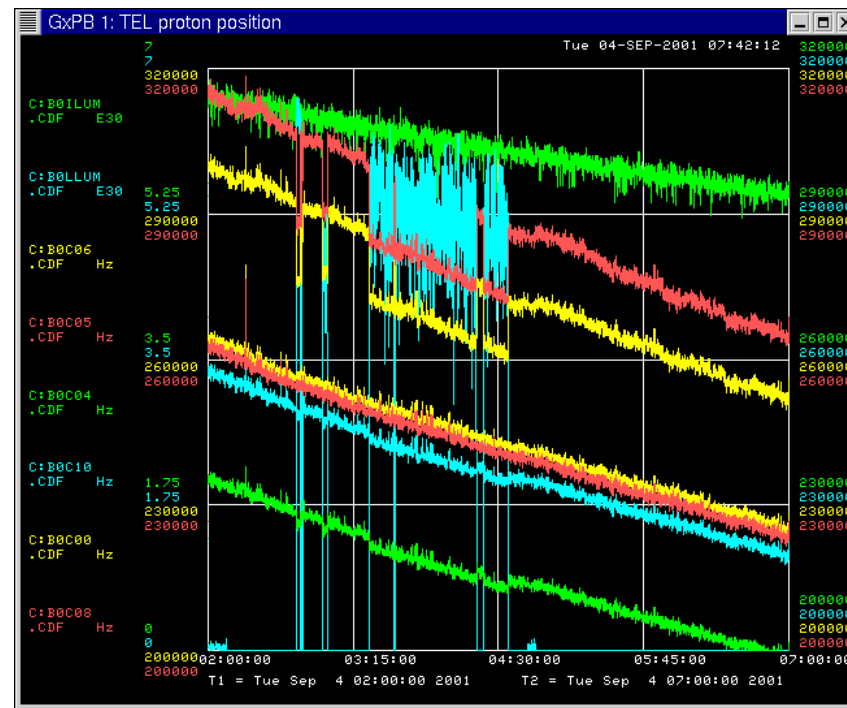
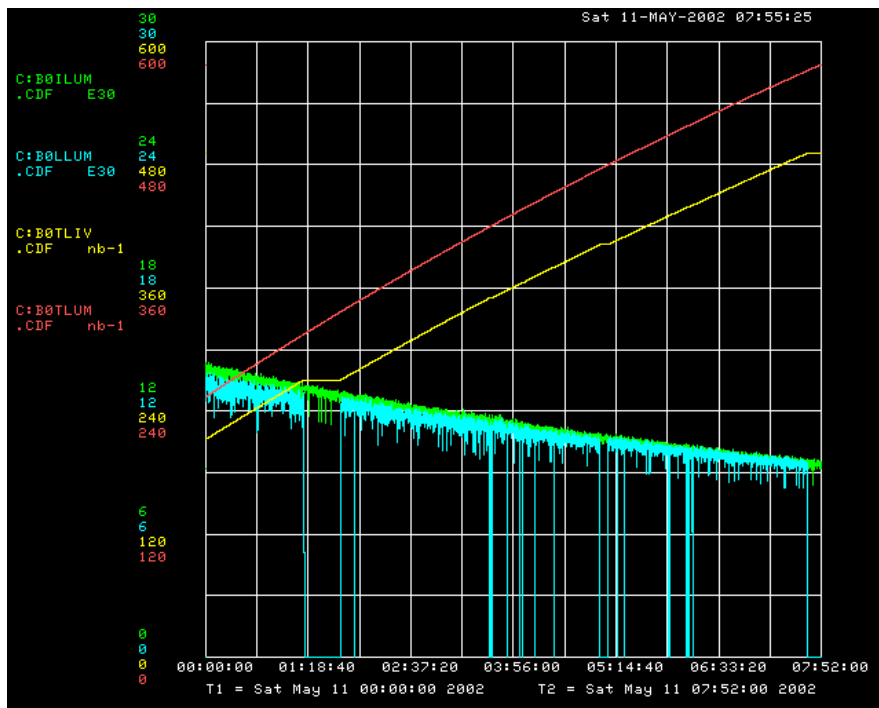
- REMEMBER: for full run II integrated luminosity (15 fb^{-1}) need to replace Si vertex detectors in CDF and D0

- LEFT: accumulated dose (in PIN diodes, normal conditions)

- RIGHT: proton loss rates (beam loss monitors)

- 100 kHz loss rate corresponds to approximately 2mrad/s

Example: CDF (Tevatron)

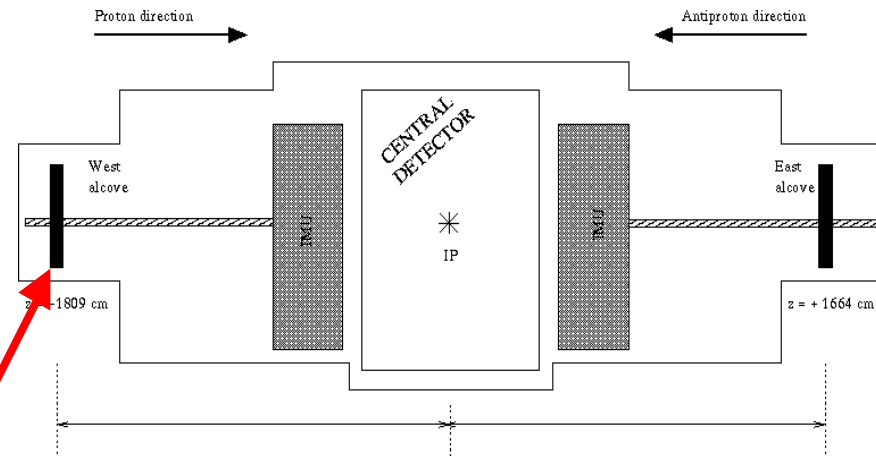
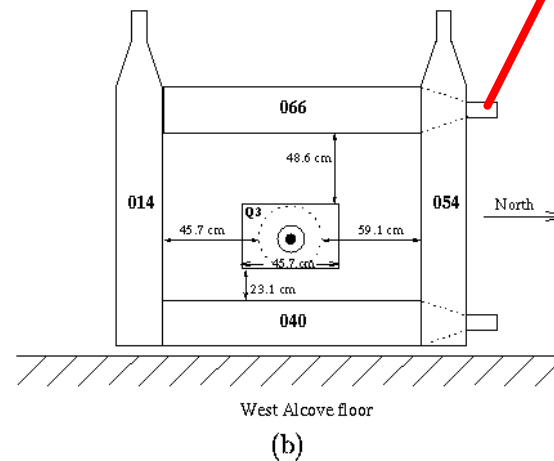
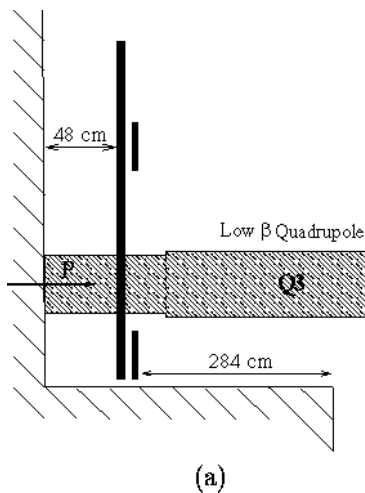


- Luminosity monitoring and background rates
 - LEFT: Instantaneous luminosity and integrated luminosity
 - RIGHT: instantaneous luminosity and rates at various scintillation counters outside the interaction point

Example: CDF halo/loss rates

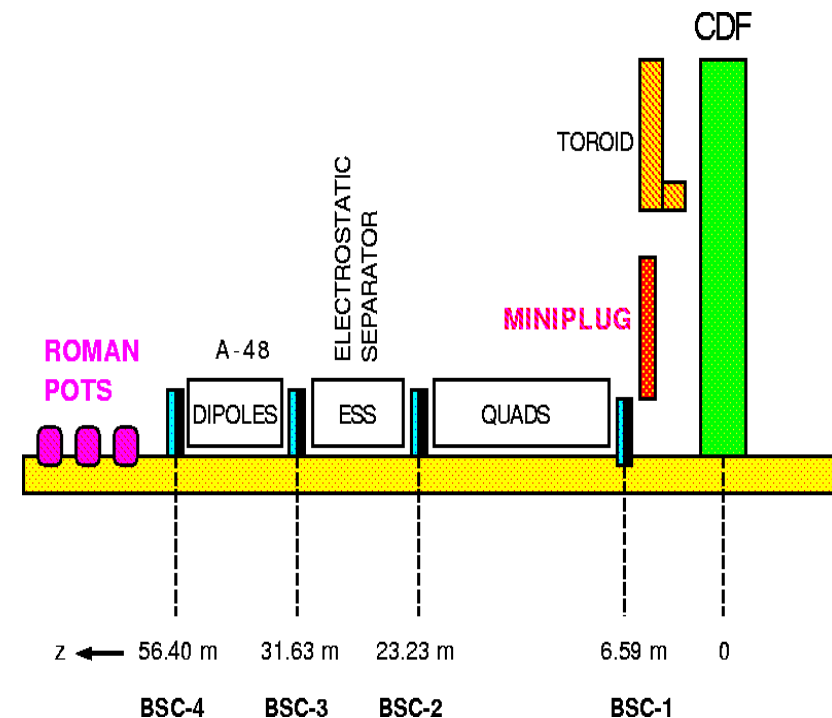
- (anti-) proton halo rate

→ Determined by coincidence between beam bunch signal and counter signal

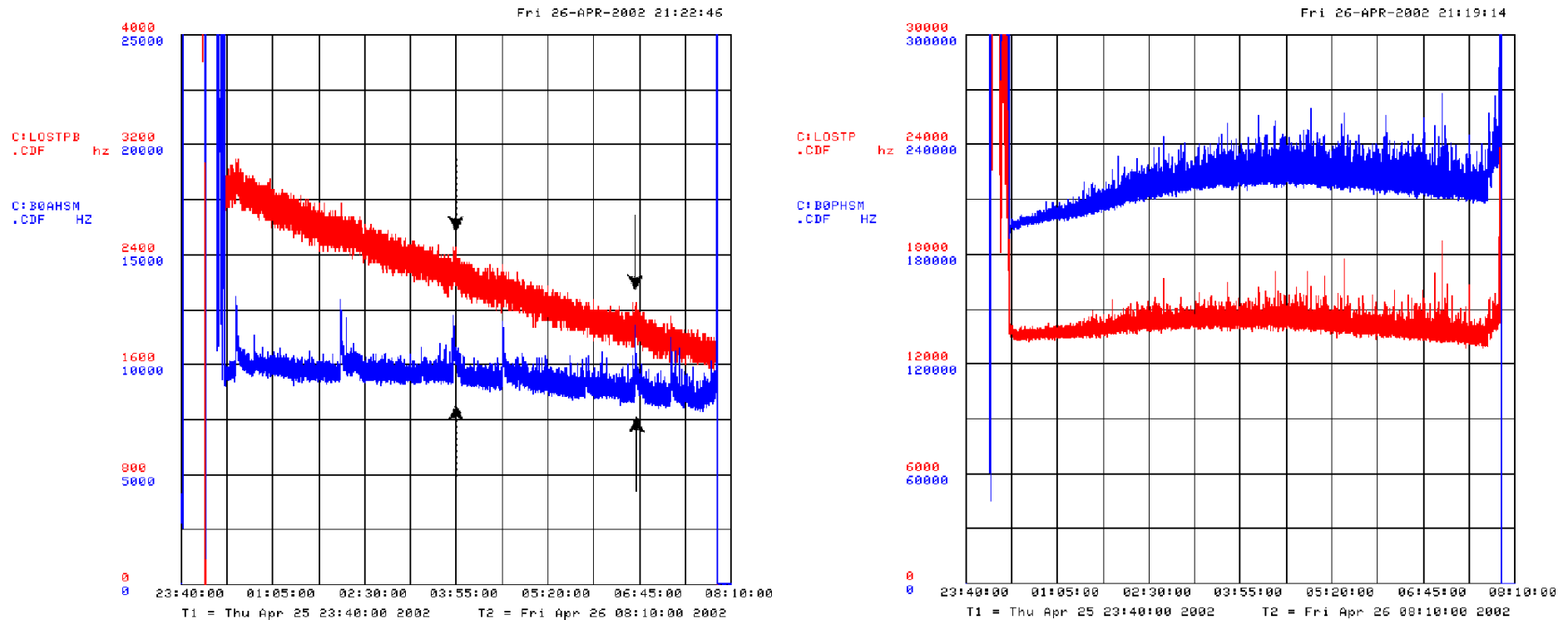


- (anti-) proton loss rate

→ Determined by coincidence between beam bunch signal and BSC-1 counter

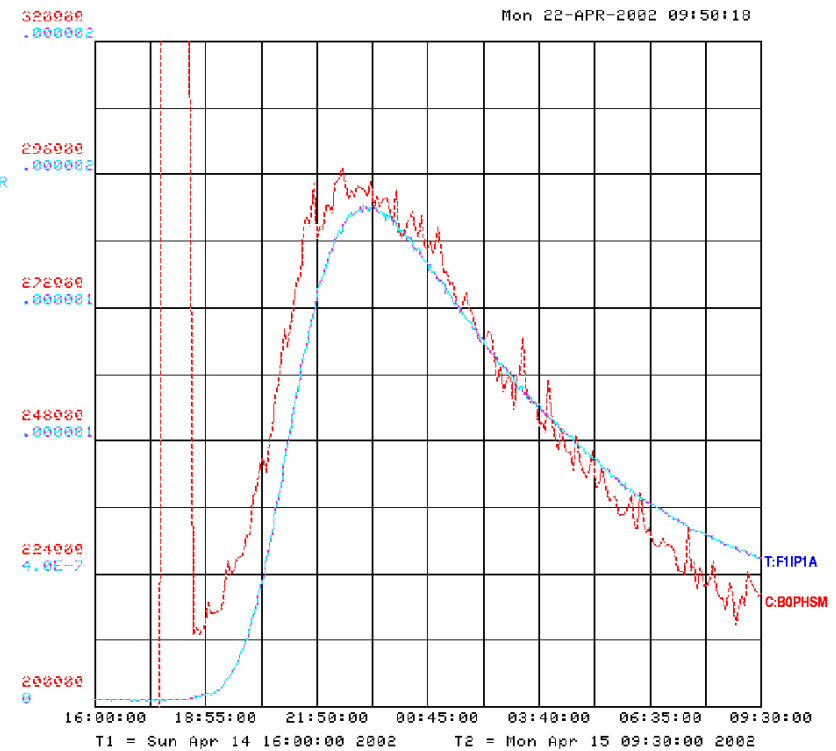
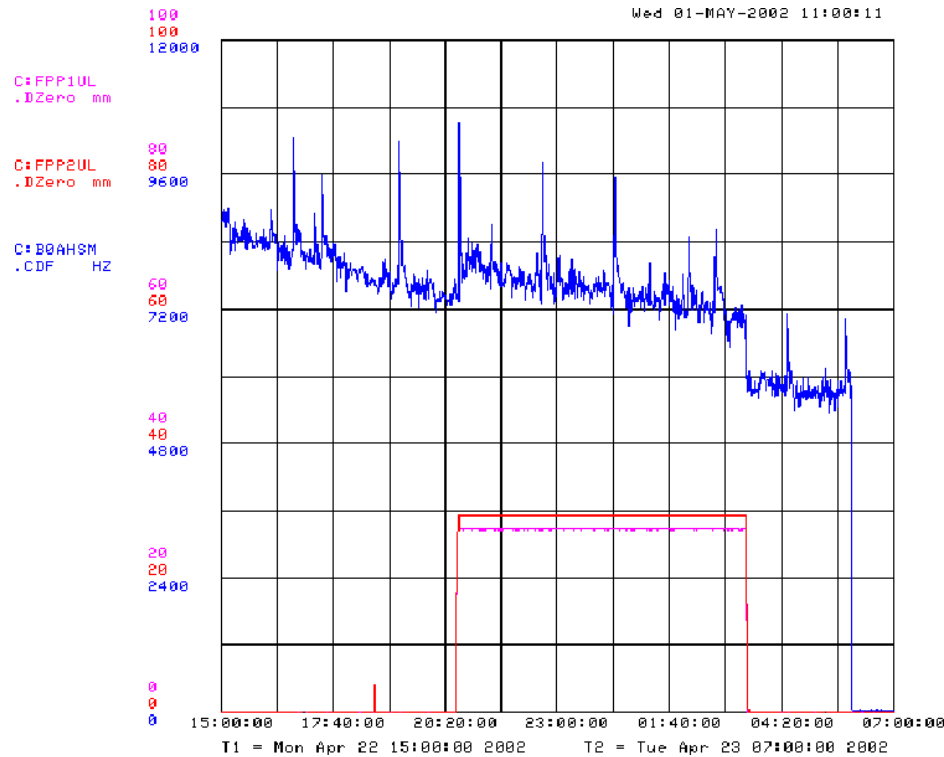


Beam loss vs. halo rates



- Anti-protons (LEFT) and protons (RIGHT)
 - Beam **halo rate**
 - scintillation counter array outside of quadrupole
 - Beam **loss rate**
 - beam shower counter close to the beam pipe
 - Instrumentation in the experimental "cavern" (hall)

Beam halo correlations



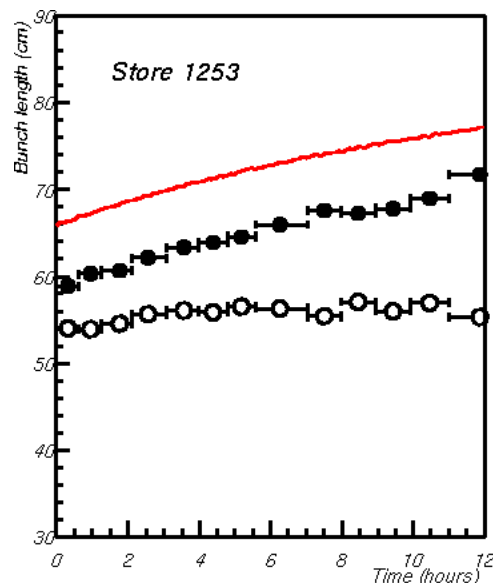
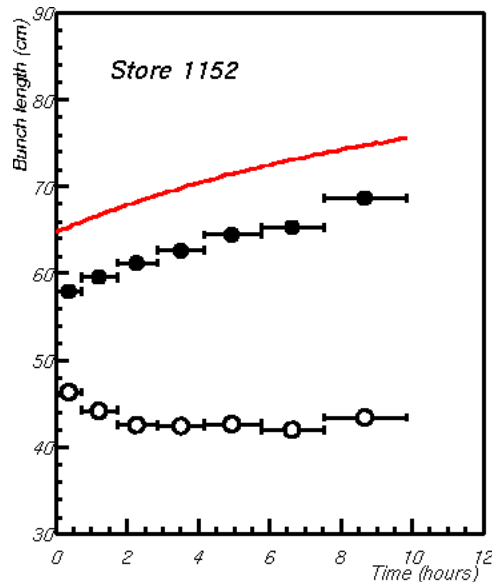
- Anti-proton halo rate

→ Correlation with movement of D0 Roman Pots

- Proton halo rate

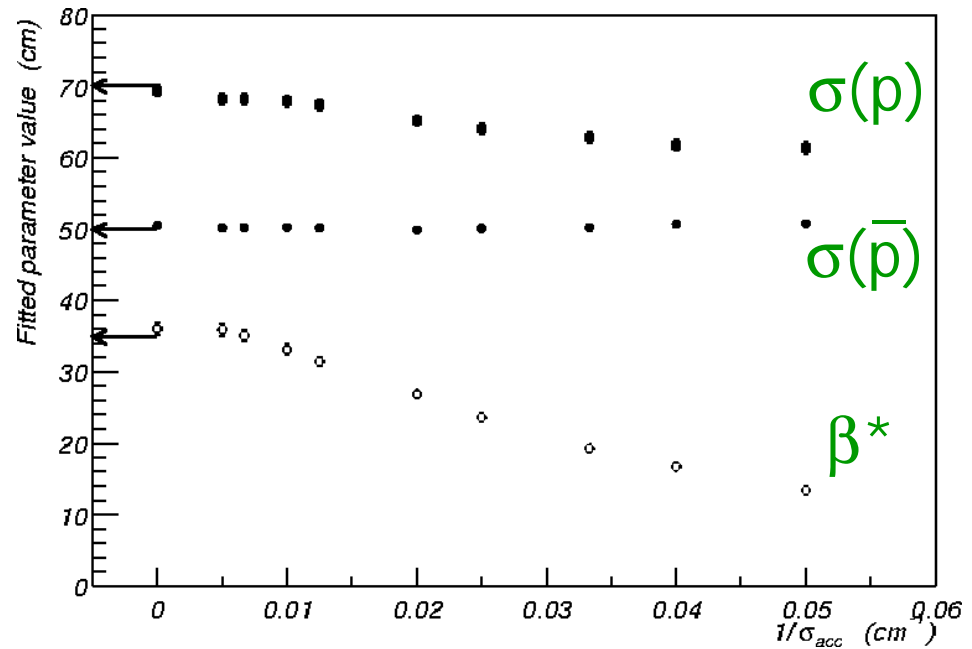
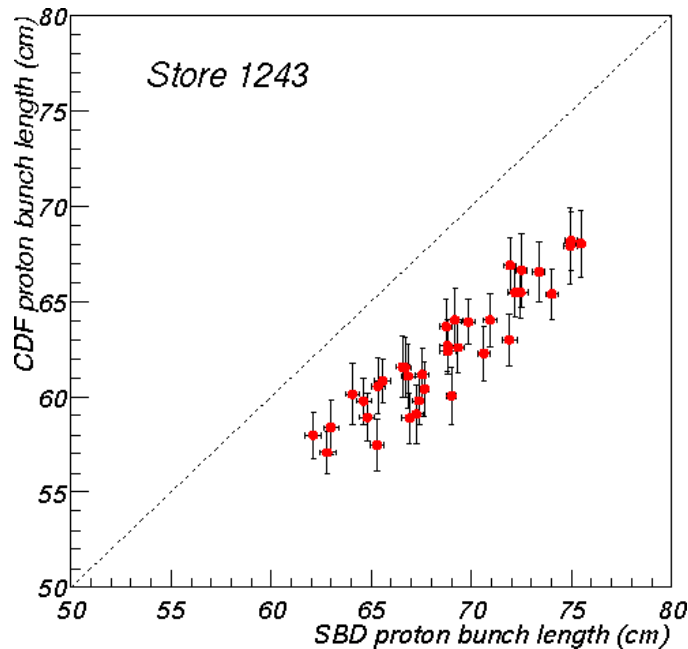
→ Correlation with beam vacuum in a sector of the Tevatron

(Anti-) Proton Bunch length



- Determine the bunch length from the measured distribution of the primary vertex at CDF
 - Using the COT central tracking detector
 - Each point using 10^4 events
 - Proton bunch length (●)
 - Anti-proton bunch length (○)
- Comparison with machine measurement (-)
 - Determined from image current across a resistor
 - Between two electrically isolated beam pipe sectors

Beam parameter determination



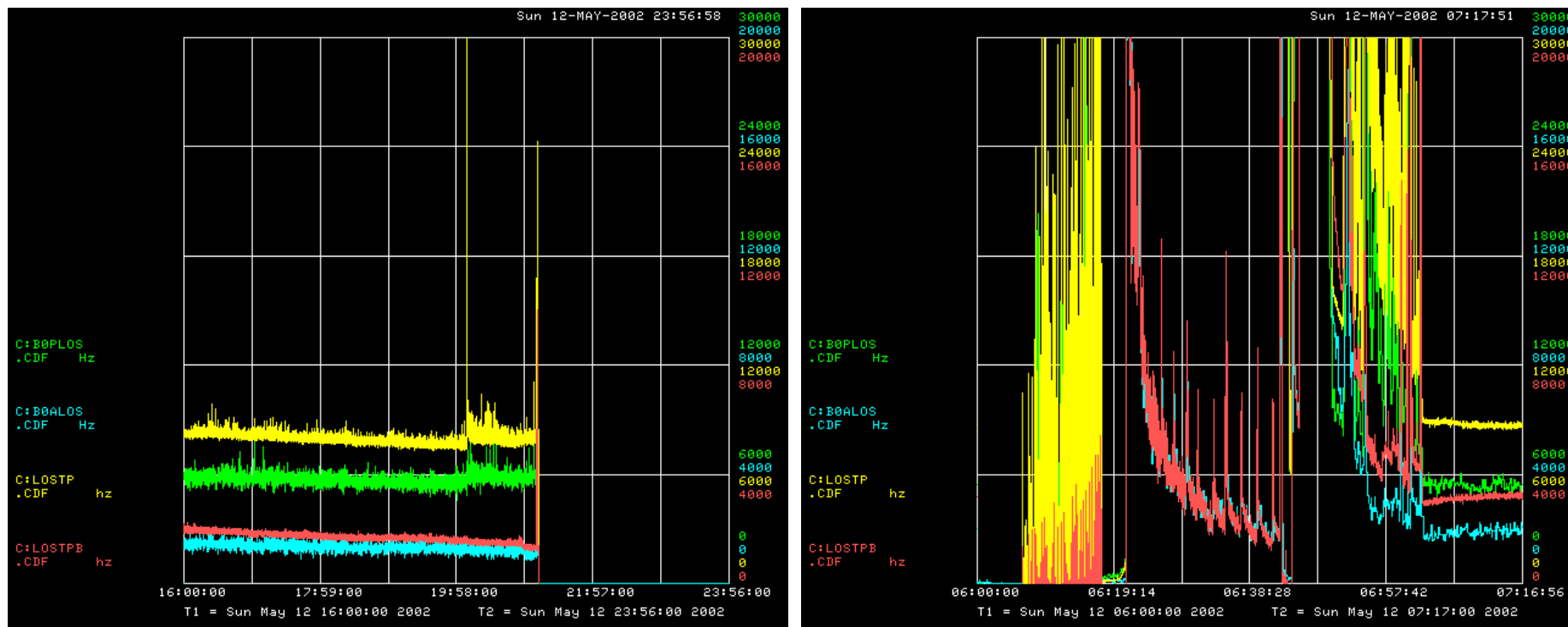
- Individual bunch length measurement
 - Correlation between CDF determination (primary vertex) and machine determination (image current)

- Extract parameters from fit
 - Proton bunch length
 - Anti-proton bunch length
 - β^* value
 - Indication given for effect of non-uniform trigger acceptance

Possible next steps ?

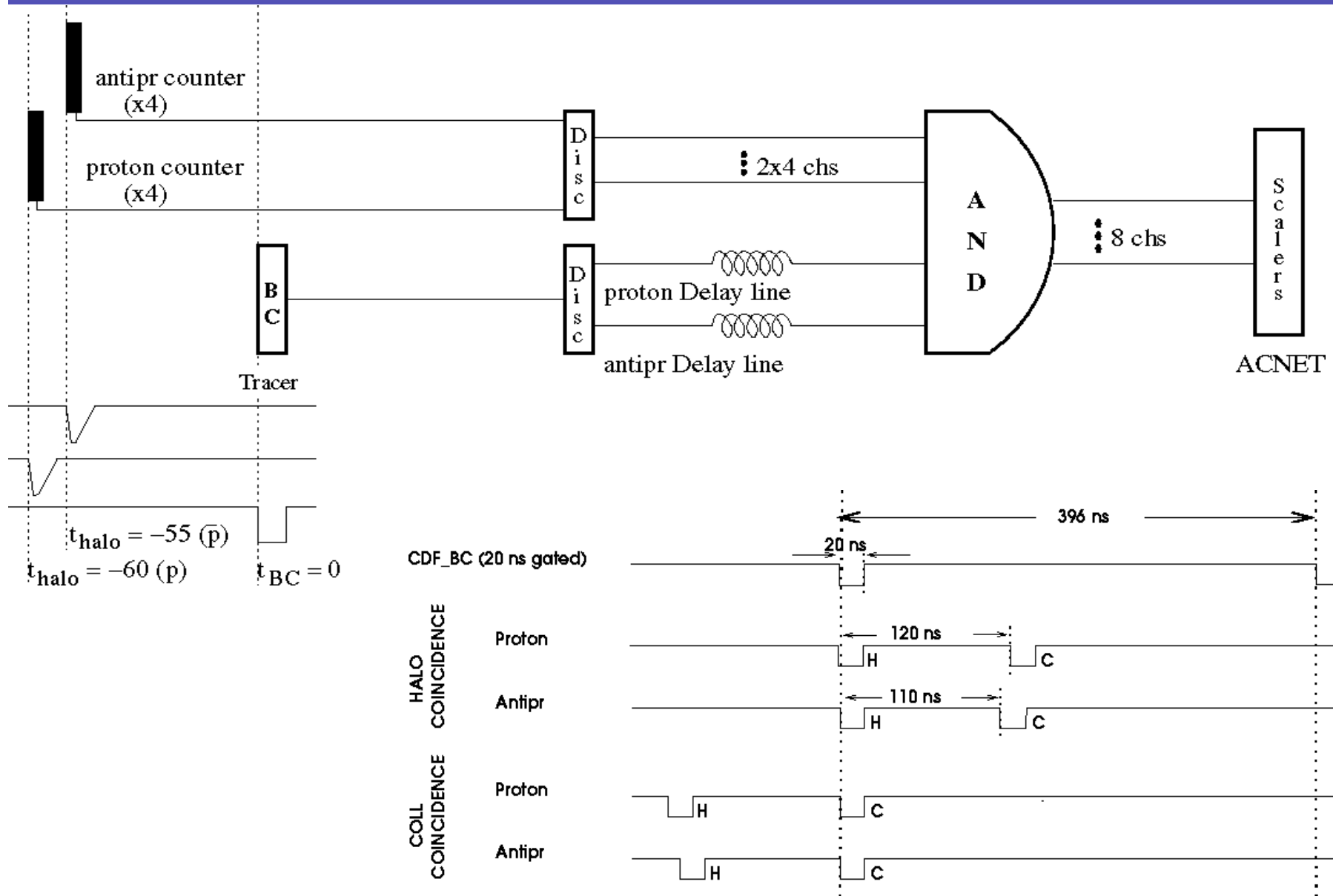
- Until end of August
 - collect your questions, requests for information / clarification ...
- Contact relevant CDF/D0/Tevatron people
 - On the issues collected
- Refine information
 - During trip to FNAL
 - Date not yet known
- Report back to the WG
 - As soon as the above steps are fulfilled
- Your input is most welcome and **NEEDED** ...

Example: CDF (Tevatron)

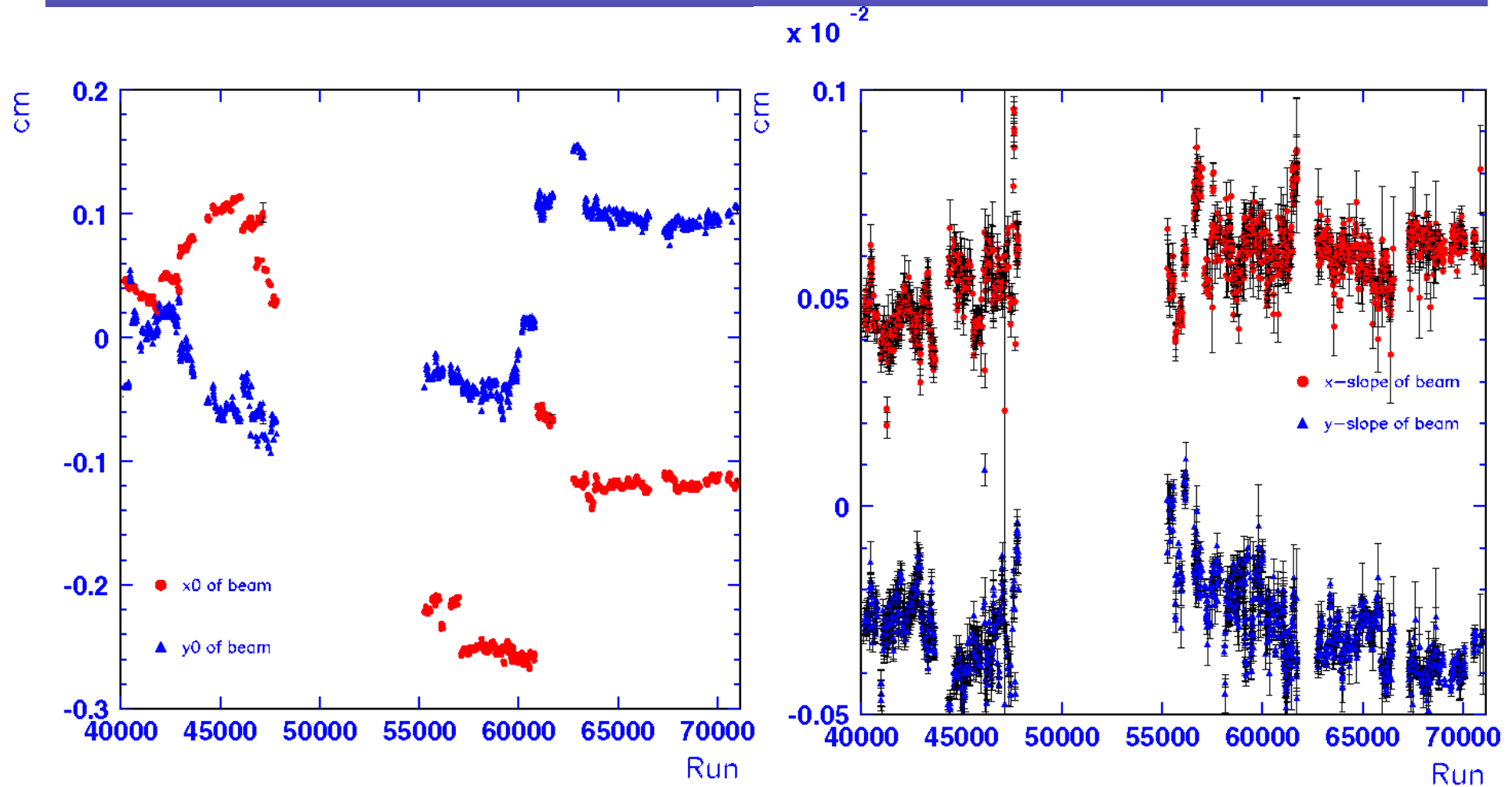


- Beam loss rate for proton and anti-protons
 - Determined using the CDF beam shower counters (scintillators around the beam pipe at a distance of about 7 m from IP)
 - LEFT: stable running until beams have been lost
 - RIGHT: example of rather unstable conditions

Halo rate logic and timing

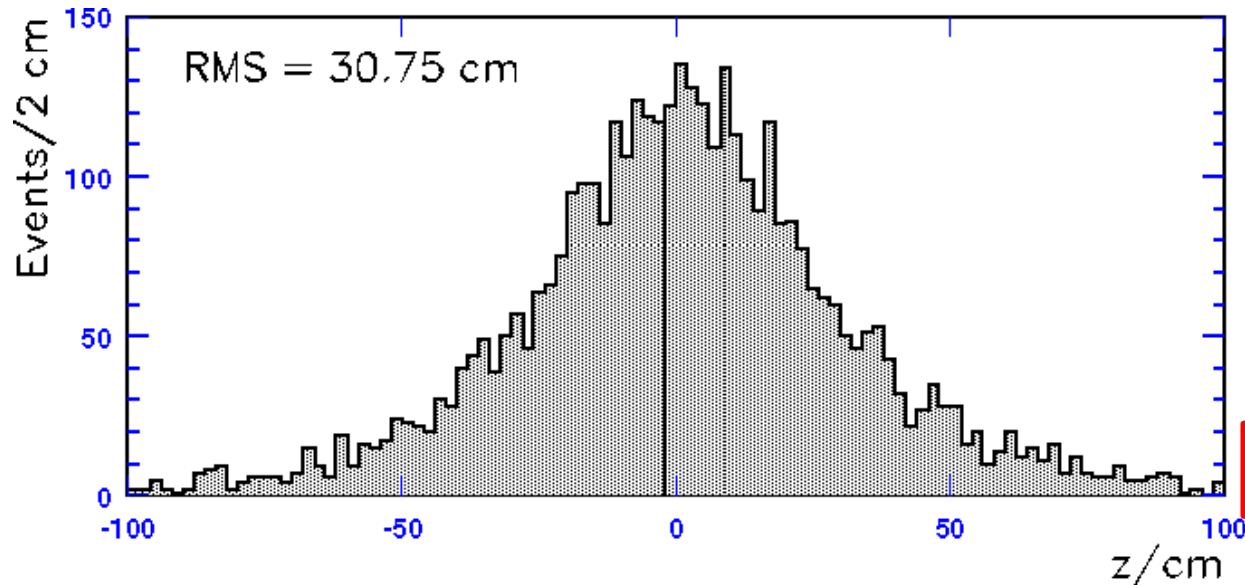


Transverse beam position: fill-to-fill



- CDF Run I history on position (LEFT) and slope (RIGHT)
 - using impact parameter distribution from silicon vertex detector
 - Unfold beam width from resolution via track pair correlations

Beam profile measurements

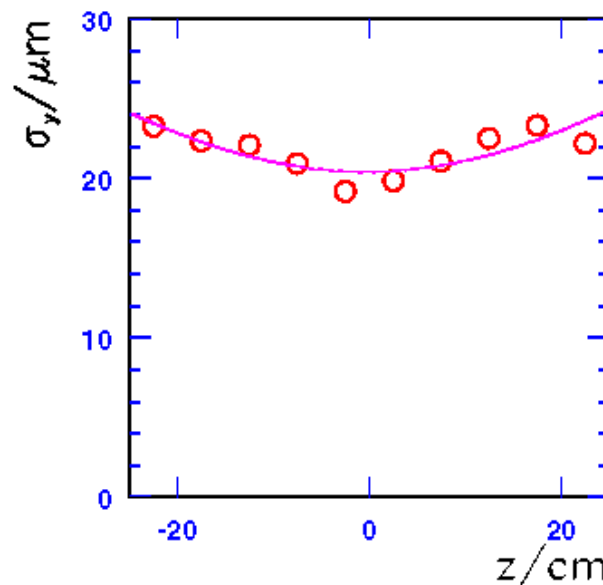
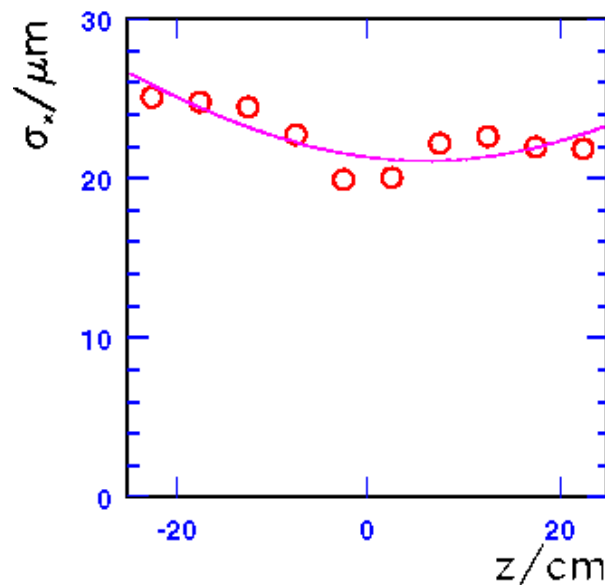


- Use the z-dependence of transverse beam width $\sigma_{x,y}$ to determine β^*

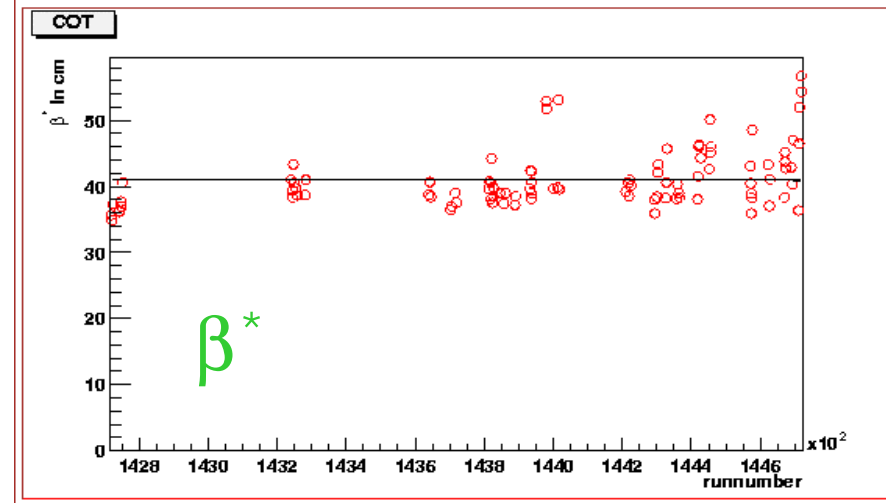
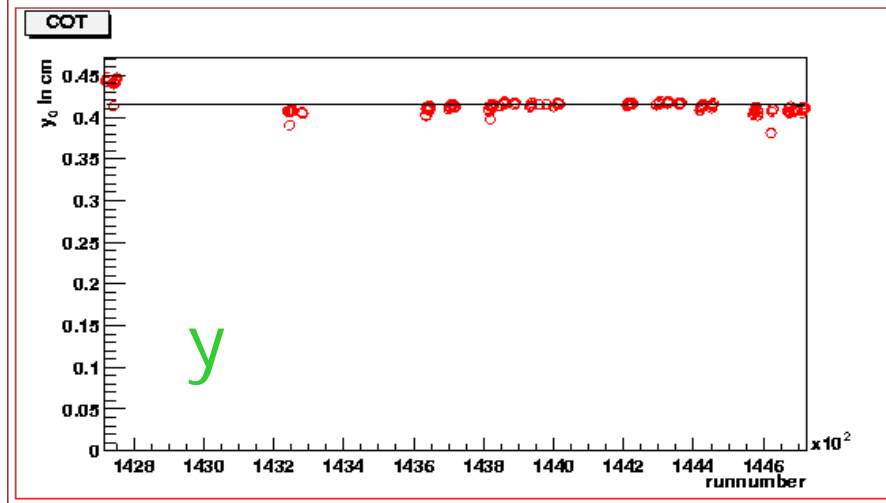
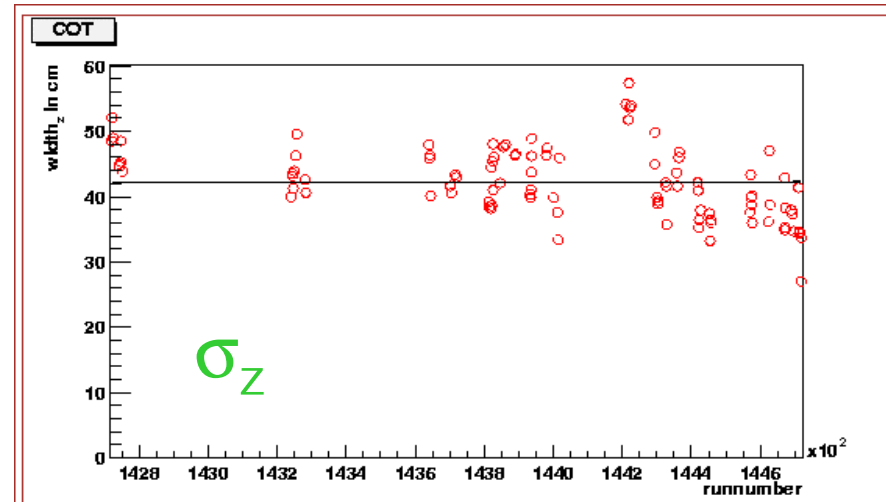
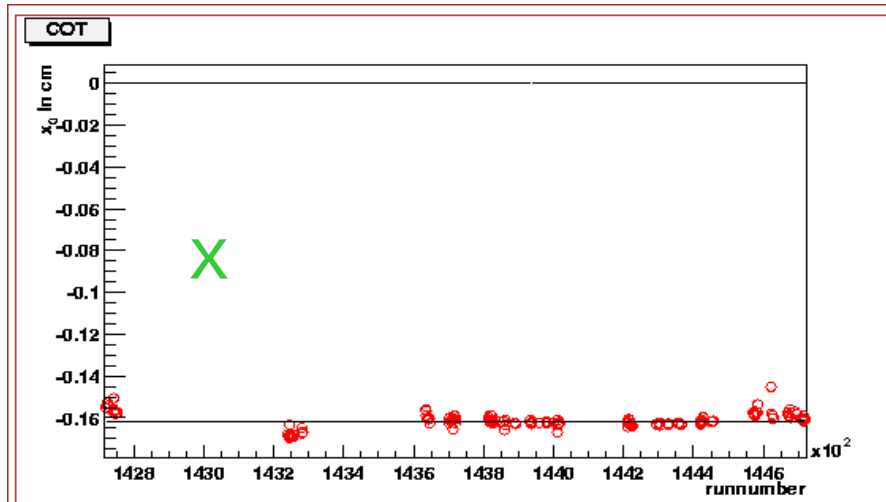
$$\sigma(z) = \sqrt{\epsilon\beta^* \times (1 + ((z - z_0)/\beta^*)^2)}$$

→ Values found are between 0.3 and 0.4 m

- Typical fit error of 5-10%
- Consistent with expectation of 0.35 m

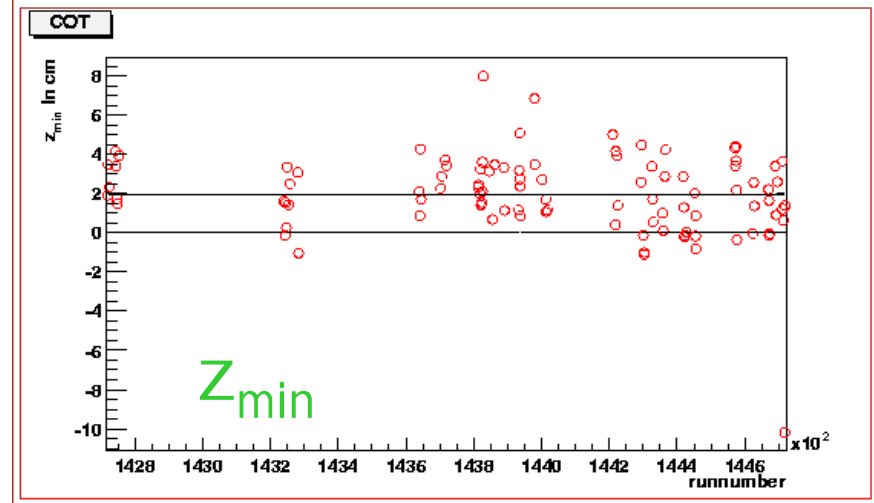
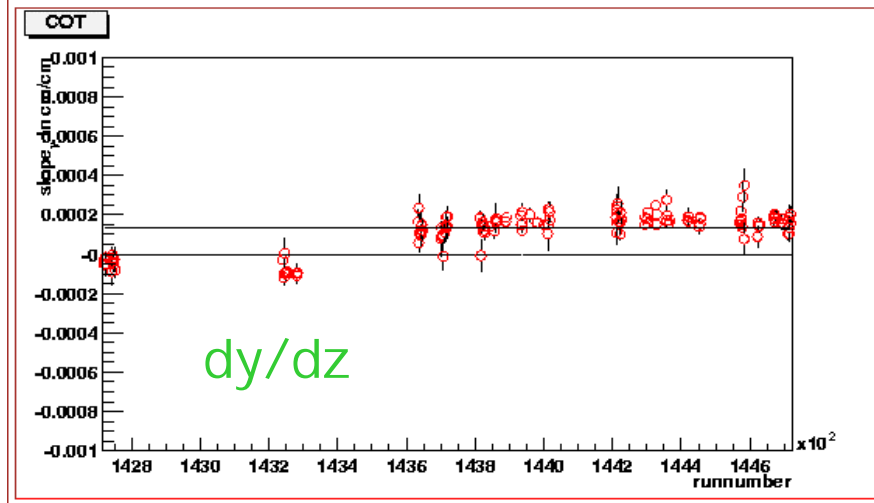
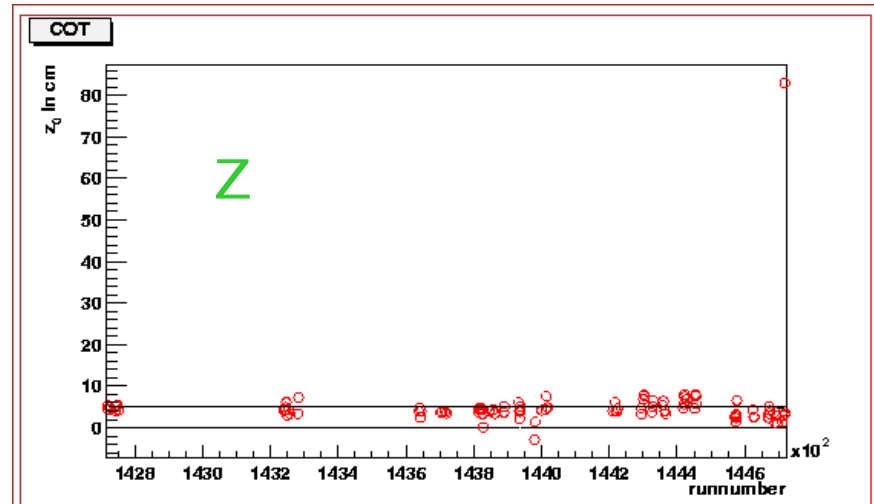
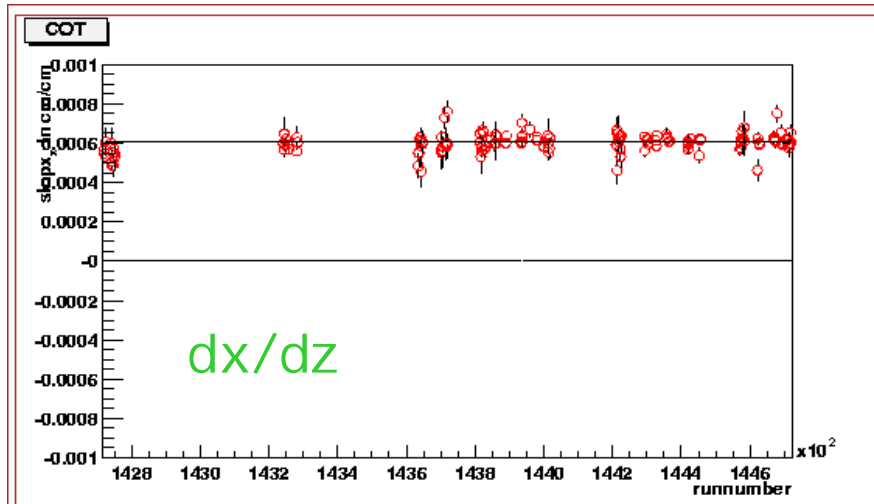


Example: Beam parameters (CDF)



- Online values using the COT (central outer tracker)

Example: Beam parameters (CDF)

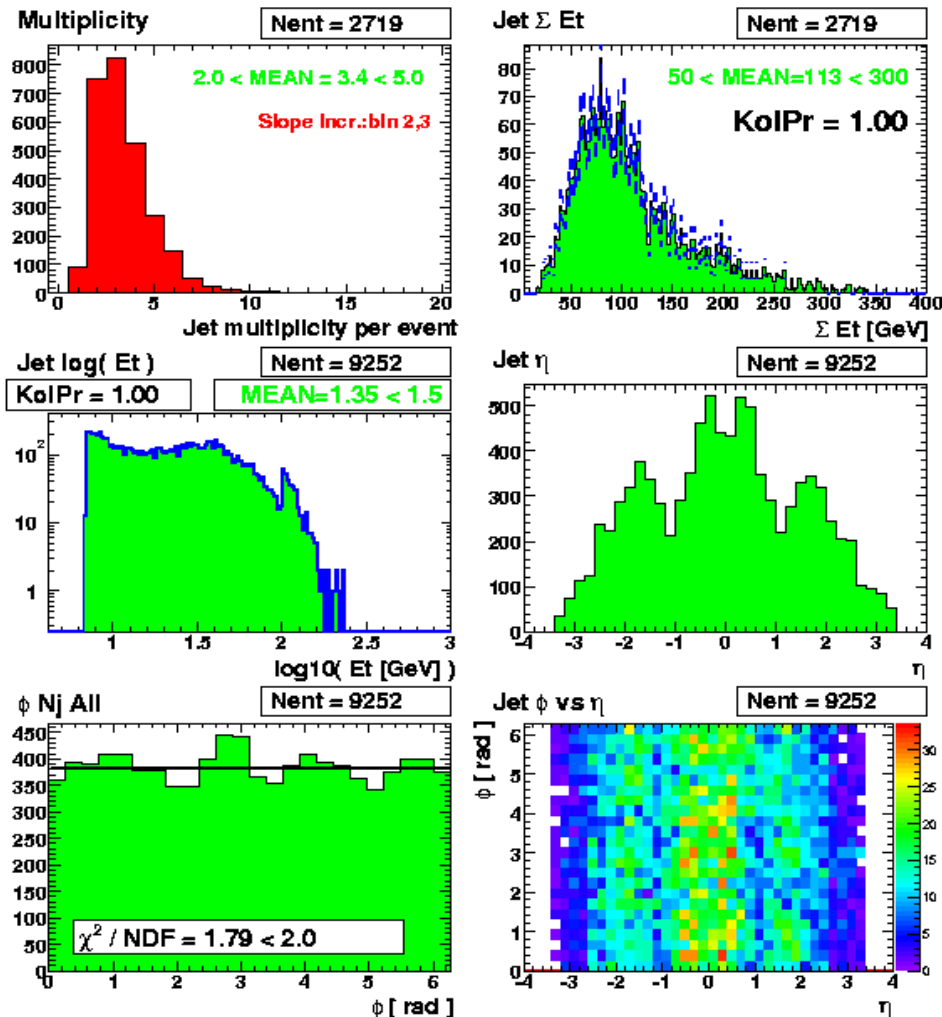


- Online values using the COT (central outer tracker)

Example: CDF online monitoring

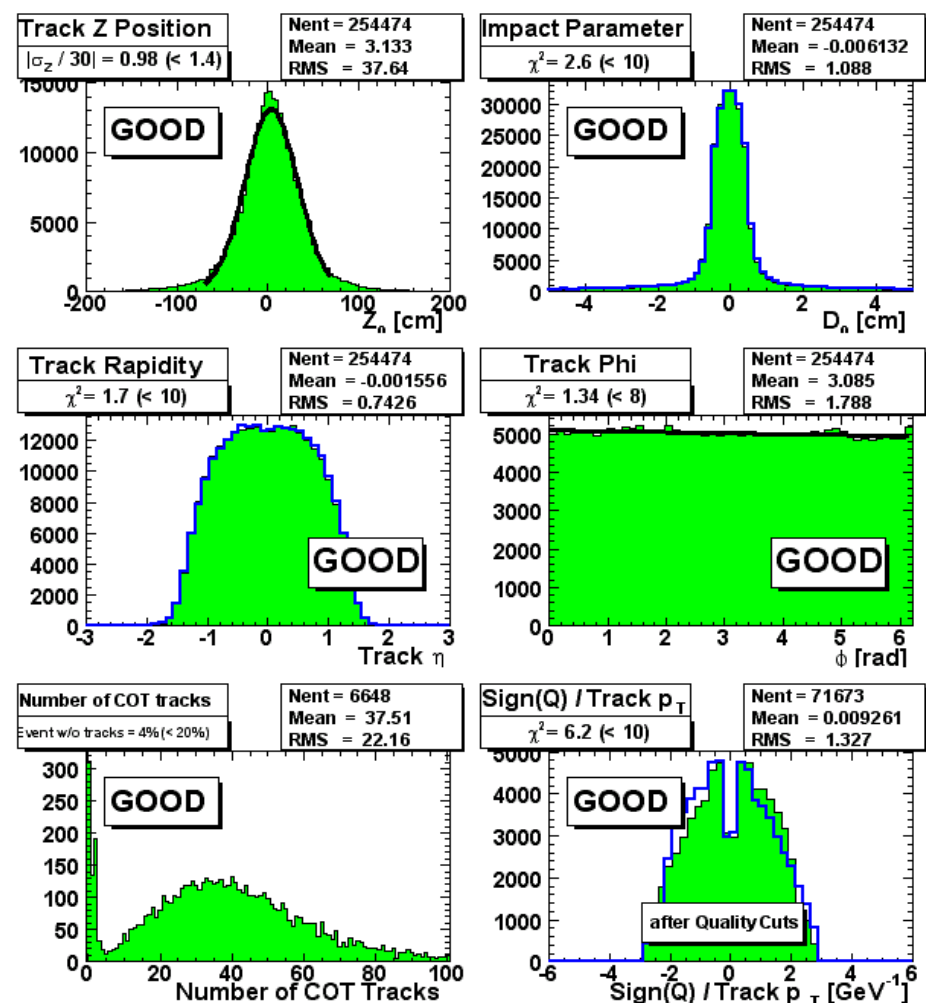
ObjectMon #4 JetMonitor Slide Show

Run:127785 Event: 688584 # of Events:4234 Time: Fri Jan 11 18:14:37 2002



ObjectMon #71 TrackMonitor Slide Show

Run:141192 Event: 1148956 # of Events:6687 Time: Wed Mar 20 16:10:52 2002



- Objects reconstructed at the Level-3 trigger (farm)