A Spectrometer for the 3 Degree Cone at CDF

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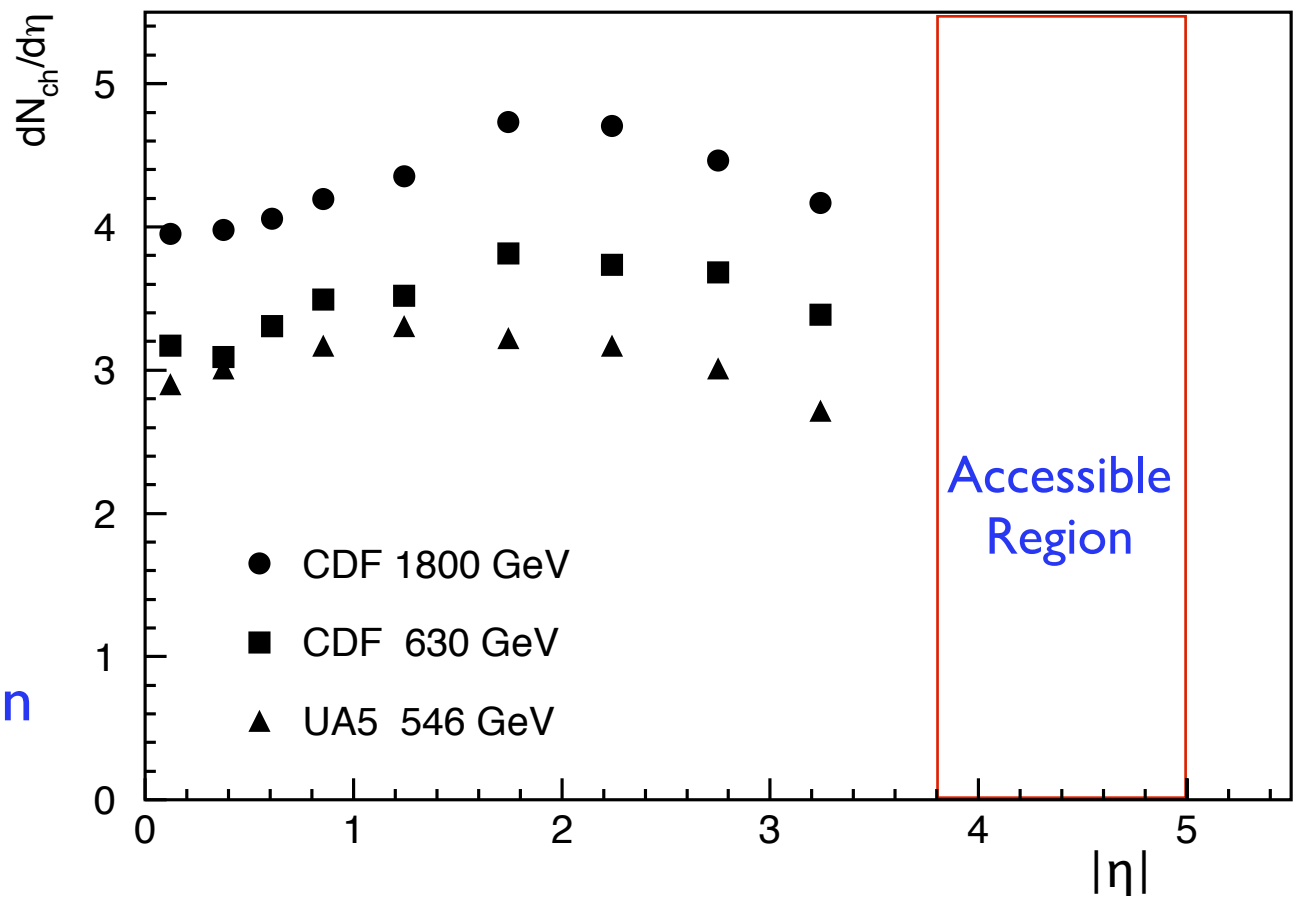
Fermilab

Pseudo-Rapidity Distributions

Pseudo-rapidity (η)

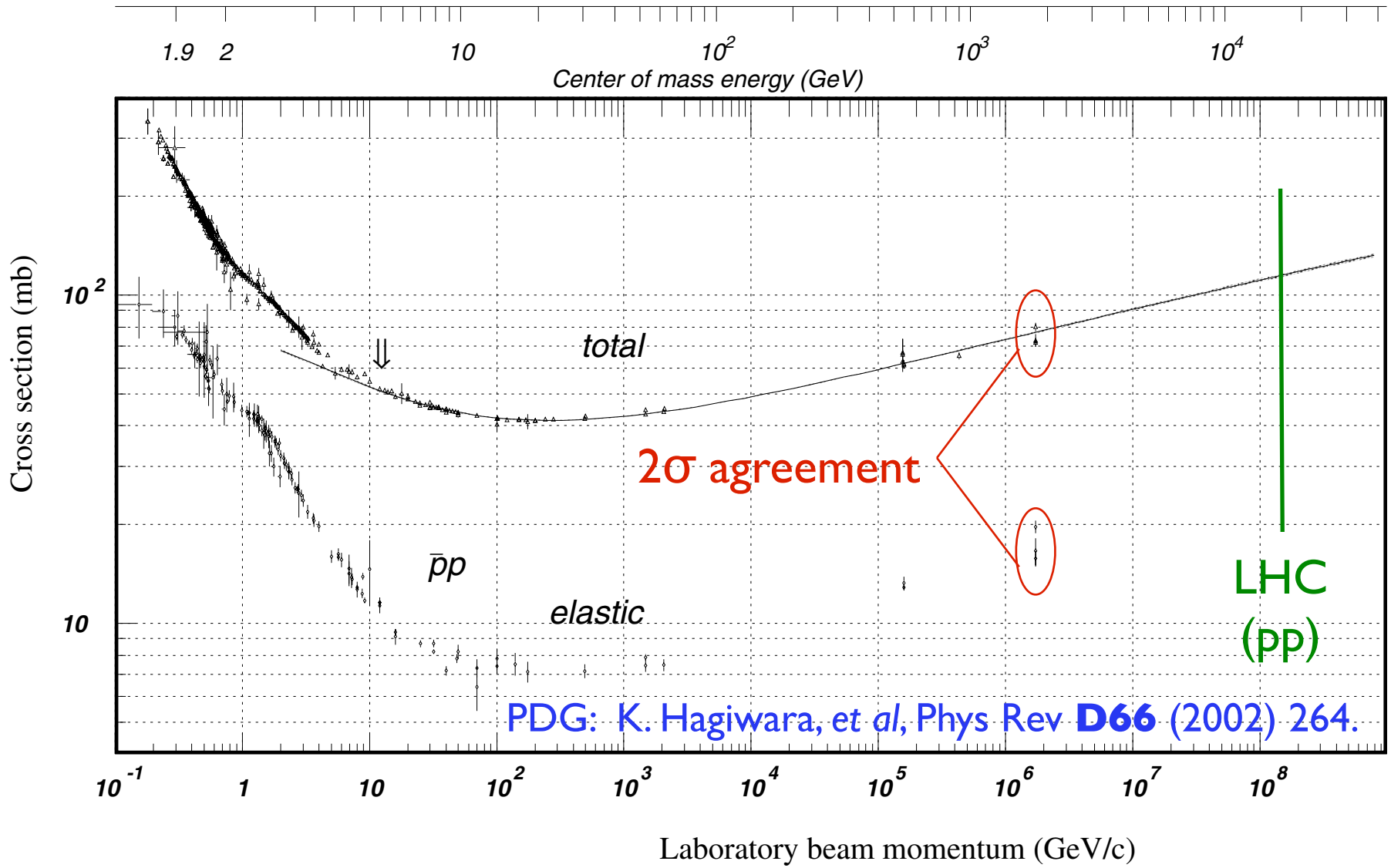
$$\eta = -\log\left(\tan\frac{\theta}{2}\right)$$

- |η|> 4 not measured
- Understand intermediate region



F. Abe, *et al.*, Phys. **D41** (1990) 2330.
G.J. Alner, *et al.*, Z. Phys. C **33**, (1986) 1.

Proton-Antiproton Cross Section



Intermediate spectrometer reduces systematics from primary vertex

3 Degree Spectrometer in CDF

Existing Detector

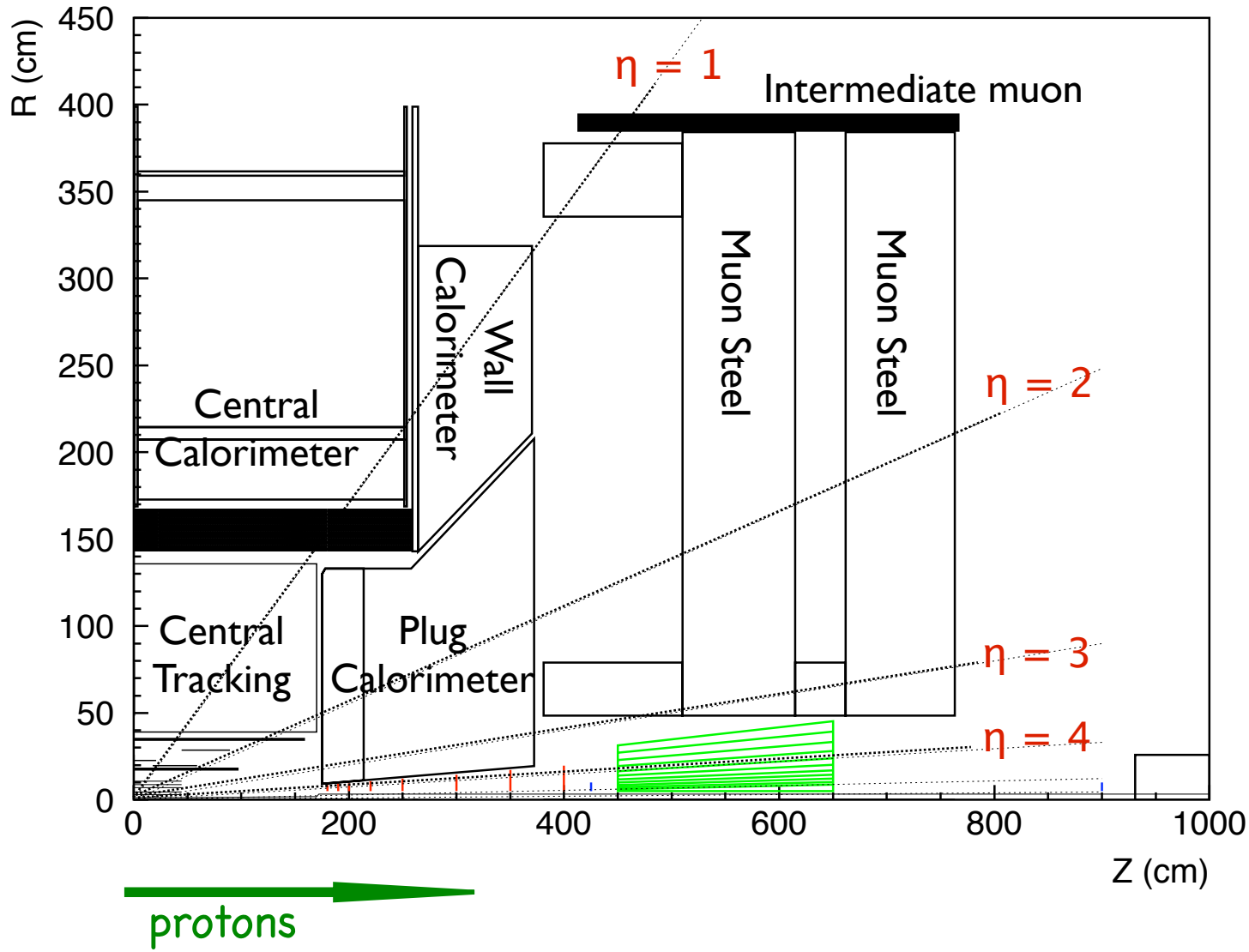
Tracking:
* COT: $|\eta| < 1$
* silicon: $|\eta| < 2$

Calorimetry:
* central: $|\eta| < 1$
* plug: $|\eta| < 3$
* forward: $|\eta| < 6$

New Detector

Tracking:
* $3.8 < |\eta| < 5$

Calorimetry:
* forward: $|\eta| < 6$ (deeper)



3 Degree Spectrometer for CDF

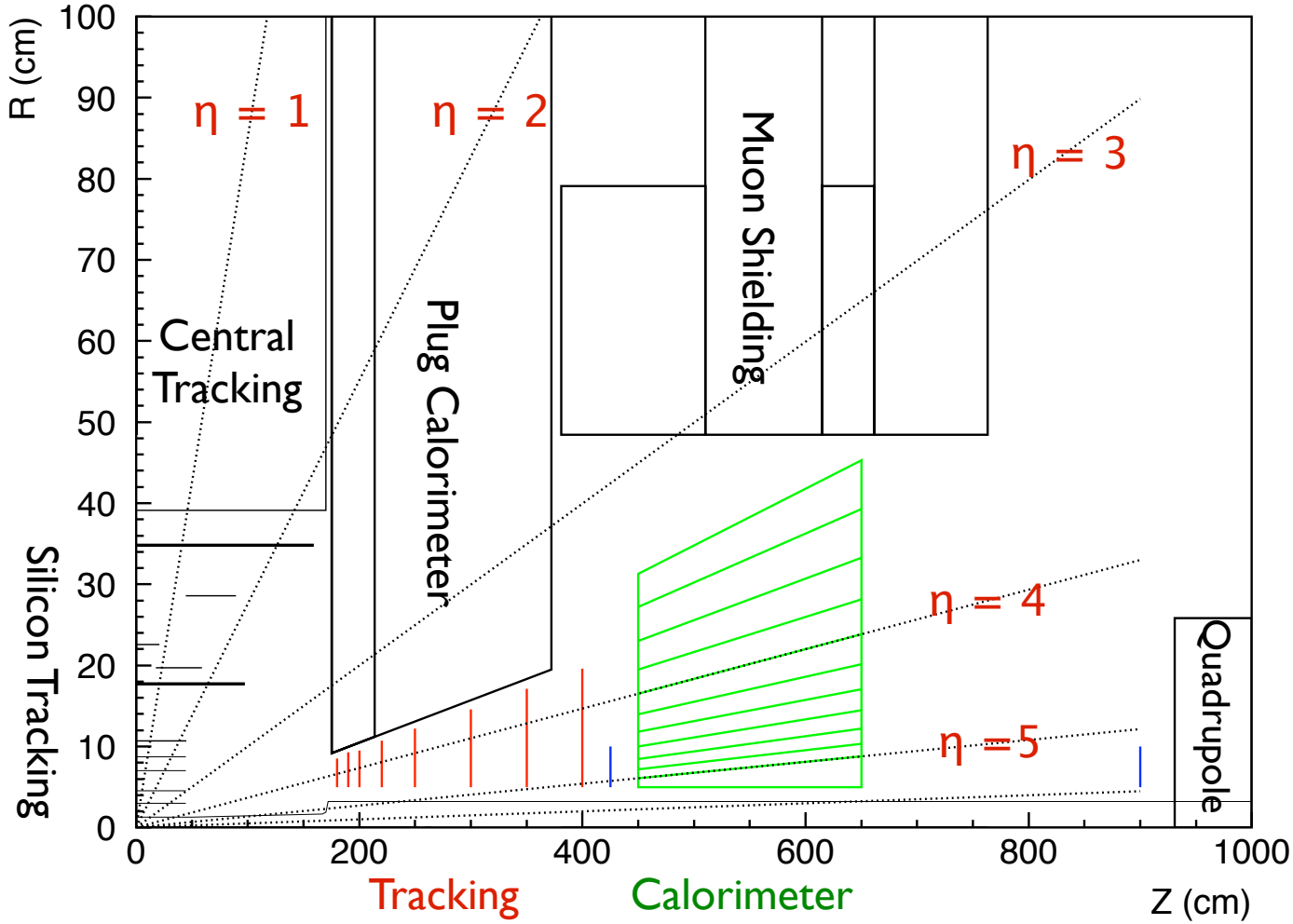
New Detectors

Tracking:

* 3.6 < |η| < 4.9
* multiple planes
  - +primary vertex
  - +momentum

Calorimetry:

* Deeper
  - +improved energy measurement
* Shield for plug cal.
  - +remove ring of fire



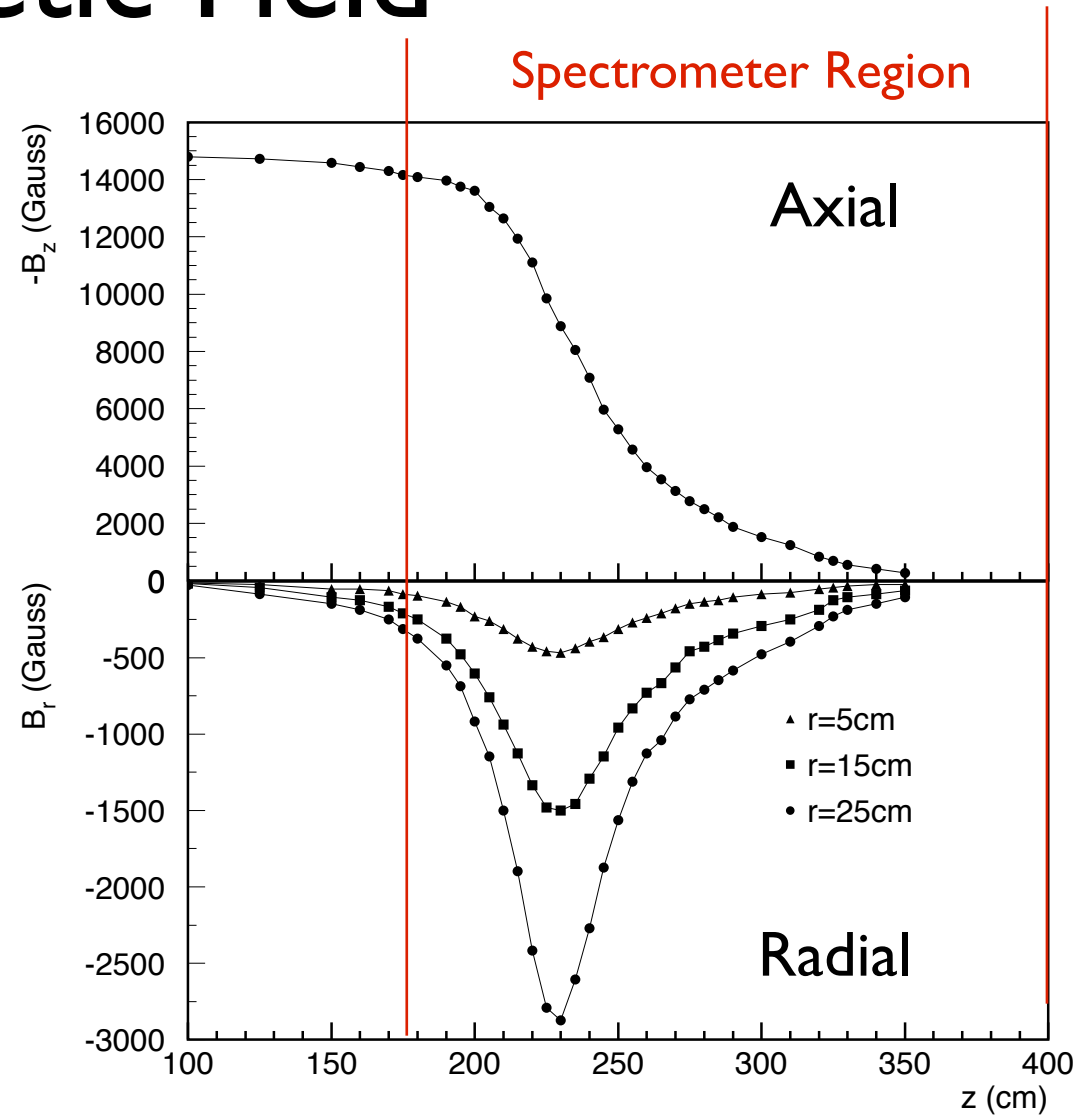
Magnetic Field

Solenoid & Fringe Field

- axial & radial fields contribute to φ deflection
- momentum resolution depends on η (Δr tracklength)

η	Δr (cm)	dP/P (%)*
3.6	12.3	0.39
4.0	8.2	0.85
4.5	5.0	2.30

*100μm position resolution



Neuman-Holmes, Schmitt, Yamada, NIM **A274** 443 (1989)

Plug Calorimeter "Ring of Fire"

Plug Occupancy

10% "central"

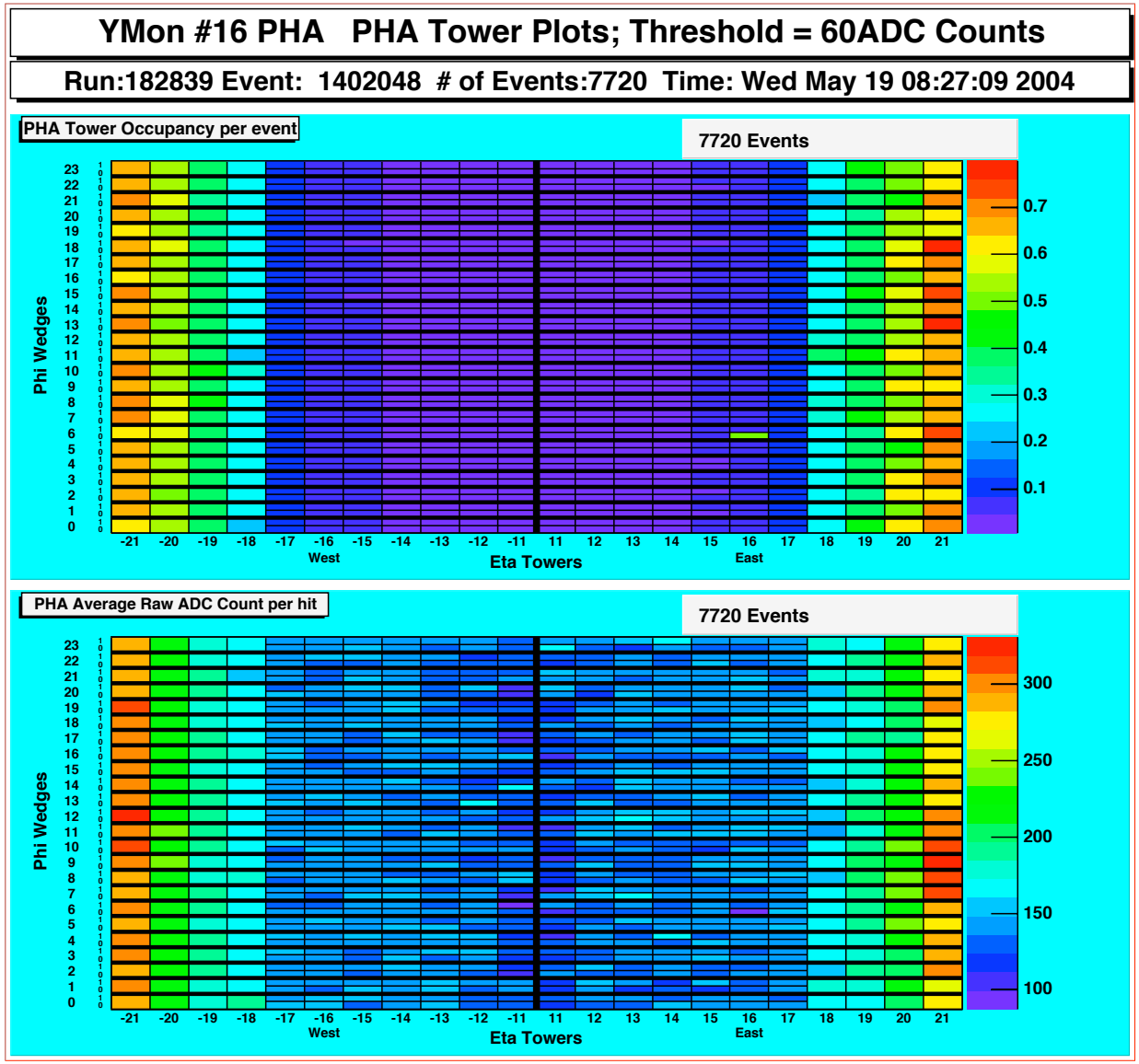
<E> ~ 300 MeV/hit

70% near beam

<E> ~ 1 GeV/hit

Beam halo creates "ring of fire"

Shield with thick calorimeter



φ

-η +η

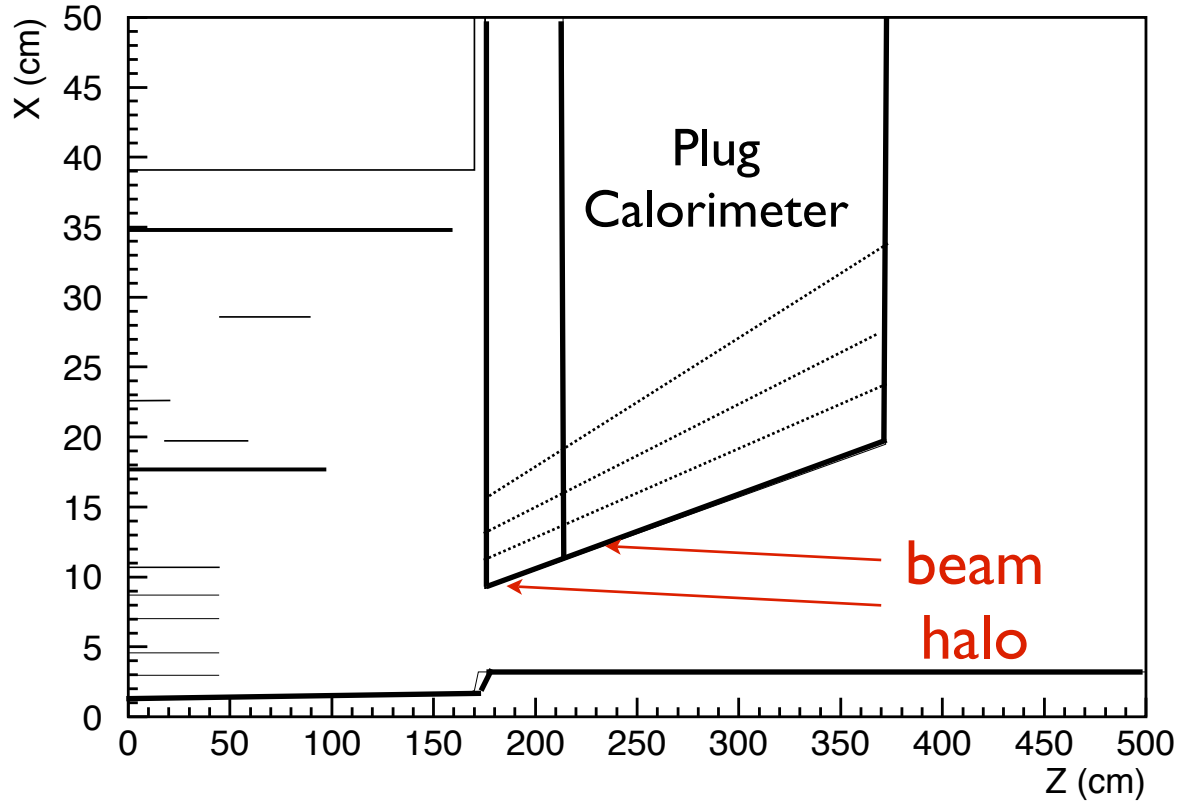
protons antiprotons

Environmental Backgrounds

High Energy Halo particles surrounding beam

- Halo rate: 70-200 Hz/cm^2
- Collision rate: kHz

Timing rejects halo



Detector Specifications

Spectrometer:

- position resolution
  - 100μm radial
  - 100μm r−φ

Calorimeter:

- More material
  - Improve energy measurement
  - Shielding for plug calorimeter
  - Time resolution < 10ns (reject halo backgrounds)

Summary

3 Degree Spectrometer

- Mimimal modifications to CDF
- Fill in/extend physics
  + ($dN/d\eta$ to $3.6<|\eta|<5.0$)
  + Improve total cross section measurement
- Momentum analysis of charge particles.
- Extend jet measurements by reducing halo background and improving forward energy measurements.
- Detector technology talks to follow
  + Micro Pattern Detectors: Jun Miyamoto
  + Calorimeter Technologies: Michele Gallinaro