CDF Endplug Shower Maximum Detector

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for the CDF Collaboration

Outline

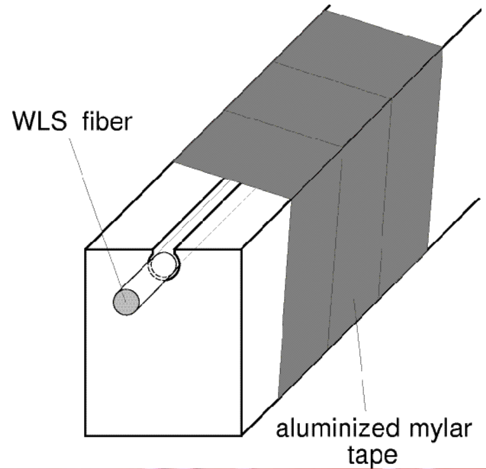
- Physics requirements
- Detector design
- Test beam results
- Installation
- Calibration
- Status
- Conclusion

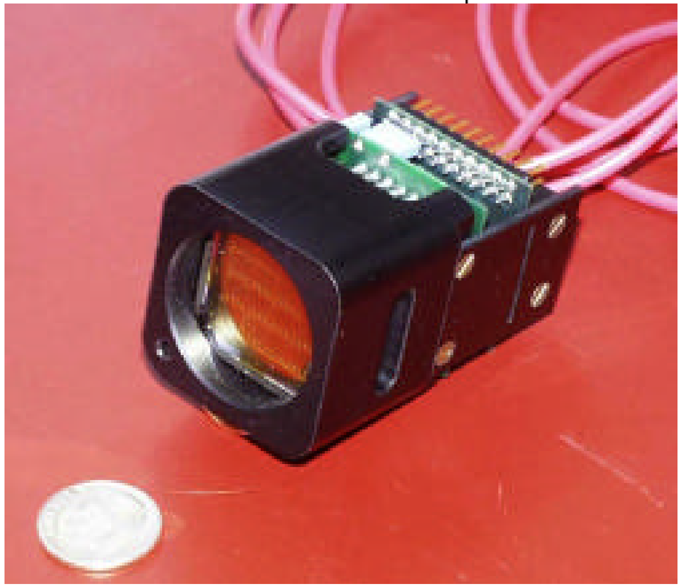
Physics Requirements

- **Purpose:**
  - Good position resolution of electrons and photons
  - Help separate electrons and photons from π^0
  - Plug EM calorimeter has ~ 7.5° $\varphi \times$ 0.12 η segmentation
- **Design requirements:**
  - 1 pe / MIP to measure high energy electrons with resolution of 1 mm
  - < 10% variation between detector channels
  - (4 pe / MIP for sensitivity to muons)
  - Fast: read out between crossings (132 nsec)

Detector Design

- Scintillator strips (Bicron BC408) read out with 0.833 mm WLS fibers (Kuraray Multi-Clad Y11-350 ppm non-S type)
- Connected to clear fibers via optical connectors
- Read out with Multi-Anode Photo-Multiplier Tubes (Hamamatsu R5900-M16)



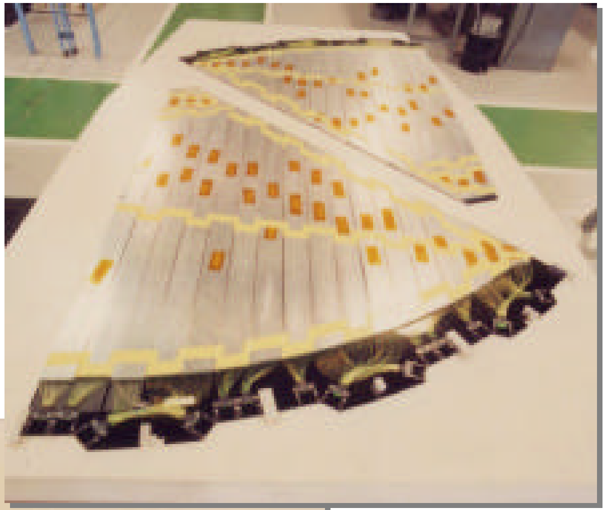


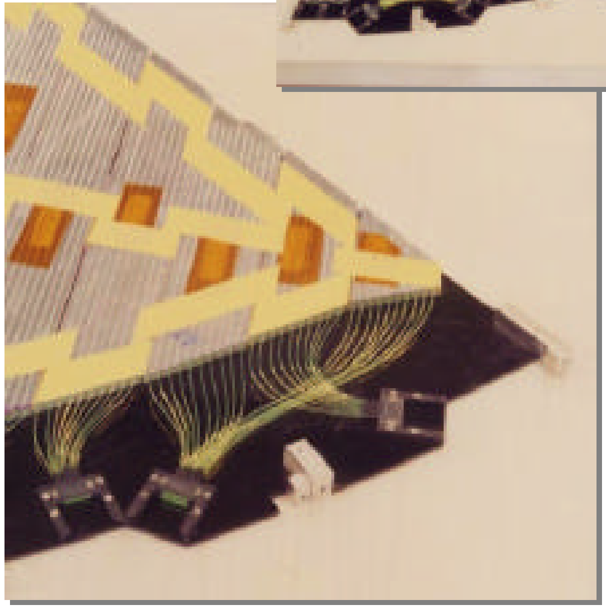
Detector Design

- Eight 45° sectors, each with 200 5mm strips
- Strips wrapped with aluminized Mylar
- 2 layers (U and V) with 45° crossing angle
- Located behind ~6 radiation lengths of material, inside Plug EM calorimeter
- Segmented into high and low eta sections:

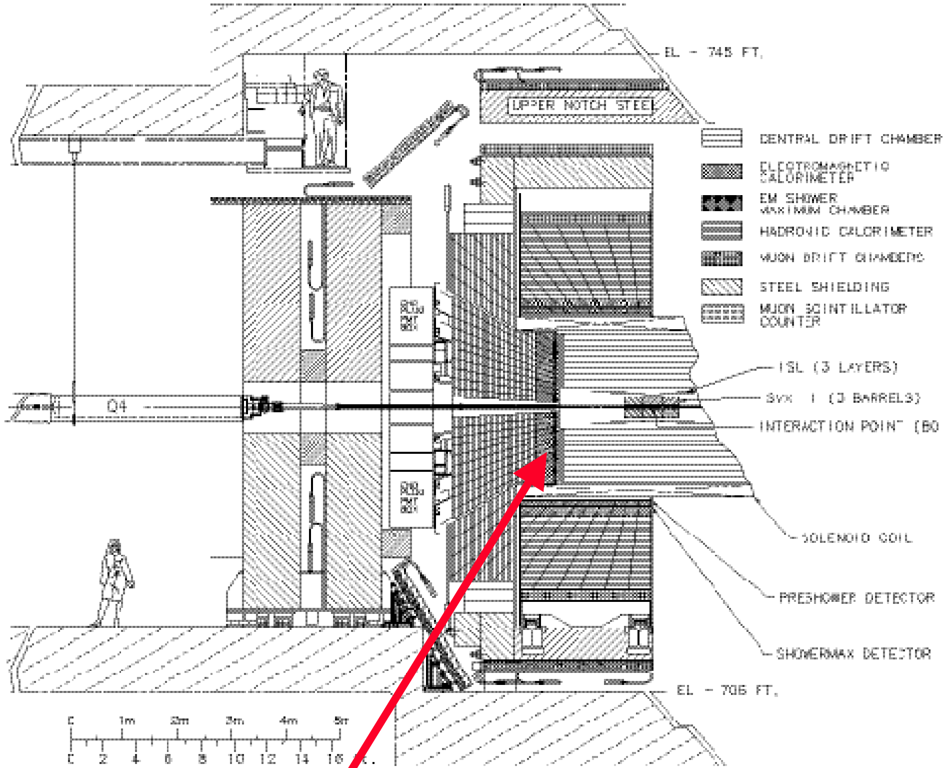
Eta range	Gain
$1.13 < \eta < 2.60$	5×10^5
$2.60 < \eta < 3.50$	1×10^5

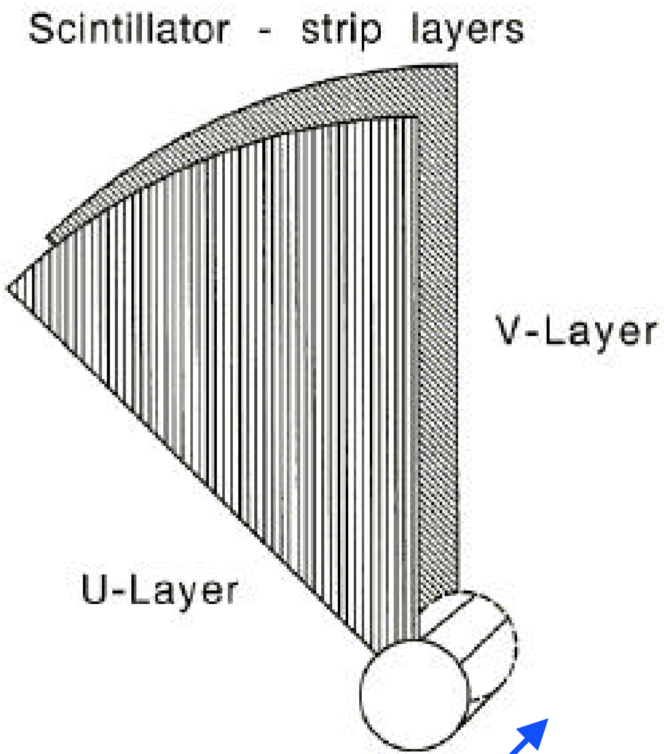
Detector Design





Detector Design





Plug Shower Max

Direction of beam

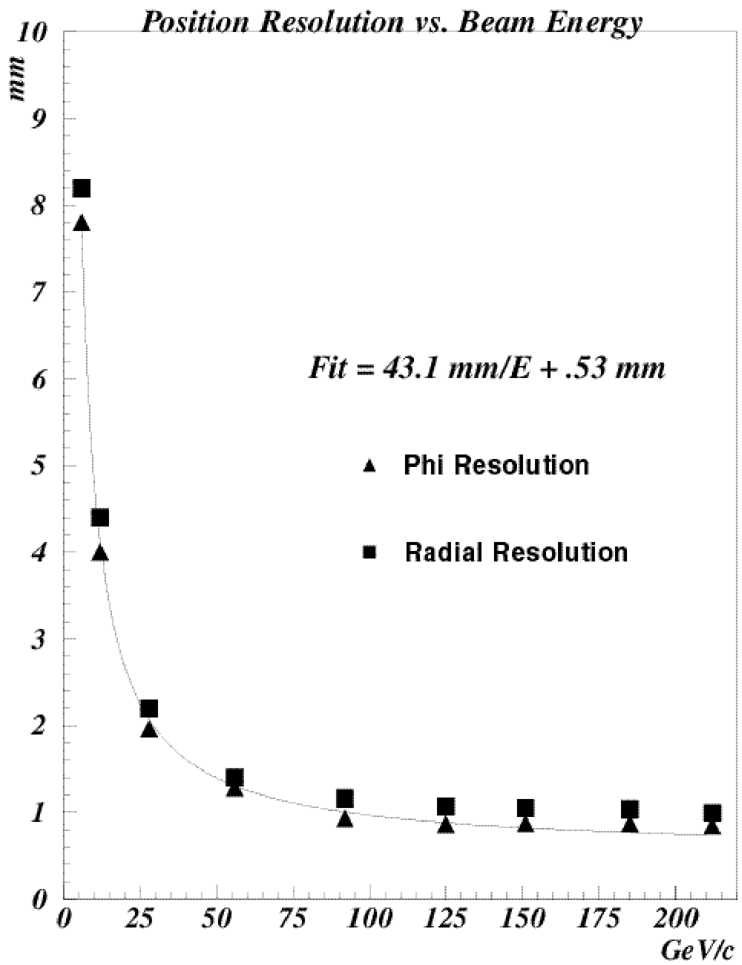
Test Beam

- Fermilab's MT6 area
- Used 5-220 GeV positrons
- Had one 45° wedge
- Resolution calculated by

$$\mu = x_{max} + \frac{E_{max}(E_2 - E_1)\Delta}{2[E_{max}(E_2 + E_1) - 2E_1E_2]}$$

where Δ is the strip width and E_{max}, E_1, E_2 are the strip energies

- Meets our 1 mm resolution spec



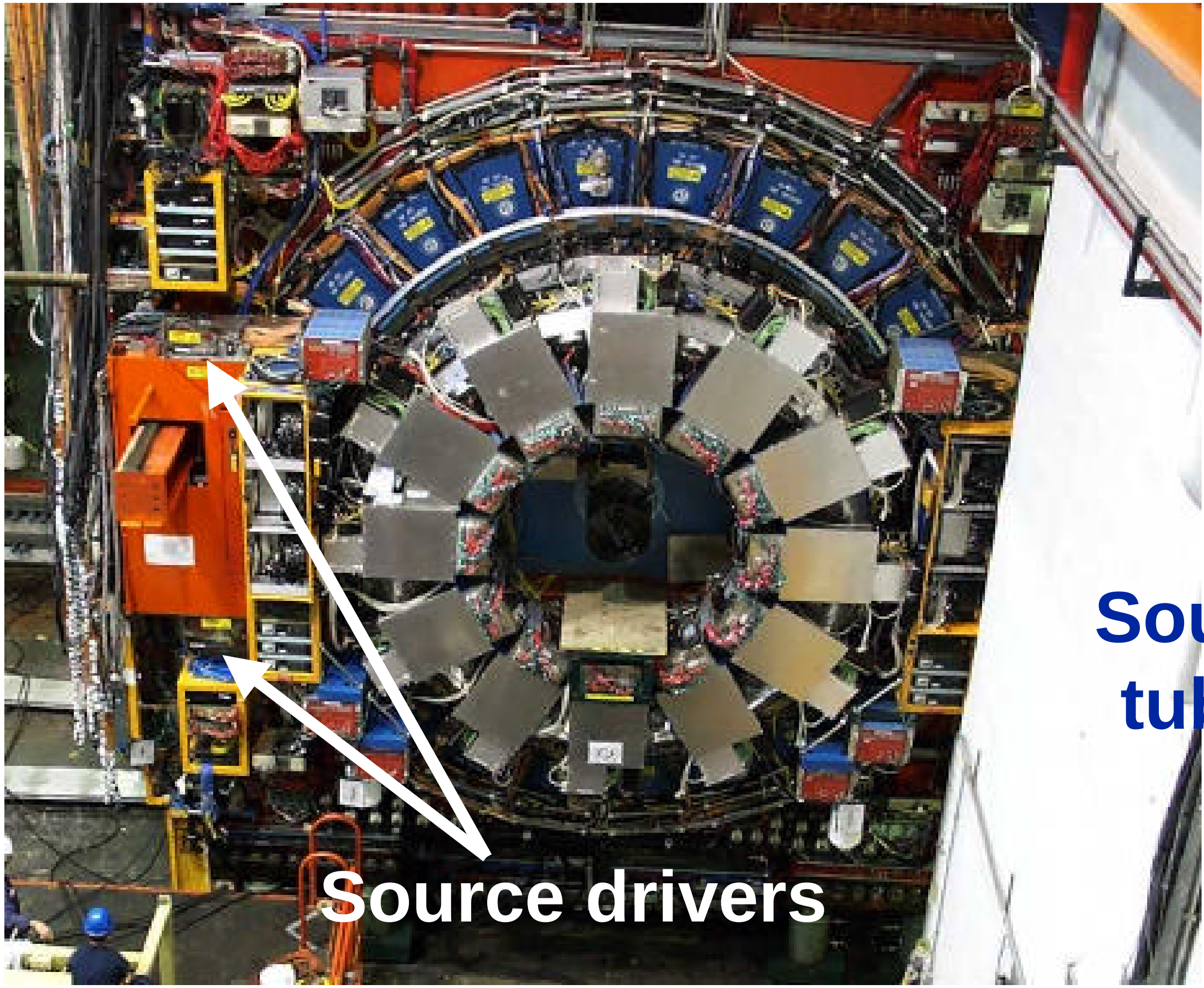
Installation

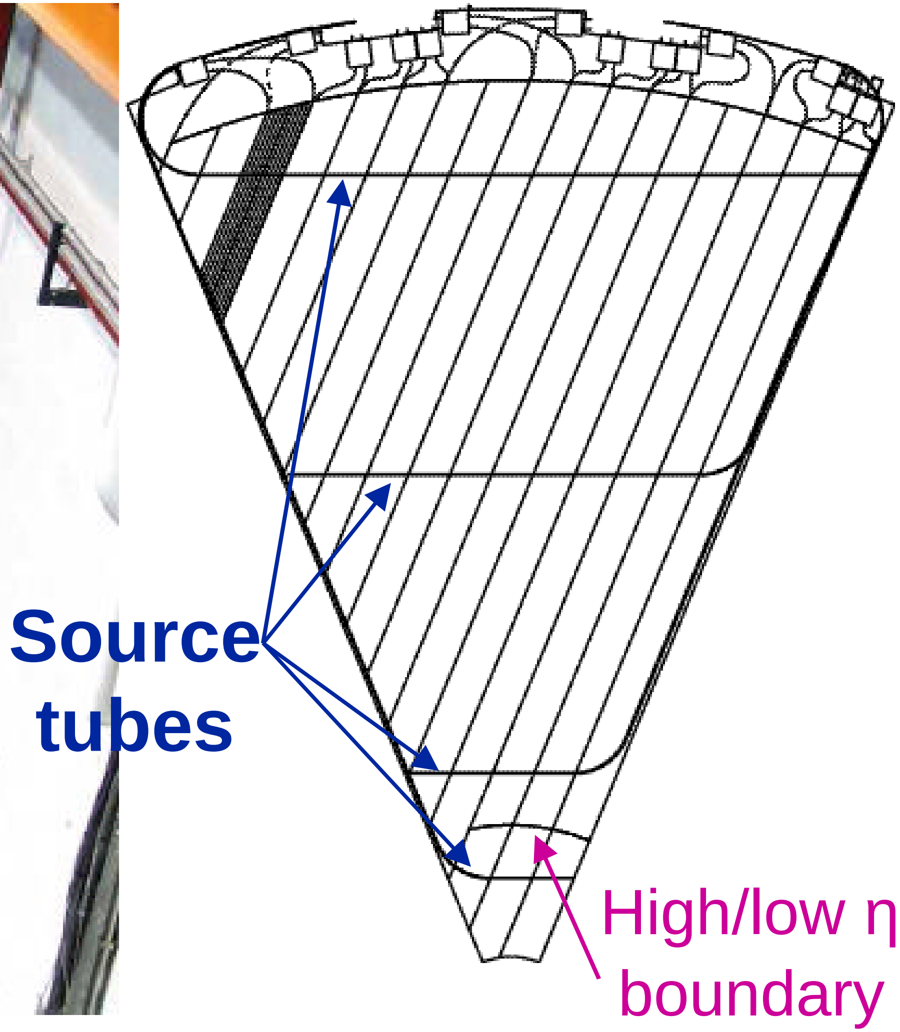
- All chambers and MAPMTs installed
- All analog electronics installed and cabled
- One octant fully instrumented
- Readout software written
- Offline calibration software written
- Database populated with 6400 $\times$ 12 constants
- Plugs mounted on the detector
- Detector in the collision hall

Calibration

- Two techniques for calibration
  - Laser flasher
    - » Shine laser on scintillator
    - » Fibers run from scintillator to single pixel on all tubes
    - » Used to monitor phototube drift
    - » Part of 'begin-run' calibrations
  - Radioactive source
    - » Co^{60} pellet on a wire
    - » Can be moved along 'source tube' near detector
    - » Used to monitor pixel to pixel drift
    - » Done during shut-downs & access periods

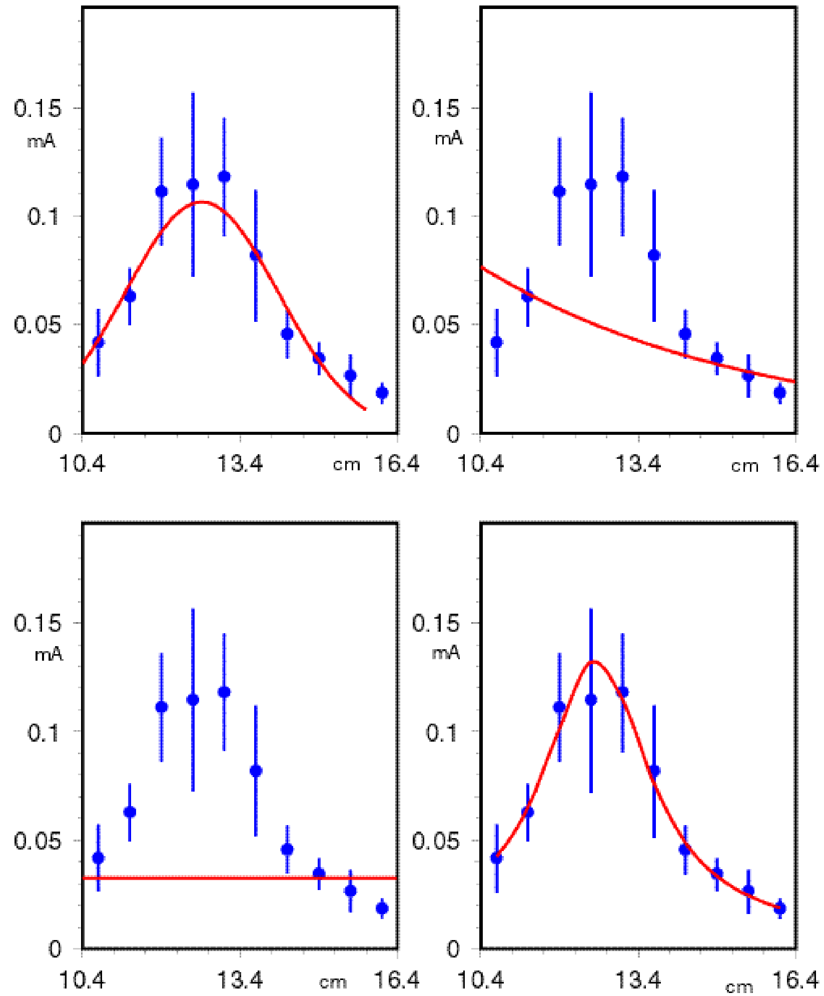
Calibration: Source Testing





Calibration: Source Testing

- Fit source run to Gaussian (UL) and exponential (UR)
  - If Gaussian, also fit constant (LL), & use as seeds for Breit-Wigner (LR)
  - If exponential, use in attenuation length calculation
- Determine relative pixel gain
- Tune high voltage values
- During run will be used to monitor long term pixel to pixel variations



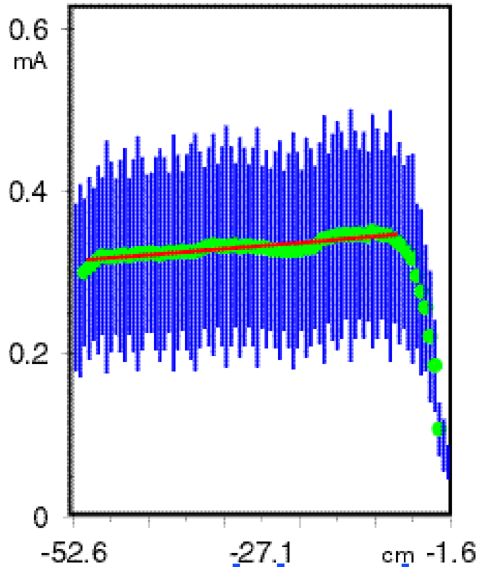
Calibration: Source Testing

- Measured attenuation length of WLS fiber by fitting to

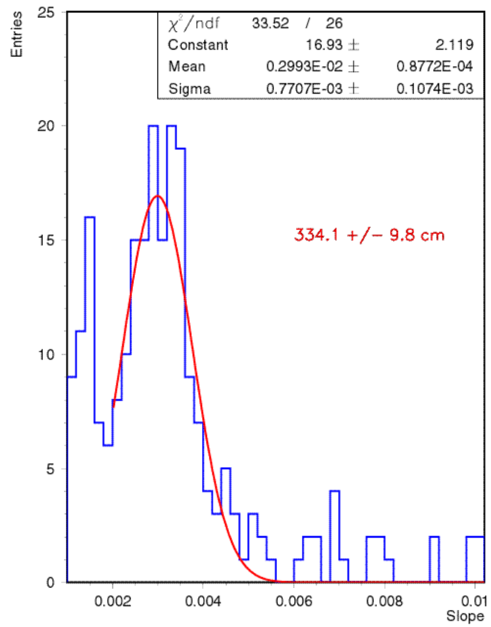
$$I = I_0 e^{-x/\lambda}$$

for many fibers and fitting Gaussian

Result is 334.1±9.8 cm



Fit of exponential to single strip



Fit to many strips to determine attenuation length

Status

- We can read out a quadrant
- Are tuning pedestals, calibrations, etc
- Expect remaining electronics to be completely installed before Christmas
- Taking cosmics since early September
- Commissioning run began early October

Conclusions

- Detector meets our specifications
- Detector and 1/4 electronics are installed
- We are taking data!
- We will be fully installed and calibrated in time for run
- It’s an exciting time to be on CDF