

# Forward Polarization Studies at RHIC

(with forward electromagnetic and hadronic calorimeters)

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For the STAR Collaboration

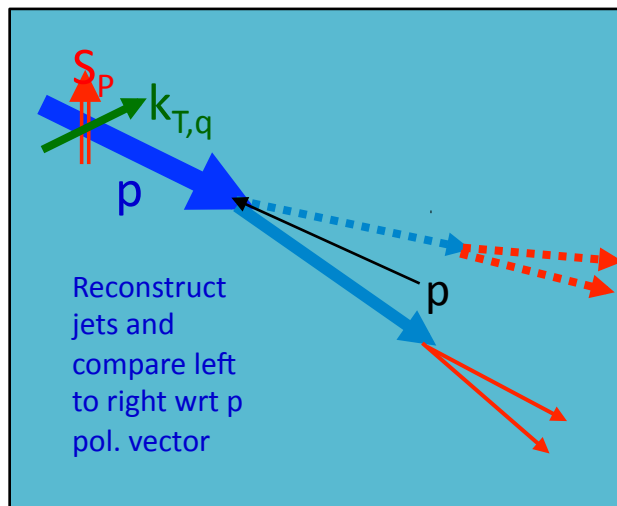
## Outline

- The Forward Hadronic Calorimeter (FHC) addition to Forward Meson Spectrometer (FMS)
- The cosmic ray test of the FHC
- Simulation studies for FHC and FMS
- Summary

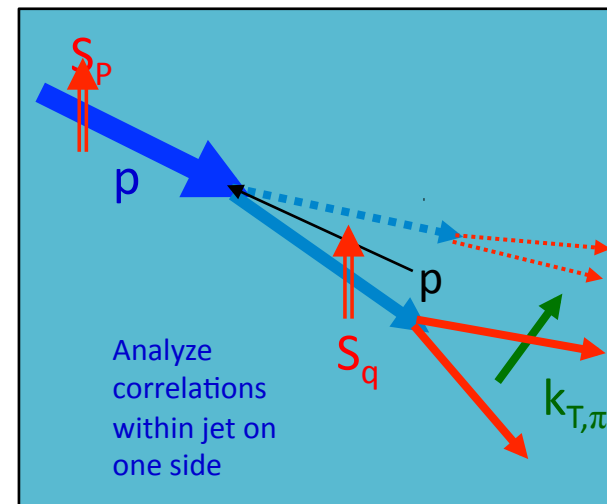


# The Forward Hadronic Calorimeter

- To study polarized pp collisions, the FHC proposed to be installed in STAR is to
  - Study forward jet productions to distinguish Sivers and Collins effects with the FMS at STAR.
  - Study large  $x_F$   $\Lambda$  transverse spin transfer which may be related to transversity.

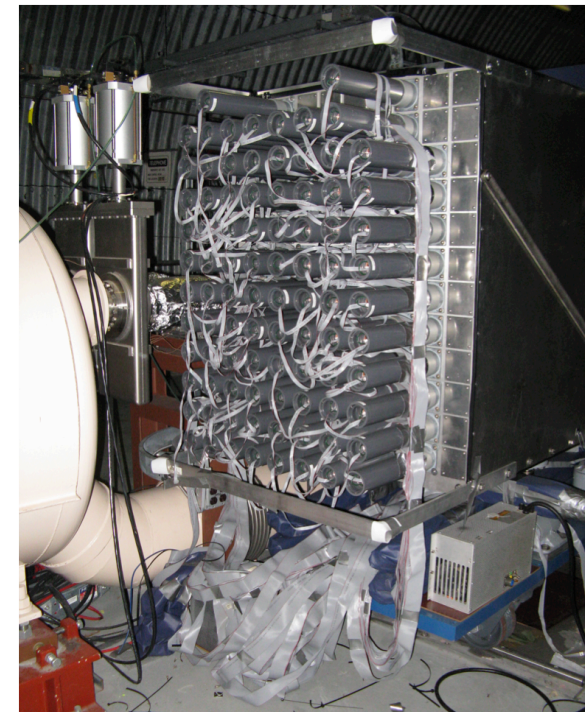
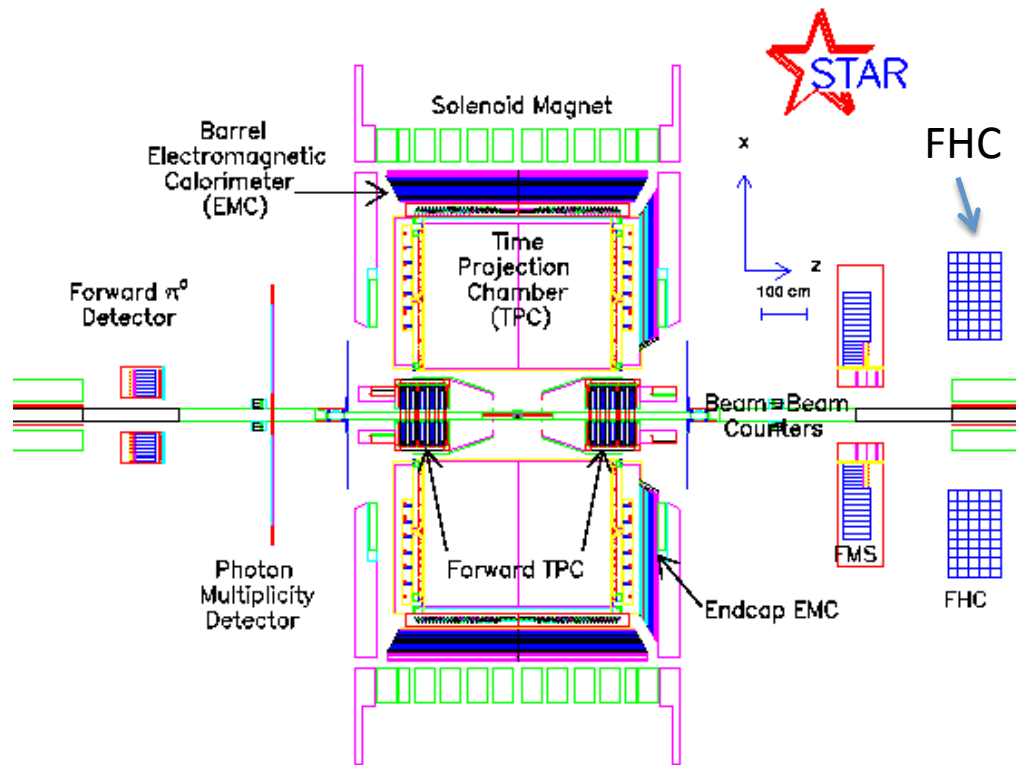


Sivers Mechanism



Collins Mechanism

# What is the FHC

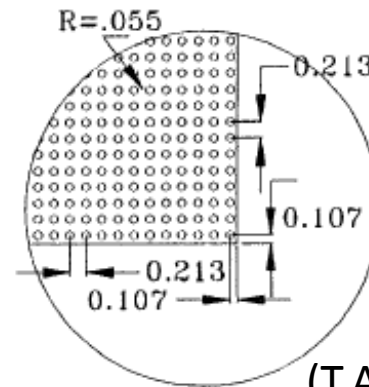
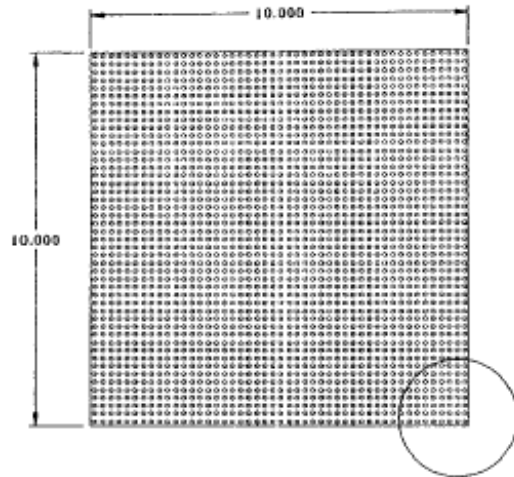


Two identical 9x12 arrays of AGS-E864 hadronic calorimeter.  
We used a 5x10 enclosure of E864 detectors for the cosmic ray test.



# FHC Cosmic Ray Test

- Motivation



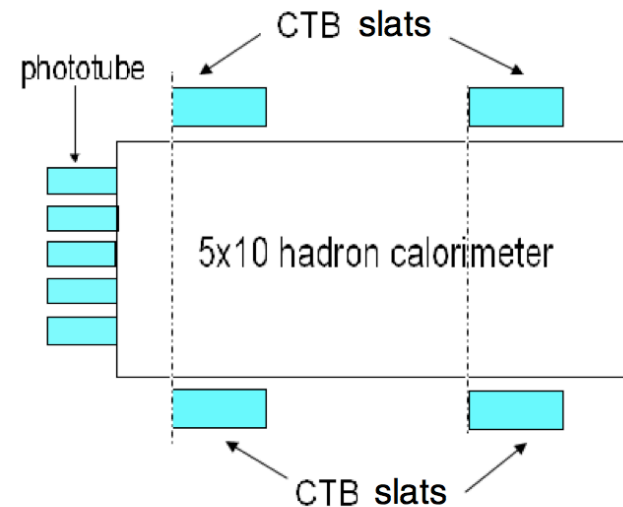
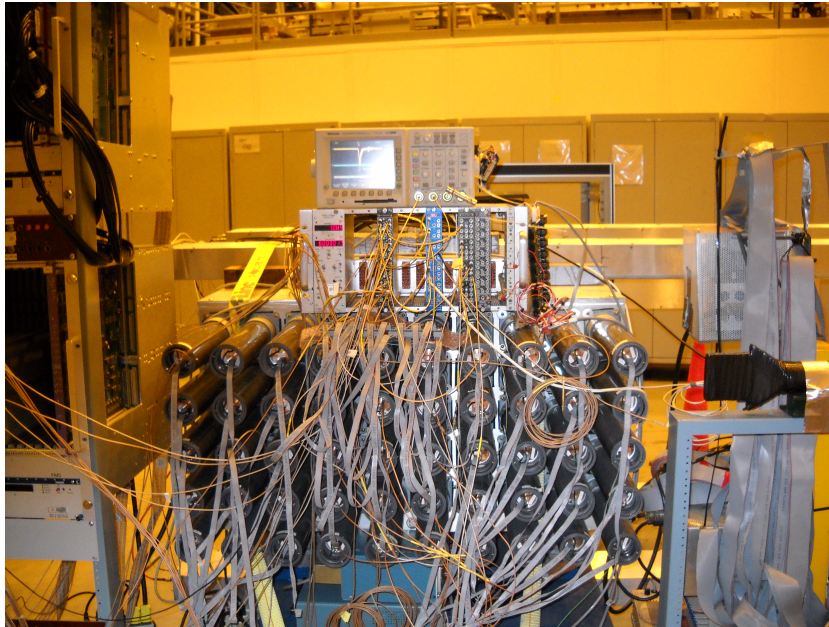
Scintillating fibers  
in one cell

(T.A. Armstrong *et al.*, Nucl. Instr. and Meth. A **406** (1998) 227)

- Whether there's damage to the scintillating fibers.
- Whether we can use cosmic rays as gain monitor during collisions.

# FHC Cosmic Ray Test

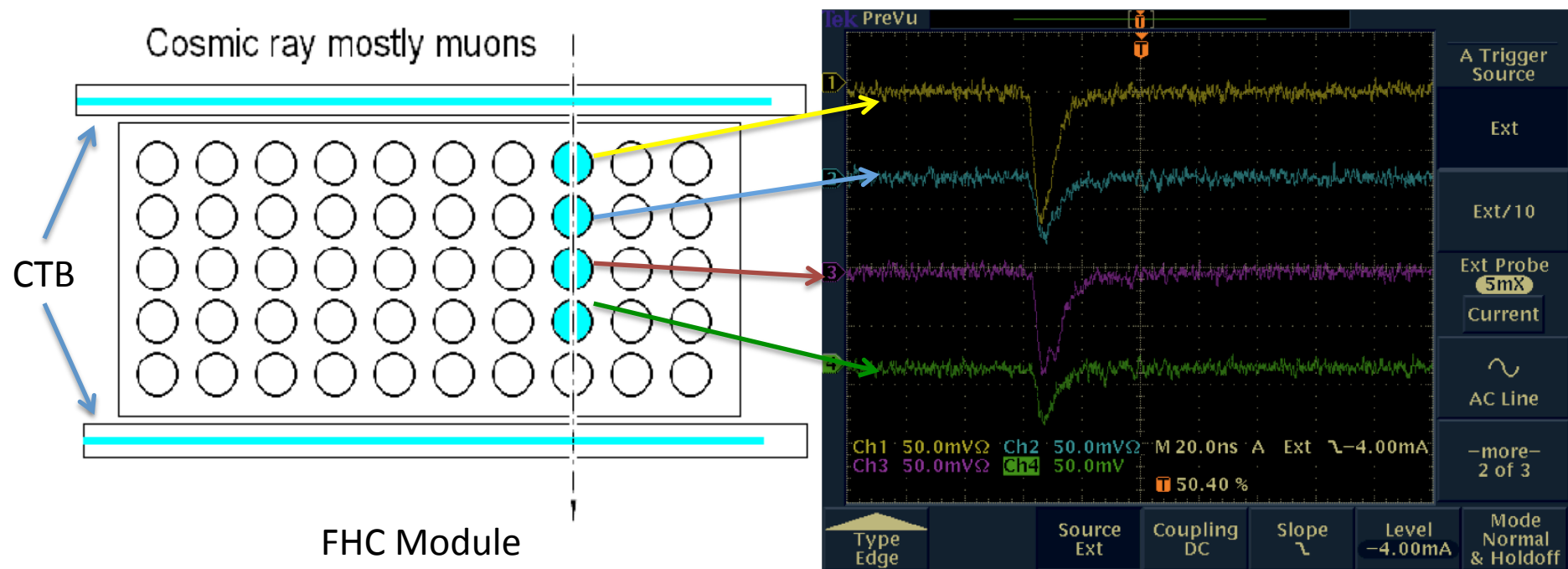
- The setup



- Central Trigger Barrel (CTB) scintillator slats constitute the outside triggers.
- Three trigger groups for attenuation length study.

# FHC Cosmic Ray Test

- We tune the high voltage input of the CTB slats to get sufficiently high cosmic ray rates.



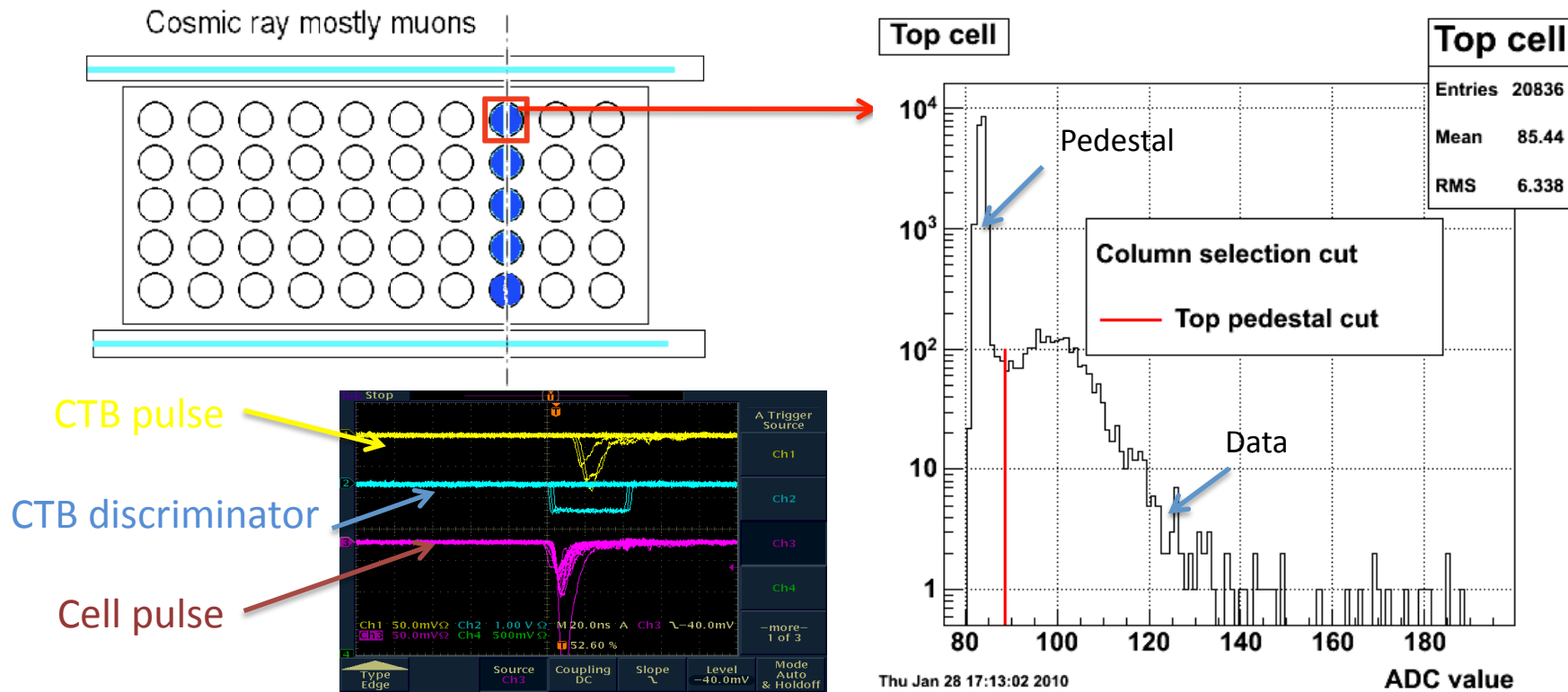
All the 5x10 FHC modules are in good conditions.





# FHC Cosmic Ray Test

- DAQ raw data without trigger.

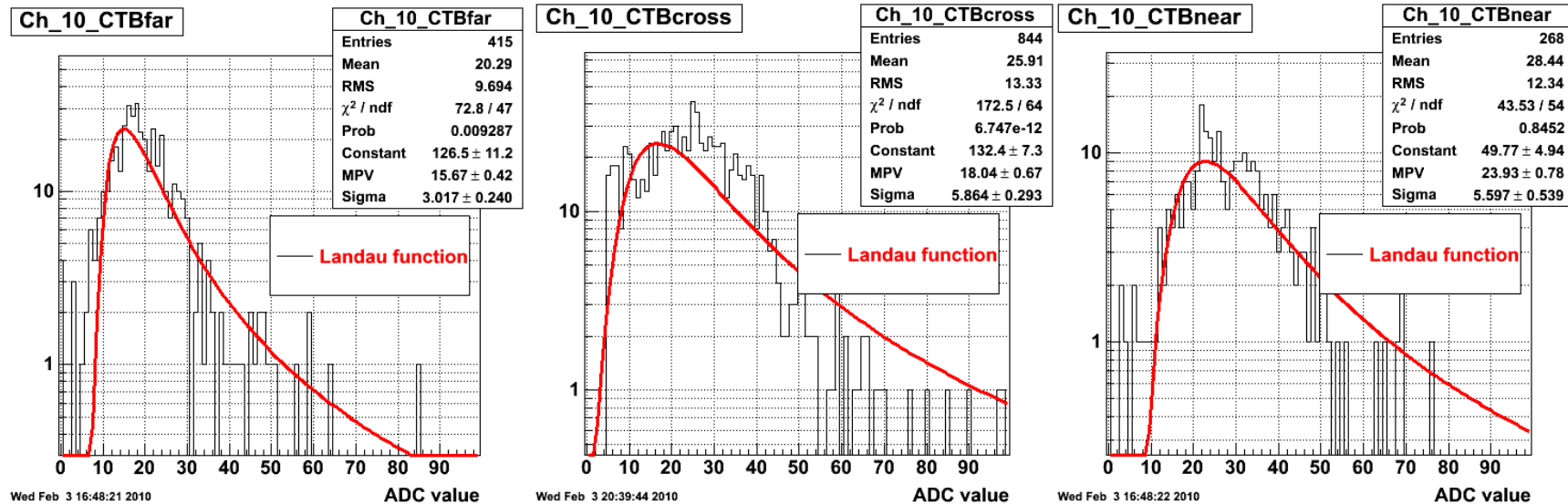


Random cosmic ray embedded in clocked STAR event stream.



# FHC Cosmic Ray Test

- Attenuation length study
  - Select CTB trigger data.



CTB far from PMT

CTB diagonal

CTB near PMT

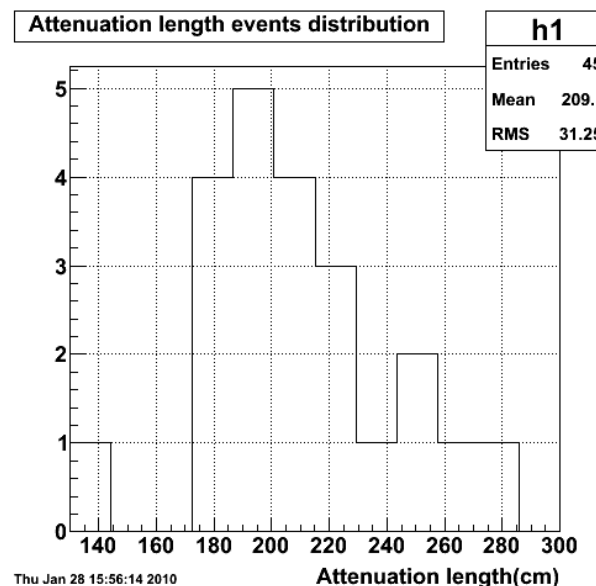
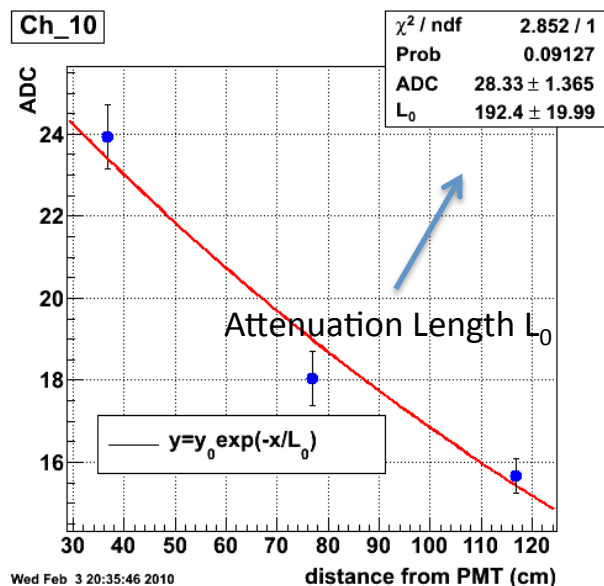
Most Probable Values (MPV) of one cell at different distances from PMT are for attenuation length extractions.





# FHC Cosmic Ray Test

- Attenuation length study



Attenuation length of one cell

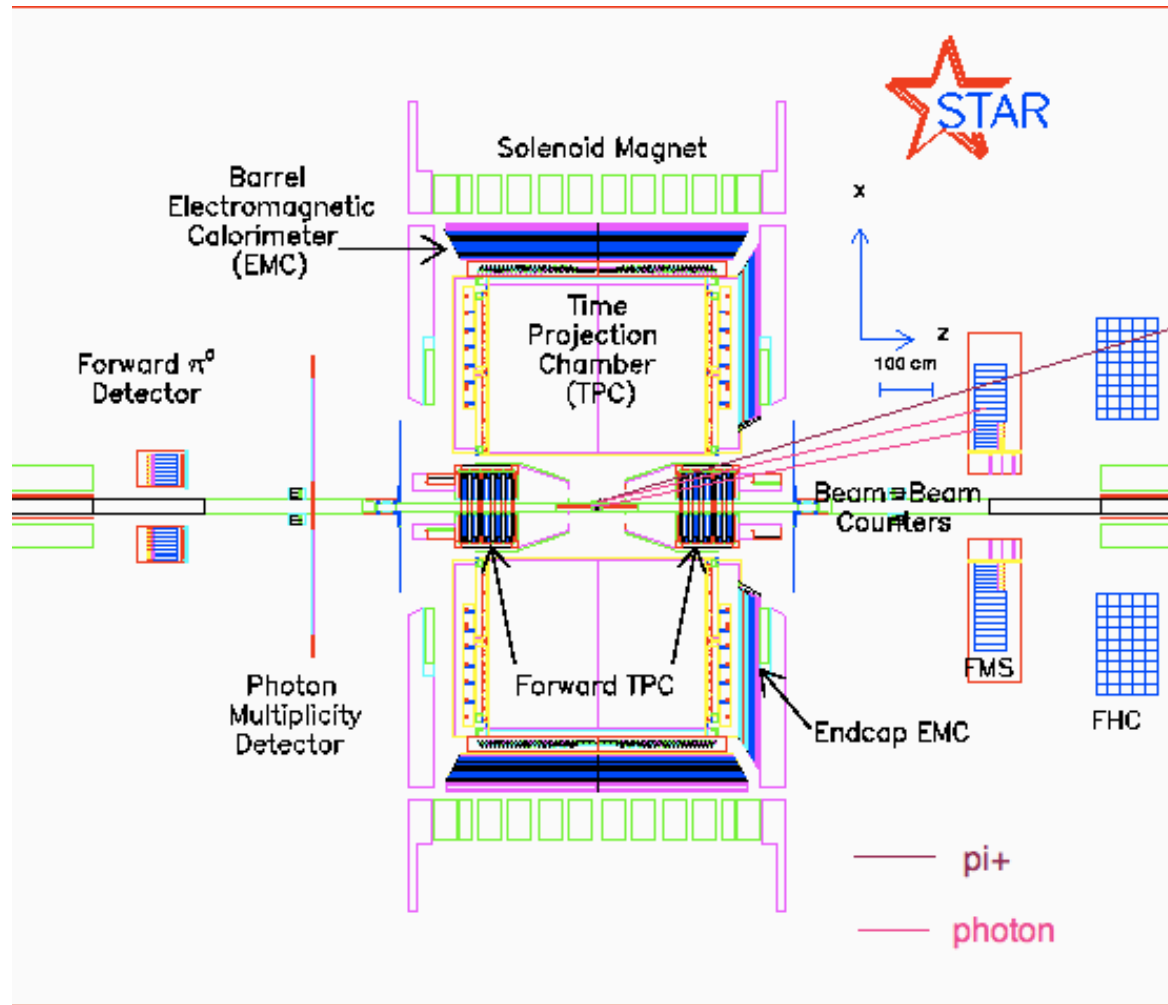
Distribution of Attenuation length

The attenuation lengths got from the exponential fit are generally consistent with 2 meters.



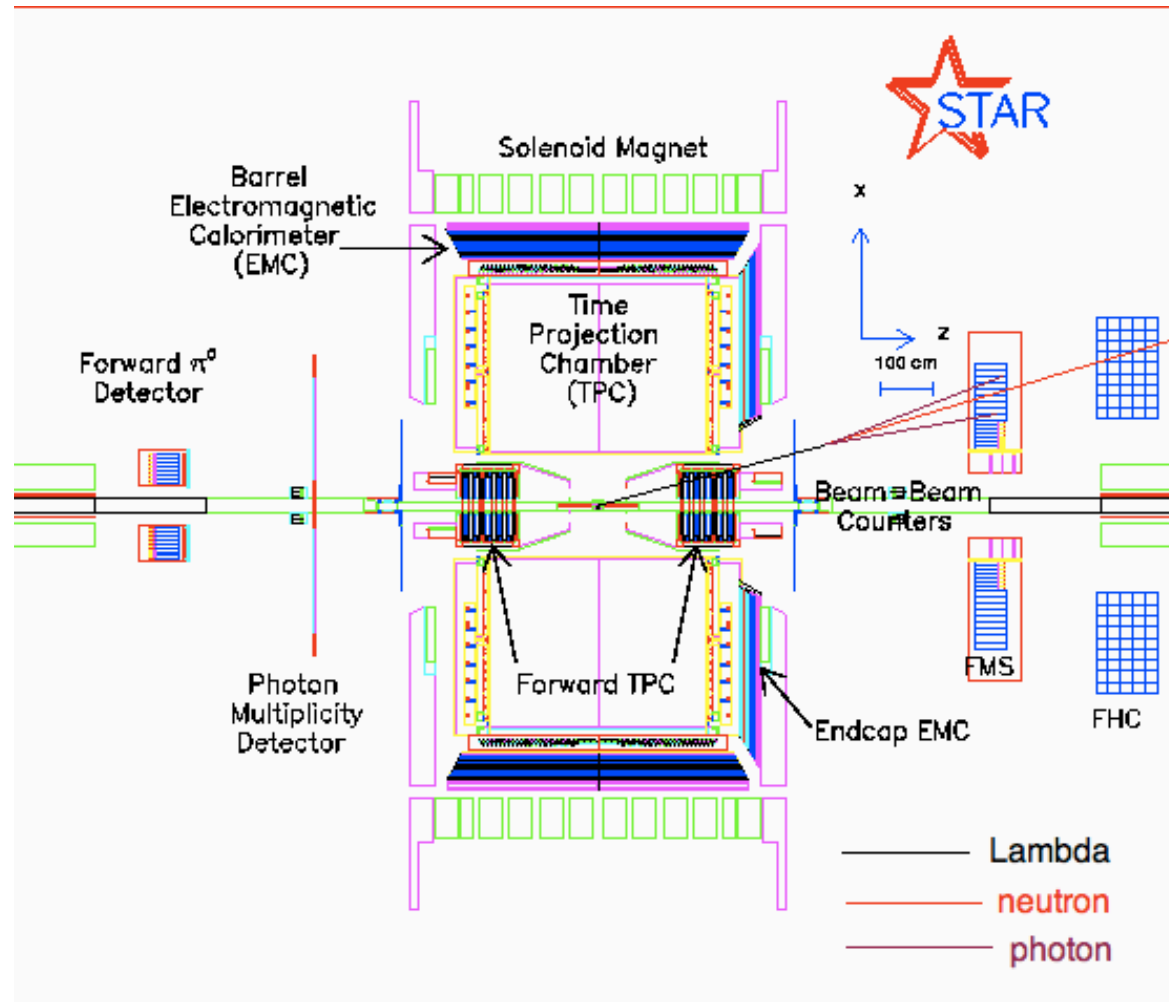
# Simulation for FHC

- Rho decay process  $\rho^+ \Rightarrow \pi^+ + \pi^0$  ( $\sim 100\%$ )



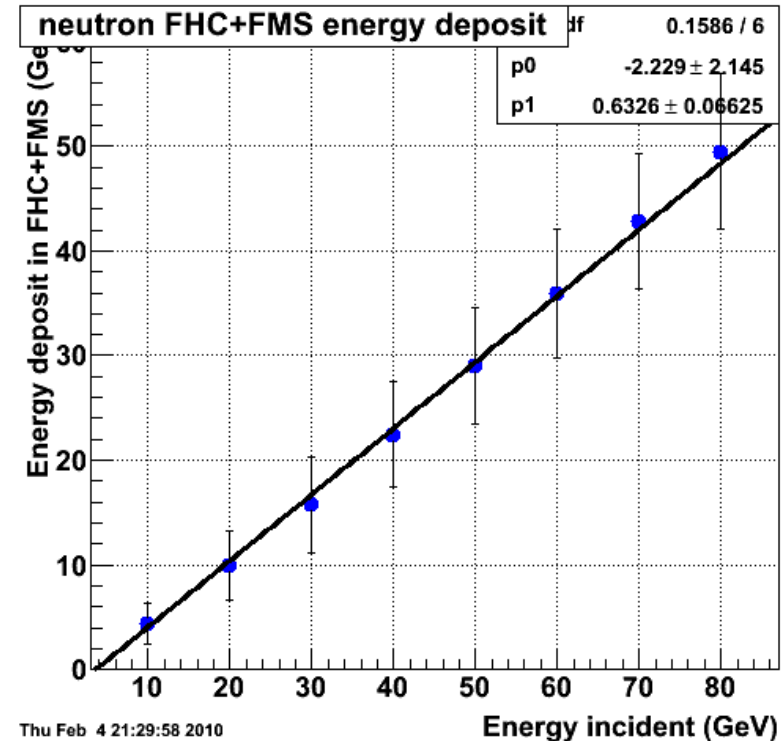
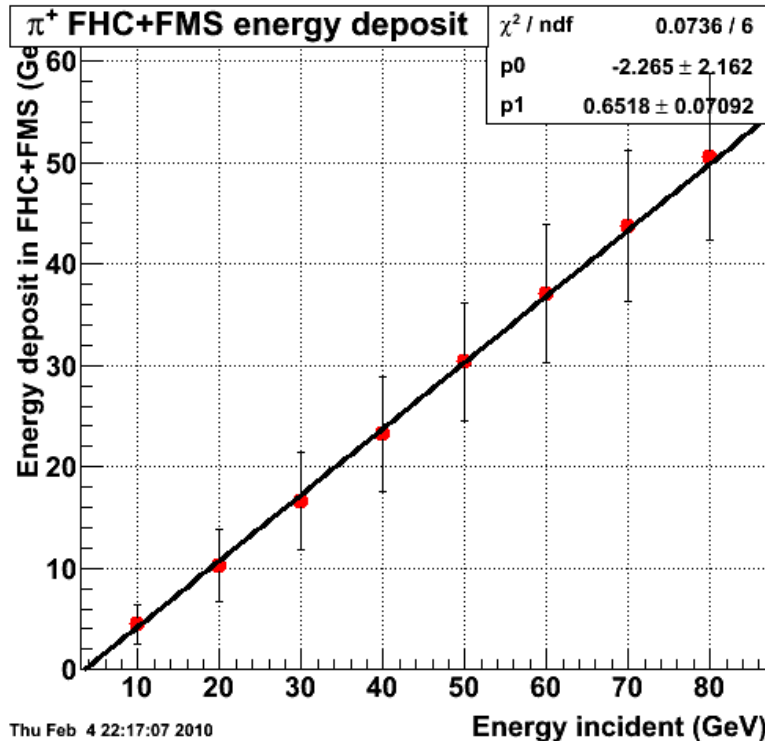
# Simulation for FHC

- Lambda decay process  $\Lambda \Rightarrow n + \pi^0$  (~35.8%)



# Simulation for FHC

- The simulated energy response using GEANT.



- The decay products of charged Rho and Lambda have similar detector response.
- The Rho reconstruction can provide good calibration at each cell.



# Summary

- Forward Hadronic Calorimeter proposed to study (transverse) spin phenomena at large  $x_F$ .
- Cosmic ray tests show that the existing modules are in good condition.
- Cosmic rays may be used also as a gain monitor during STAR data taking.
- Simulation studies show that the  $\rho^+$  meson provides a promising calibration for the Lambda channel.

