

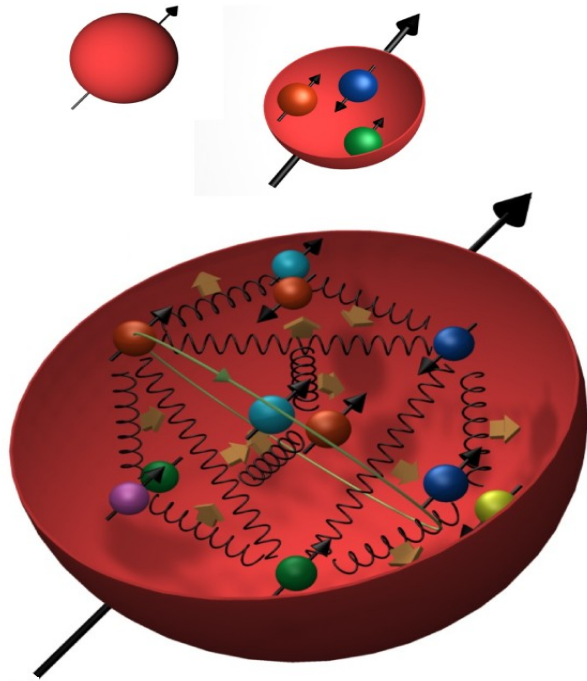
# The Scintillating Fiber Tracker

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- Spin of the nucleon, GPDs and DVCS
- HERMES experiment
- Recoil Detector
- The SFT

# Nucleon Spin and GPDs



$$\frac{1}{2} = \underbrace{\frac{1}{2} \Delta\Sigma + L_q}_{J_q} + \underbrace{\Delta G + L_g}_{J_g}$$

$\Delta\Sigma \approx 0.33$  HERMES : Phys. Rev. **D75**(2007)

$\Delta G$  First measurements ---- **small**

$L_q, L_g$

Accessible through

**Generalized Parton Distributions (GPDs)**

**Ji Sum Rule :**

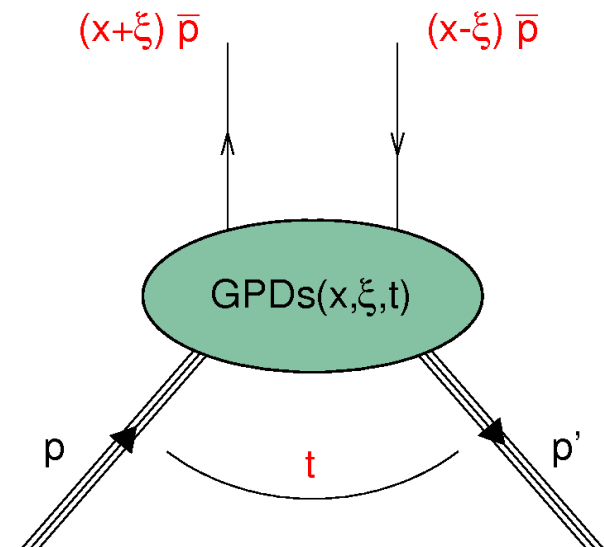
**GPDs**

$$J_{q,g} = \lim_{t \rightarrow 0} \int_{-1}^1 dx x \{ H_{q,g}(x, \xi, t) + E_{q,g}(x, \xi, t) \}$$

$x \pm \xi \rightarrow$  momentum fraction of struck quark

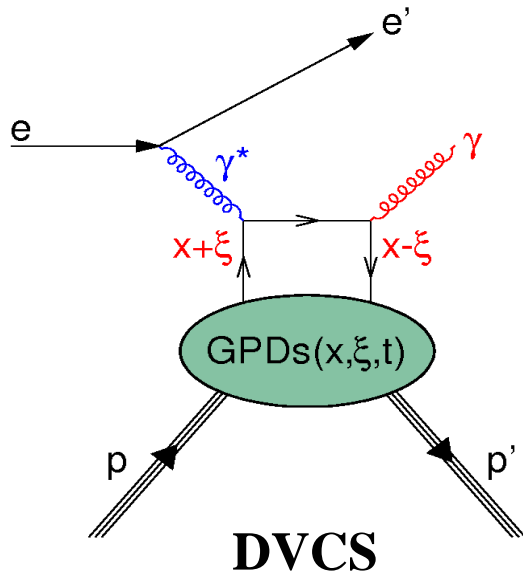
$\xi \rightarrow$  fraction of the momentum transfer

$t \rightarrow$  momentum transfer to the target



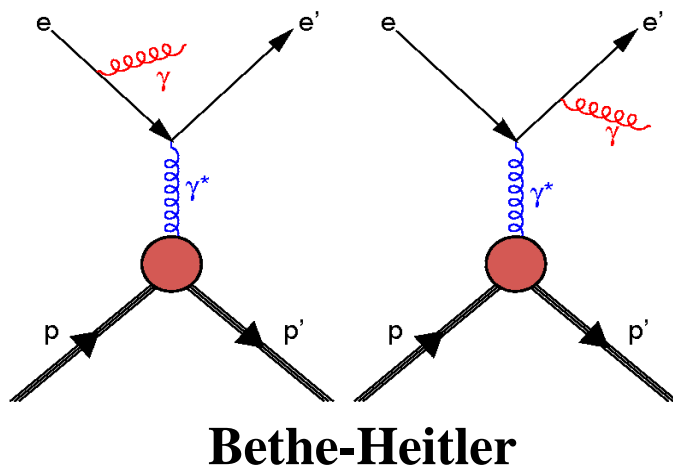
# Deeply Virtual Compton Scattering (DVCS)

**DVCS** : simplest/cleanest Hard Exclusive Process to access **GPDs**



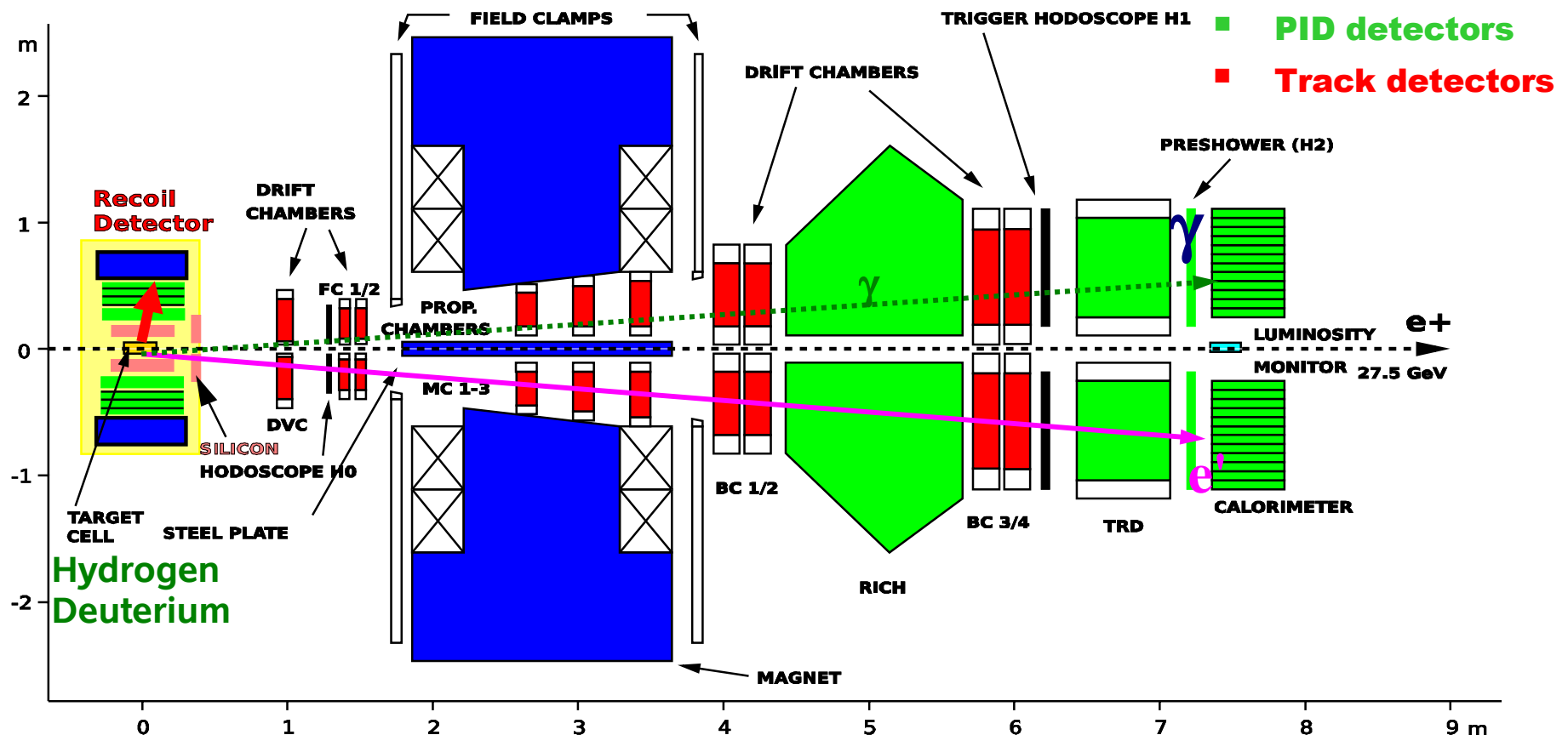
$$\begin{aligned} d\sigma(eN \rightarrow eN\gamma) \propto & |T_{\text{BH}}|^2 + |T_{\text{DVCS}}|^2 \\ & + \underbrace{T_{\text{BH}}^* T_{\text{DVCS}} + T_{\text{BH}} T_{\text{DVCS}}^*}_{\text{Interference term}} \end{aligned}$$

- The same final state in DVCS and Bethe-Heitler
- BH dominates at HERMES kinematics
- GPDs accessed by measuring the azimuthal asymmetries via the **Interference term**

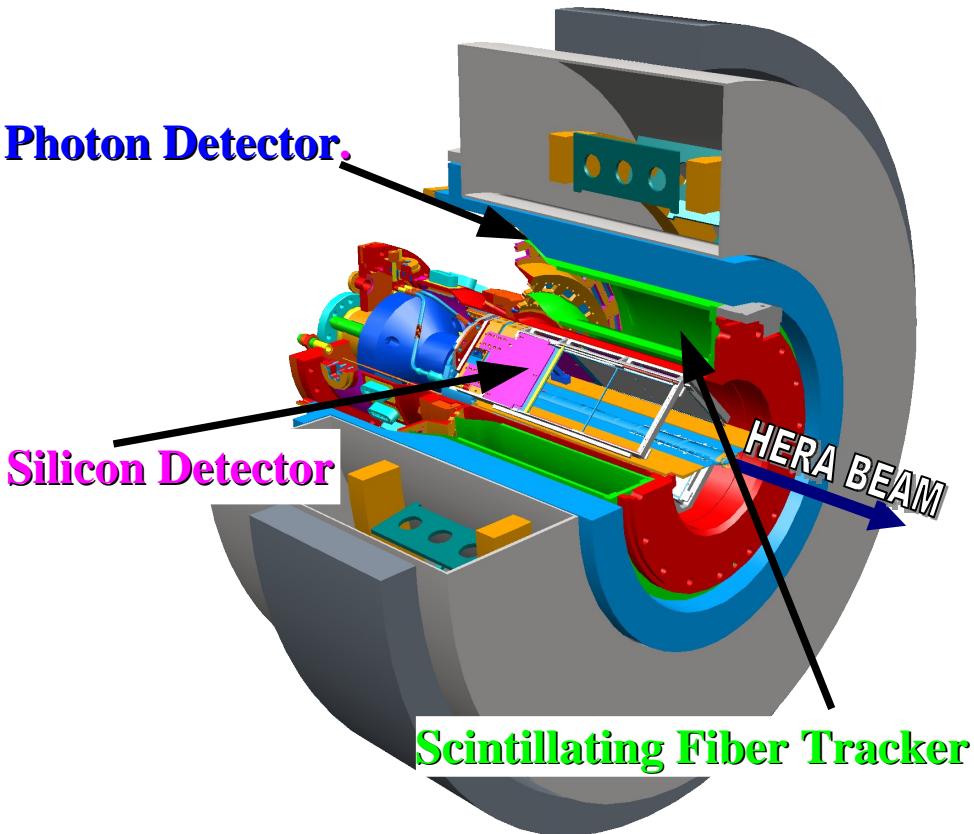


# HERMES Experiment

- A Recoil Detector installed to identify the recoiling protons
- Dedicated high luminosity run in 2006~2007 with unpolarized hydrogen and deuterium target.



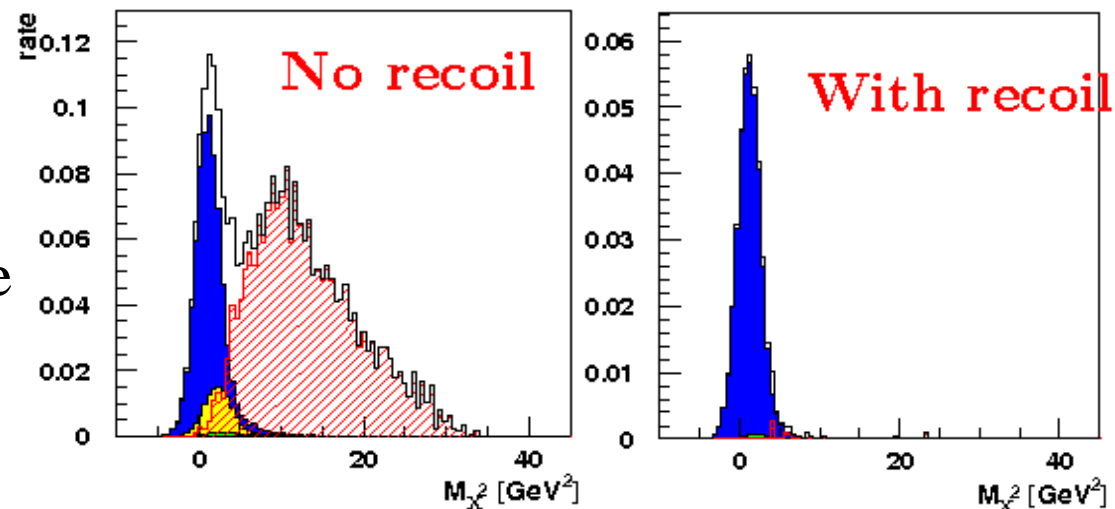
# The Recoil Detector



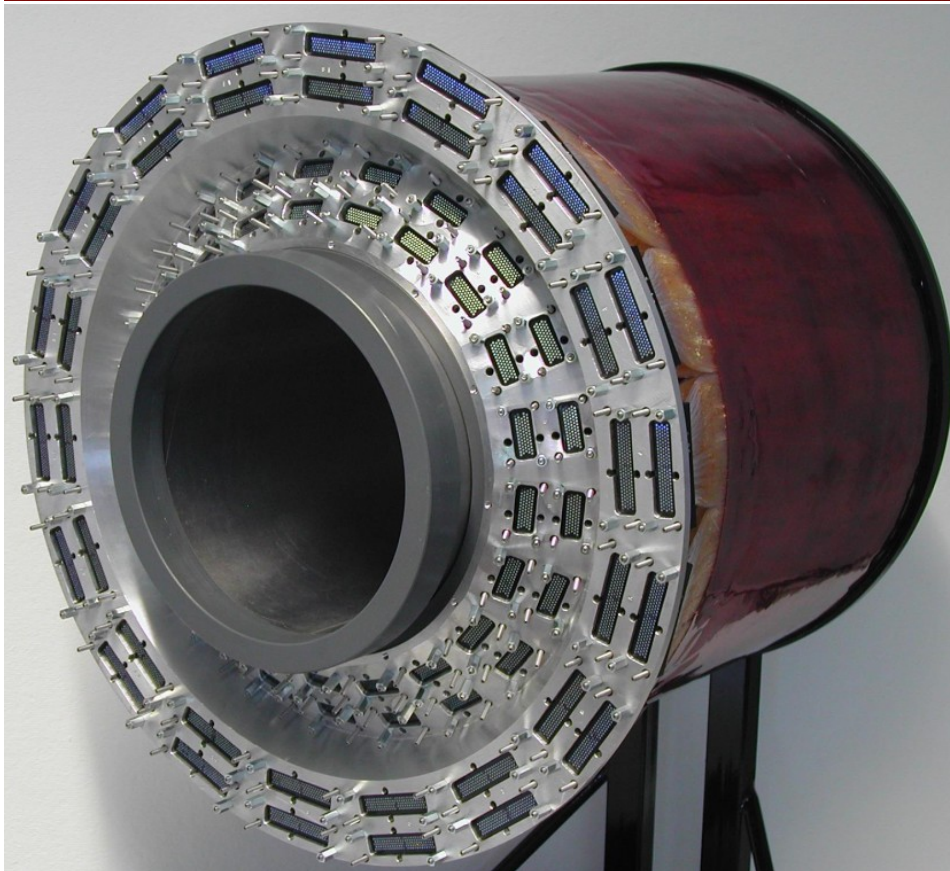
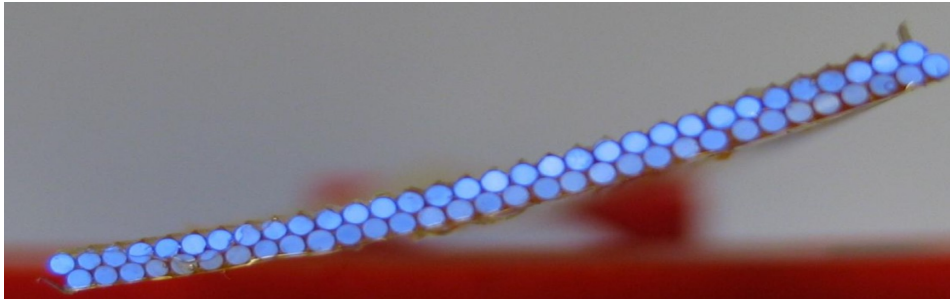
- Consists of silicon detector, scintillating fiber tracker and photon detector
- Detection of recoiling proton
  - ➔ p-measurement 135-1400 MeV/c
  - ➔ 76%  $\phi$  acceptance
  - ➔  $\pi$ /P PID via dE/dx

**1 tesla magnetic field**

- Improvement of t-resolution
  - ➔ study kinematical dependence
- Background suppression
  - ➔ semi-incl. : 5%  $\rightarrow$   $\ll$  1%
  - ➔ associated : 11%  $\rightarrow$   $\sim$  1%

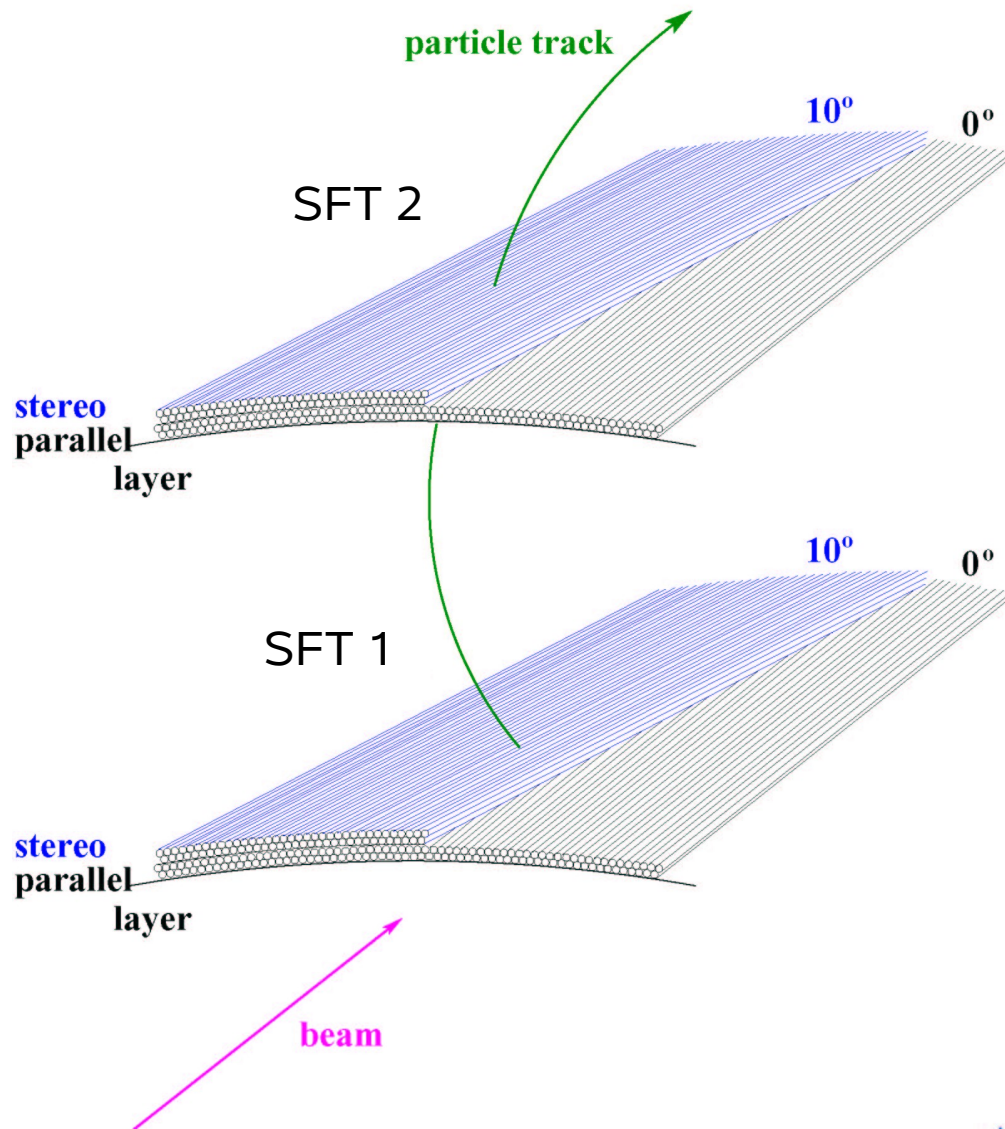


# Scintillating Fiber Tracker (SFT)



- 2 cylinders of 2 X 2 layers,  $10^\circ$  stereo angle
- 1 mm Kuraray fibers, mirrored ends
- 6910 fibers mapped on 4882 readout channels
- Kuraray lightguides, 64 channels Hamamatsu PMTs
- Readout by GASSIPLEX chips
- Signal from last dynode channel used for timing

# Scintillating Fiber Tracker (SFT)



- Momentum reconstructed by the bending of the charge particles inside 1 Tesla magnetic field

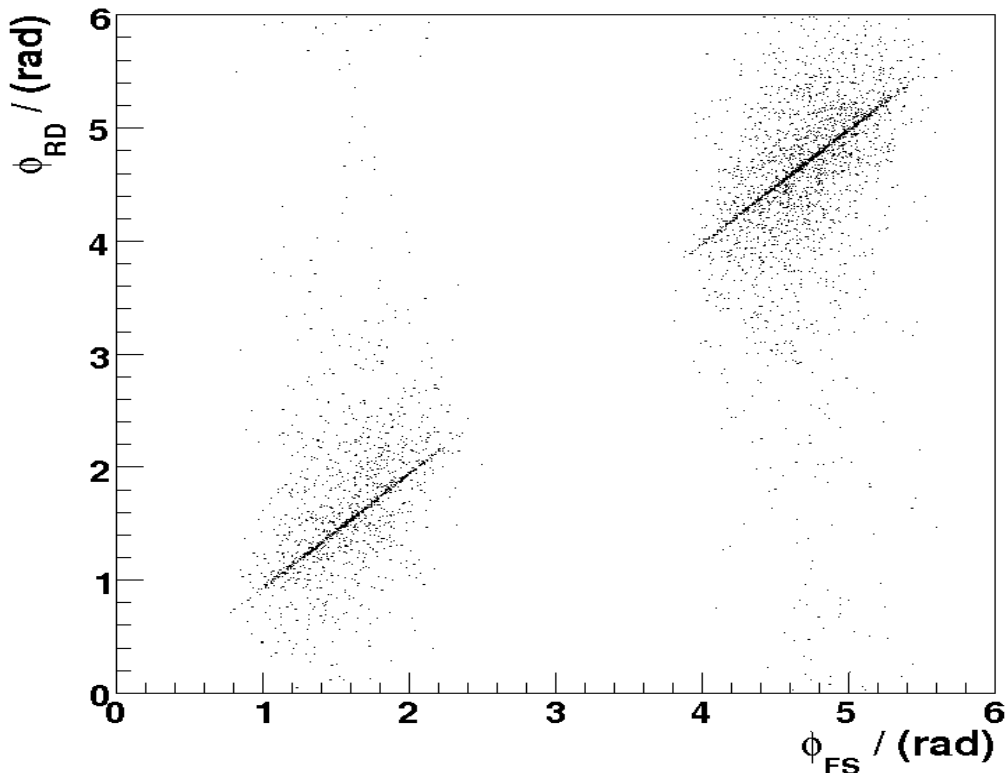
- The range of momentum measurement 250-1400 MeV/c

- PID from  $dE/dx$   
 $250 < p < 650$  MeV/c

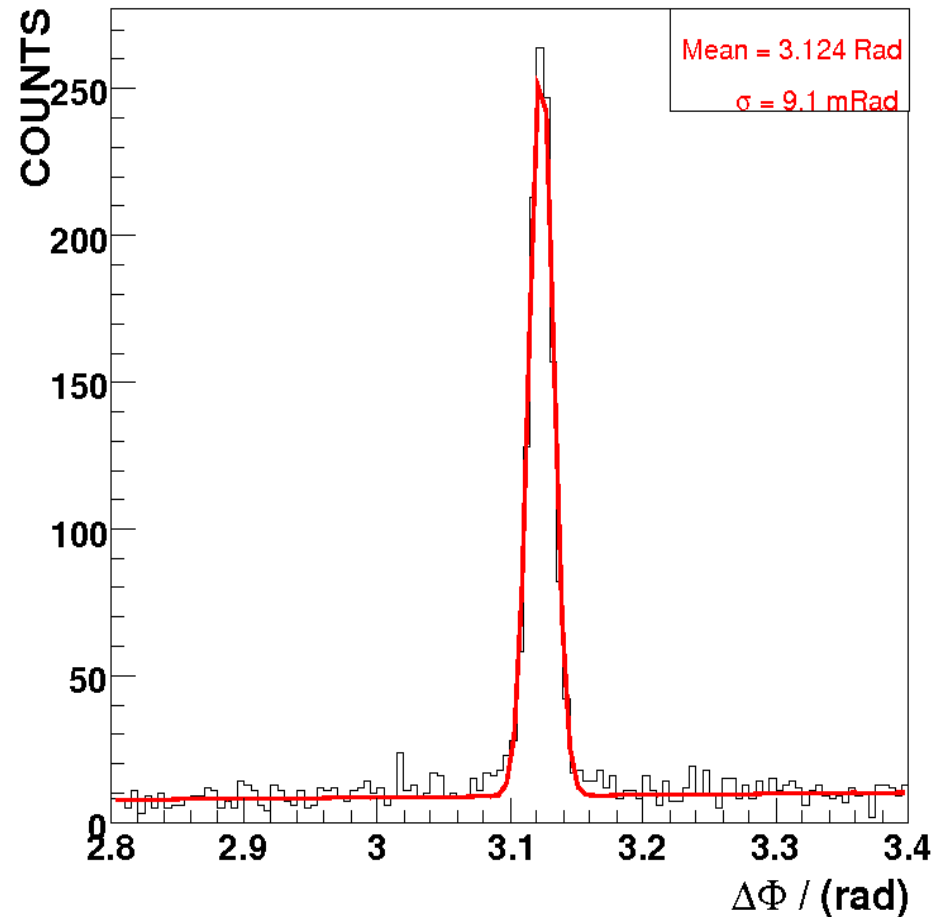
- $\phi$  resolution 8mrad

# E-P Elastic Scattering

- The first time to see the ep elastic scattering in HERMES
- Clear correlation seen in SFT
- It maybe used for the Alignment

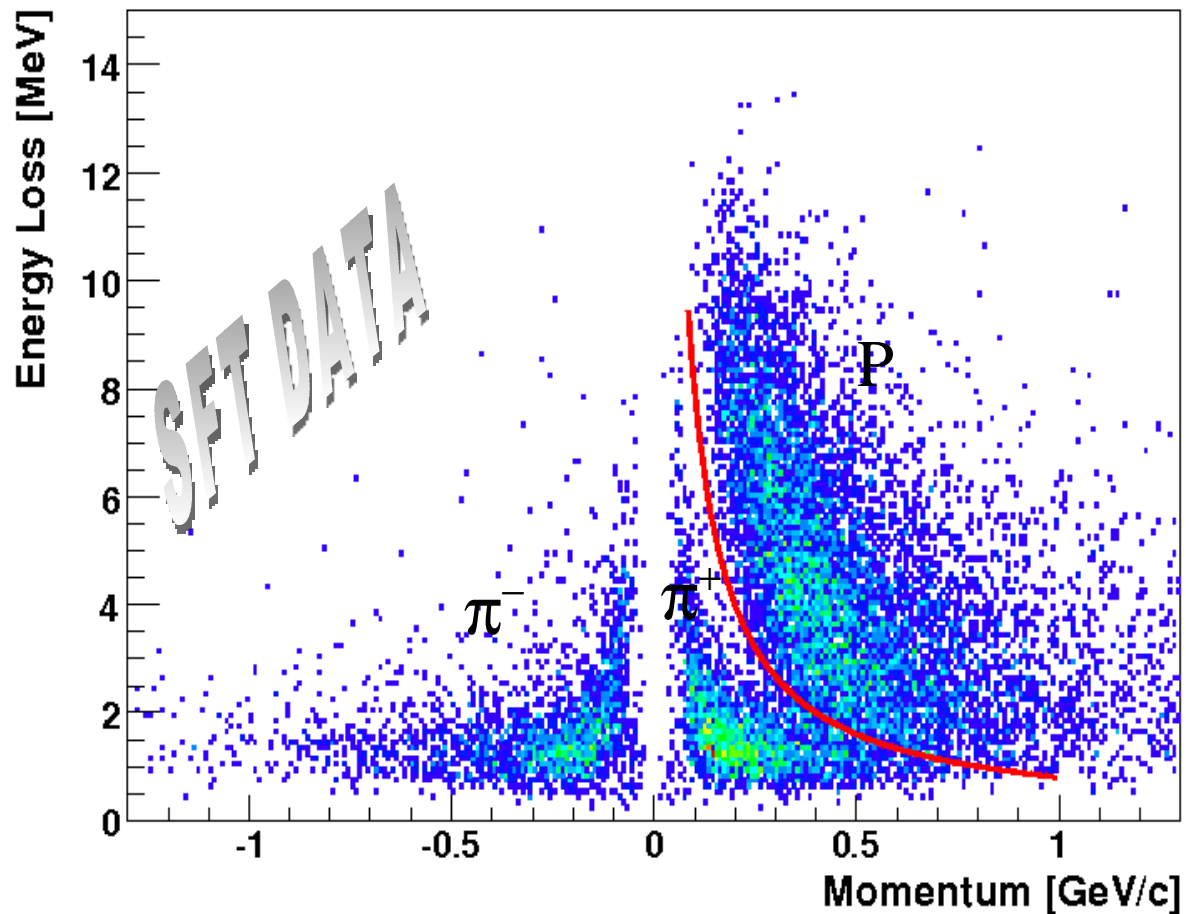


**Difference in the  $\phi$  angle of the elastic protons measured from forward spectrometer and SFT**

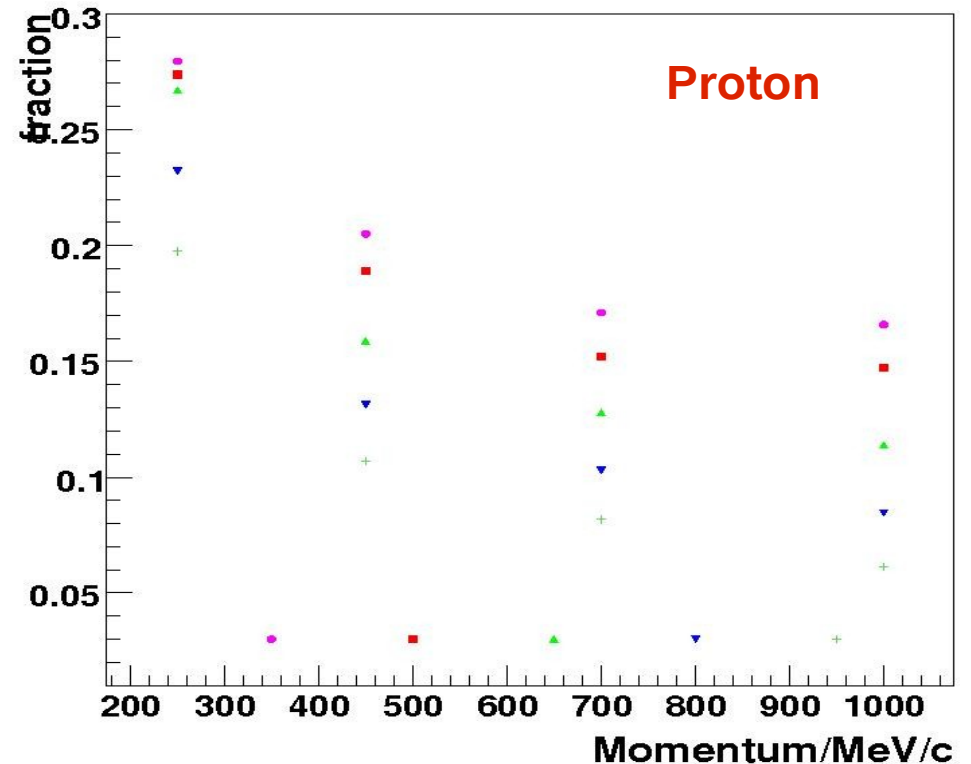
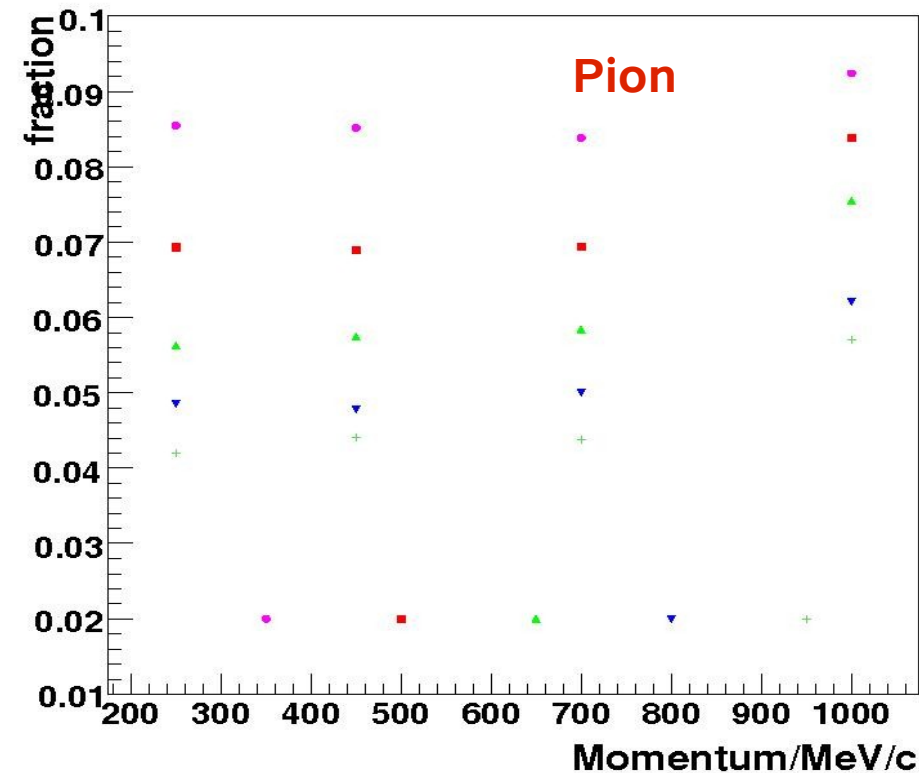


# Present Status of Particle Identification

- Energy deposits allow proton /  $\pi$  separation
- Energy signal from MIPs (pions) used for calibration

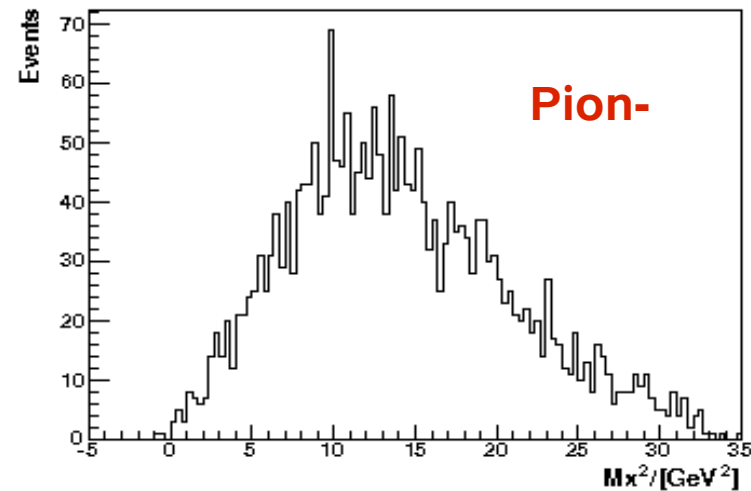
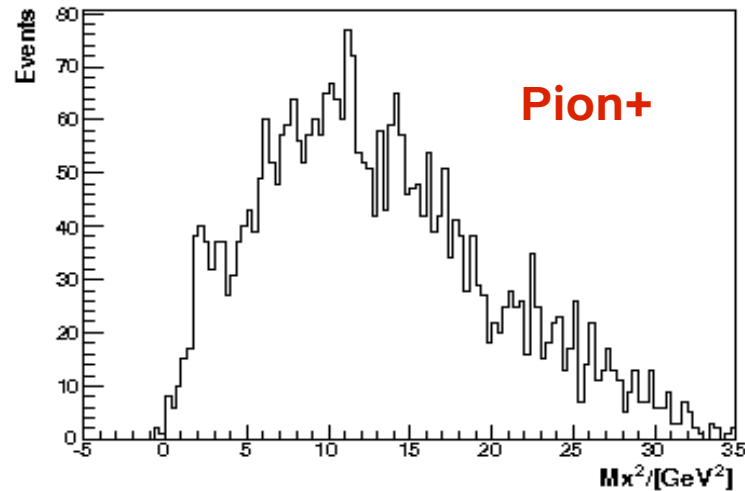
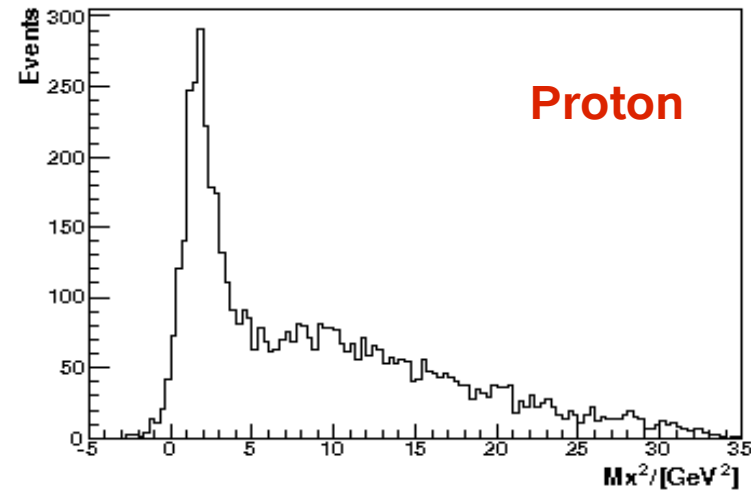
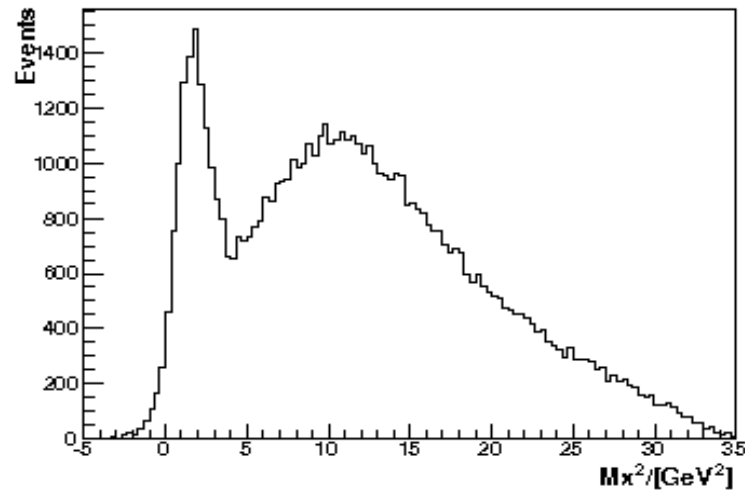


# Hit Multiplicities of PMT



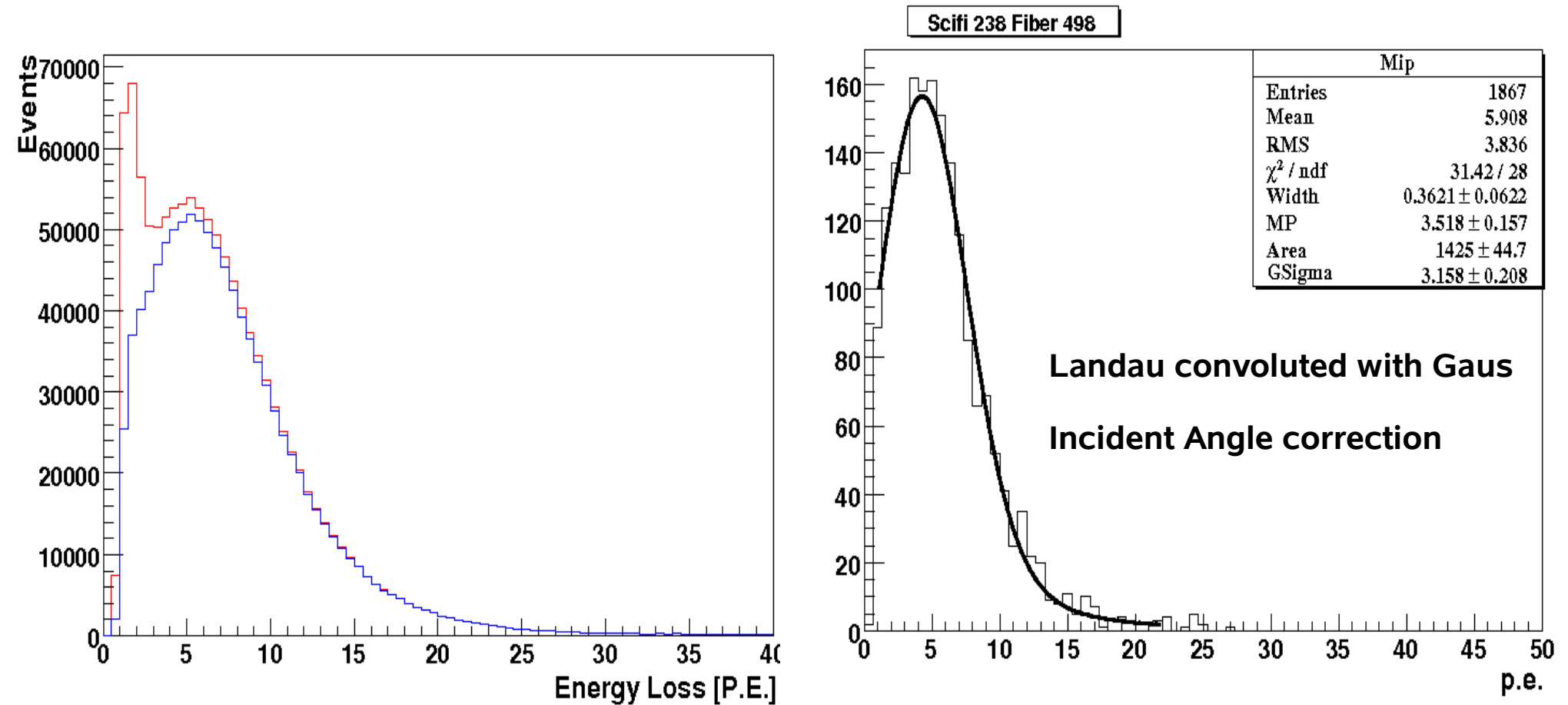
- Fraction of events with hit multiplicity( $\geq 4$ hits) in pmt.
- Simple PID implemented to the energy deposit of SFT.

# The Missing Mass with SFT Particles



● Missing Mass Spectra when the recoiling particles identified by the SFT

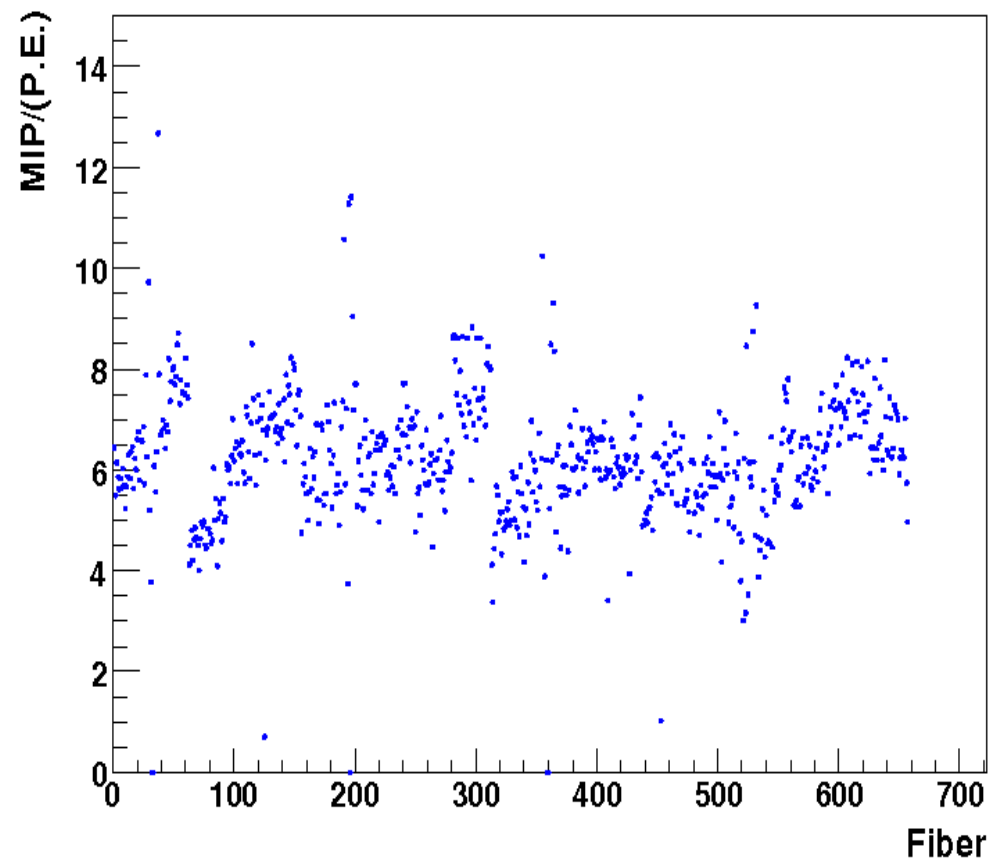
# Energy Deposit of MIPs



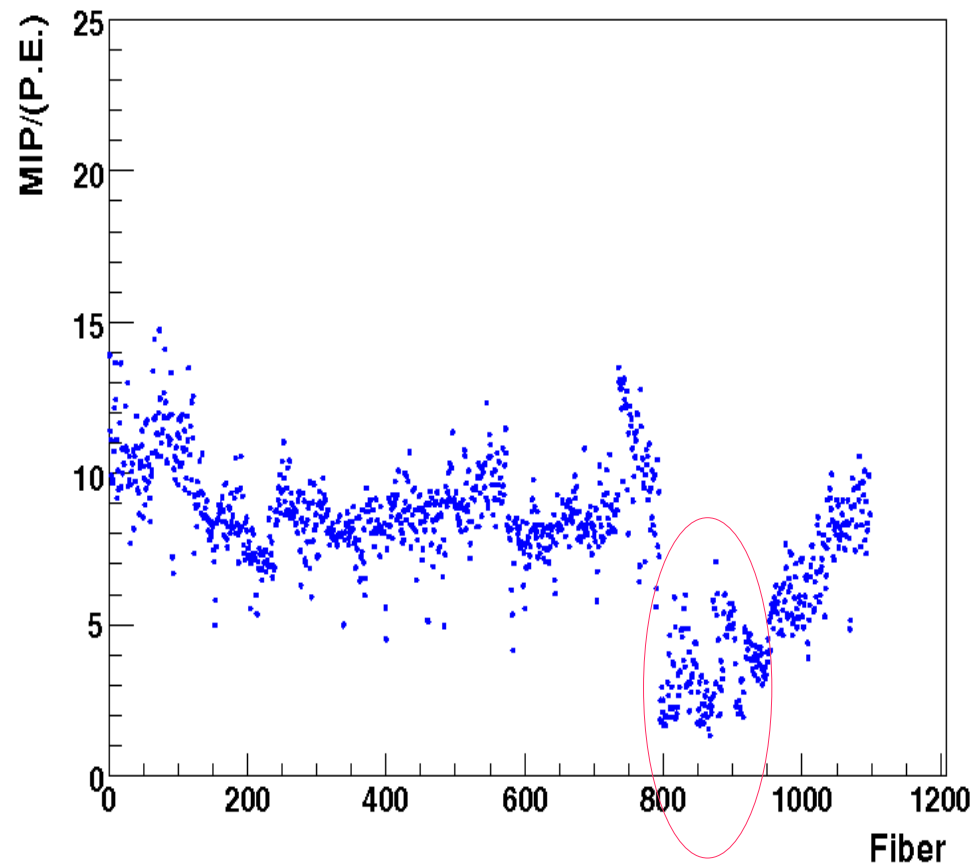
● Energy deposit of pions in single fiber

● Leading fibers from tracks were selected

# MIPS in Fibers from Positron Data

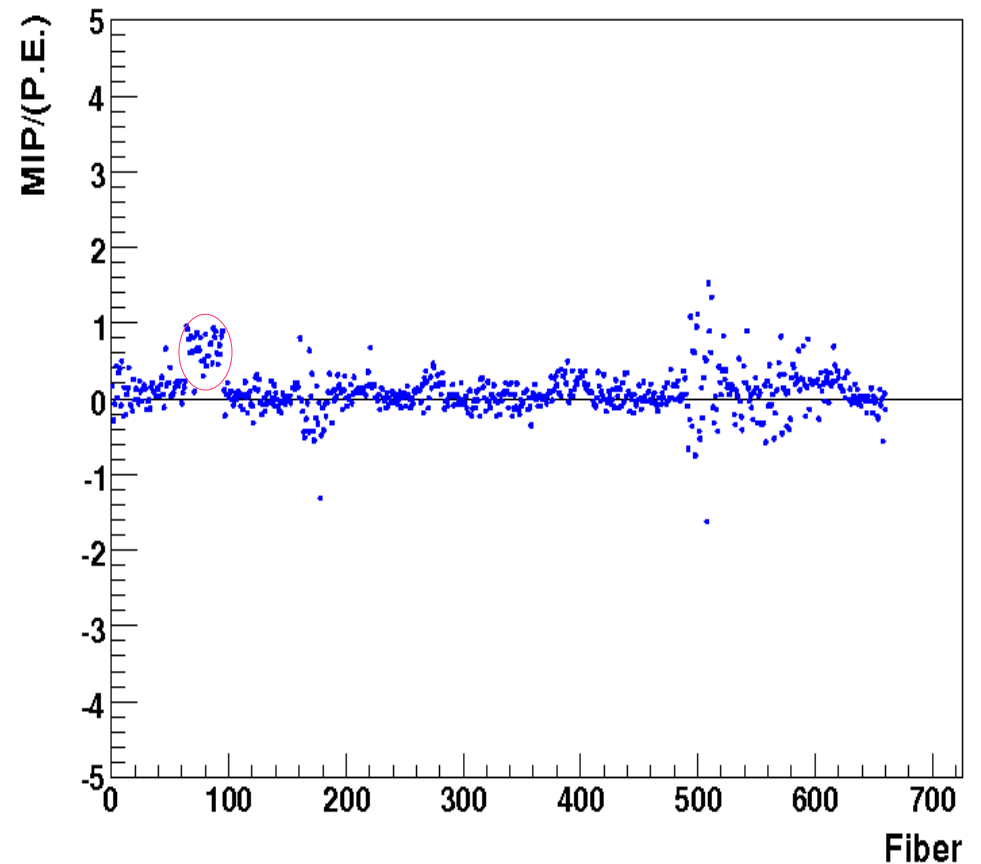
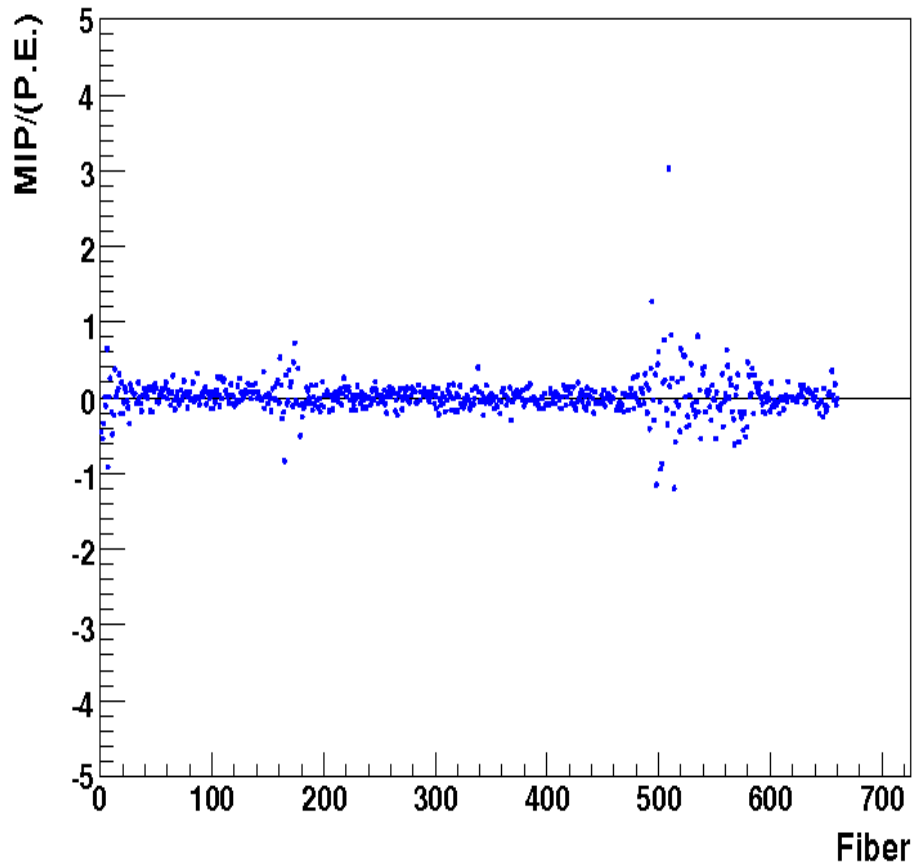


MIPs' position from Layer238  
PMT/LG structure can be seen



MIPs' position of Layer242

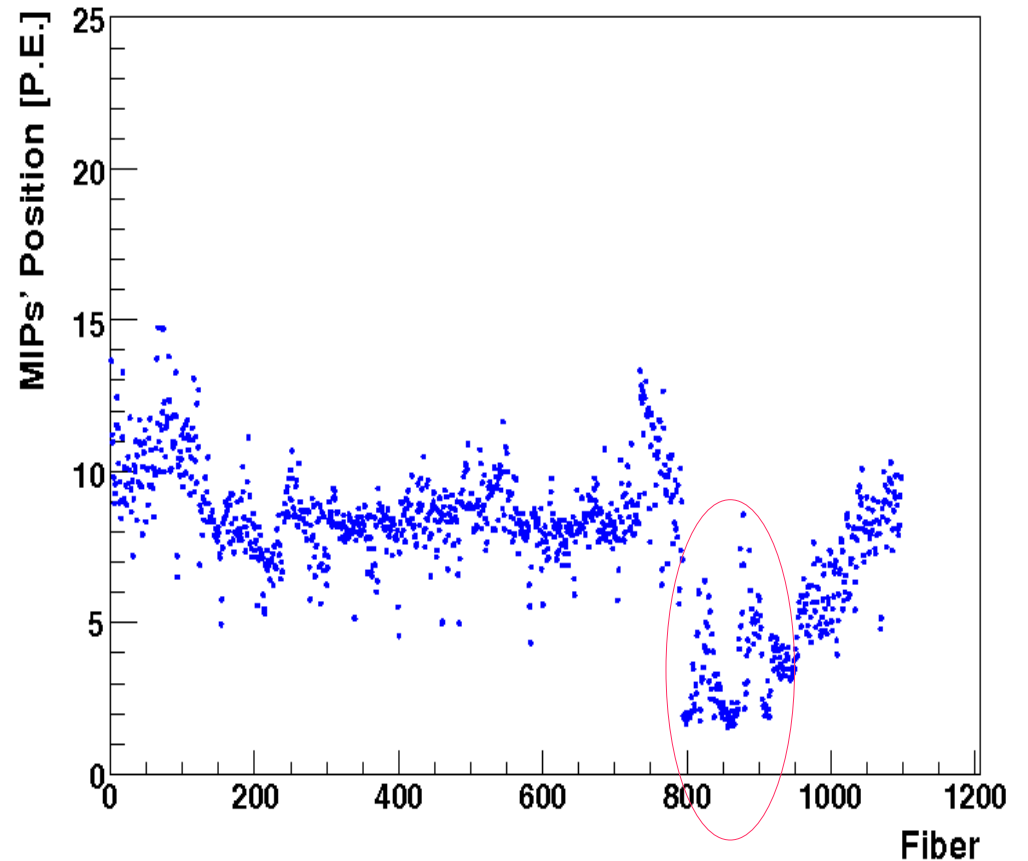
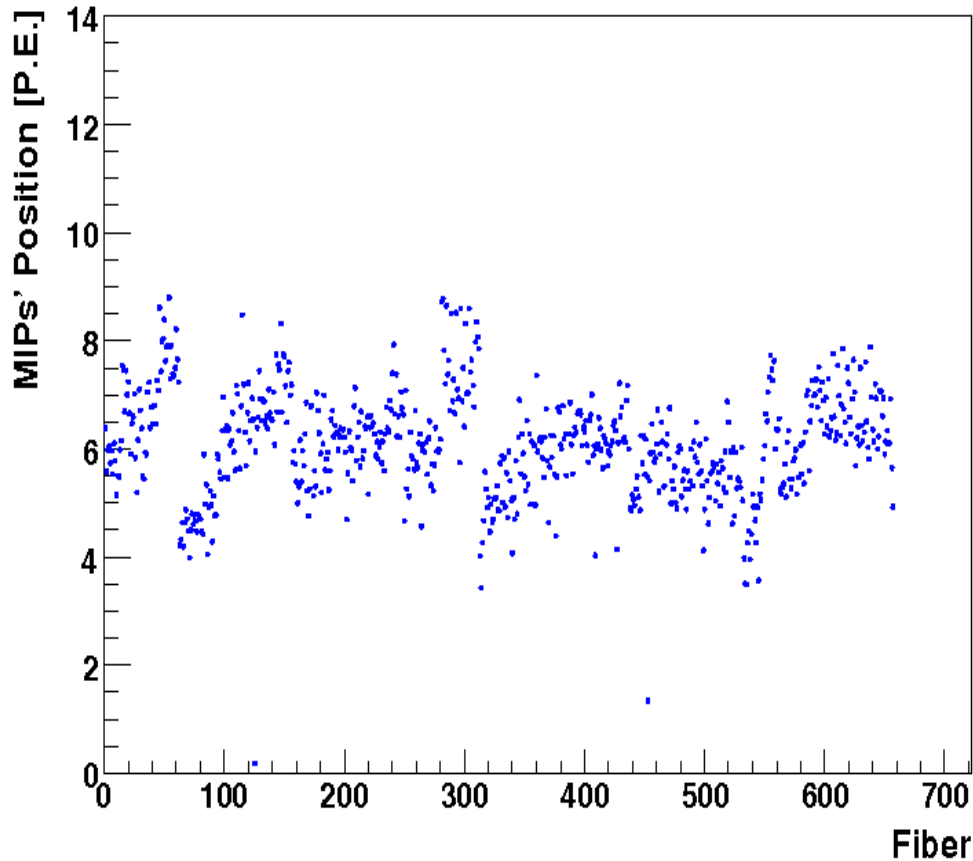
# The Stability of MIPs' Position



MIPs' positions are stable from different time periods.

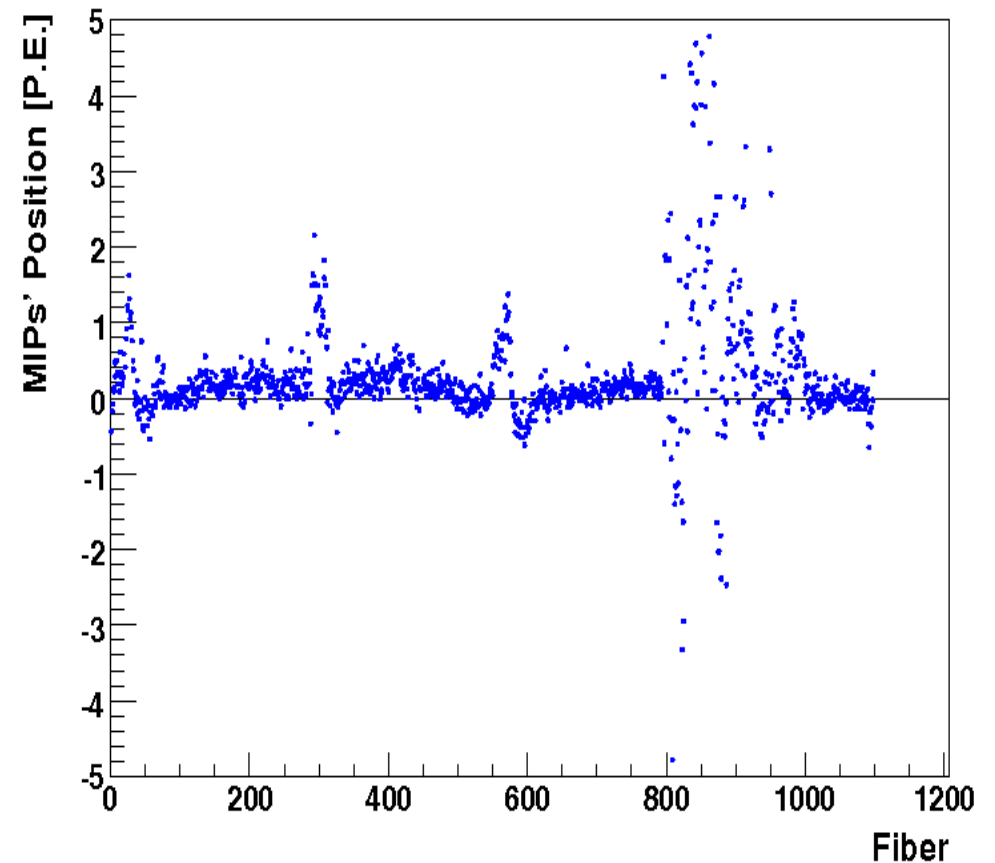
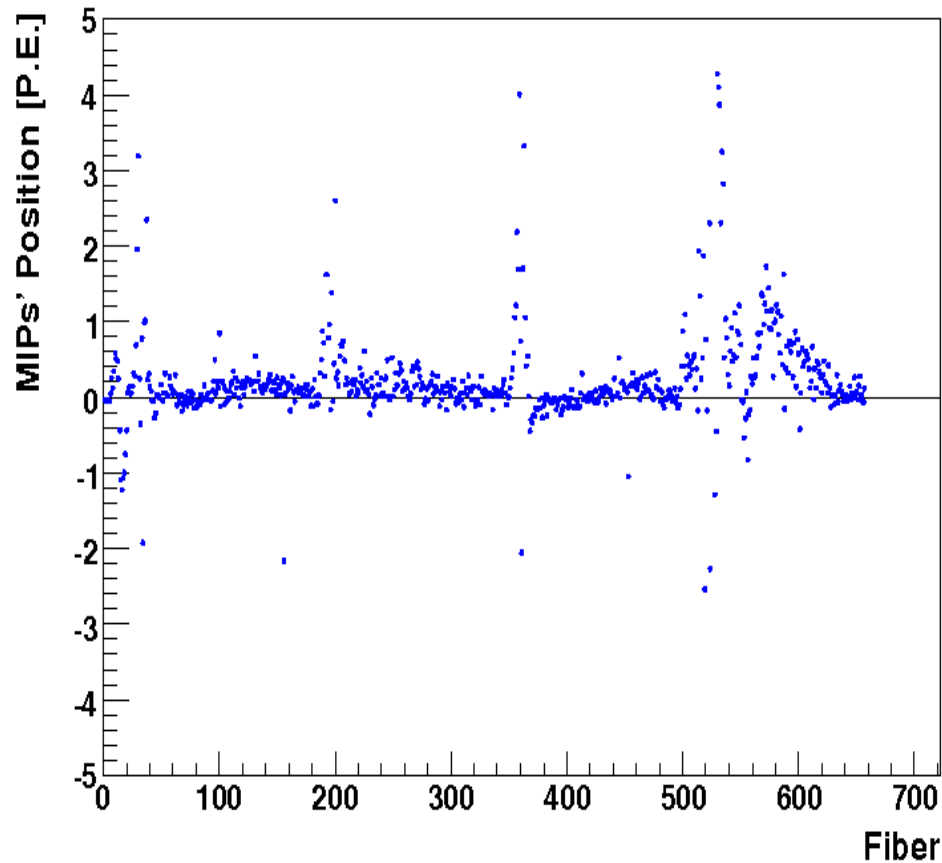
Only certain PMT show the drift in 07b production.

# MIPS in Fibers from 2006 Data



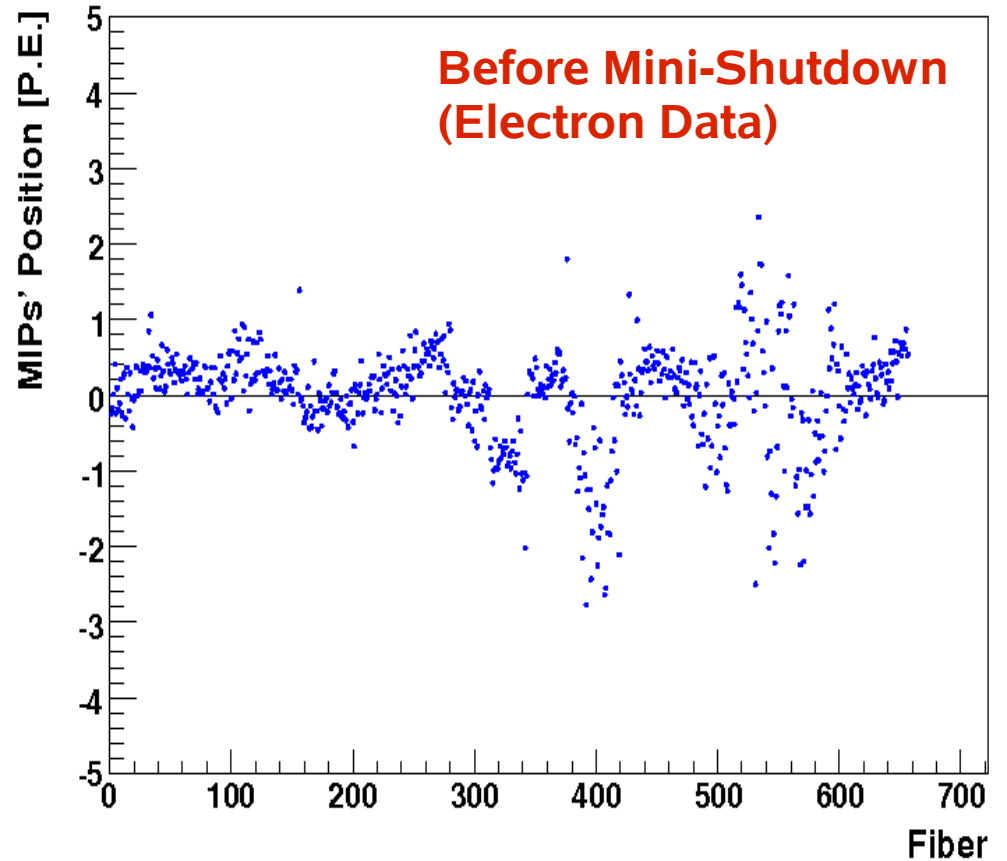
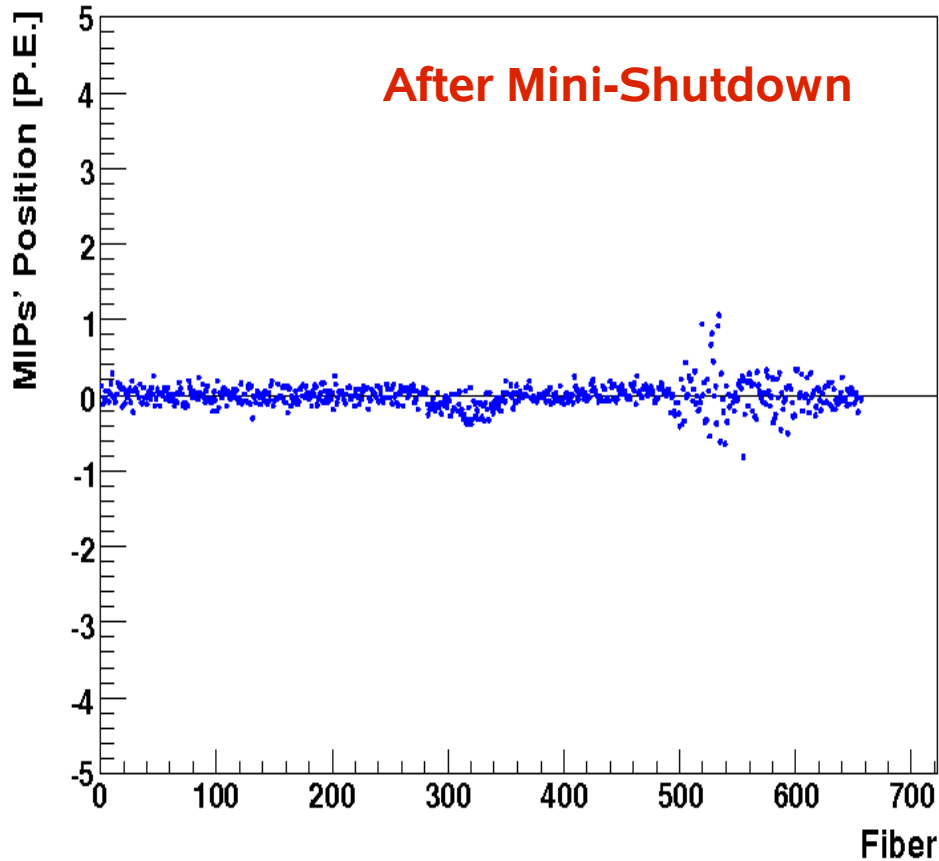
- Similar structure as from 2007 data
- Only two space points are used in the tracking (Silicon not operational)

# MIPS in Fibers from 2006 Data



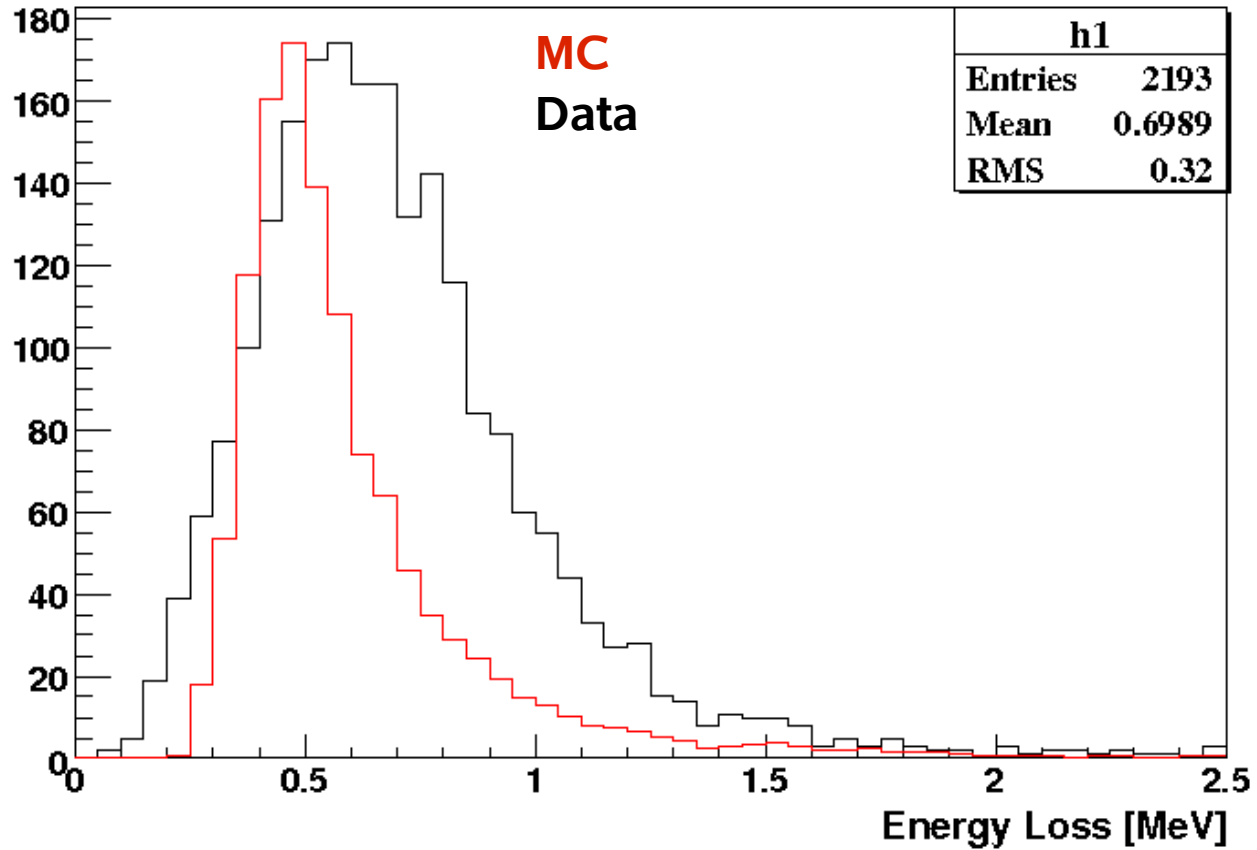
● The comparison of MIPS from complete tracking and sft only tracking cases

# The Stability of MIPs' Position



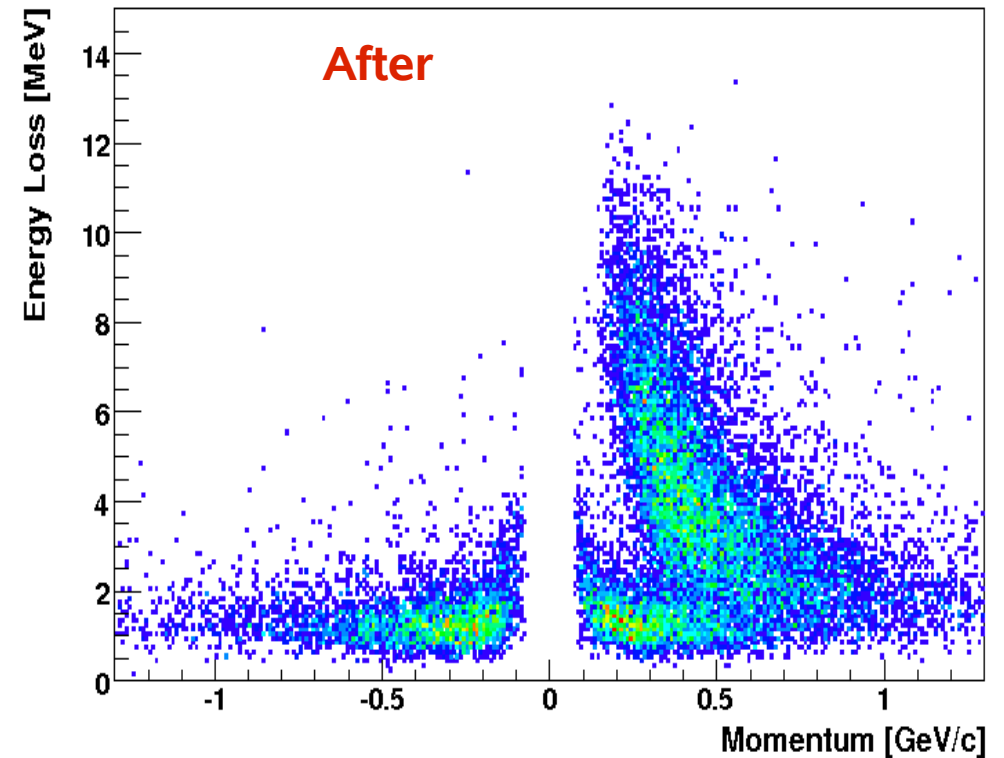
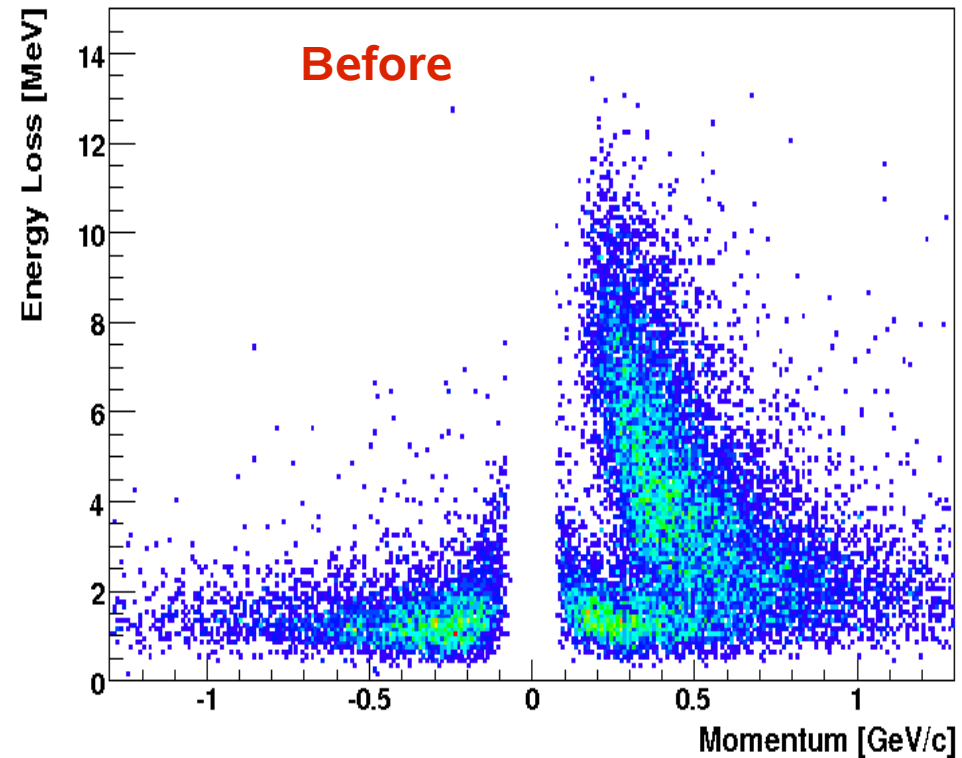
MIPs' positions from different time periods without operational silicon

# Data-MC Comparison



- To adjust the parameters in XTC to make the Data-MC comparable

# The Improvement from the Calibration



Next Part : Efficiency