Analysis Update on E06-010

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(for Hall A Transversity Collaboration)

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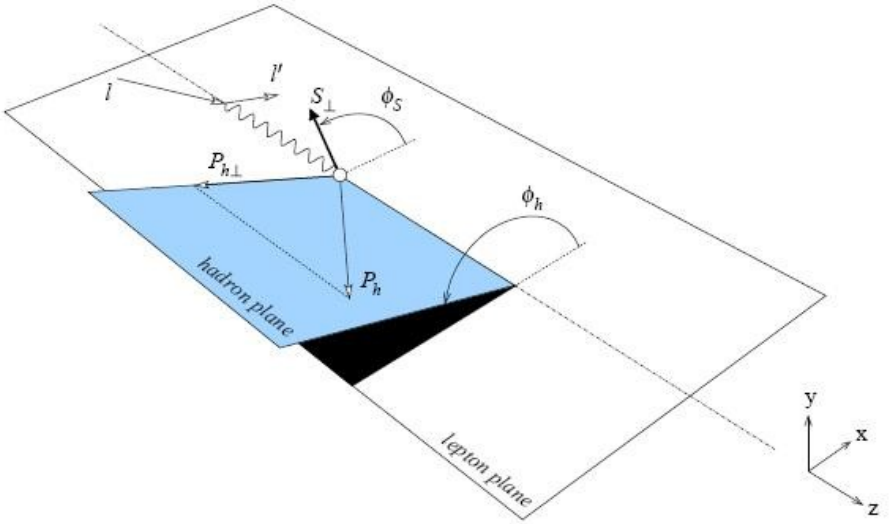
Transversity in Hall A (E06-010)

- Took data from Oct 2008 – Feb 2009.
- Measure target SSA in $n^{\uparrow}(e, e'\pi^{+/-})X$ reaction using ^3He target.
- Extract **Collins**, **Sivers** and **Pretzelosity** effects.
- Only world data from HERMES and COMPASS on proton and deuteron
- Parasitic measurements:
  - $\mathbf{g_{1T}}$ using Double Spin Asymmetry **(A_{LT})** in SIDIS.
  - $\mathbf{A_y}$ using target SSA in BigBite inclusive DIS. (See J.Katich's talk)



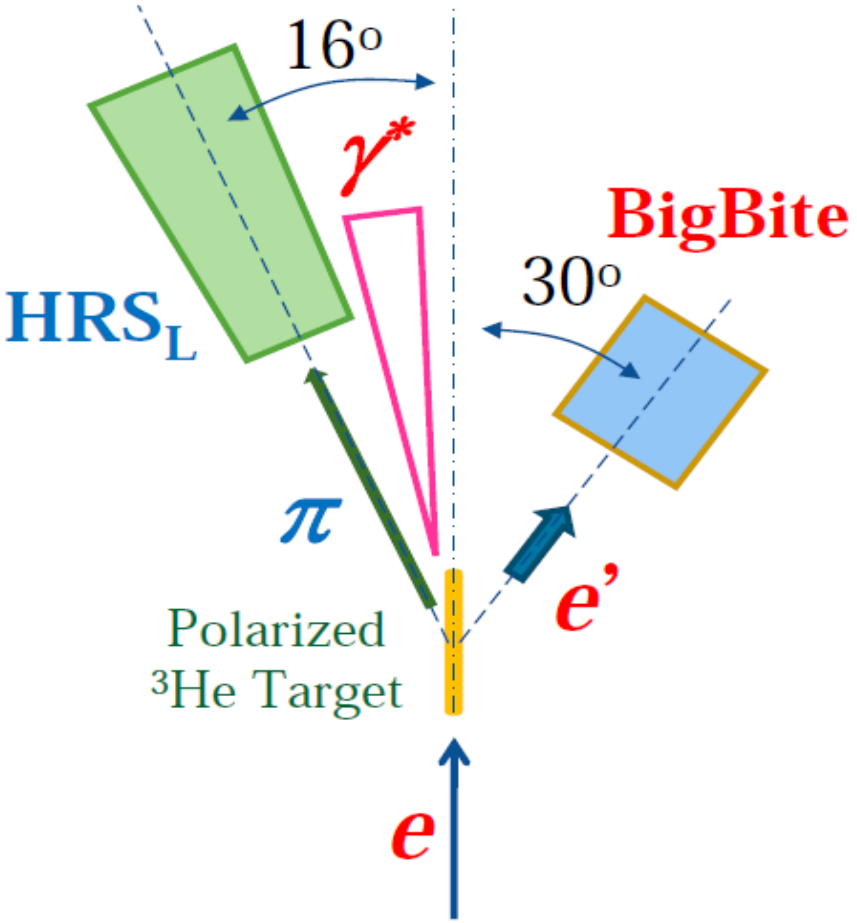
Simultaneous fit to $\sin(\phi + \phi_s)$ and $\sin(\phi - \phi_s)$

$$\sigma_{UT} \propto S_T (1-y) \frac{P_{h\perp}}{zM_h} \sin(\phi_h^l + \phi_S^l) \cdot \sum e_q^2 h_1^q(x) \otimes H_{1q}^{\perp h}(z, P_{h\perp}^2) \qquad \text{Transversity}$$

$$+ S_T (1-y+\frac{y^2}{2}) \frac{P_{h\perp}}{zM_N} \sin(\phi_h^l - \phi_S^l) \cdot \sum e_q^2 f_{1T}^{\perp q}(x) \otimes D_{1q}^h(z_h, P_{h\perp}^2) \qquad \text{Sivers}$$

$$+ S_T (1-y) \frac{P_{h\perp}^3}{6z^2 M_N^2 M_h} \sin(3\phi_h^l - \phi_S^l) \cdot \sum e_q^2 h_{1T}^{\perp q}(x) \otimes H_{1q}^{\perp h}(z_h, P_{h\perp}^2) \qquad \text{Pretzelosity}$$

E06-010 Setup in Hall A



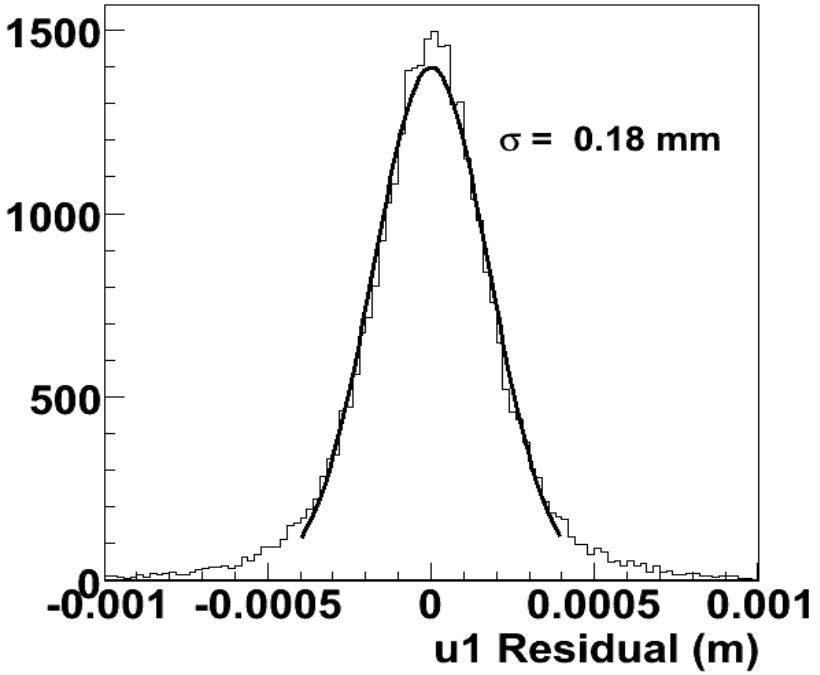
- Electron beam E = 5.9GeV
- 40cm polarized ^{3}He target
- Preliminary polarization: 65%
- Avg Current: 12uA (max 14uA)
- BigBite momentum:

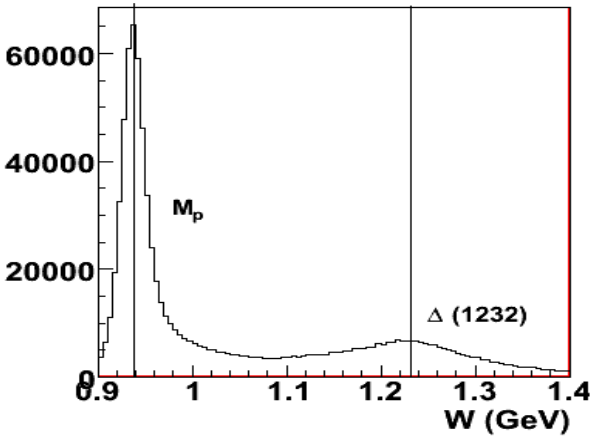
  p_e = 0.7 ~ 2.0 GeV/c
- HRS momentum:

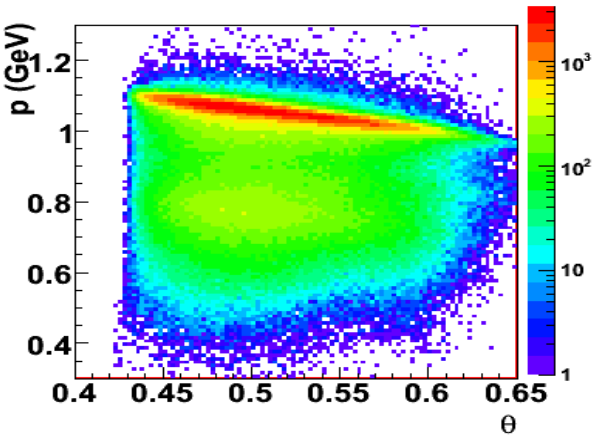
  p_h = 2.35 GeV/c

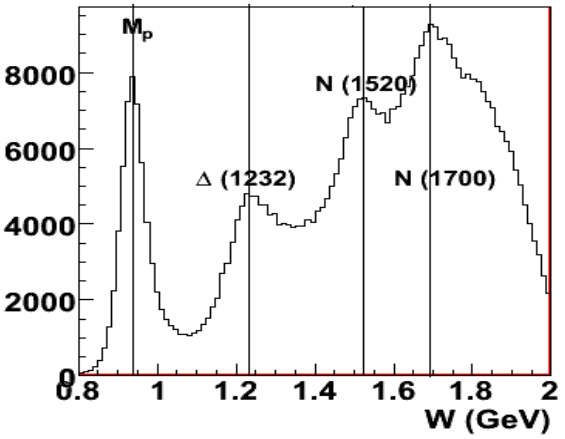
BigBite Analysis: Wire Chambers

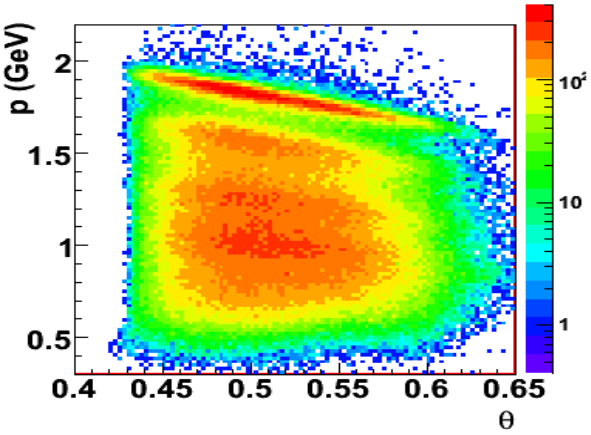
- Optics calibration using 1-pass and 2-pass beam energies.
- Chamber resolution: 180um





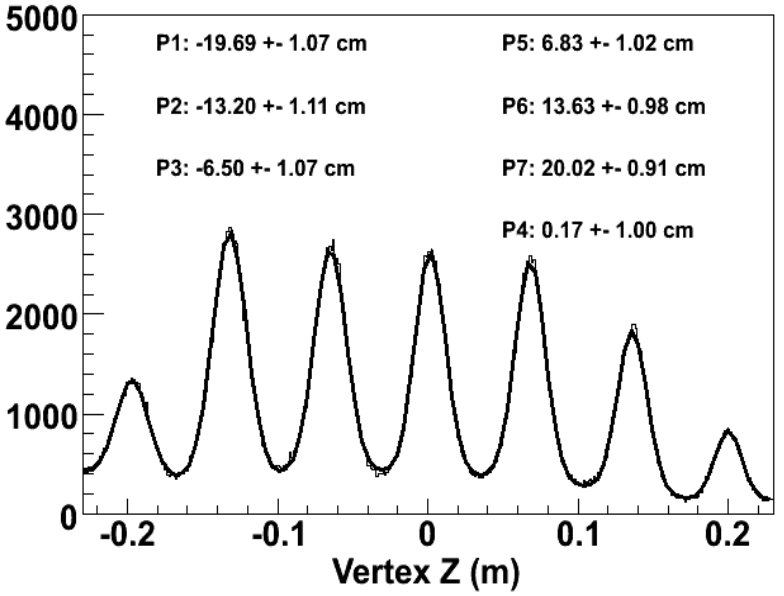




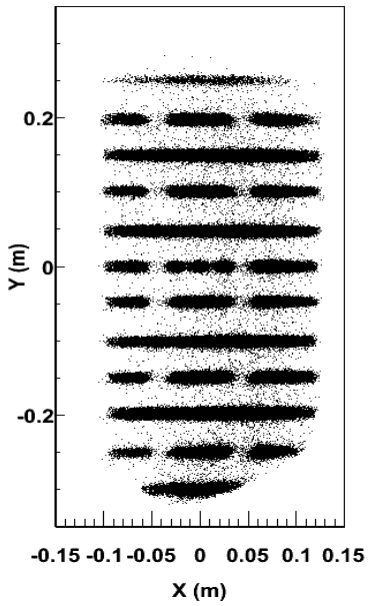


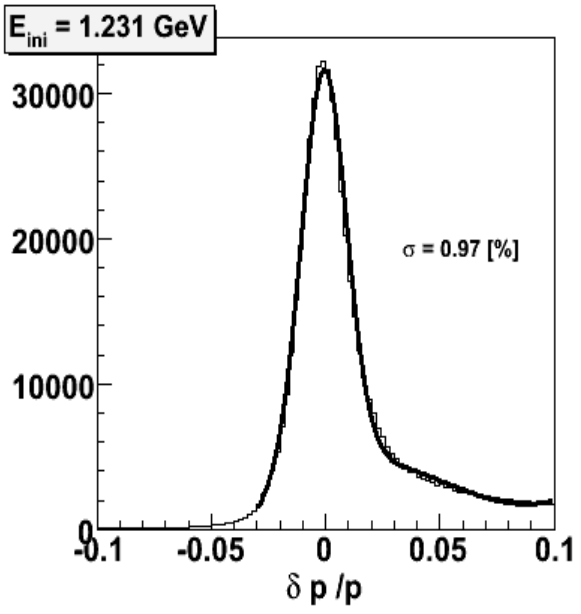
BigBite Analysis: Optics

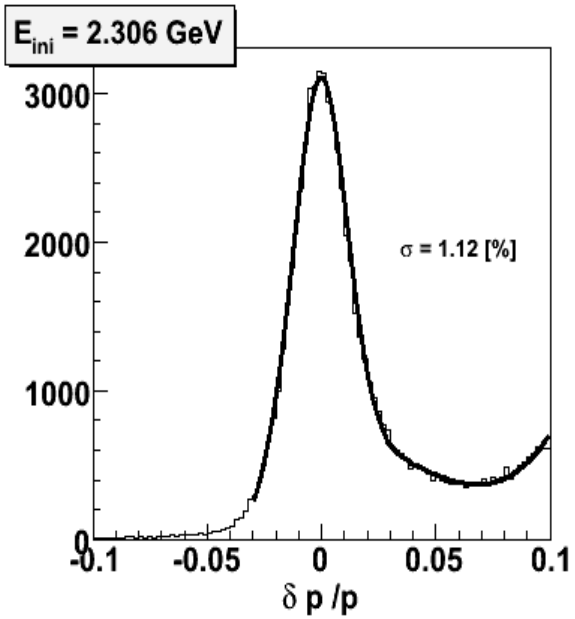
- Angular resolution: **< 10mrad**
- Vertex : **0.72cm**
- Momentum : **1%**



1.5” Lead Sieve Plate

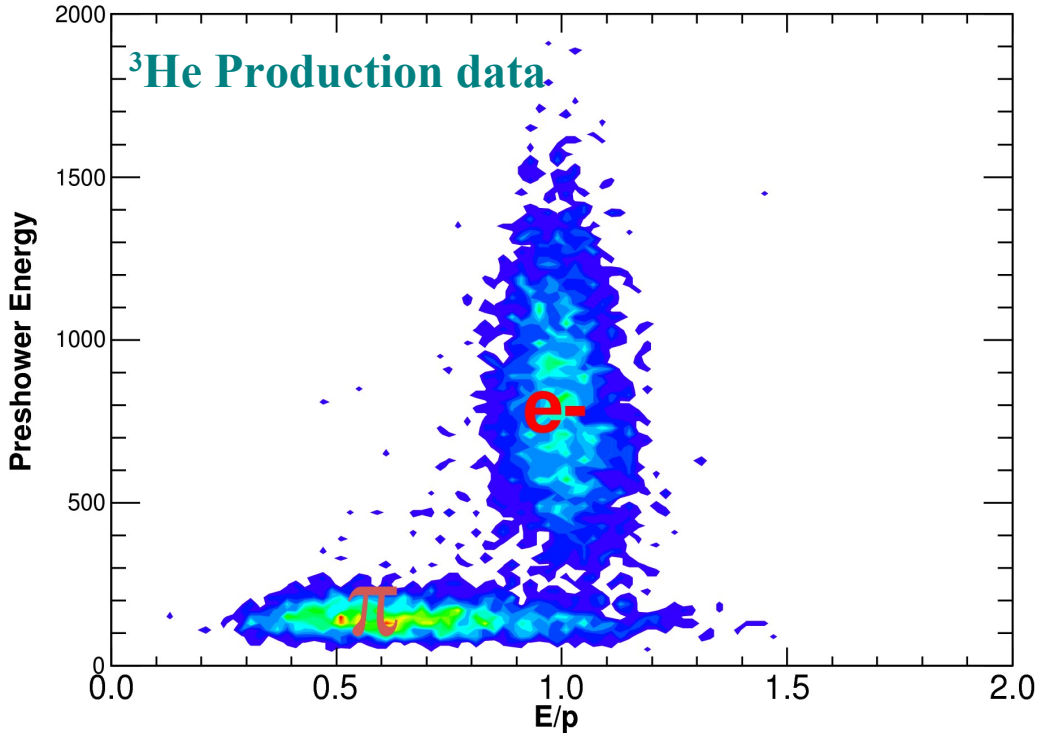


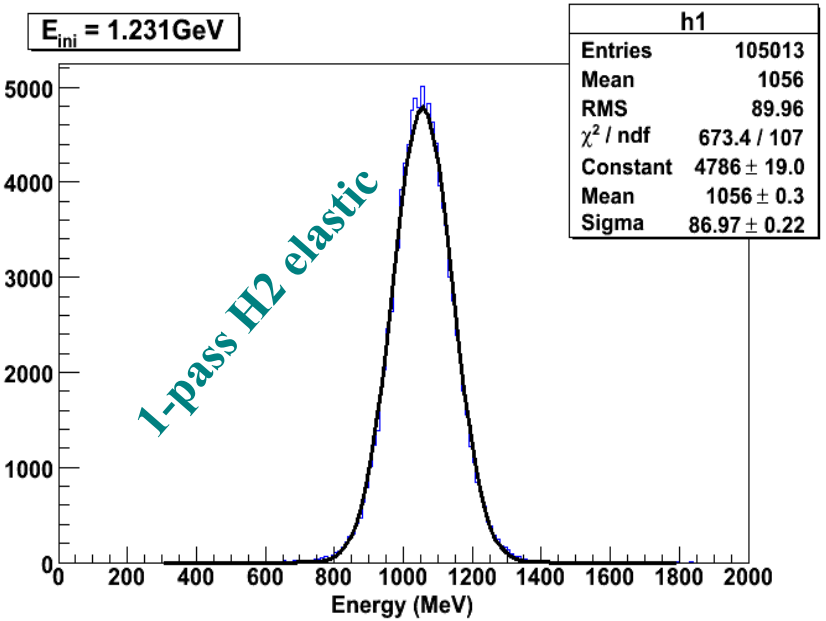


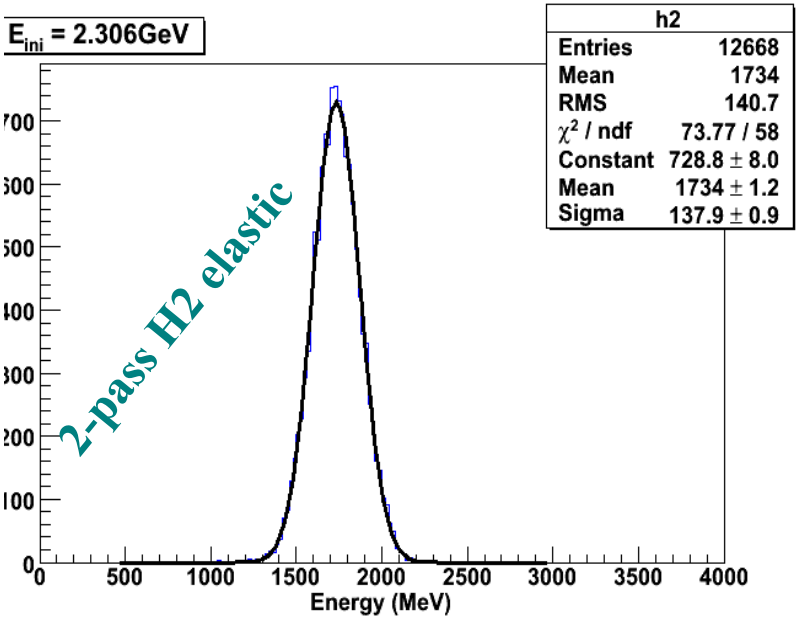


BigBite Calorimeter

- Calibration using H(e,e') elastic data at 1-pass and 2-pass beam energies.
- Resolution: 8%
- Well separated electrons and pions.
- Improved shower clustering software.

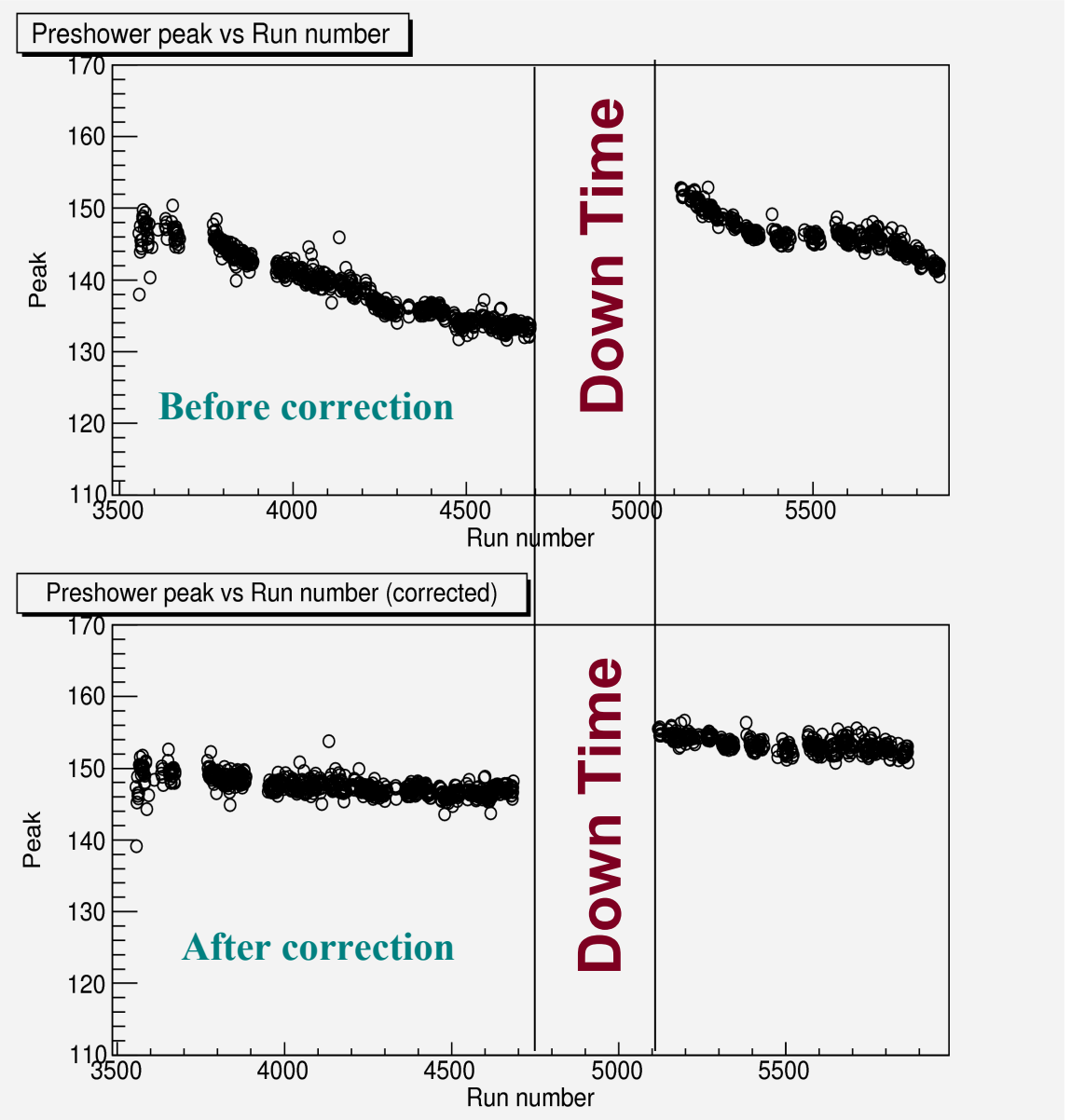






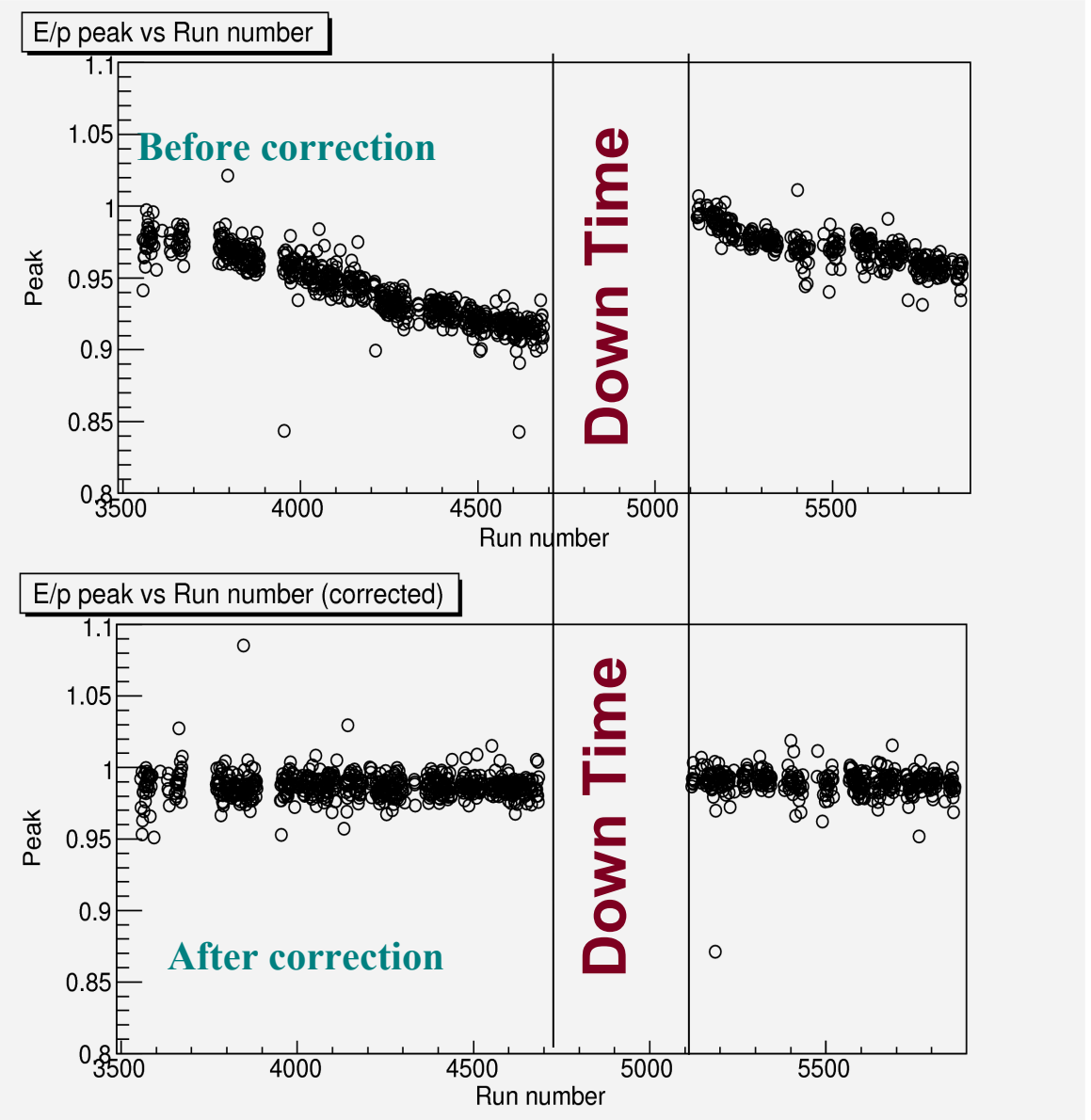
BigBite Calorimeter Degradation: Preshower

- Gain drop observed in Preshower. (~15%)
- Due to radiation damage.
- Adjusted HV in down time.
- Data divided into several periods.
- Corrections done in each period.
- Position dependent corrections.
- Preshower peak stable after correction



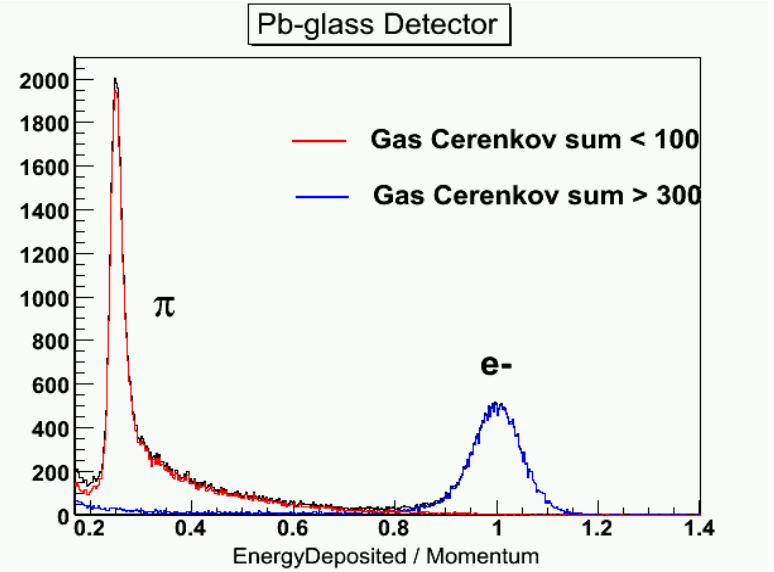
BigBite Calorimeter Degradation: Shower

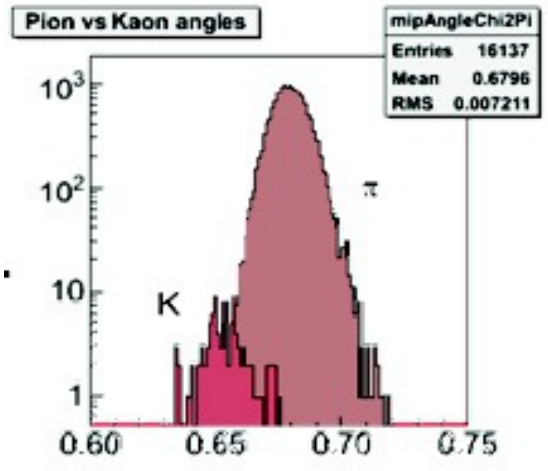
- Small effect on shower (< 5%).
- Away from beam line.
- Corrections applied after preshower is corrected.
- E/p stable after correction.



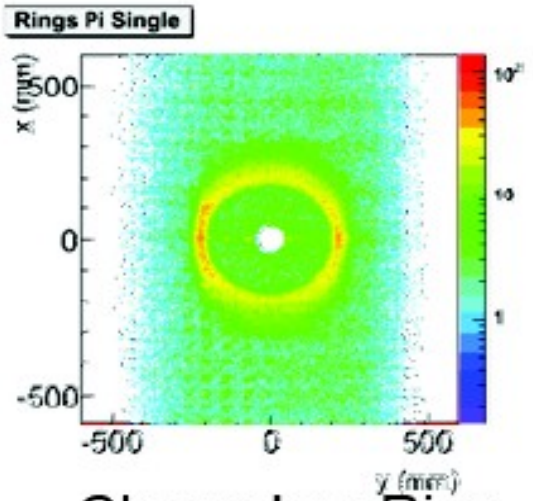
Left HRS Detector Performance

- Hadron arm
- Clean e/π separation in Pb-glass detector.
- TOF : Particle ID for hadron.
- Coincidence TOF Resolution: **340ps**
- Clear Identification of Kaons.

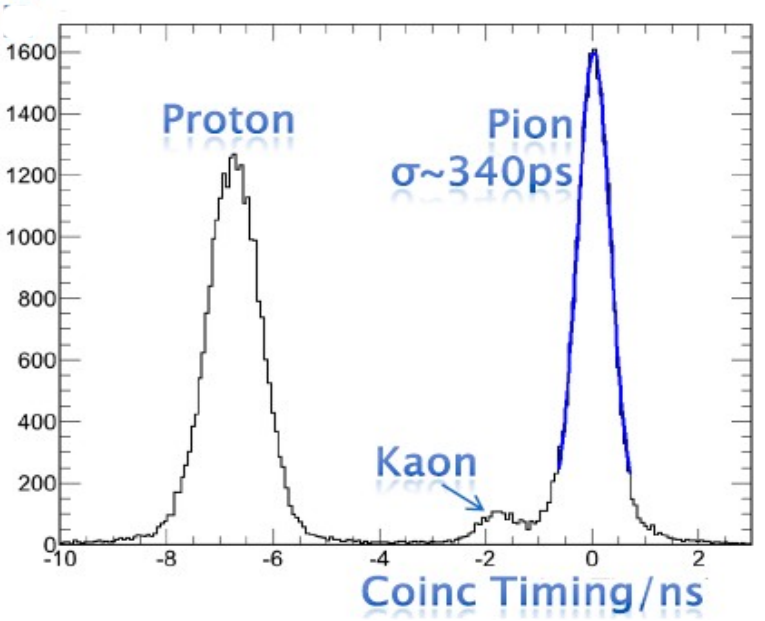




4 σ Separation

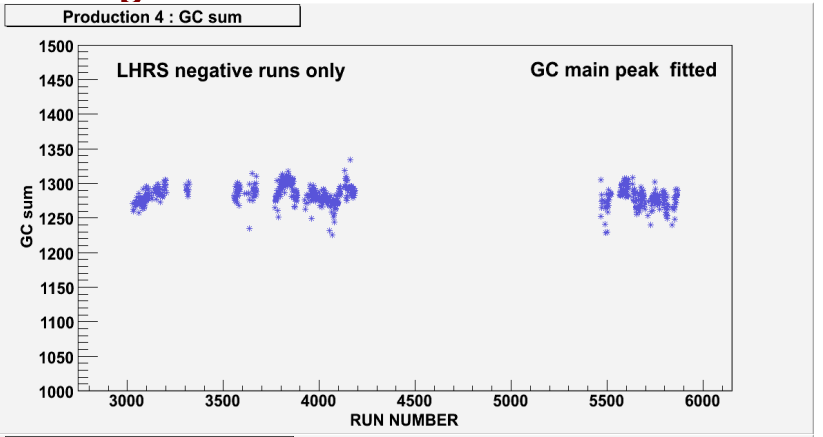


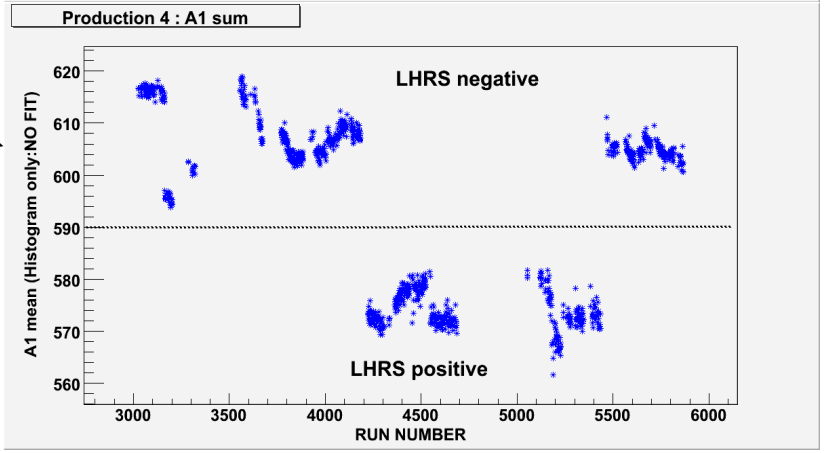
Cherenkov Ring From RICH

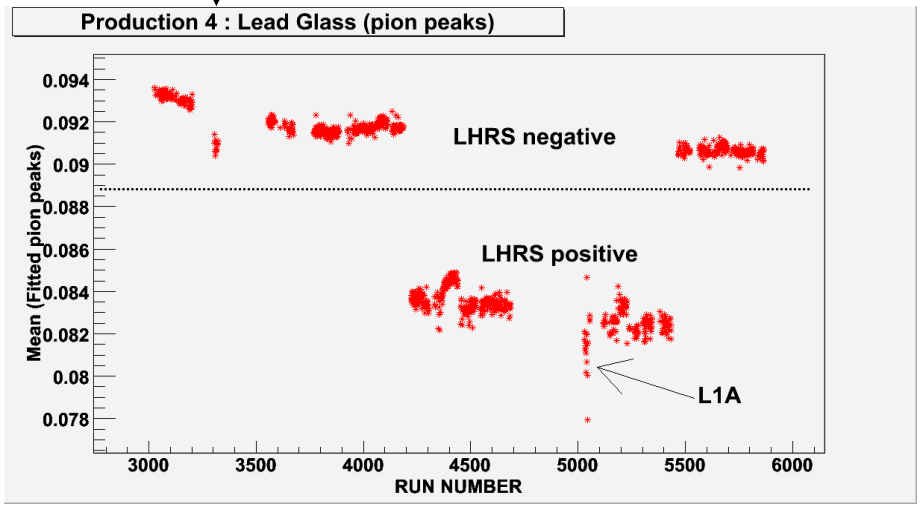


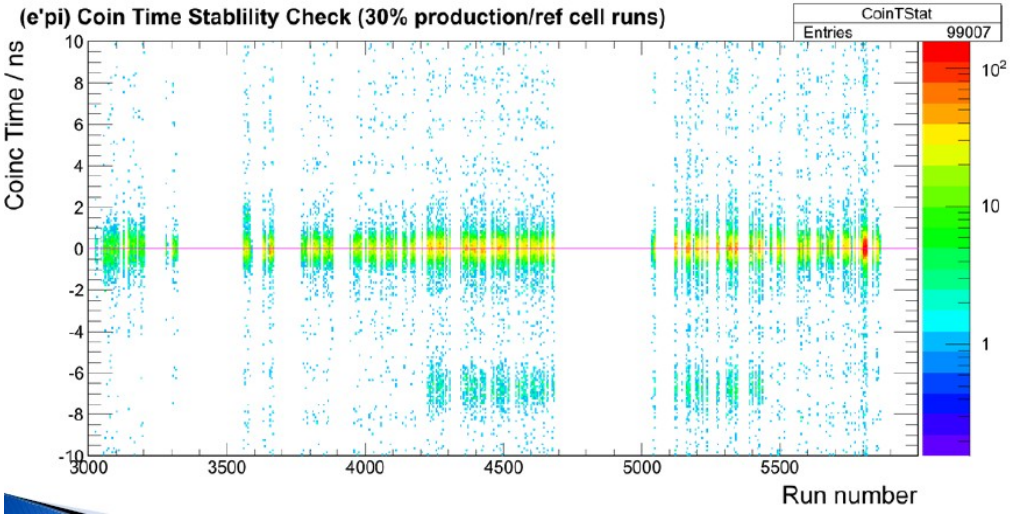
Left HRS Detector Stability Checks

- Extensive data quality checks done.
- Gas Cerenkov in negative polarity
- A1 detector
- Coincidence TOF
- Pb-glass



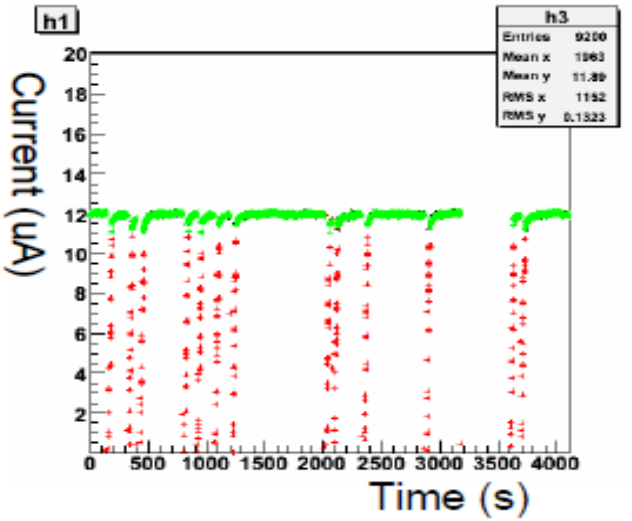




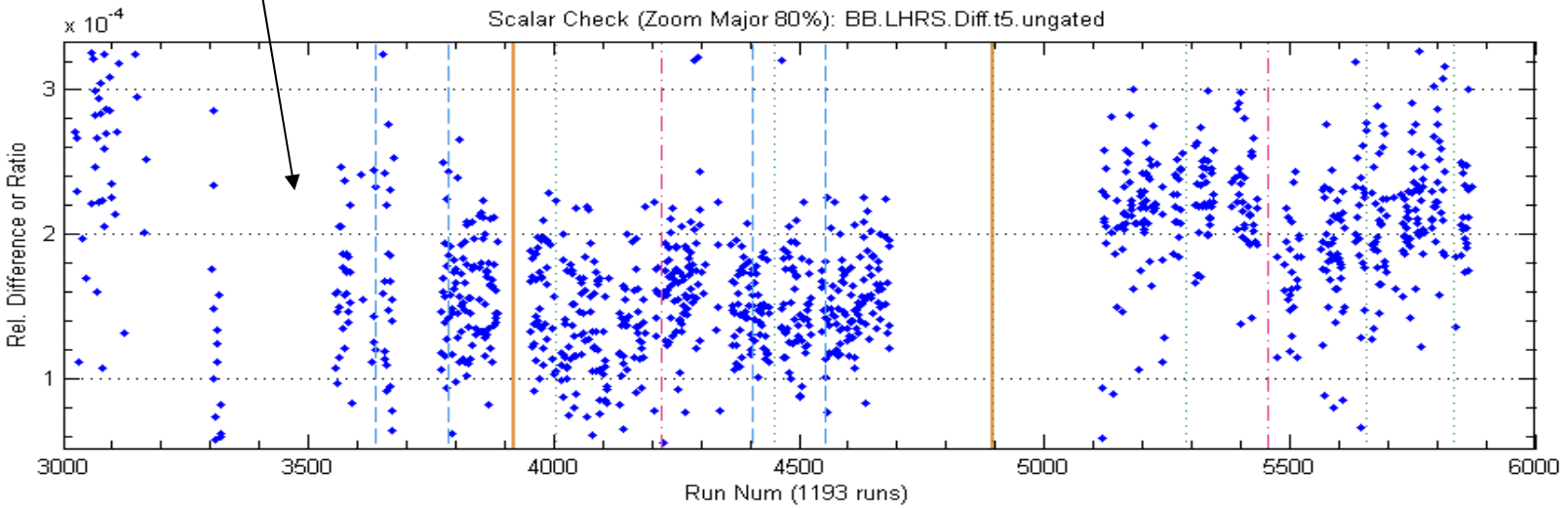


Scaler Stability Checks

- Two identical sets of scalers : BigBite and L-HRS.
- Cross-check between two sets.
- Problems in few channels of L-HRS scalers.
- BigBite scalers used for the final analysis.
- Coincidence trigger(T5) scaler stability check.

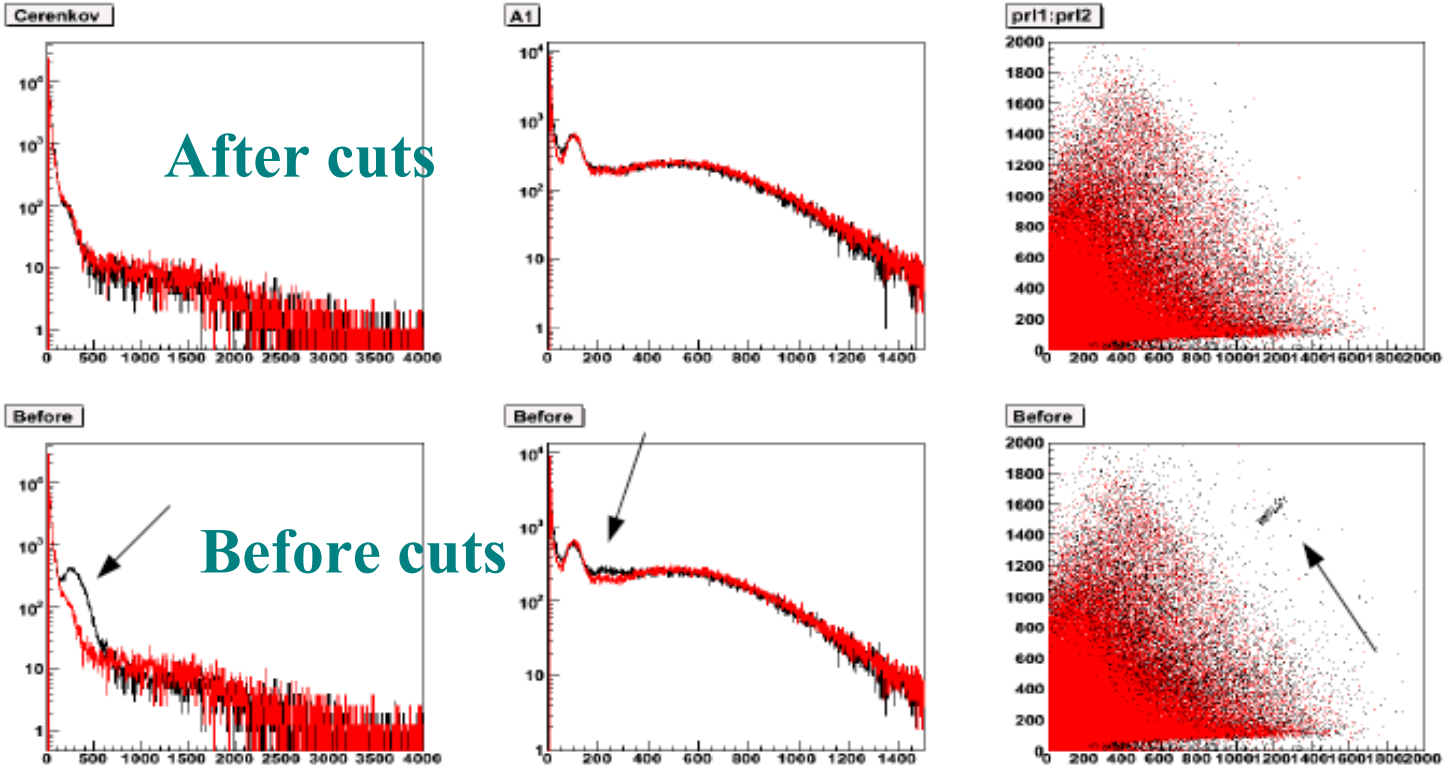


Beam trips are cut away



Level-1 Accept Issues in Left HRS

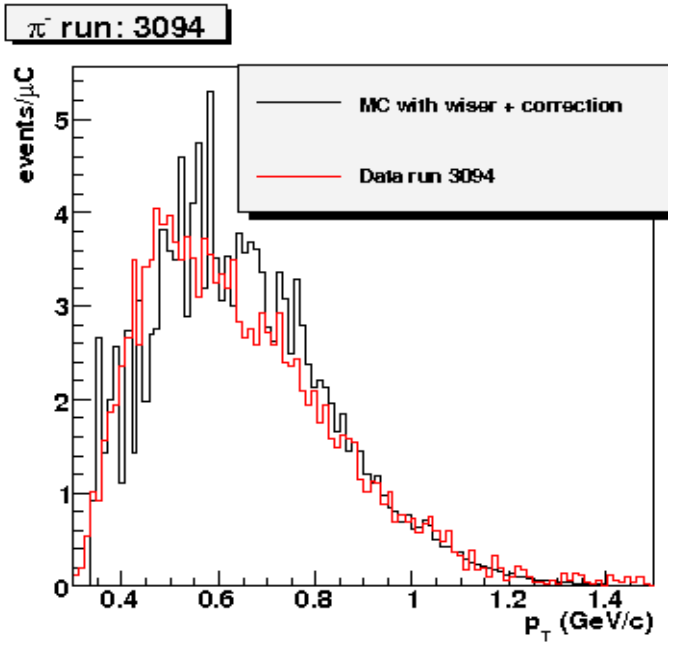
- L1A generates gates for ADCs and TDCs.
- Intermittent double-pulsing of L1A signal due to flaky cable (during Jan 2009).
- Affected about 56 runs.
- Small fraction of events are affected (< 10 %).
- Identified and flagged the events.
- Cut away events from the analysis.

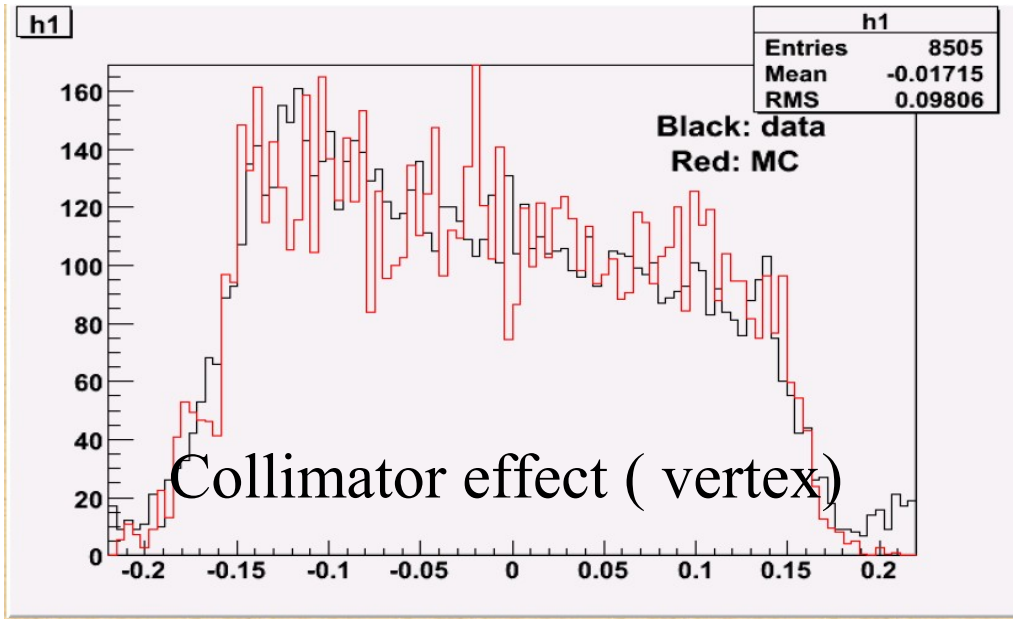


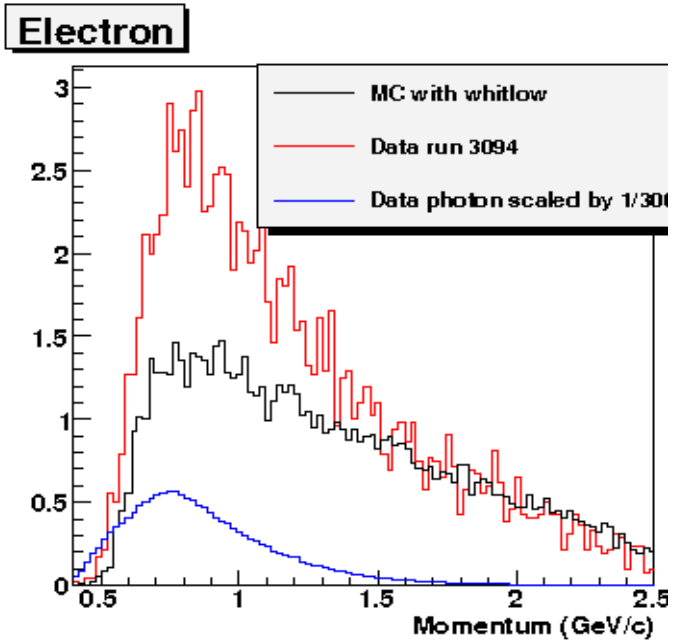
Monte Carlo Studies (BigBite)

- Major contamination from pions.
- GEANT-3 MC reasonably describe rates in the BB and L-HRS.
- From singles to coincidence:
  - Pion contamination reduced by factor of 5.
  - Photon contamination reduced by factor of 6.
- Work in progress…

(Xin Qian)







Status of the Analysis

Since Last Collaboration Meeting

- All the detector calibrations are finished.
- 4^{th} round farm replay is done.
- Data is “skimmed” into easy-to-use ROOT files.
- Extensive data quality/stability checks are done.
- BCM/BPM/Raster calibrations are finished.
- Scalers checks are finished.
- L-HRS optics is updated.

Current Analysis Focus

- Understanding possible sources of contamination in the BigBite.
- Developed Monte Carlo to study the contamination.
- Witness channel asymmetries as data quality checks.
- **Two teams** of three students each.
- Cross-check between two teams.
- Started to look at coincidence $(e,e'\pi^{+/-})$ and $(e,e'K^{+/-})$ channel asymmetries.
- Working on best method to separate Collins/Sivers effects.

Summary

- All the detector calibrations are finished.
- All the corrections (BB Shower, trigger timing etc..) are done.
- Scaler analysis is done.
- Fourth round farm replay (incorporating all the corrections) is done.
- Cross-checking witness channel asymmetries.
- Monte Carlo to understand various contamination processes.
- Target analysis is almost finished.
- Started to look at coincidence asymmetries
- **Preliminary results in Spring 2010!**