

BigBite Analysis

5-Pass $S=0$ E/p, PSum cuts and 5-Pass $S=90$ Data Quality

Matthew Posik

¹Temple University
Philadelphia, PA 19122

09/28/2011

1 5.89 GeV Target Spin = 0°

- E/p
- Cuts
 - Čerenkov
 - PSum

2 5.89 GeV Target Spin = 90°

- MWDC Stability
- TDC Stability
- Cut History

3 What's Next

E/p Calibration

- Due to the width of the E/p spectrum that I showed last week, I re-calibrated the E/p for the 5.89 GeV S = 0 run set.
- This was done by matching the deposited energy to the reconstructed momentum:

$$\chi^2 = \sum_{i=1}^M \left[p_i - \sum_{j=1}^{N^{ps}} C_{ij}^{ps} (A_{ij}^{ps} - P_j^{ps}) - \sum_{k=1}^{N^{sh}} C_{ik}^{sh} (A_{ik}^{sh} - P_k^{sh}) \right]^2$$

- M = total events
- $N^{ps}(N^{sh}) = 6(9)$, number of blocks in cluster
- A = Raw ADC
- P = Pedestal Value of ADC
- C = Calibration Constant

5-Pass Calibration constants

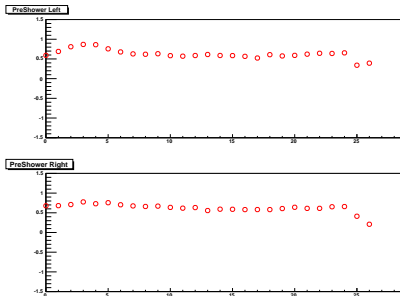


Figure: Shows 5-pass S=0 pre-shower calibration constants.

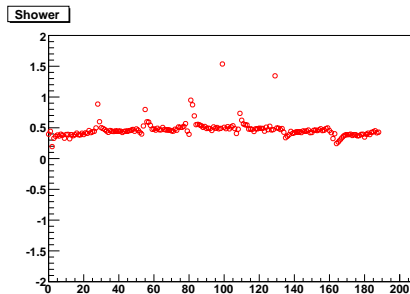


Figure: Shows 5-pass S=0 shower calibration constants.

5 Pass Energy Resolution Before/After Comparison

Cuts include: optics flag, T2 trigger, pre-shower energy, z-vertex, charge, momentum (see [09/22/2011](#) talk)

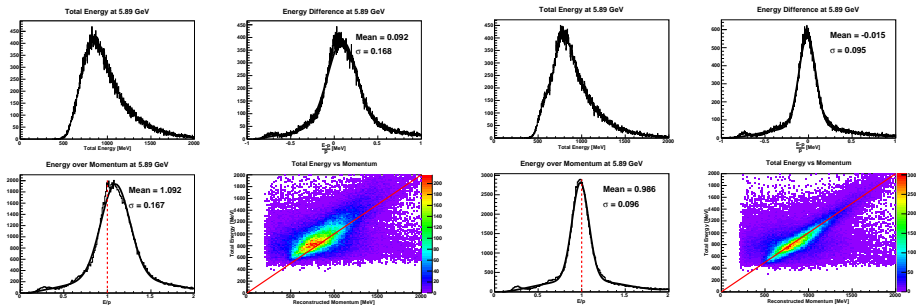


Figure: Shows energy resolution for 5-pass data before calibration

Figure: Shows energy resolution for 5-pass data after calibration

New 5-Pass S=0 Cuts

- Looked additional cuts for 5-pass data ...
- Defined BigBite Čerenkov cuts
 - TDC
 - Mirror
 - X track projected onto the Čerenkov plane
 - Select events that pass through Čerenkov mirrors
- Defined TDC cut on pre-shower hardware sum (PSum)
- Consists of 26 TDCs and ADCs

BigBite Čerenkov Beam Line Side Čerenkov TDC Cuts

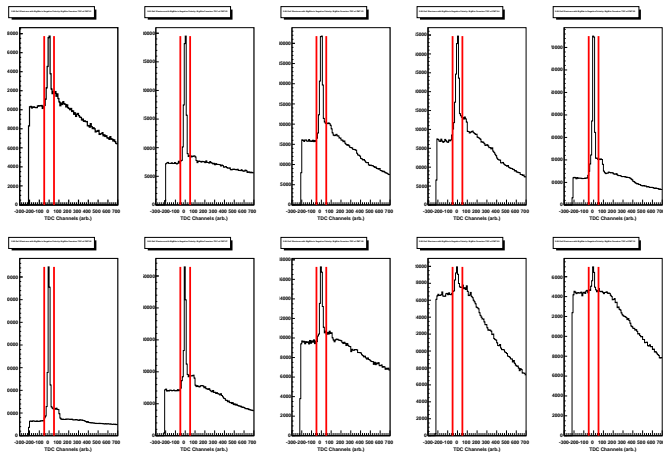


Figure: Red lines show TDC cut window for 5-pass S=0 data on small angle side of Čerenkov.

BigBite Čerenkov R-HRS Side TDC Cuts

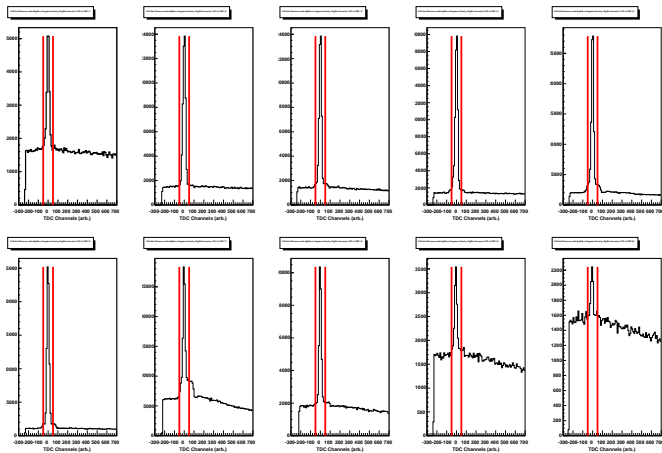


Figure: Red lines show TDC cut window for 5-pass S=0 data on large angle side of Čerenkov.

BigBite Čerenkov Beam Line Side Mirror Cuts

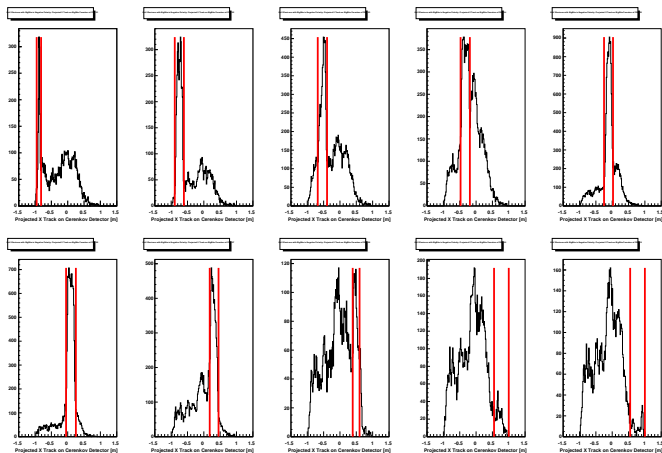


Figure: Red lines shows track x projection on the Čerenkov plane for 5-pass S=0 data on small angle side of Čerenkov.

BigBite Čerenkov R-HRS Side Mirror Cuts

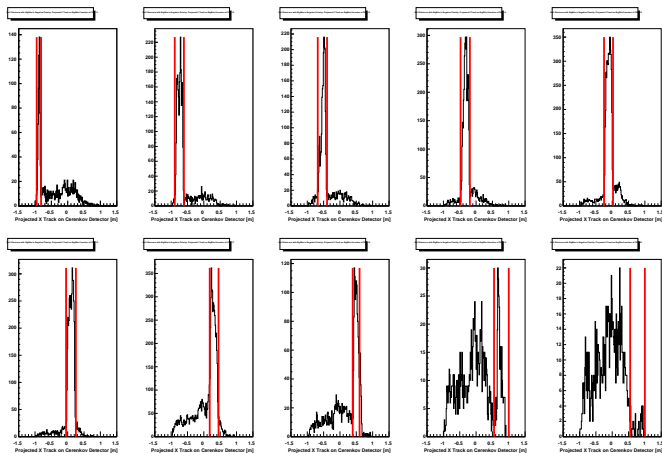


Figure: Red lines shows track x projection on the Čerenkov plane for 5-pass S=0 data on large angle side of Čerenkov.

Total Čerenkov X-Projection Mirror Cuts

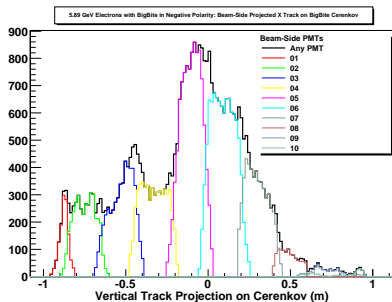


Figure: Shows total and individual beam line side mirror cut.

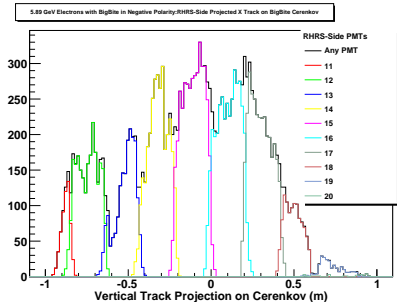


Figure: Shows total and individual R-HRS side mirror cut.

Čerenkov Cut Applied to E/p

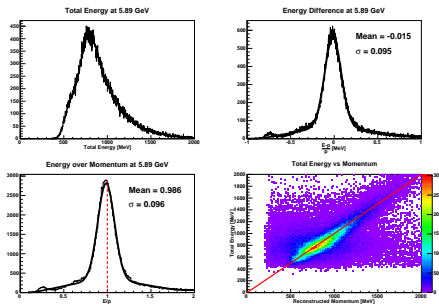


Figure: Shows calibrated E/p with no Čerenkov cut applied.

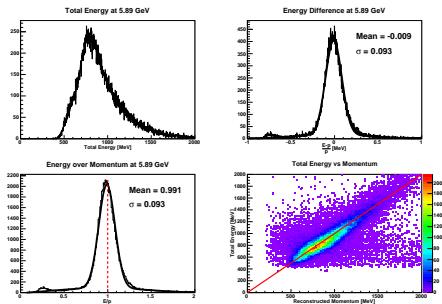


Figure: Shows calibrated E/p with Čerenkov cut applied.

E/p Cuts Applied to Pre-Shower

E/p Mean = 0.991, E/p σ = 0.093

Pre-Shower with E/p Cuts at 5.89 GeV

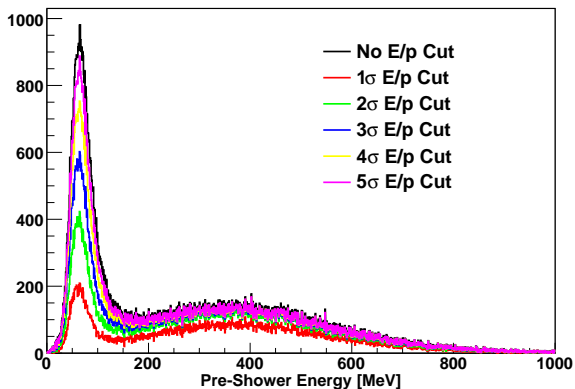


Figure: Shows various E/p cuts applied to the pre-shower.

PSum Cuts

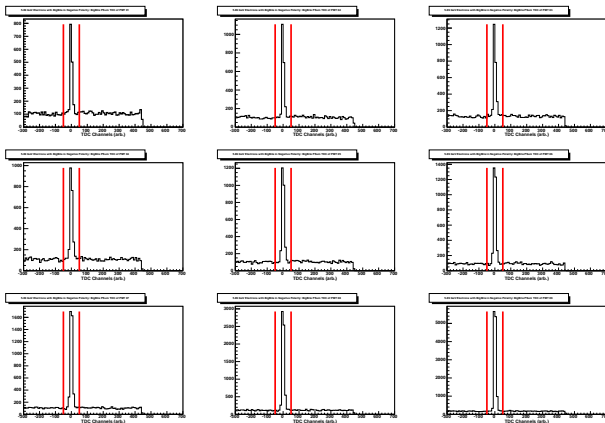


Figure: Red lines shows pre-shower sum TDC window cut for 5-pass S=0 data.

Other 17 pre-shower sum TDCs look like above, so not shown.

Forming PSum Cut

- PSum cut is formed as follows:

$$\text{PSum_TDC}[i] = TMath :: Abs(BB.psum.RT[i] - Mean[i]) < Width$$

- where i is TDC number and runs from 1 to 26
- Mean is the mean of the TDC timing peak
- Width is the width of the cut window. In this case **Width = 50 TDC channels**
- For the final cut, we select events that fall into any of the 26 TDC timings by an OR of the 26 TDCs.
- $\text{PSum_total_cut} = PSum^{TDC}[1] || PSum^{TDC}[2] || \dots || PSum^{TDC}[26]$

PSum Cuts Applied to Pre-Shower

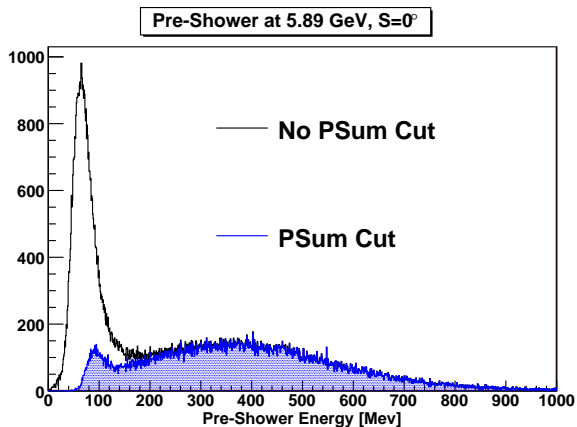


Figure: Black histogram is with basic cuts and Čerenkov cuts. Blue has same cuts as black histogram and pre-shower sum TDC cuts.

5-Pass $S=0^\circ$ Summary

- E/p calibration done for 5.89 GeV $S = 0^\circ$
- E/p resolution of 9%
- Čerenkov TDC and mirror cuts are now set for $S = 0^\circ$

MWDC t_0 and Track Residuals

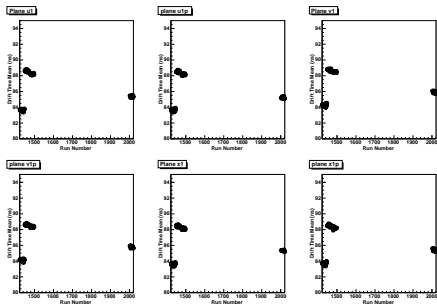


Figure: Shows t_0 Stability of MWDC chamber 1 for runs 1423-1498, 2002-2022

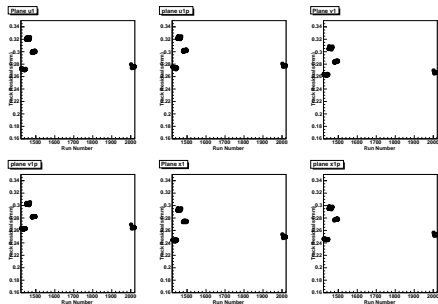


Figure: Shows track residuals stability of MWDC chamber 1 for runs 1423-1498, 2002-2022

5.89 S = 90° Stability Changes

- Changes in Stability are seen in all quantities looked at (will show soon)
- They seem to be correlated to changes in the shower/pre-shower thresholds
- Plot on the right shows shower thresholds for particular run periods

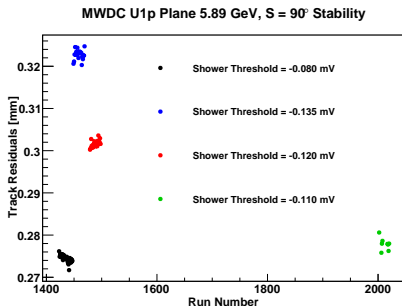


Figure: Shows the MWDC U1p plane residual values as a function of run number with the shower threshold value applied.

BigBite Čerenkov TDC Stability

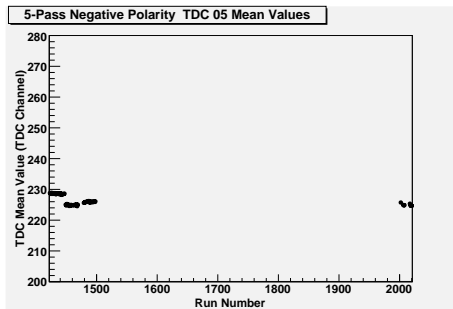


Figure: Shows TDC 5 of the BigBite Čerenkov for $S=90^\circ$ 1423-1498, 2002-2022

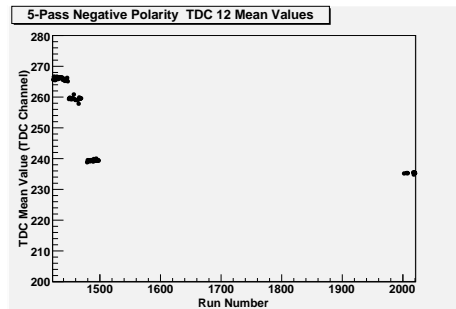


Figure: Shows TDC 12 of the BigBite Čerenkov for $S=90^\circ$ 1423-1498, 2002-2022

5-Pass Cuts: Stability

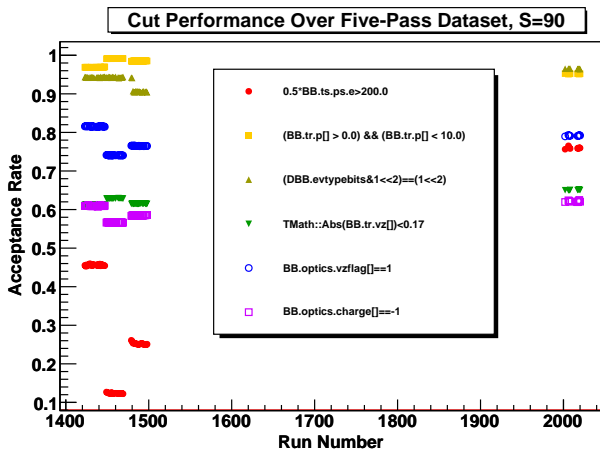


Figure: Shows cut history of cuts on 5-pass S=90 data.

5-Pass S=90° Summary

- Stability issues seem to be caused by **shower/pre-shower threshold** changes
- Quantities are **stable** within a given threshold value
- MWDC t_0 and **track residuals** look good over wave-plate OUT S=90°
- Čerenkov TDCs may need to be adjusted for each threshold change

What's Next...

- Continue with 5-pass $S=90$ data quality (wave-plate IN):
 - Look at MWDC t_0 and track residuals
 - Look at Čerenkov TDC
- Continue working on 5-pass $S=0$ data:
 - Work on solidifying E/p and pre-shower cuts
 - Implement track match to pre-shower/shower cuts
 - Look at re-scattering cut
- Revisit BigBite e^+/e^- ratios during 4-pass running with correct ps and LT:
 - I have pre-scales for all 4-pass runs
 - In computing live time, I need $n=0$ events
 - Currently our replayed root files have cut $n_{\zeta} > 0$
 - Replay 4-pass runs with only scalar and DBB variables on data1 disk