d_2^n Shower

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Shower Energy Minimization

- Shower and PreShower blocks are summed and reconstructed into clusters (3x3)blocks for shower.
- Energy of the Clusters is then Minimized using a χ^2 linear minimization.

Shower Calibration

$$\chi^2 = \sum_{n=1}^{N} \left[\sum_{i \in M^n} C_i^{sh} \left(A_i^{sh} - P_i^{sh} \right) + \sum_{i \in M^n} C_i^{ps} \left(A_i^{ps} - P_i^{ps} \right) - E_e^n \right]^2$$

- $n = 1 - N$ Number of Events
- M^n Number of blocks in cluster
- C_i^{sh} Calibration coefficient of i^{th} shower block
- C_i^{ps} Calibration coefficient of i^{th} preshower block
- A_i^{sh} Amplitude in i^{th} shower block
- A_i^{ps} Amplitude in i^{th} preshower block
- P_i^{sh} Pedestal in i^{th} shower block
- P_i^{ps} Pedestal in i^{th} preshower block
- E_e^n Known energy of particle (momentum tracking)

Problem with Reconstruction Script

Problem

Energy reconstruction script crashes (divide by zero error) when including all electron cuts:

- One or more reconstructed tracks
- Trigger 2 cut
- Preshower cut
- z-Vertex cut
- Invariant mass cut
- E/p cut

Electron Cuts

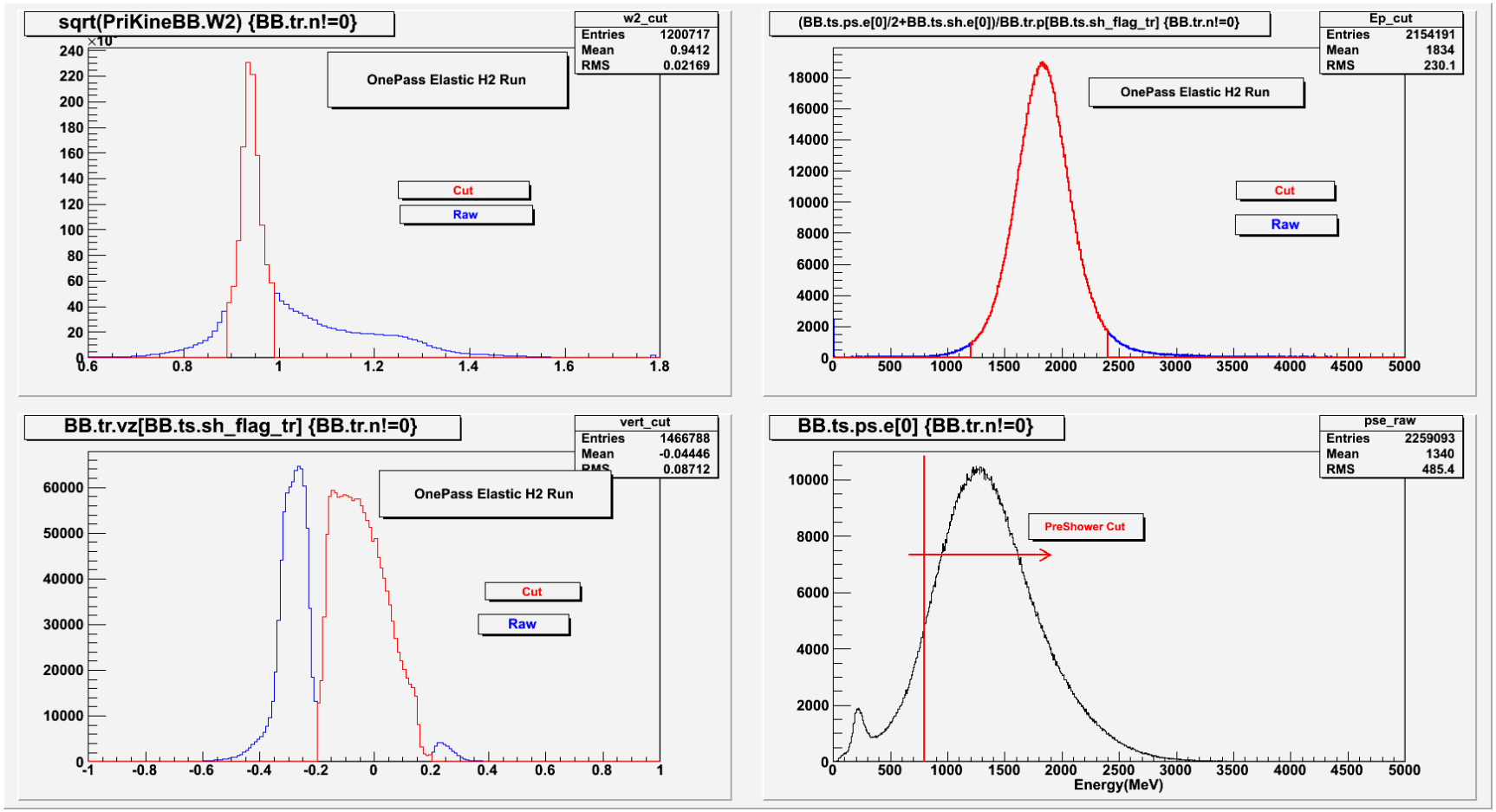
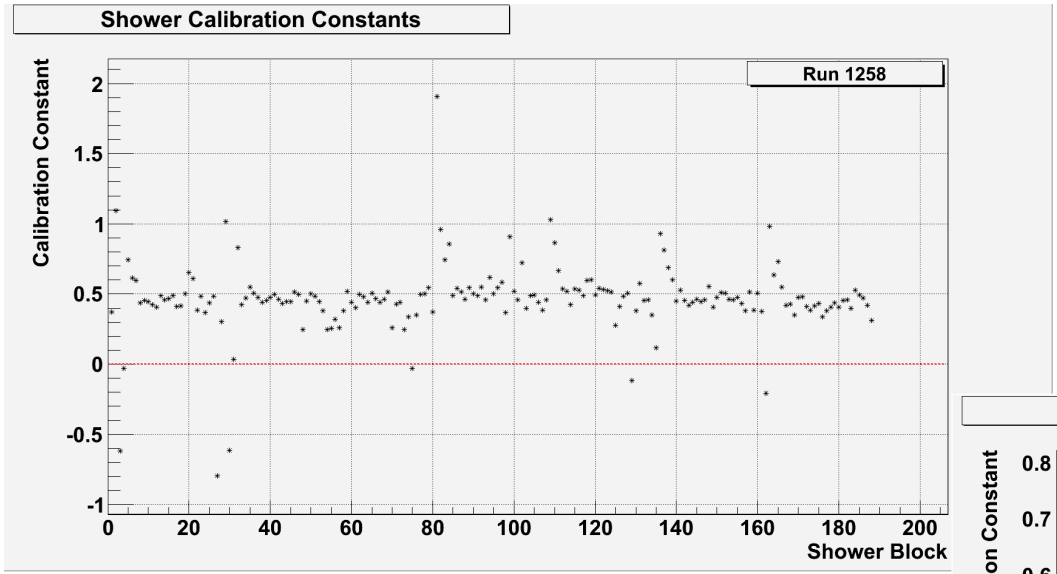


Figure 1: Electron cuts used in H2 elastic runs

Problem with Reconstruction Script

- Removing the E/p cut allows the reconstruction script to finish and the minimization of the energy to converge.
- Produces negative Calibration coefficients
- Negative coefficients on blocks
  - Blocks 1,4,5,28,37,76,130 and163.
  - All blocks except for 130,76 lay on the edge and block 37 near the edge.

Negative Coefficients



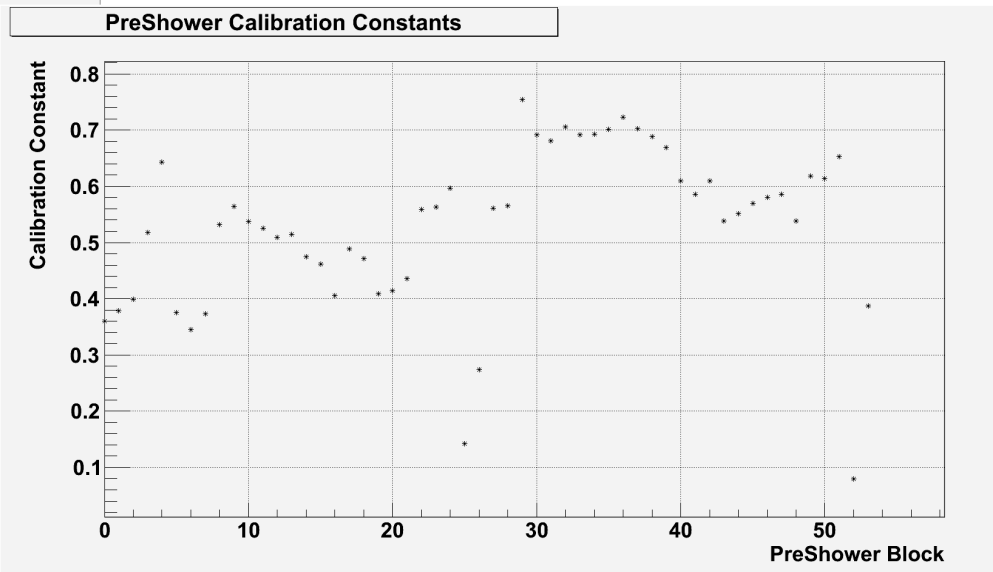


Figure 2: Calibration Constants for H2 elastic run

Block Amplitudes

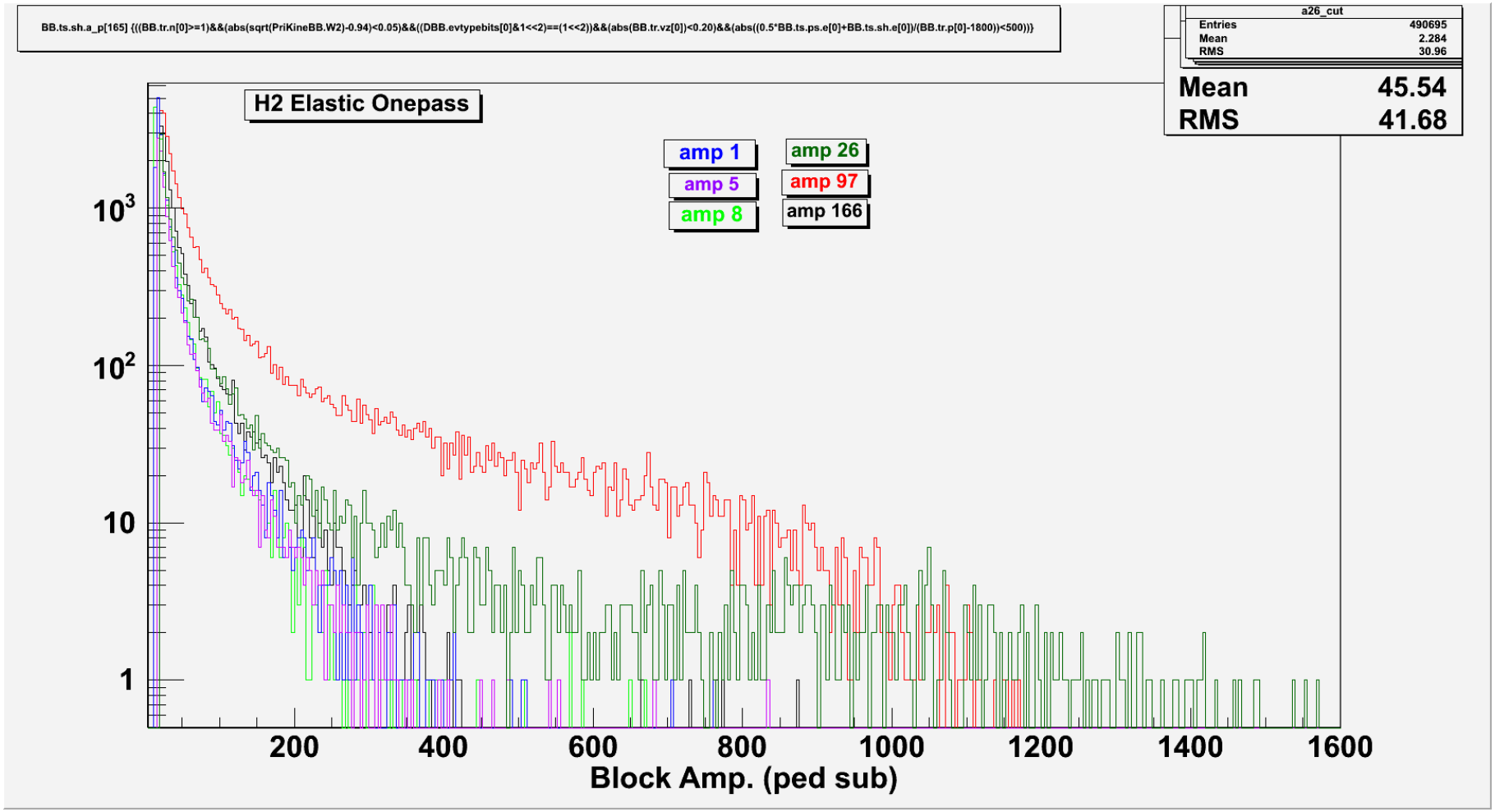


Figure 3: Block amplitudes of various block with electron cuts applied

A Look Closer at the Cuts

Can test if the cut in the reconstruction script are working right by comparing number of events in reconstructed file to events in

$$T->Draw("BB.tr.n", cuts)$$

If cuts are working correctly they should be equal.

Working Cuts

The following cuts work correctly:

- one or more tracks
- trigger 2
- z- vertex
- preshower

On one rootfile each produce 62,706 events.

Not Working Cuts

The following cuts do not work correctly:

- Invariant mass
- E/p

Using invariant mass there are more events in the reconstructed root file and E/p cut gives a ”divide by zero” in the reconstructed root file. What do these cuts have in common?...Momentum

Not Working Cuts

E/p:

- Added the condition that $BB.tr.p > 0$
- Now the E/p events match each gives 60,961 events

W2:

- Using the $BB.tr.p > 0$ does not work for Invariant mass cut.
- the $T->Draw()$ gives 42,767 events and reconstructed root file gives 42,826 events.

Something is still wrong with momentum.

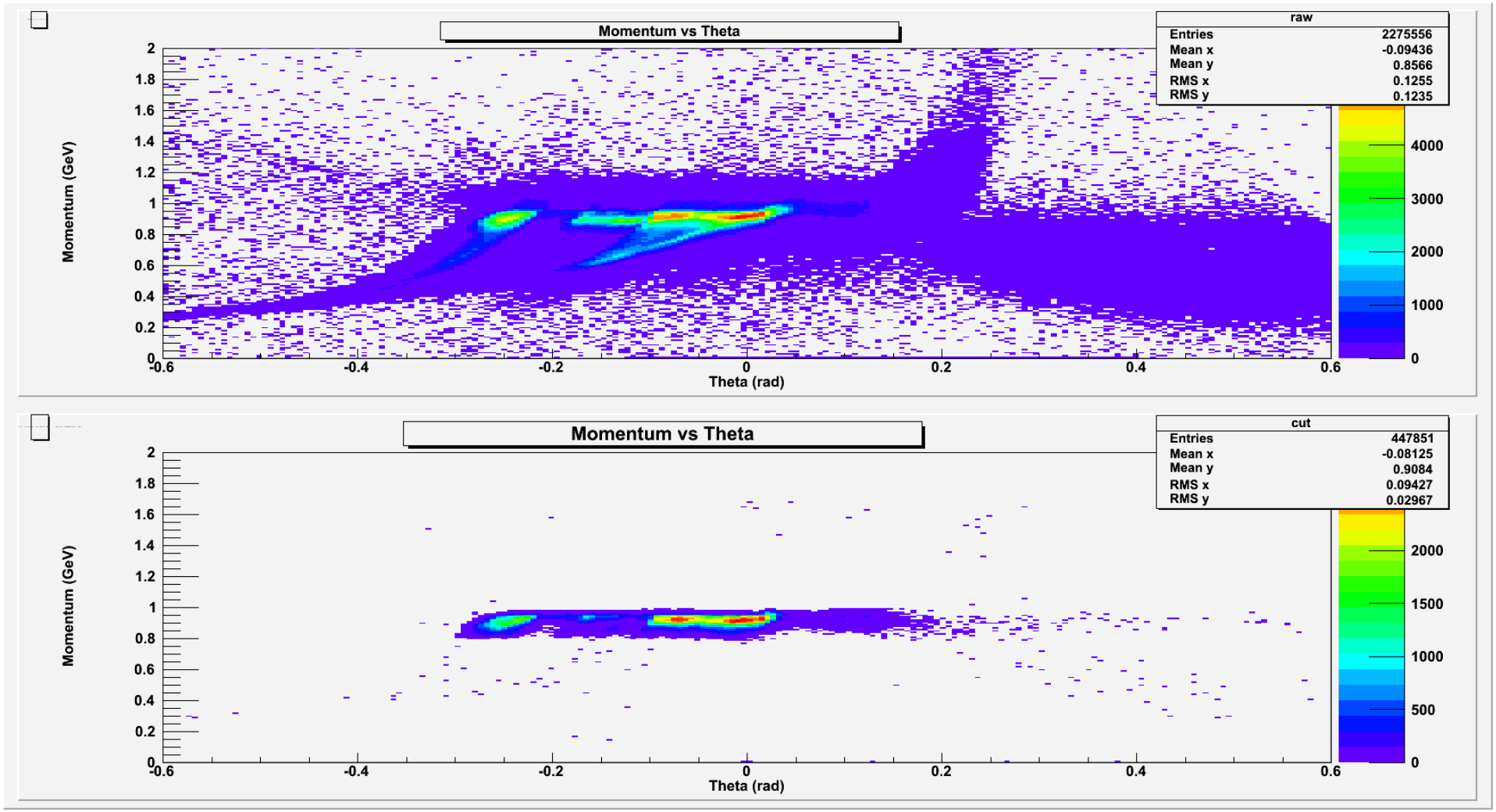


Figure 4: Momentum vs Theta for onepass elastic H2 runs without and with electron cut.

$$p_{elastic} = \frac{(1.231)(0.938)}{\left(0.938+1.231\left(1-\frac{BB.tr.pz}{BB.tr.p}\right)\right)}\ ,\ \frac{BB.tr.pz}{BB.tr.p} = cos(\theta_e)$$

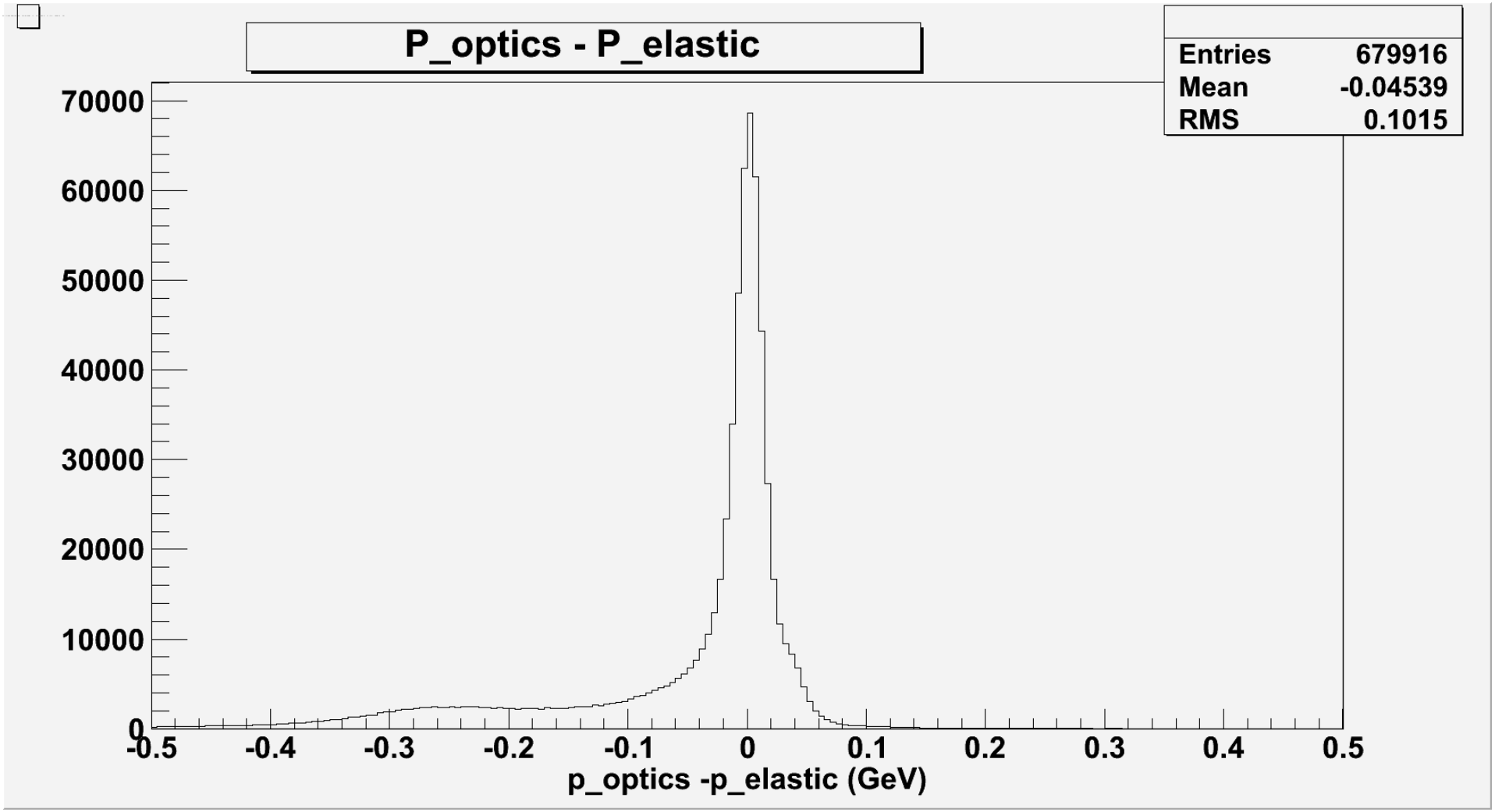


Figure 5: Difference of tracking momentum and elastic momentum for onepass elastic H2 runs without and with electron cut.

Theta

Why double peak structure on left theta and an axis shift?

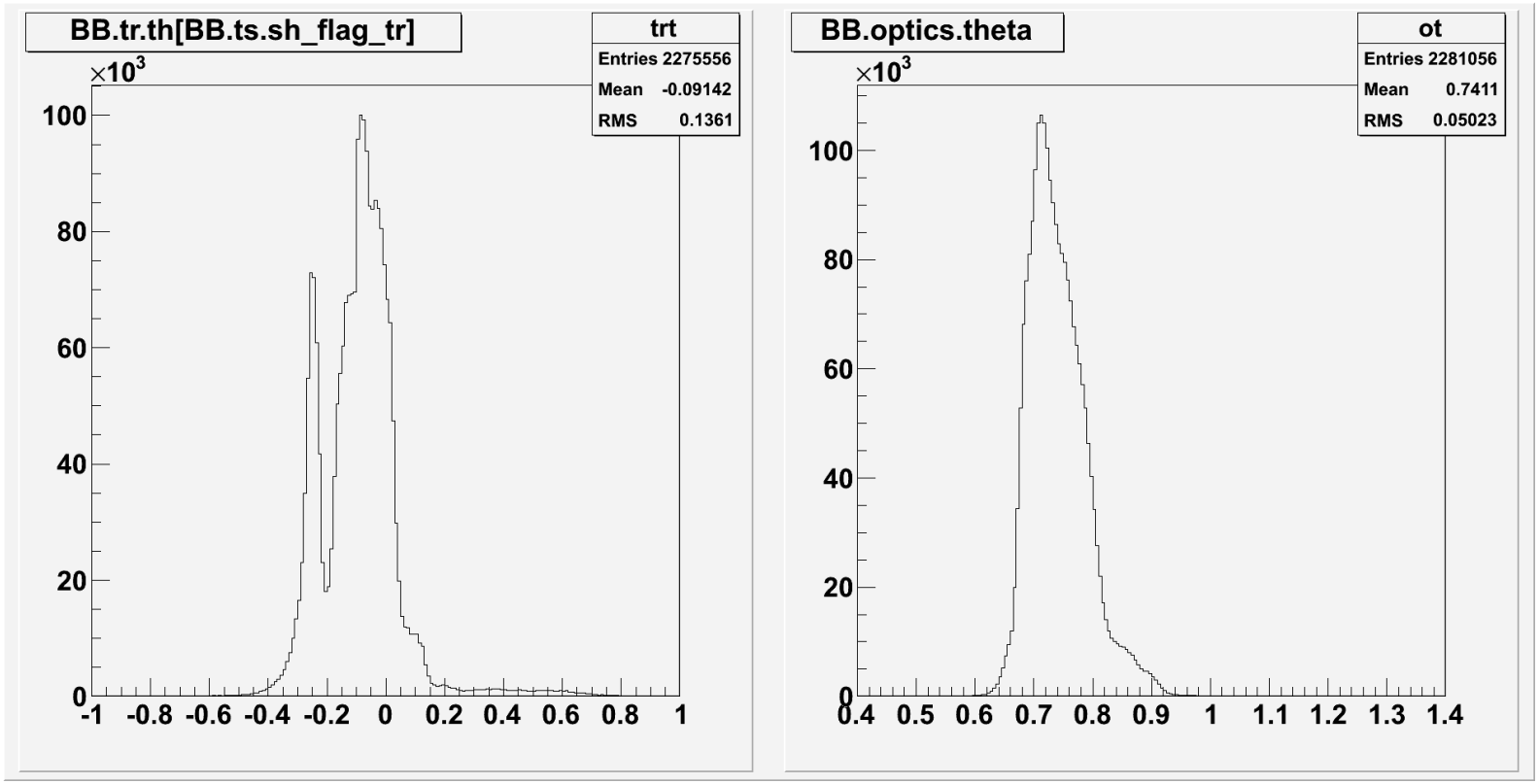
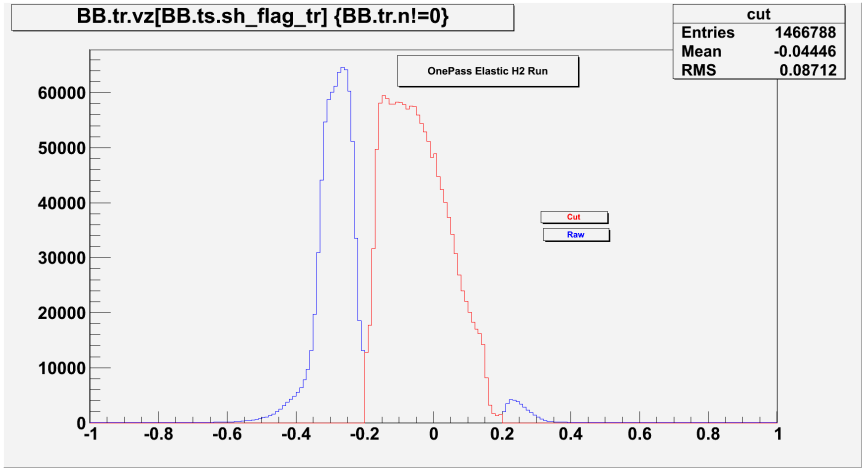


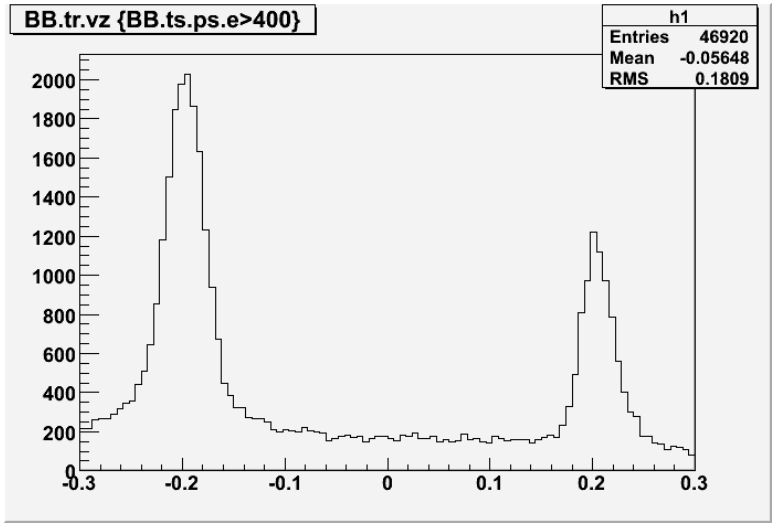
Figure 6: old tracking theta and new tracking theta

Is it an optics issue? Need to check how BB.optics class works.

Z-Vertex

Why is the z-vertex so different?





Using Negative Calibrations

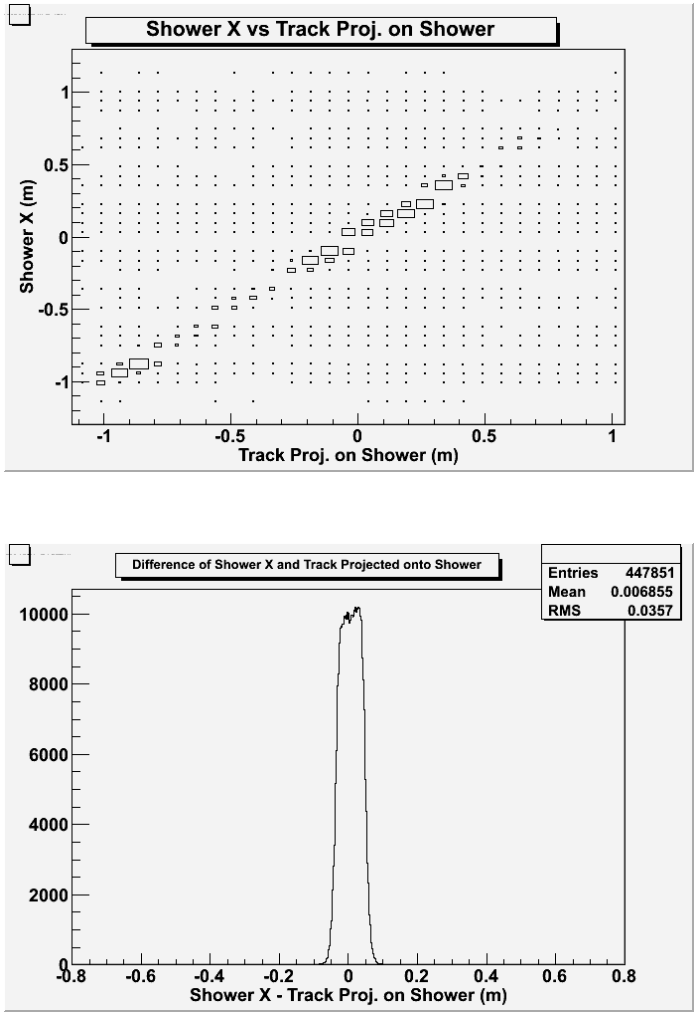


Figure 8: Shower x and projected track x distributions for onepass elastic H2 runs.

Using Negative Calibrations

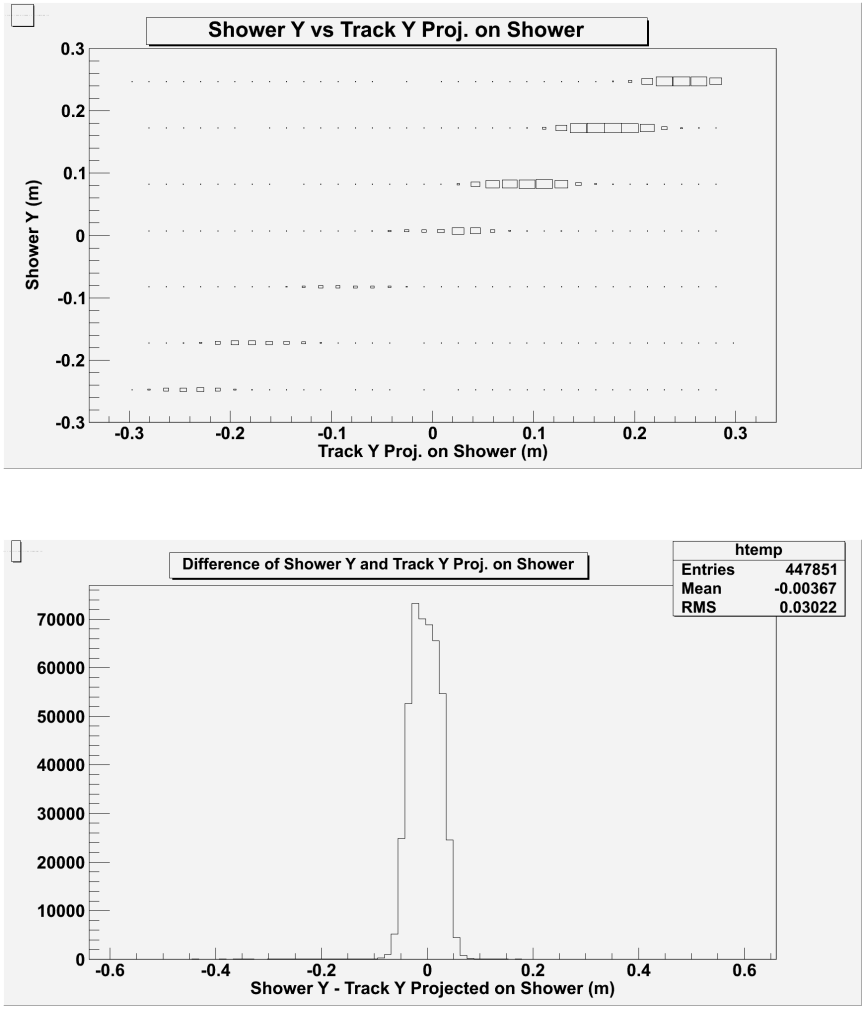
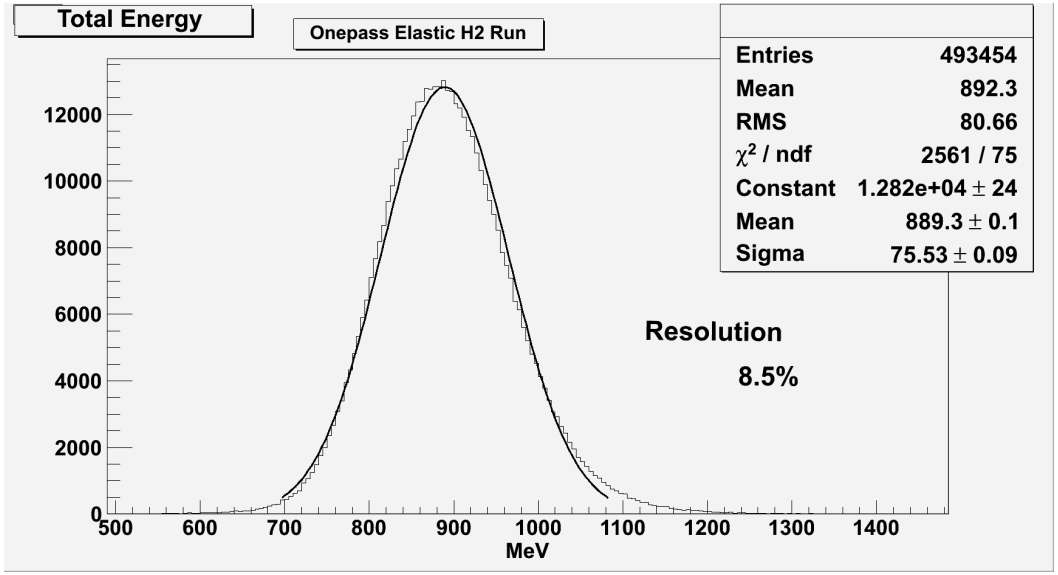


Figure 9: Shower y and projected track y distributions for onepass elastic H2 runs.



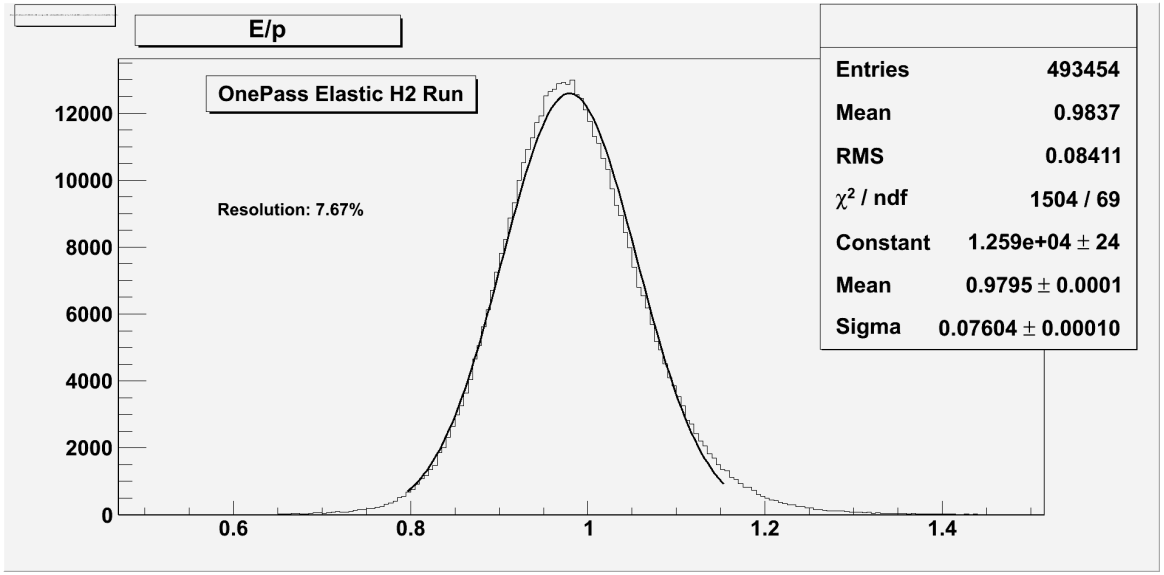


Figure 10: Total Energy and E/p shower resolution for onepass elastic H2 runs.

Preshower vs E/p

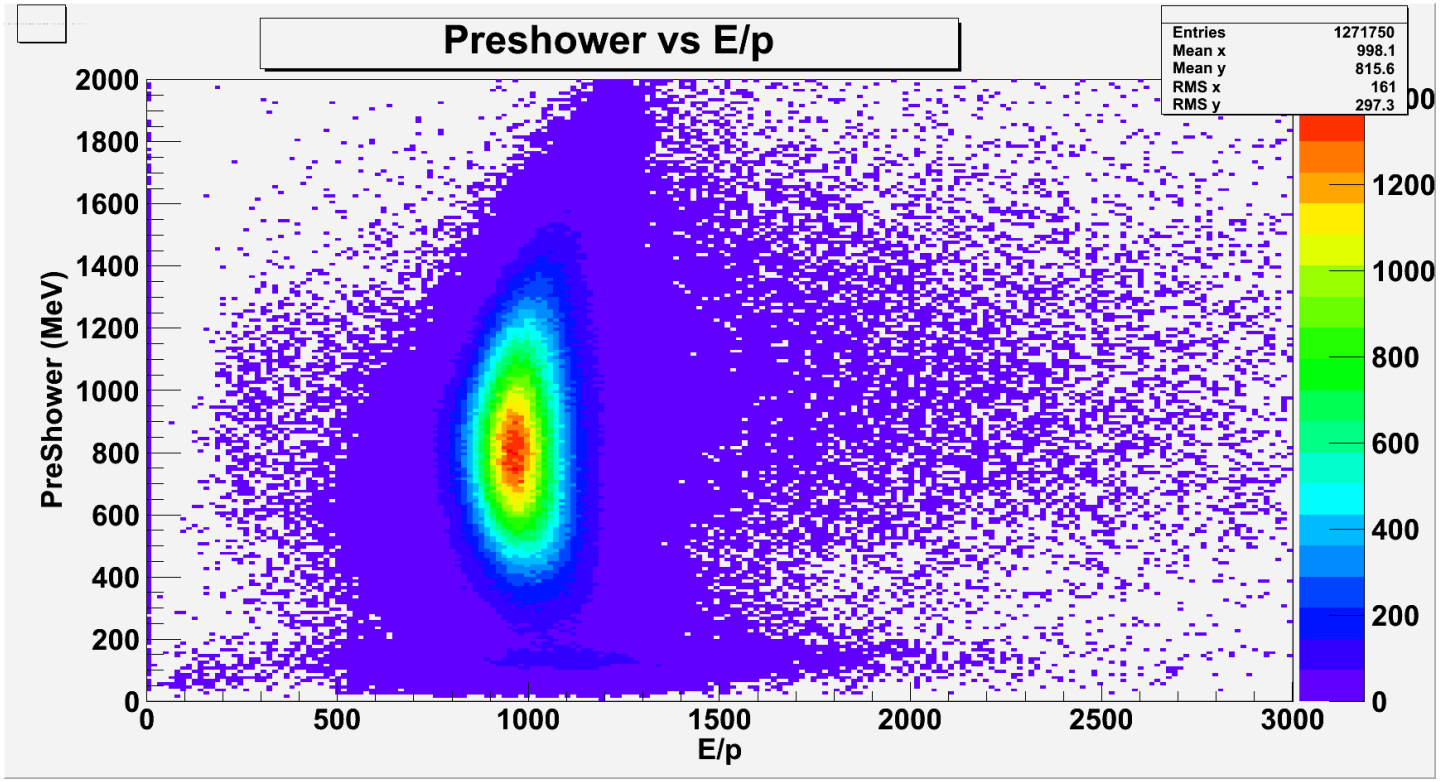


Figure 11: Preshower vs E/p onepass elastic H2 runs.

To-Do

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- Fix d2 analyzer.
  - Missing tracks are needed for shower calibration
- Run shower calibration energy reconstruction and minimization scripts for one-pass runs.