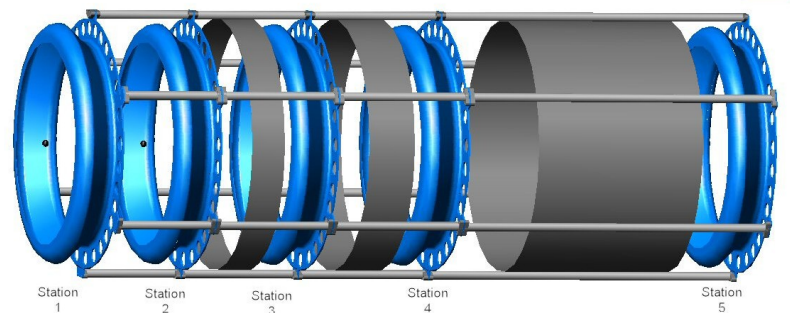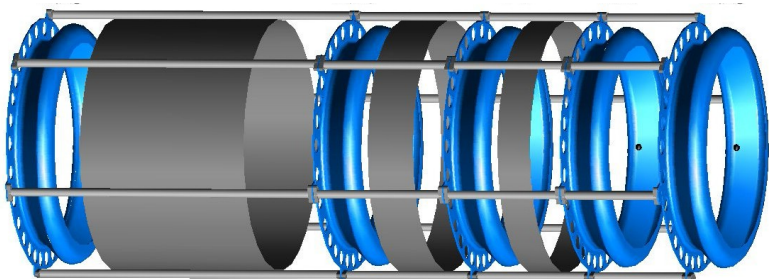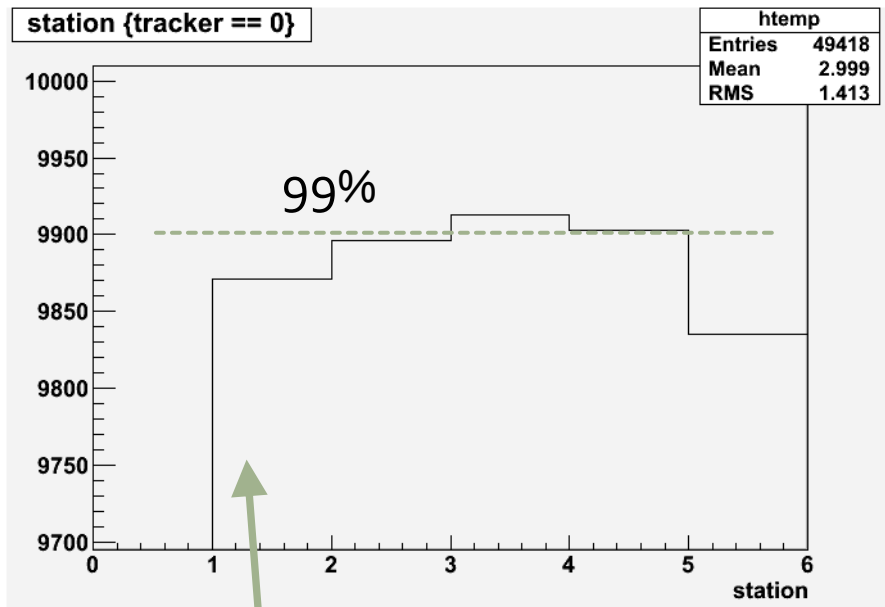Timothy Carlisle
Oxford

Tracker Reconstruction

Reconstruction in G4MICE

- Simulate → Digitize → Reconstruct
- TrackerRec/ package
- 4 or 5 point tracks (Kalman fit)
- ROOT files for each Tracker Station
  - No TrackerRef Plane as yet
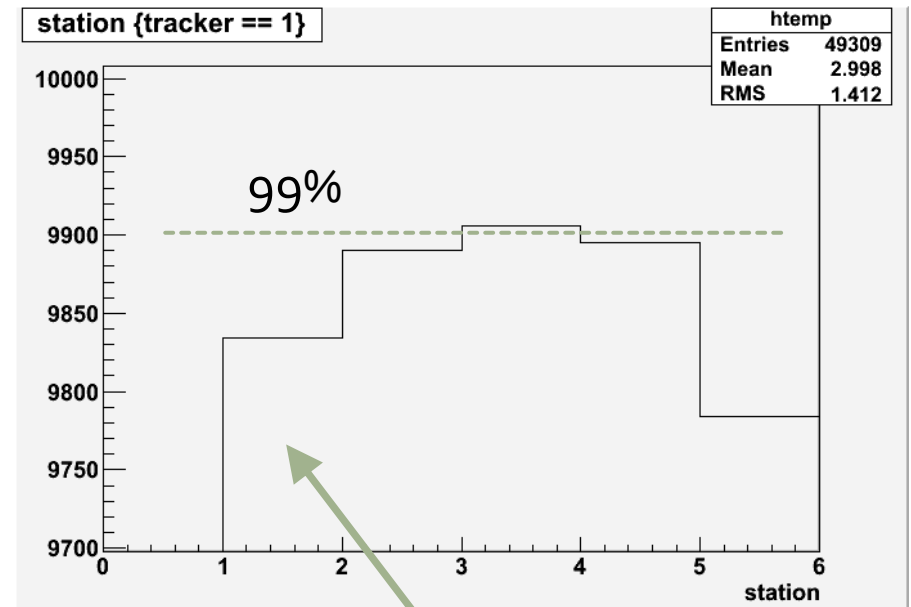- Use station 1 as ref. → innermost stations

Station 1   Station 2   Station 3   Station 4   Station 5

Track Fitting Efficiency

- ## Upstream Tracker

99%

Inner station

- ## Downstream Tracker

99%

Inner station

10,000 muons
6mm beam
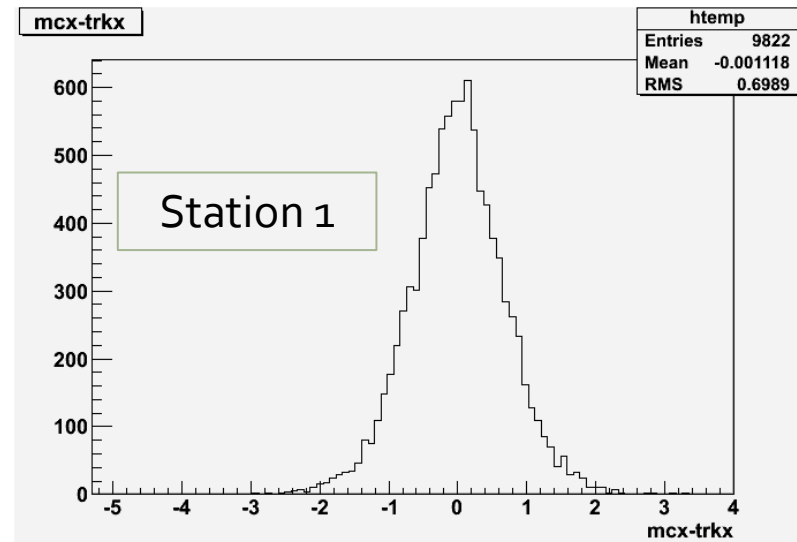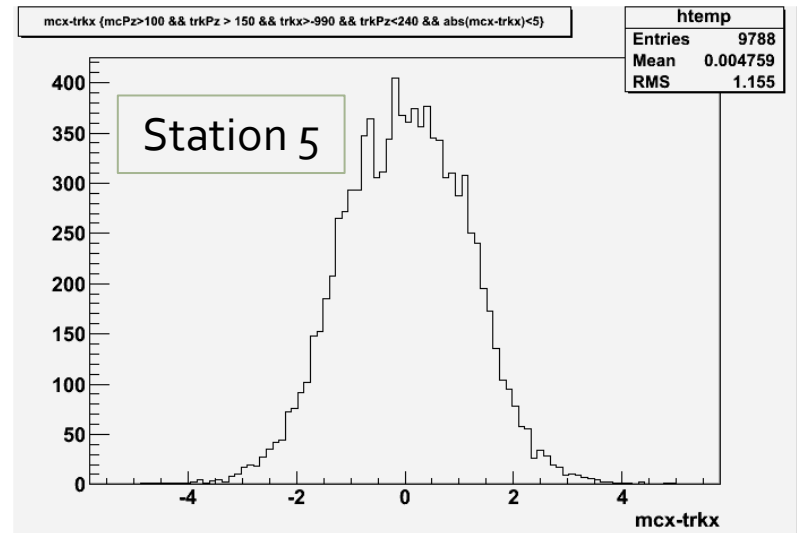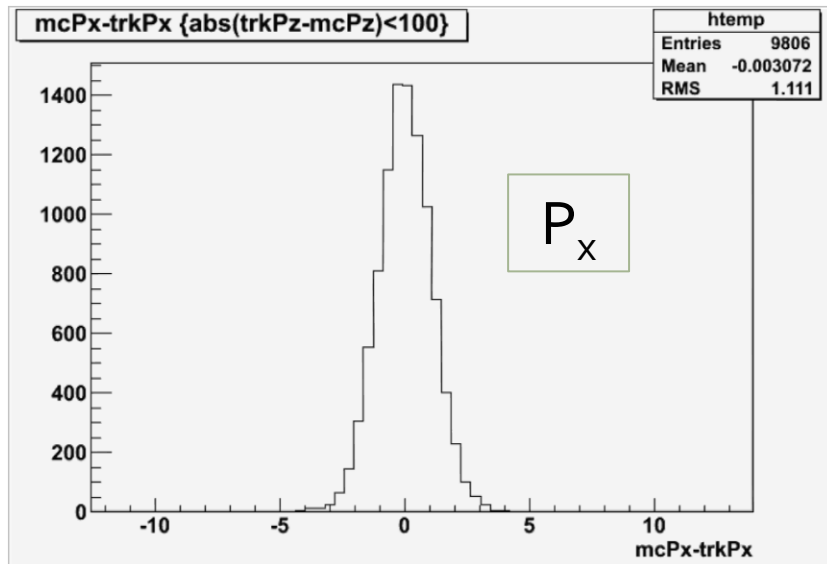Two Trackers, no material
Step IV fields

x Resolution

- 10,000 events, ε =6mm
- Res. 0.7 mm at stations 1 & 2
- Res. ~1.2 mm at outer stations
- Feature of fitting algorithm?

10,000 muons
6mm beam
Step IV fields

mcx-trkx {mcPz>100 && trkPz > 150 && trkx>-990 && trkPz<240 && abs(mcx-trkx)<5}

htemp	
Entries	9788
Mean	0.004759
RMS	1.155

Station 5

mcx-trkx

htemp	
Entries	9822
Mean	-0.001118
RMS	0.6989

Station 1

Momentum Resolution

- (mcPx-TrkPx) ~ 1 MeV/c
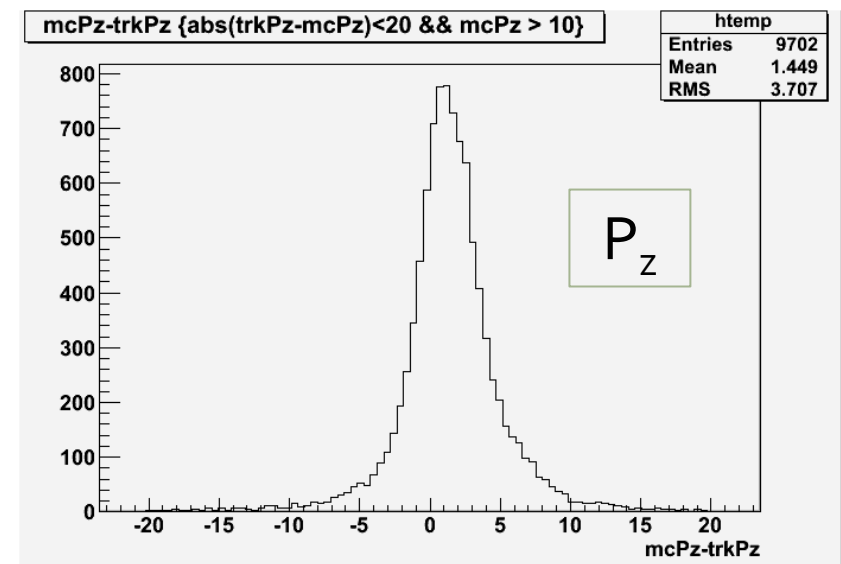
- (mcPz-TrkPz) ~3.7MeV/c
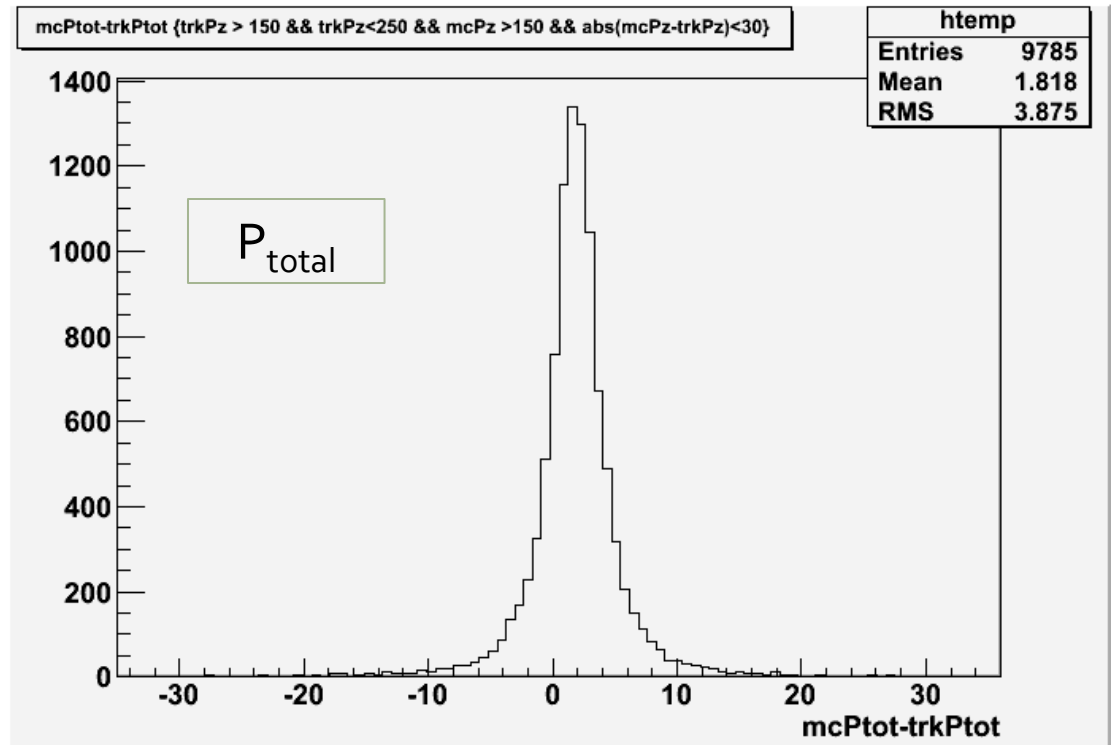
10,000 muons
6mm beam
Step IV fields

dE/dX?

- Landau distribution is ~3 MeV wide
- P_{total} resolution ~ 3.9 MeV/c
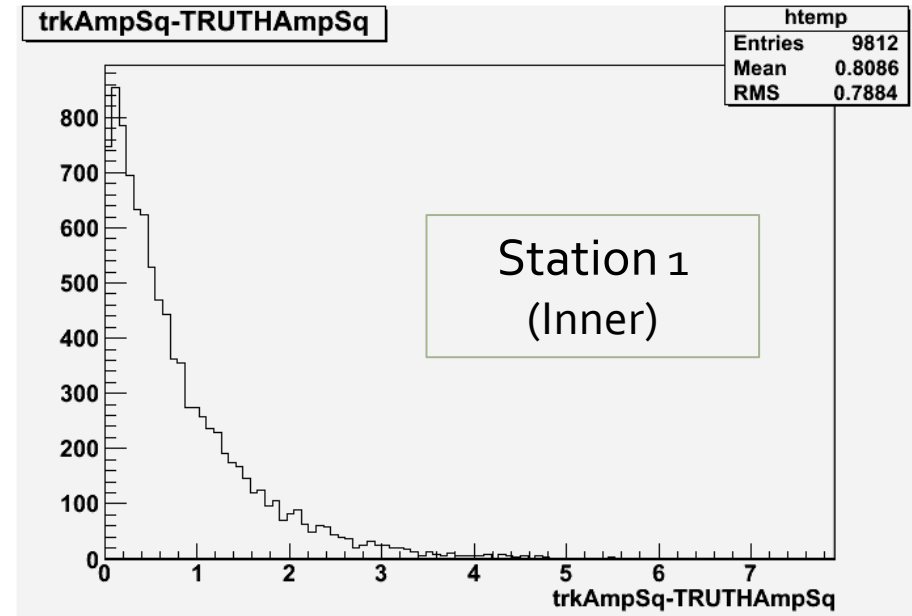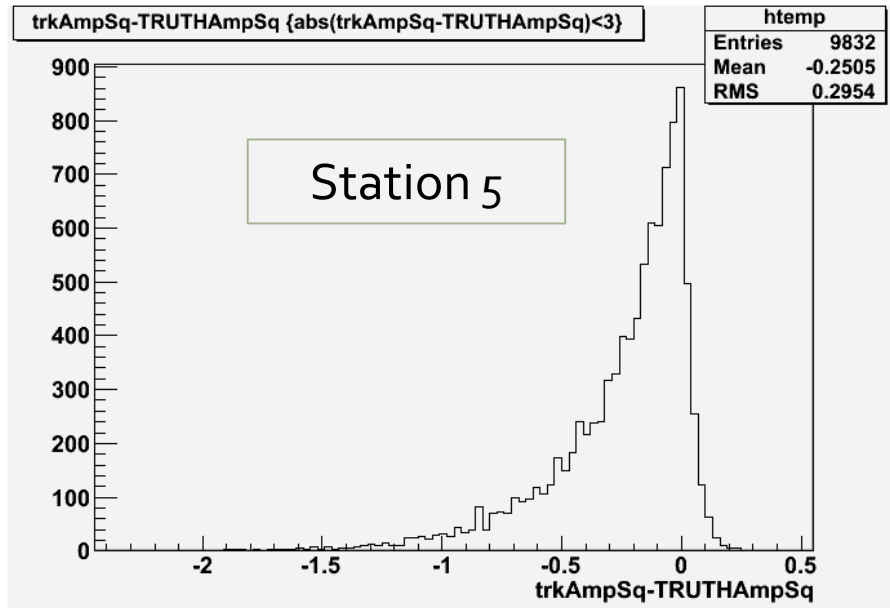- P_z res. the weak link
- EMR / ToFs?

Transverse Amplitude

- Single particle emittance
- Useful for selection cuts
- Beastly:

$$A_T^2 = \frac{1}{m}\left[\frac{\beta_T}{\langle p_z \rangle}\left(p_{Xc}^2 + p_{Yc}^2\right) + \gamma_T \langle p_Z \rangle\left(x_c^2 + y_c^2\right) + 2\alpha_T\left(x_c p_{xc} + y_c p_{yc}\right) + 2(\beta_T \kappa - L_d)\left(x_c p_{yc} - y_c p_{xc}\right) \right]$$

- Calc. using <u>mc truth</u> α β γ for beam envelope

Amplitude Resolution

- 0.3mm < ΔAmpSq < 0.8mm depending on the station
- Unclear why sign change...
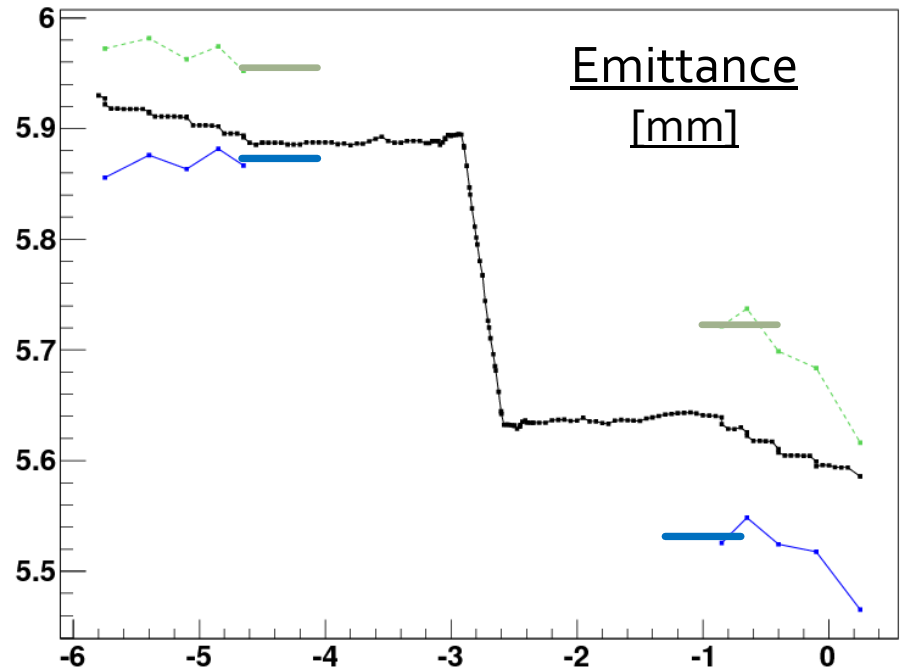
10,000 muons
6mm beam
Step IV fields

[Crude] Cooling Measurements

- 35cm LH2
- Calc. ε at each station
- Inner station → ref. plane
- 4.5% cooling (mc truth)

- **TrkMC: 5.5%**
- **TrkRec: 3.8%**

Emittance [mm]

Black – mc [Virtual Planes], 98.5% Transmitted

Green – Trk mc
Blue – reconstructed

Abs(mc – rec) < 50 for x, y, px , py
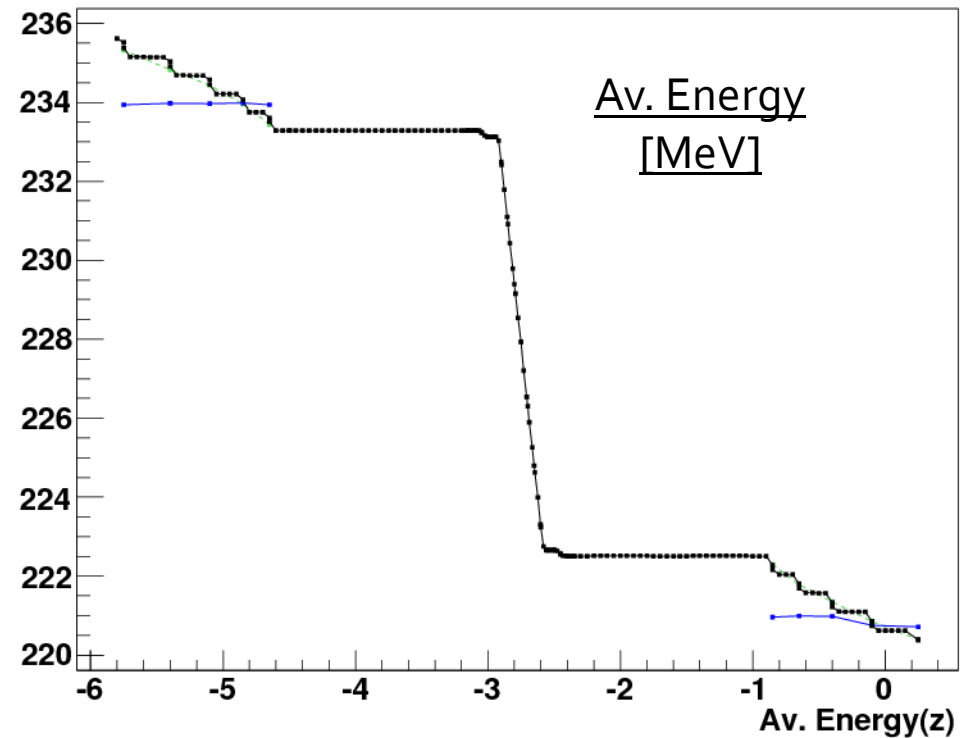
10,000 muons
6mm beam
Two Trackers, LH2
Step IV fields

Energy

- few MeV loss due to stations
- Rec. Energy ~ const.
- Averaged for rec. tracks?

Black – mc [Virtual Planes]

Green – Trk mc
Blue – Trk reconstructed

Av. Energy
[MeV]

Summary

- TrackerRec/ → Station by Station output at present
- Efficiency 98-99%
- Position resolution dep. on station
- At inner station:
  - $\sigma_{\Delta x, \Delta y} \sim 0.7\text{mm}$
  - $\sigma_{\Delta Px, \Delta Py} \sim 1\ \text{MeV/c}$
  - $\sigma_{\Delta Pz} \sim 3.7\ \text{MeV/c}$

- Energy resolution ~ 4MeV
  - Beyond Landau width- use EMR / ToFs?
- Amplitude resolution *appears* < 1mm