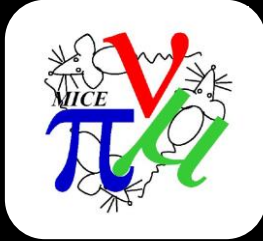




# Tracker Software Update

Adam Dobbs, MICE CM37

7<sup>th</sup> Nov 2013



# Contents

- People
- Data structure reminder
- Reconstruction Reminder
- Pattern Recognition Results
  - Reducer output
  - Momentum Residuals
  - Momentum Resolution
- Kalman Results
- Current Status and To Do

# People



Ken Long

## Hardware

Geoff Barber (IC)  
Kevin Ladhams (IC)  
Adam Dobbs (IC)  
Melissa George (IC)  
Craig MacWaters (RAL)  
Edward Overton (Shef)  
Chris Heidt (UCR)

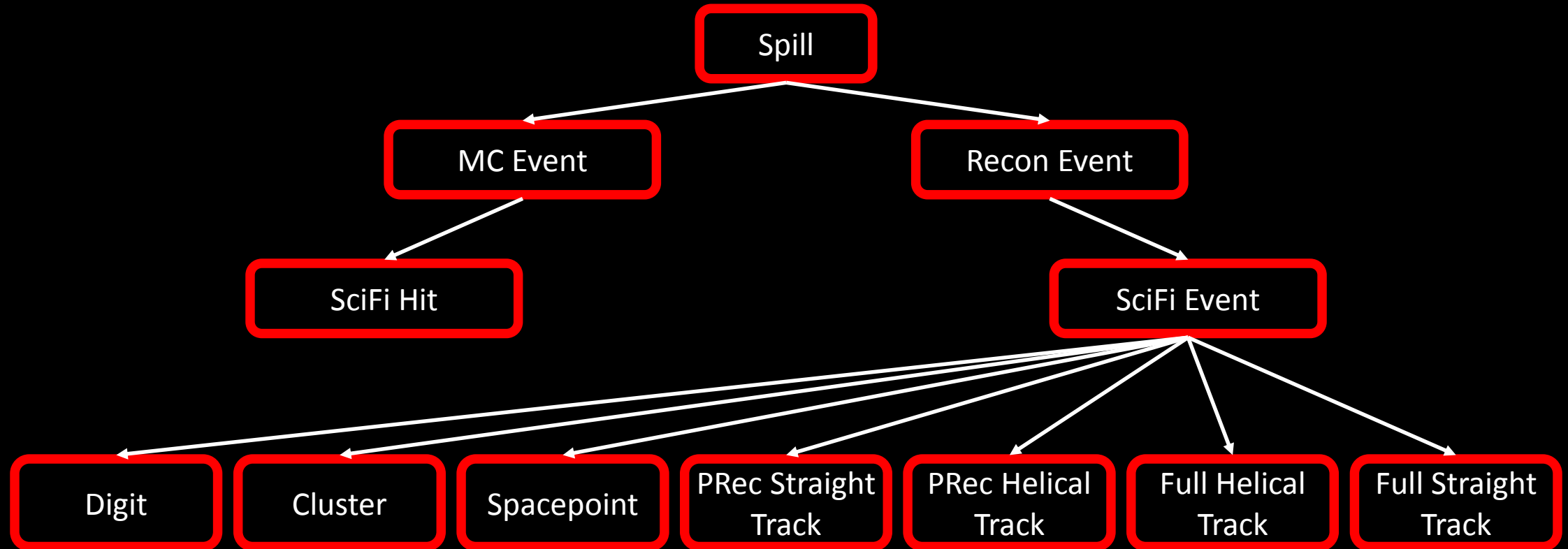
## DAQ / Electronics / Controls

David Adey (FNAL)  
Alan Bross (FNAL)  
Matt Robinson (Shef)

## Software

Adam Dobbs (IC)  
Edward Santos (IC)  
Melissa George (IC)  
Chris Hunt (IC)  
Chris Heidt (UCR)

# Data Structure I

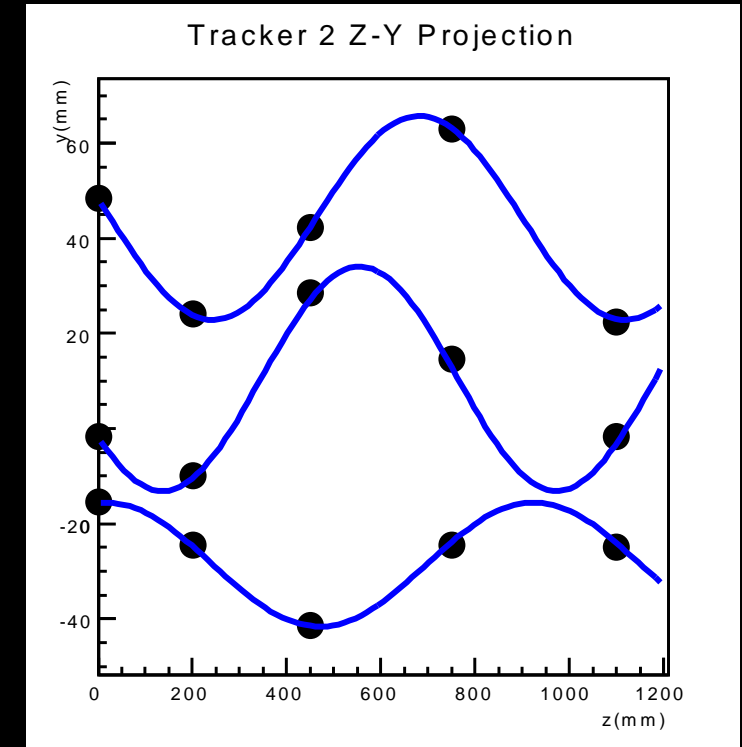
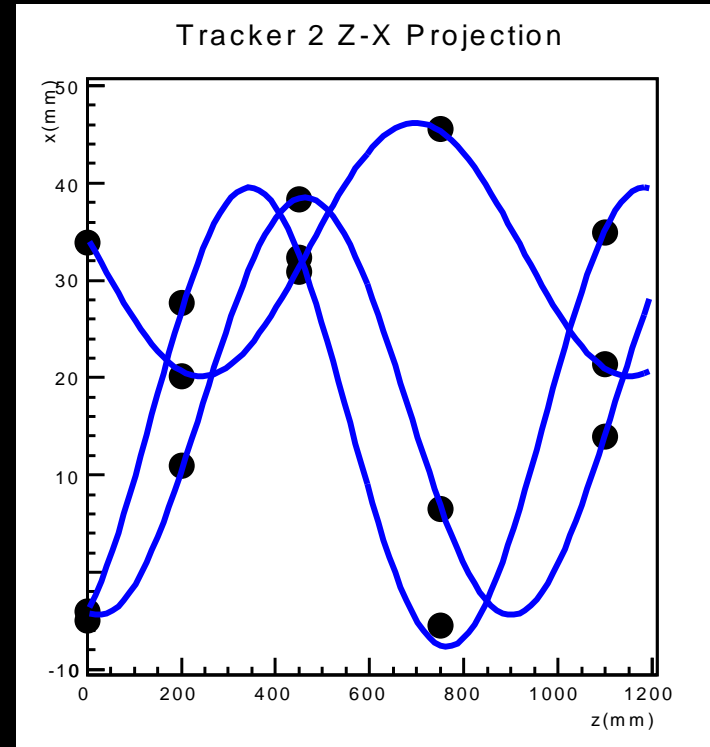
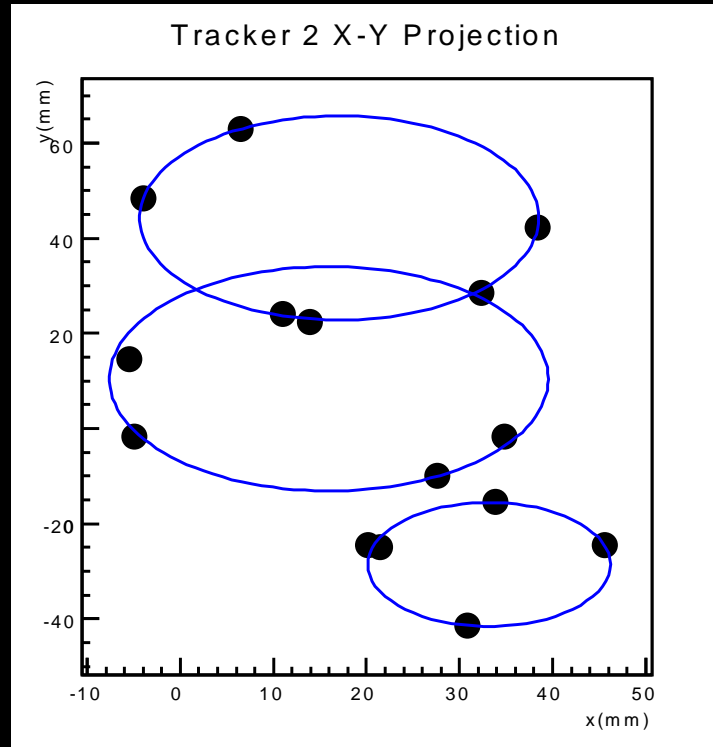
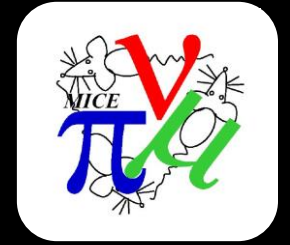




# Reconstruction

- **Digitisation** – unpack the real data or digitise MC data
- **Clustering** – look for adjacent channel hits and group them
- **Spacepoints Reconstruction** – look for intersecting clusters on different planes
- **Pattern Recognition** – use a linear least squares circle fit in x-y, and straight line fit in s-z to associate spacepoints with tracks
- **Final track fit** – use a Kalman filter to smooth and filter the tracks, accounting with multiple coulomb scattering and energy loss

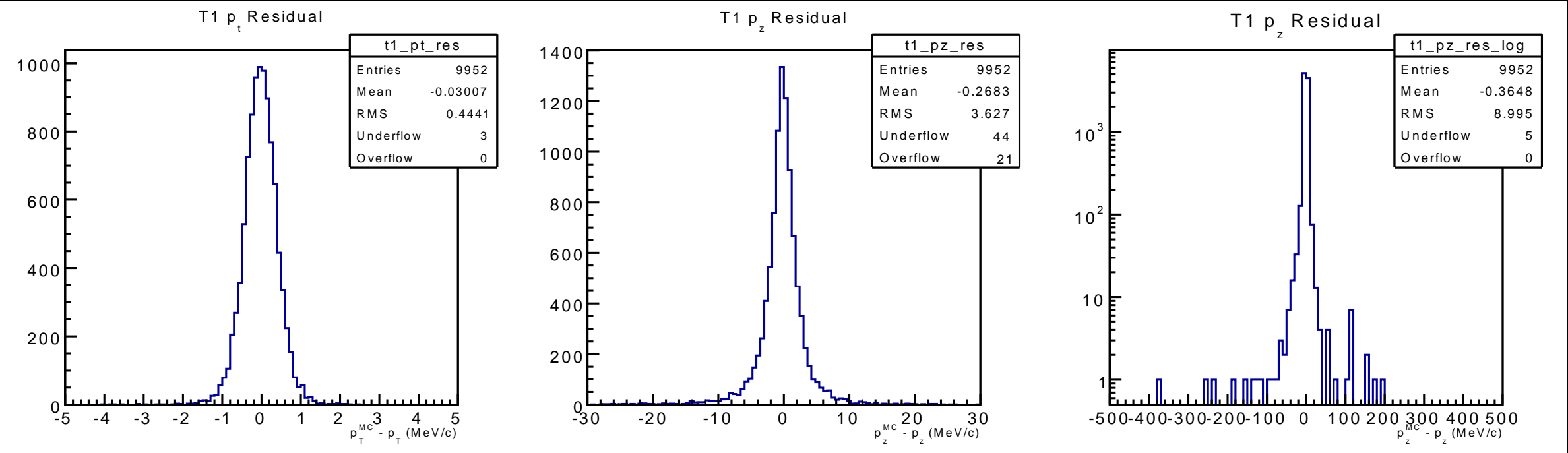
# Results I: Pattern Recognition



Helical Pattern Recognition tracks in T2, shown using a Reducer



# T1 Momentum Residual Histograms

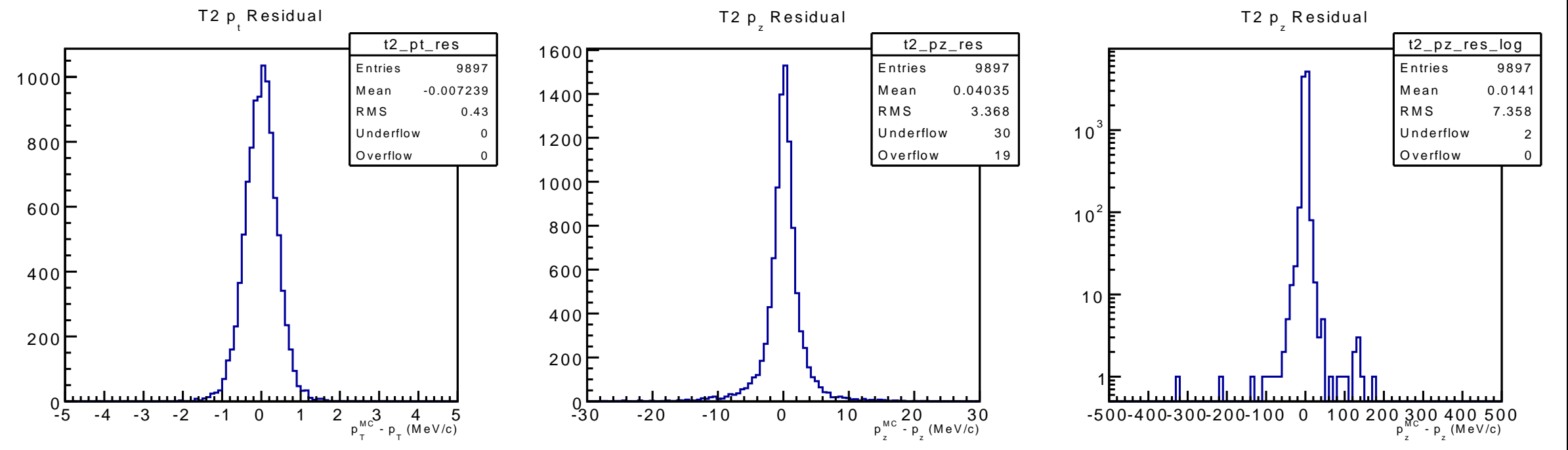


Pattern Recognition momentum residual plots for  $\mu^-$  for 10,000 events

- Generally good, some outliers need investigating
- Small amount of charge mis-id (<1 in 500 tracks), effect removed from histos



# T2 Momentum Residual Histograms



Pattern Recognition momentum residual plots for  $\mu^-$  for 10,000 events

- Same comments as before

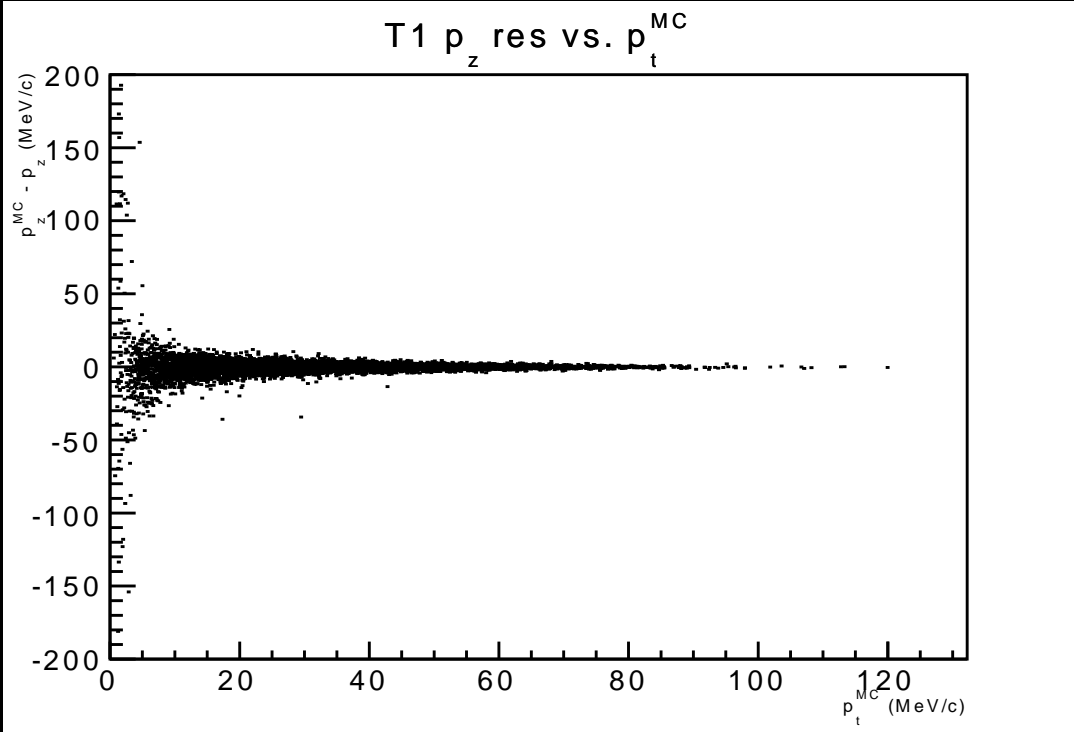
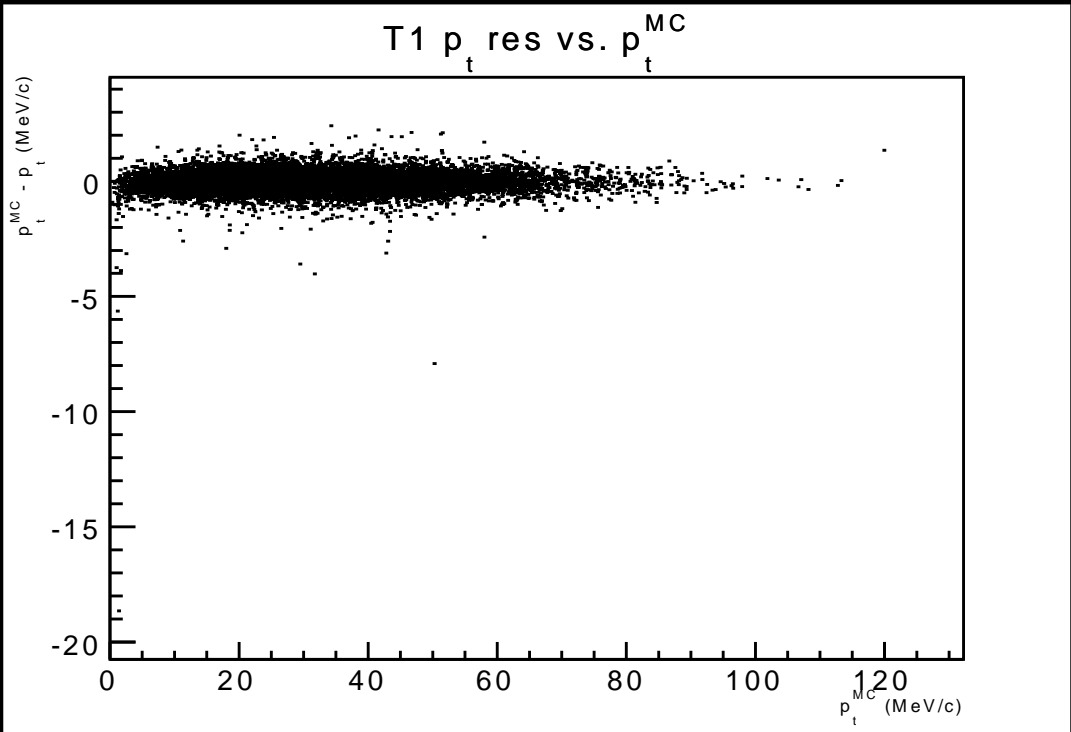




# T1 Momentum Residual Graphs

Pt residual vs Pt

Pz residual vs Pt

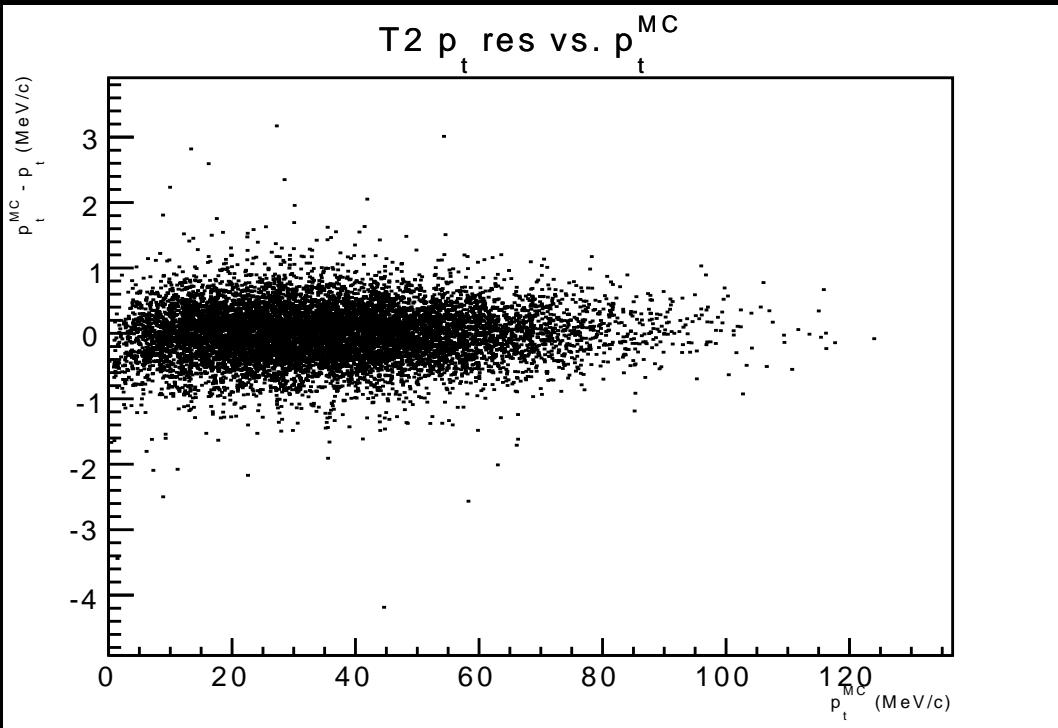


Pattern Recognition momentum residual plots for  $\mu^-$  for 10,000 events

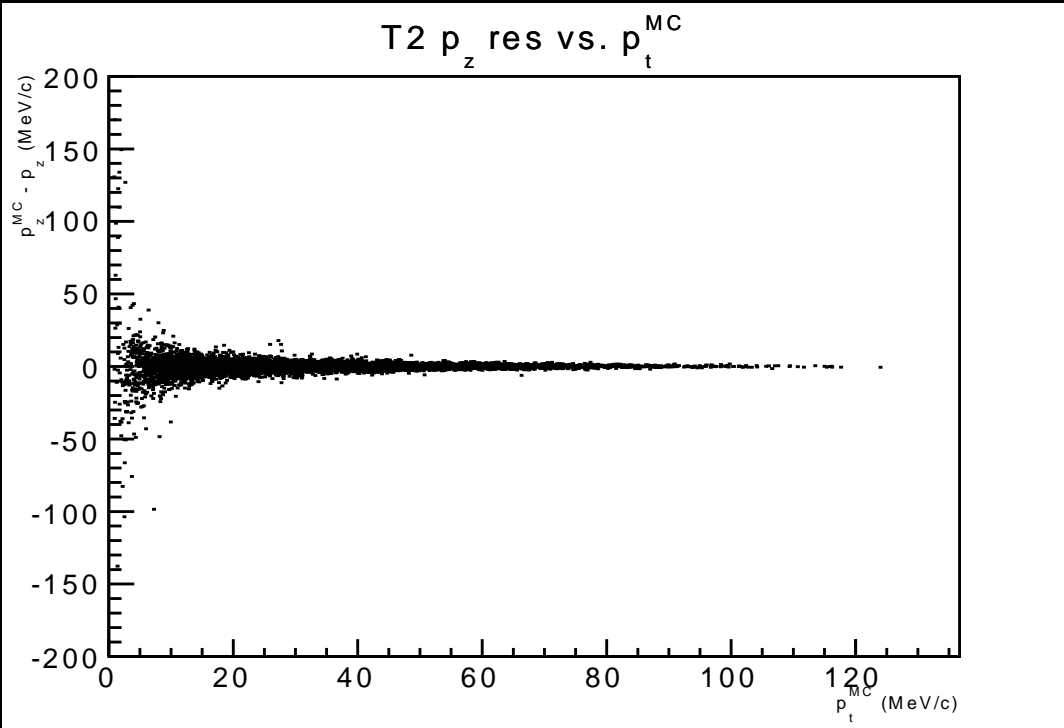


# T2 Momentum Residual Graphs

Pt residual vs Pt

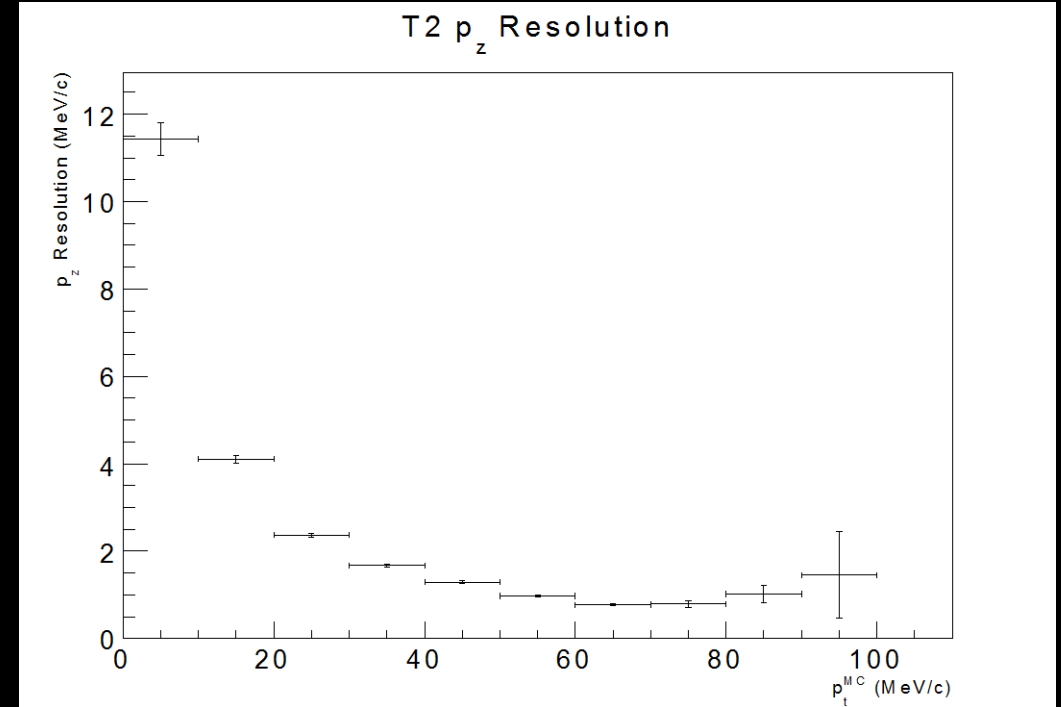
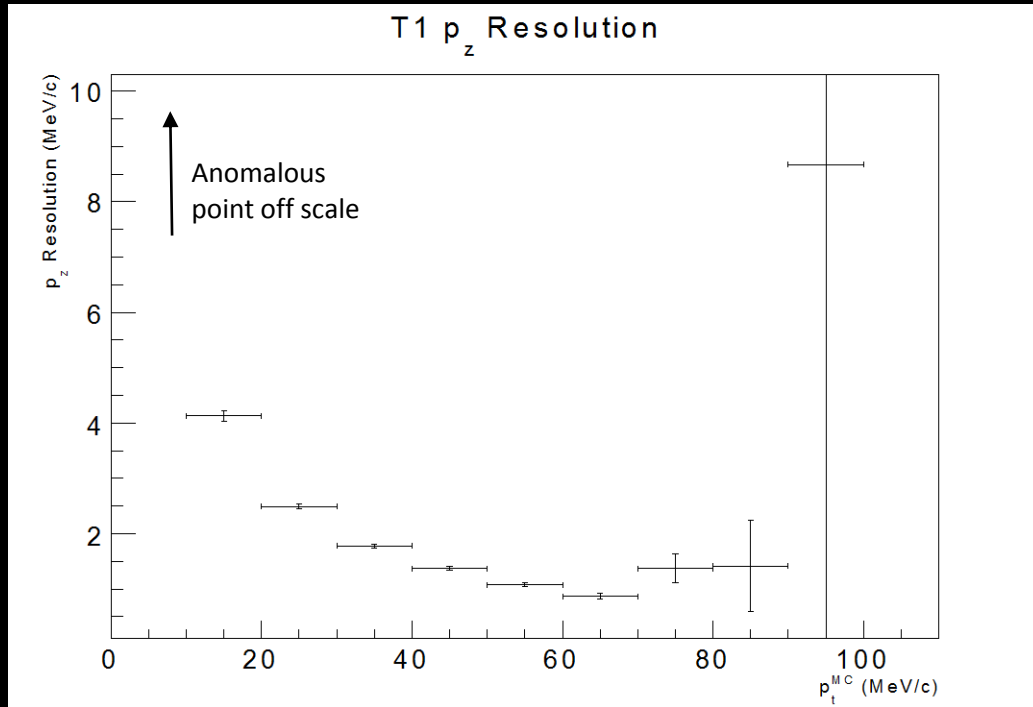


Pz residual vs Pt



Pattern Recognition momentum residual plots for  $\mu^-$  for 10,000 events

# PR Longitudinal Momentum Resolution



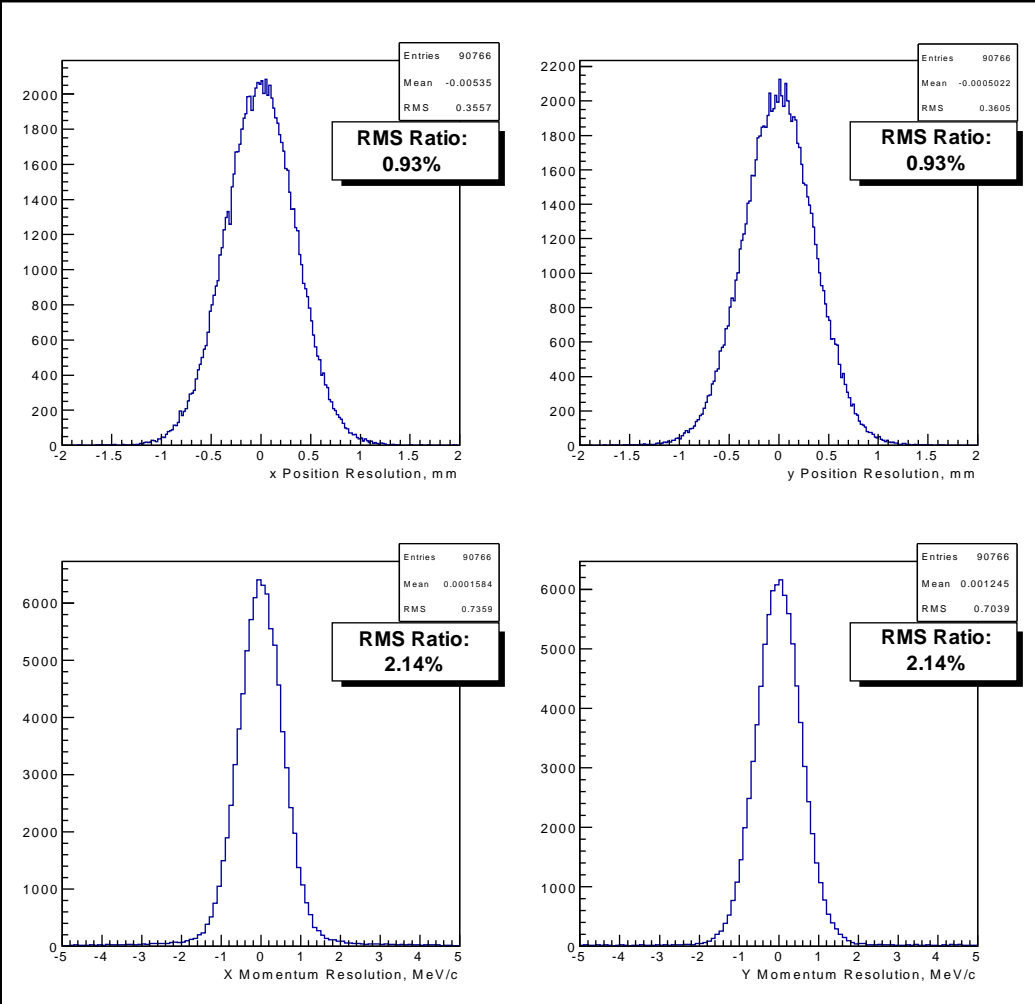
Pattern Recognition longitudinal momentum residual plots for  $\mu^-$  for 10,000 events

Resolution found by forming histograms of  $p_{z\_mc} - p_z$ , for 20 MeV/c  $p_{t\_mc}$  intervals, followed by gaussian fit, fit sigma gives resolution

**NB: Hot off the press (yesterday...) so view with caution for now**

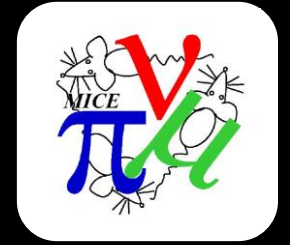


# Results II: Kalman



- Resolution of the track parameters computed as the difference between MC truth and reconstruction values
- The distribution RMS to beam RMS ratio is shown
- Requirement to measure 10% change in emittance to 1% accuracy → transverse momentum resolution must be better than 10% of the beam RMS →  $\text{Distro RMS} / \text{Beam RMS} < 10\%$
- Results show we are well within this requirement! (0.93% and 2.13%)

# Current Status



Item	Owner	Functionality	Tests	Doc	Other To Do
<b>Kalman</b>	Santos	Trunk	Unit	No	Clean up Integration tests
<b>Pattern Recognition</b>	Dobbs	Trunk	Unit	Some	Refactor Clean up Spacepoint efficiency study Check outliers Integration tests
<b>Recon to Spacepoints</b>	Santos	Trunk	Unit	Some	Integration tests
<b>Digitisation</b>	Santos	Trunk	Unit	No	
<b>MC Digitisation</b>	Heidt	Trunk	Unit	No	Clean up
<b>Error propagation</b>	Santos	Development	No	Some	
<b>Alignment</b>	Santos	Development		No	

# Current Status (cont)



Item	Owner	Functionality	Tests	Doc	Other To Do
<b>Noise</b>	Heidt	Development	No	No	
<b>Geometry</b>	Heidt	Development	No	No	Check geometry in CDB Access from CDB
<b>Calibrations</b>	Heidt / Santos?	Development	No	No	
<b>Performance</b>	Hunt	Not started	No	No	
<b>Reducer / Online</b>	Dobbs	Development	Some	No	Make fast for online

# Questions





# Data Structure II

- **Hits** – Monte Carlo objects formed when a particle traverse a detector
- **Digits** – Detector response to a channel hit
- **Clusters** – Groups of digits from adjacent channels in same plane
- **Spacepoints** – 2 or 3 clusters from different planes on the same station, giving an (x,y) position
- **PRec Tracks** – Tracks found by Pattern Recognition
- **Full Tracks** – The final tracks produced by the Kalman fitter