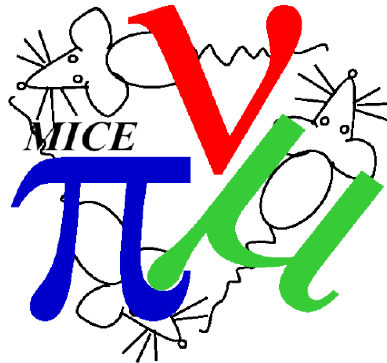




# Tracker to Solenoid Alignment

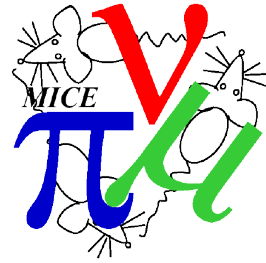
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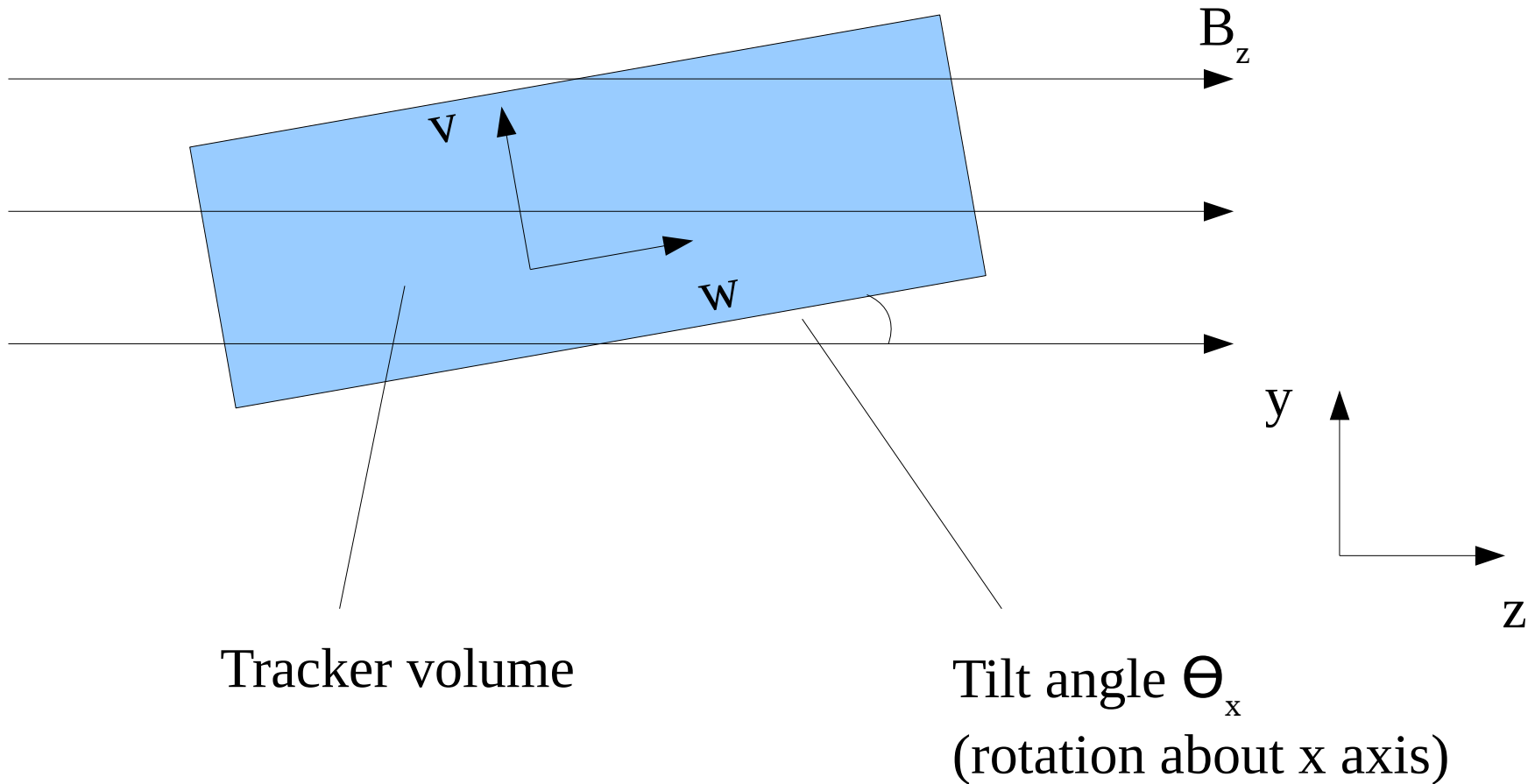
C. Rogers,  
ASTeC Intense Beams Group  
Rutherford Appleton Laboratory



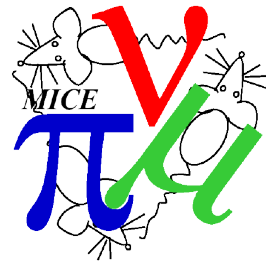
# Tracker to Solenoid Alignment



- Aim is to measure the tracker tilt angle wrt solenoid field

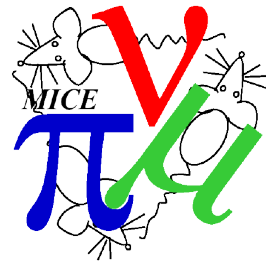


# Algorithm



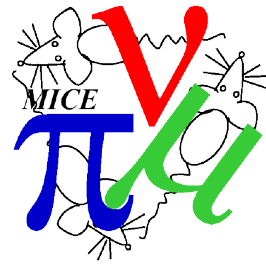
- Tracks make a helix through the field
- Projection onto solenoid x-y is a circle
- Use polynomial expansion for a circle
  - $R^2 = (x-x_0)^2 + (y - y_0)^2$
- Transform to tracker coordinate system (u, v, w)
  - Small angle approximation
  - $R^2 = (u+\Theta_x w-x_0)^2 + (v +\Theta_y w - y_0)^2$
- Expand and divide through by constant term
  - $\{(u^2+v^2) + 2\Theta_x wu + 2\Theta_y wv - 2y_0v - 2x_0u - 2(y_0\Theta_y+x_0\Theta_x)w \}/a_0 = 1$
  - $a_0 = x_0^2+y_0^2-R^2$
- This is a sum of polynomial terms; we can fit track by track using linear least squares
- Then histogram the resultant angles
  - The mean might be the measured angle

# Data Taking



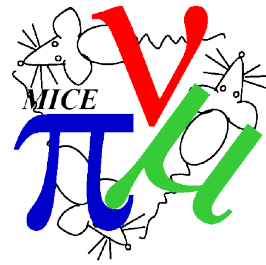
- Data was taken on night of Wednesday July 22<sup>nd</sup>
  - Problem found in tracker crate, data was no good
  - Tracker readout was repaired (Ed Overton)
- Data was taken on night of Thursday July 23<sup>rd</sup>
  - Three runs each ~ 2 hours, 7288, 7289, 7290
  - Tracker, OnRec experts were present for first couple of hours
  - No significant issues during the data taking
  - Beamline was set for 140 MeV/c settings

# Reconstruction

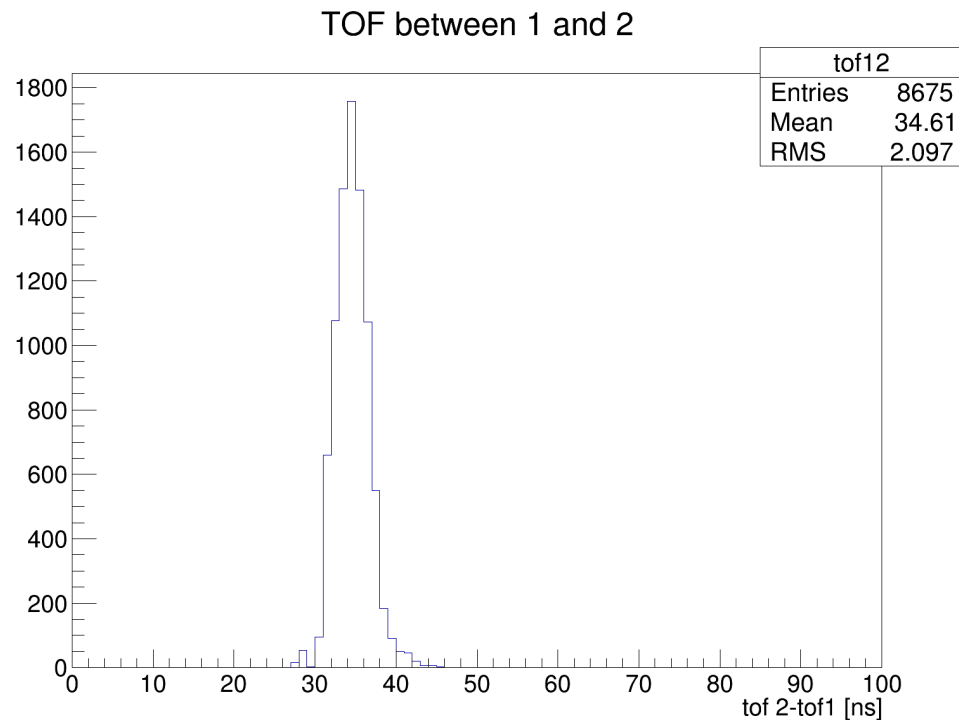


- Reconstruction was done during the data taking
  - Problem was found in tracker cabling (Chris Hunt)
  - Revised cabling and calibration files were installed in MAUS, (Ed Overton and Chris Heidt)
  - New reconstruction performed on Rogers laptop on Tuesday
- Note that;
  - The spectrometer was at 1.6 T or so, with no end coils
  - The tracker volume was filled with air, not Helium

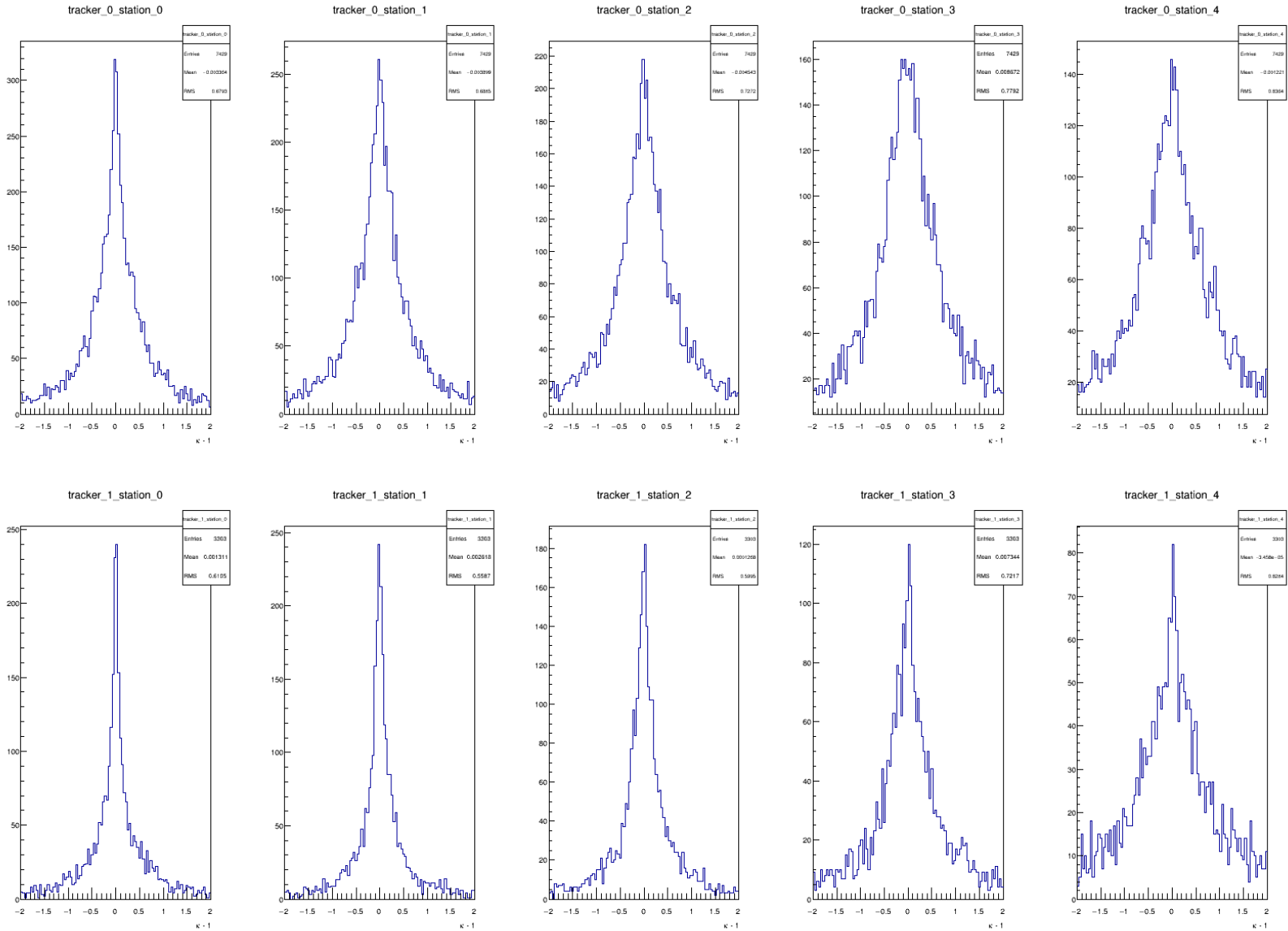
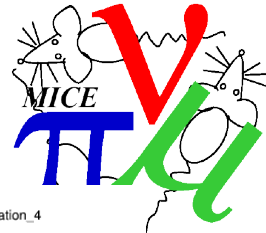
# Cuts



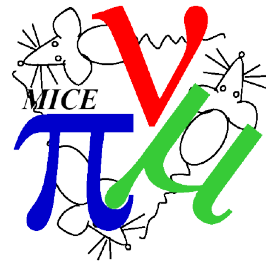
- Cuts are:
  - Require exactly one space point in TOF1 and TOF2
  - Require exactly 15 clusters and 5 space points in TKD
  - No timing cut; looks like pretty pure muon beam
- Results in about 3000 events per run



# Fit residuals 7288



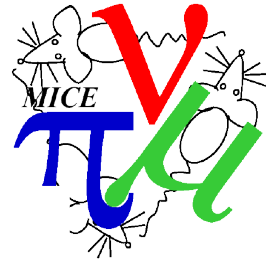
# Fit residuals 7288



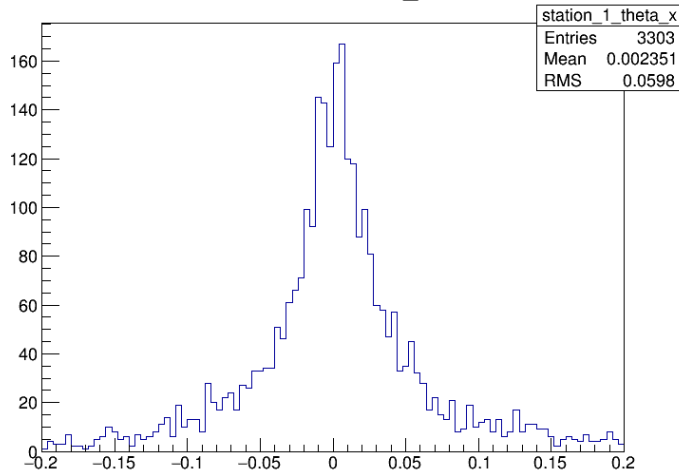
- 3303 tracks
- RMS
  - Station 1 0.61,
  - Station 2 0.56,
  - Station 3 0.59,
  - Station 4 0.72,
  - Station 5 0.83
- Means consistent with 0
- Why is the residual higher for more downstream stations?
  - End field effect?



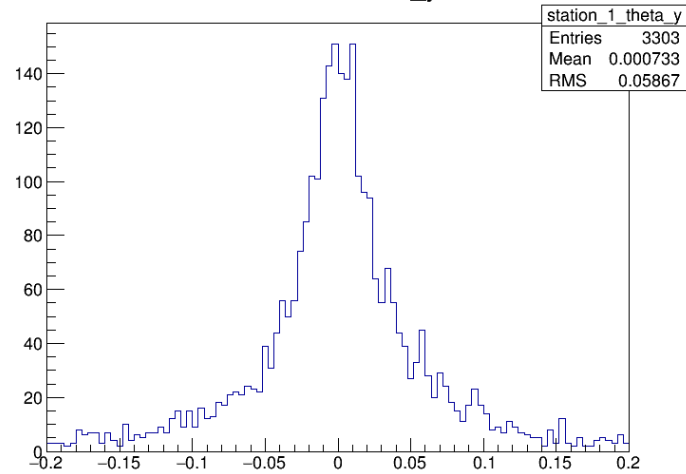
# Fitted Theta - 7288



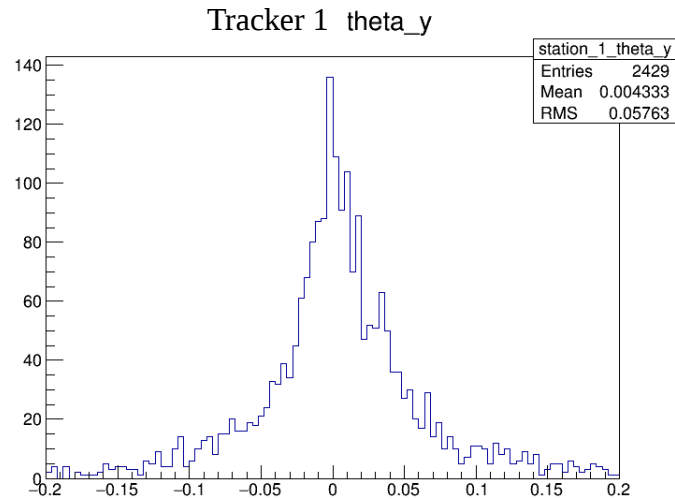
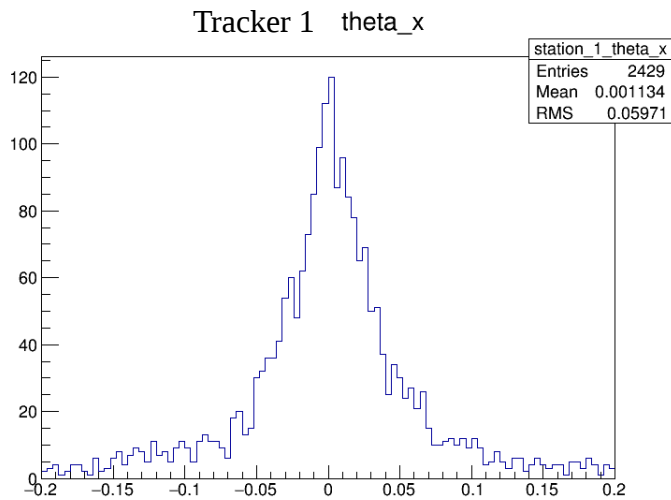
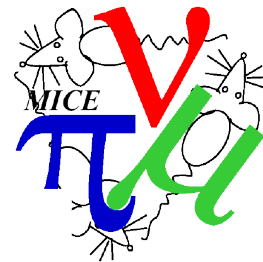
Tracker 1 theta\_x



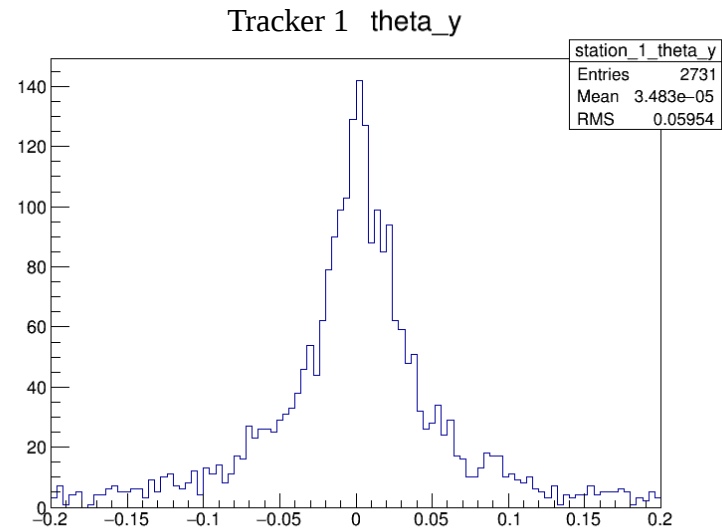
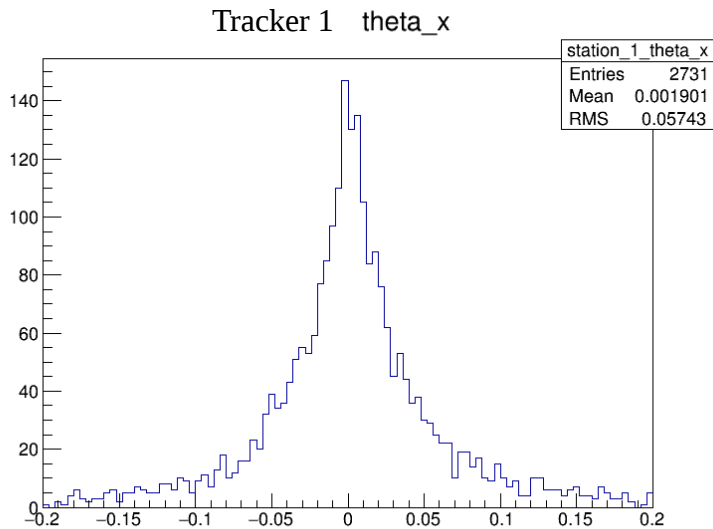
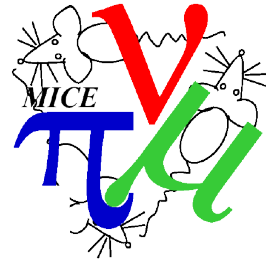
Tracker 1 theta\_y



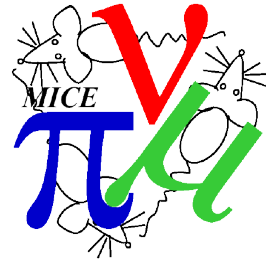
# Fitted Theta - 7289



# Fitted Theta - 7290



# Comments



- 7288 and 7290 are consistent with JHC's field mapping
  - $\theta_x$  about 2 mrad +/- 1 mrad
  - $\theta_y$  about 0 mrad +/- 1 mrad
- 7289 is not consistent with JHC's field mapping
  - $\theta_x$  about 1 mrad +/- 1 mrad
  - $\theta_y$  about 4 mrad +/- 1 mrad
- To be investigated
  - Clipping of tails in distribution; ROOT calculation of RMS is incorrect
  - Tracks fitted with  $\theta_x \sim 0.1$  rad are not small angles
  - Try a chi squared cut
  - Look at beam distributions to check run conditions were same