Tracker Meeting: simulation of the first station calibration in a vertical orientation

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Introduction

- Reading out from the first station is expected soon;
- We need to calibrate the standalone station with cosmics.

Timing calibration:

- drift velocity: Δt versus longitudinal position;
- channel to channel delays.

What is it needed for this purpose?

- unbiased reconstruction of the longitudinal position in a straw.

During CM, there was a discussion related to the orientation of the station:

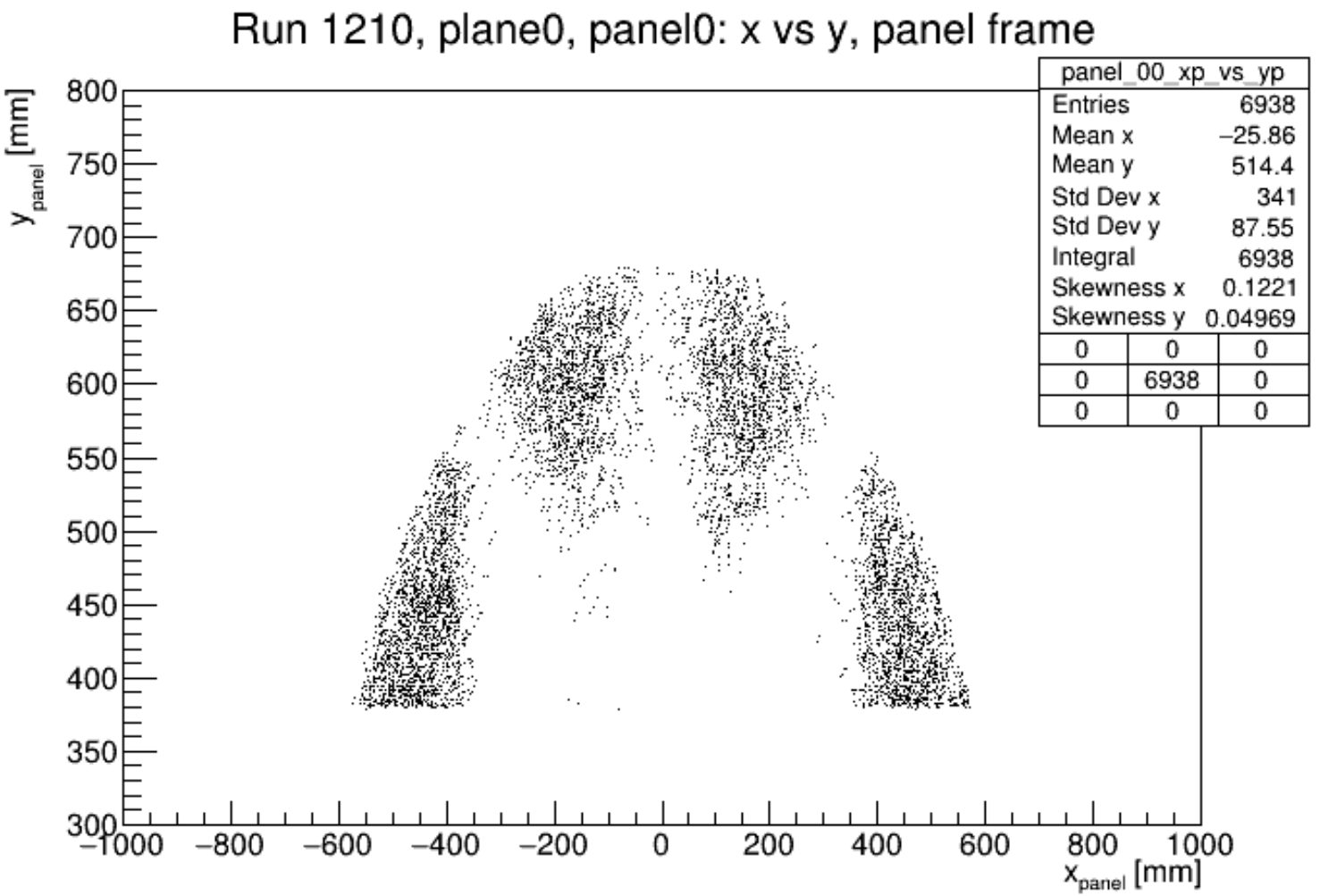
- Vertical orientation is preferred for electronics and cooling system and because the station will be vertical during the experiment;
- Horizontal orientation was chosen for the first calibration of a plane and enables an unbiased reconstruction.

A simulation has been performed to reconstruct cosmics tracks with vertically oriented station, aiming to understand possible biases in determining longitudinal position caused by the non-uniform illumination of a panel.

Cosmics simulation and selection criteria

- Simulated cosmics crossing only one station;
- Station in vertical orientation in extracted position;
- No magnetic field;
- To reconstruct a straight line in 3D, at least 4 hits at different z are needed: tracks selected with $nhits_{face_i} \geq 1$;
- To improve the resolution, $nhits_{panel_i} \leq 3$ were selected.

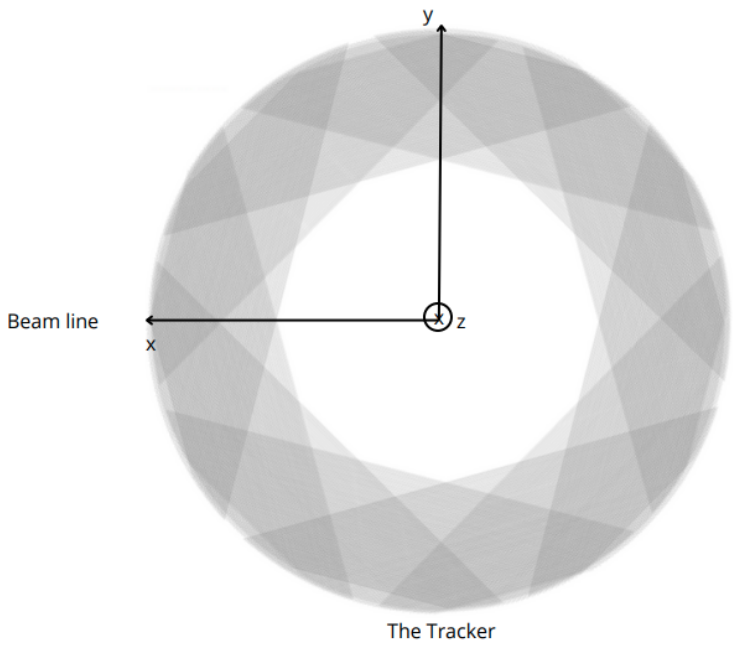
Panel illumination



- illumination pattern of a panel in a vertical orientation (panel frame);
- the longest wires have no hits in the center;
- these will be difficult to calibrate (noise).

Reconstruction of Cosmic tracks

- The station is not yet calibrated: whether a straw has been hit or not is the only info we have;
- The reconstruction of the hit position is performed using:
  - the straw direction;
  - the straw midpoints (x, y);
  - the straw z coordinate.
- The intersection of two straw in two different faces, in the same plane, is considered to be the hit point;
- Two intersection points are found $\rightarrow$ reconstructed line.



Combo, Stereo Hits and Reconstructed line

1. Geometrical Combo Hits

Determination of a unique straw in a panel:

- mean of straws midpoint (x_m, y_m, z_m);
- straws direction (D_x, D_y).

2. Geometrical Stereo Hits

Determination of the hit point in a plane:

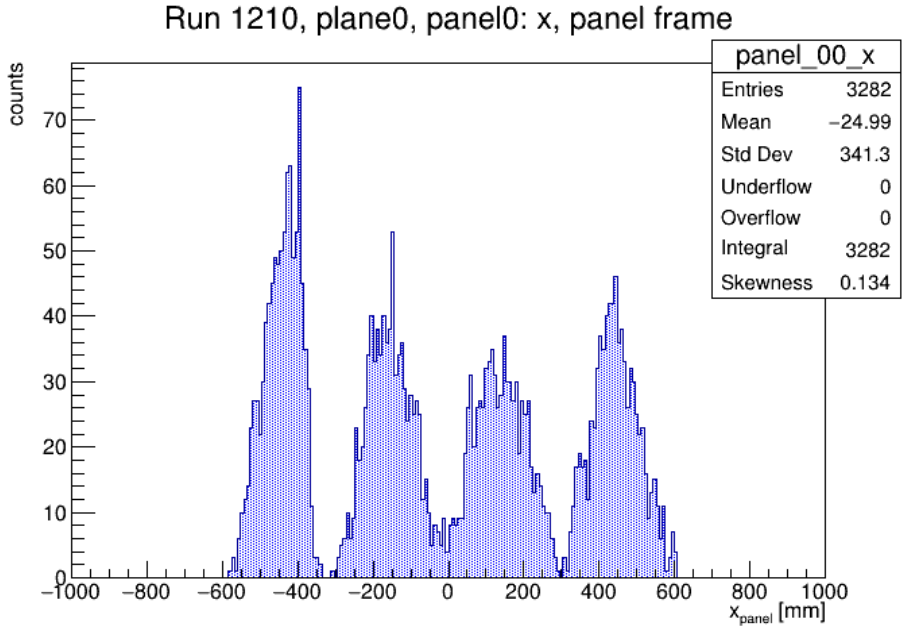
- intersection point (x, y) using the two straws directions and midpoints from two panels;
- mean of z coordinate between the two faces.

3. Reconstructed Line

Determination of a unique reconstructed track:

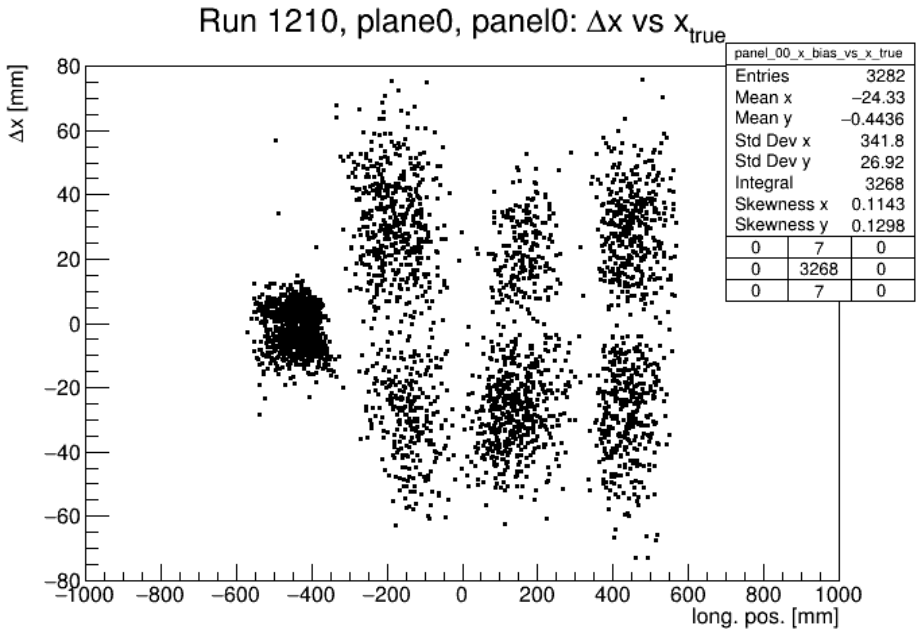
- one stereo hit per plane: one line reconstructed geometrically;
- the intersection point of the line with panels is found knowing the z_m coordinate.

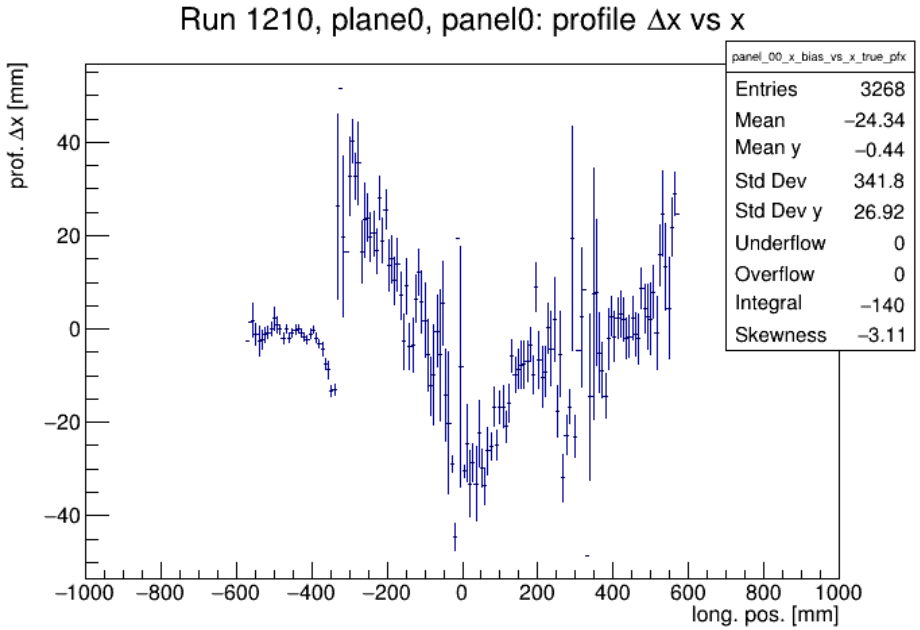
Results: longitudinal position reconstruction



- all histograms show longitudinal position in the panel frame;
- reconstructed longitudinal position distribution presents peaks in the overlaps with other panels (four spots as in previous slides);
- $\Delta x = x_{rec} - x_{true}$;
- the longitudinal position bias range is about -6÷6 cm.

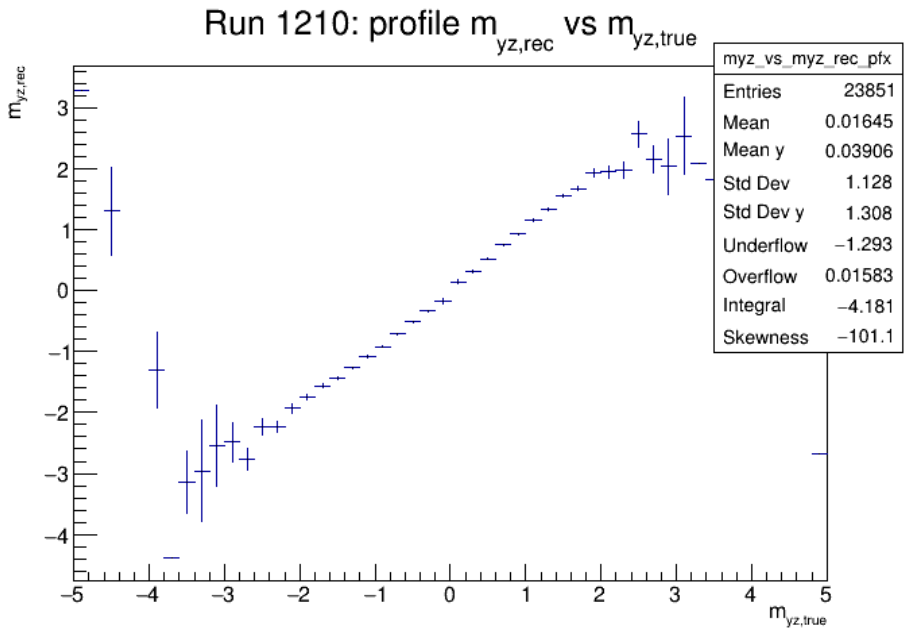
Results: systematics on longitudinal position reconstruction

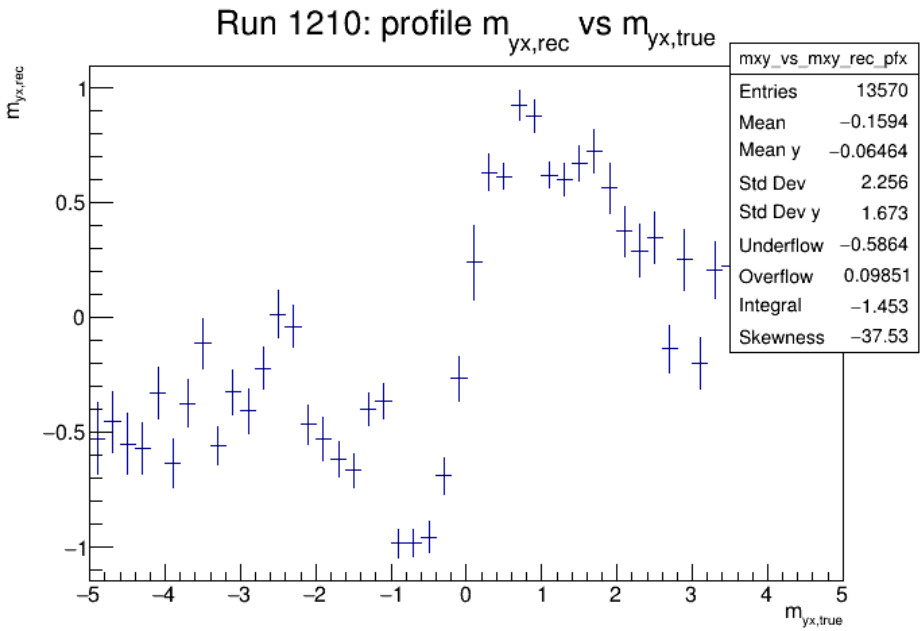




- 2D distribution of Δx versus x_{true} shows four different spots referring to the overlap regions;
- the first spot (CAL side) is referred to ninety degrees panels overlap;
- profile of the Δx versus x_{true} shows a systematic effect in determining the longitudinal position of a range greater than -4÷4 cm.

Results: systematics on track direction reconstruction





- $m_{yz} = \frac{\Delta y}{\Delta z}$ and $m_{yx} = \frac{\Delta y}{\Delta x}$;
- first histogram shows the mean of reconstructed m_{yz} versus the true one and it shows a systematic effect in determining the *zy* track direction (-4÷3);
- second histogram shows the mean of reconstructed m_{yx} versus the true one and it shows a systematic effect in determining the *xy* track direction (-1÷1);
- true hits far away from the straws midpoint lead to the misreconstructed *zy* and *xy* direction lines.

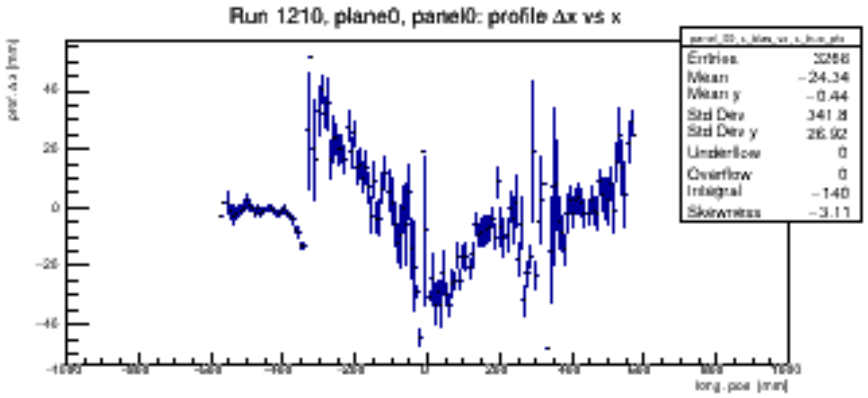
Conclusions

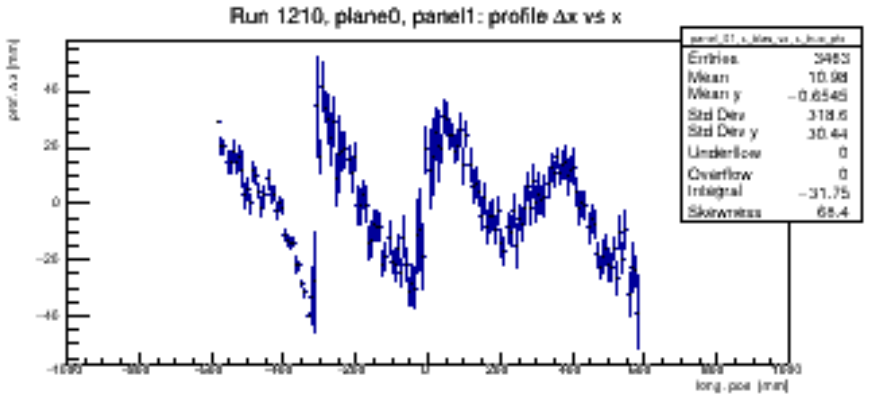
In a vertical configuration of the station:

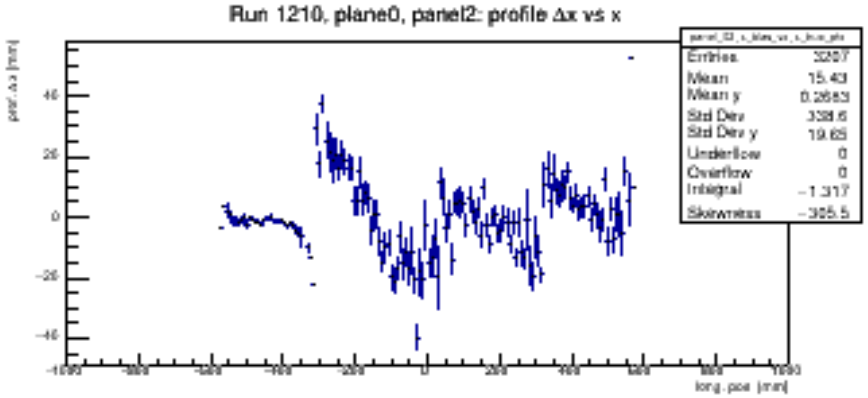
- as shown in the panel illumination plot, long wires will not be correctly calibrated due to the fact that only the extreme parts (noisy) of the straw are hit;
- there will be systematic effects in determining the longitudinal position of a range greater than -4÷4 cm;
- there will be systematic effects in determining tracks *xy* and *zy* directions.

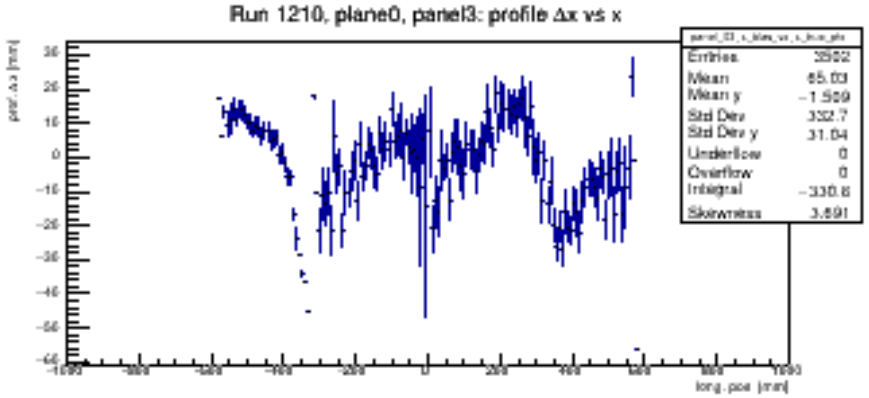
At the end, we won't be able to perform a good timing calibration.

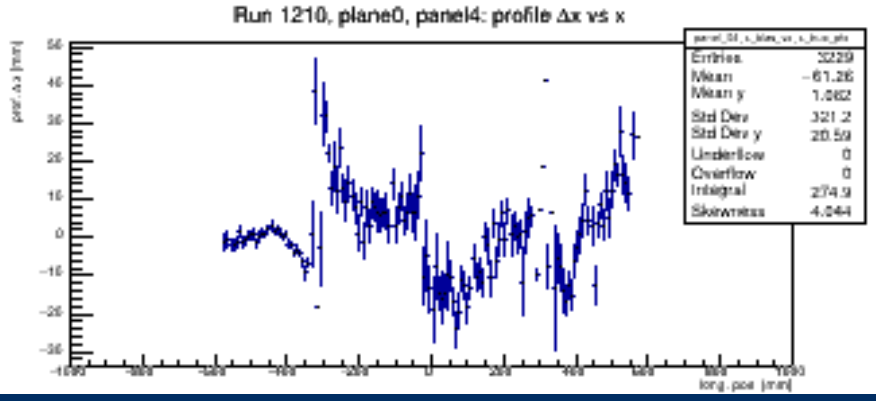
Backup Slide

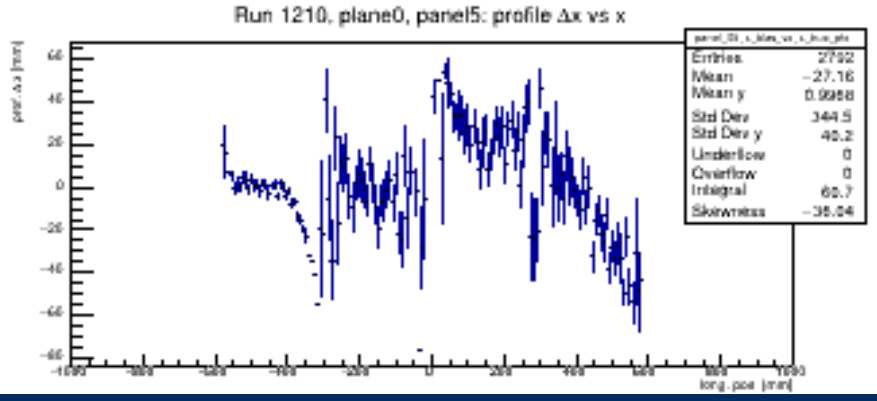












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