INTT Pixel Displacements

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Overview

- Continuation of previous INTT work
  - Comparison of nominal assembly vs actual assembly using survey data
  - Position and orientation is summarized with a “transform” or “align”
    - contains 6 degrees of freedom
    - determines the affine transform that converts a vector from one coordinate system to another coordinate system, but points to the same point in space
  - Improved on original workflow and implementation

Github

- https:
  - https://github.com/josephbertaux/INTT_Dealignment.git
- ssh:
  - git@github.com:josephbertaux/INTT_Dealignment.git
- The previous repository still exists (INTT_Geo)
- Survey data is copied here as well
- Improved workflow by creating a class specifically to re-parse the .txt files containing the survey data

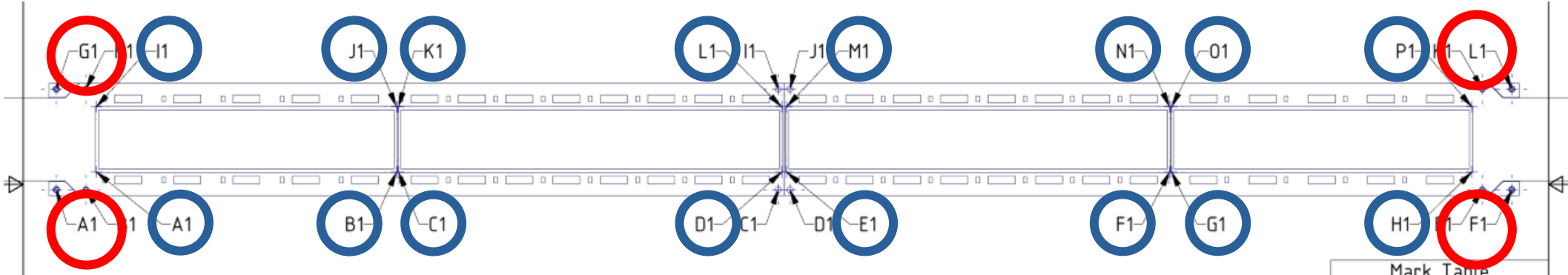
Goal

- Quantify the average and worst-case pixel distances from nominal from the current INTT survey data
  - Useful to determine the priority of a dealignment implementation in detector reconstruction
  - Create a datafile for the tracking group to use for this
    - Human-readable, columnized data with the subsystem hitset key and columns for the align tranform parameters
    - INTT still needs to be surveyed at other levels, but we can begin testing and debugging the machinery

Procedure

- Similar as before—use the nominal and measured marks over the sensors and ladders to determine:
  - nominal sensor-to-ladder align transform
  - actual sensor-to-ladder align transform
  - (the relevant marks are illustrated on subsequent slides)
- Once these are obtained
  - compute the distances between nominal and actual positions of a sensor’s pixels
  - assumed the pixels are distributed in a perfect grid across a sensor (imperfect but adequate)

Nominal Ladder Marks



Hole Table

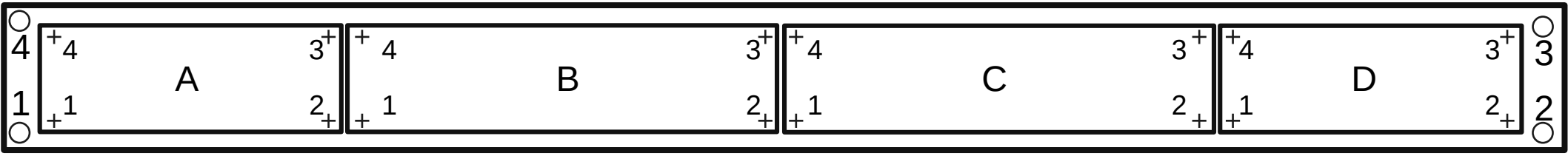
HOLE	XDIM	YDIM
A1	0.0000	0.0000
B1	10.0000	0.0000
C1	244.0000	0.0000
D1	248.0000	0.0000
E1	482.0000	0.0000
F1	492.0000	0.0000
G1	0.0000	34.0000
H1	10.0000	34.0000
I1	244.0000	34.0000
J1	248.0000	34.0000
K1	482.0000	34.0000
L1	492.0000	34.0000

Mark Table

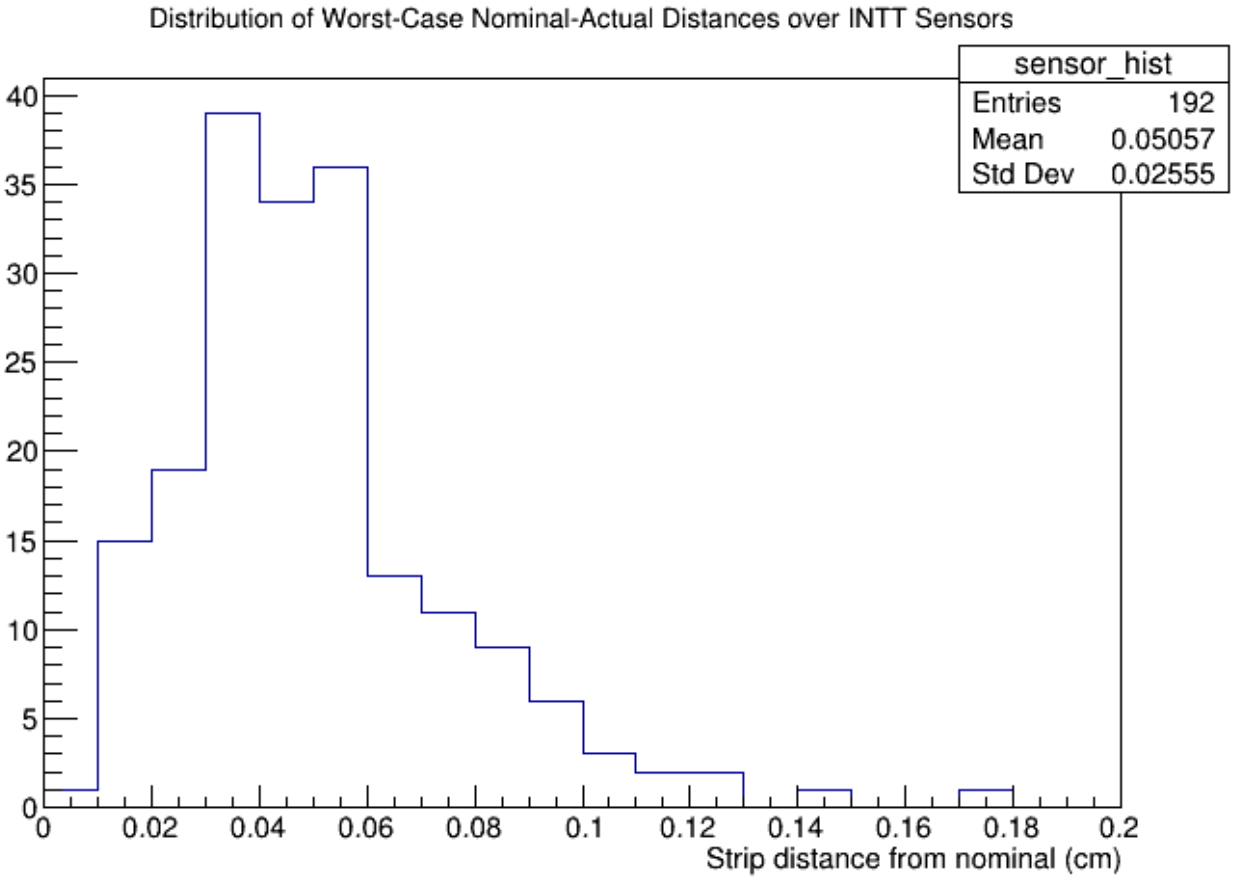
Mark	XDIM	YDIM
A1	13.5000	6.0000
B1	115.0000	6.0000
C1	115.7000	6.0000
D1	245.2000	6.0000
E1	246.8000	6.0000
F1	376.3000	6.0000
G1	377.0000	6.0000
H1	478.5000	6.0000
I1	13.5000	28.0000
J1	115.0000	28.0000
K1	115.7000	28.0000
L1	245.2000	28.0000
M1	246.8000	28.0000
N1	376.3000	28.0000
O1	377.0000	28.0000
P1	478.5000	28.0000

Image credit:
Dan Cacace
dcacace@bnl.gov

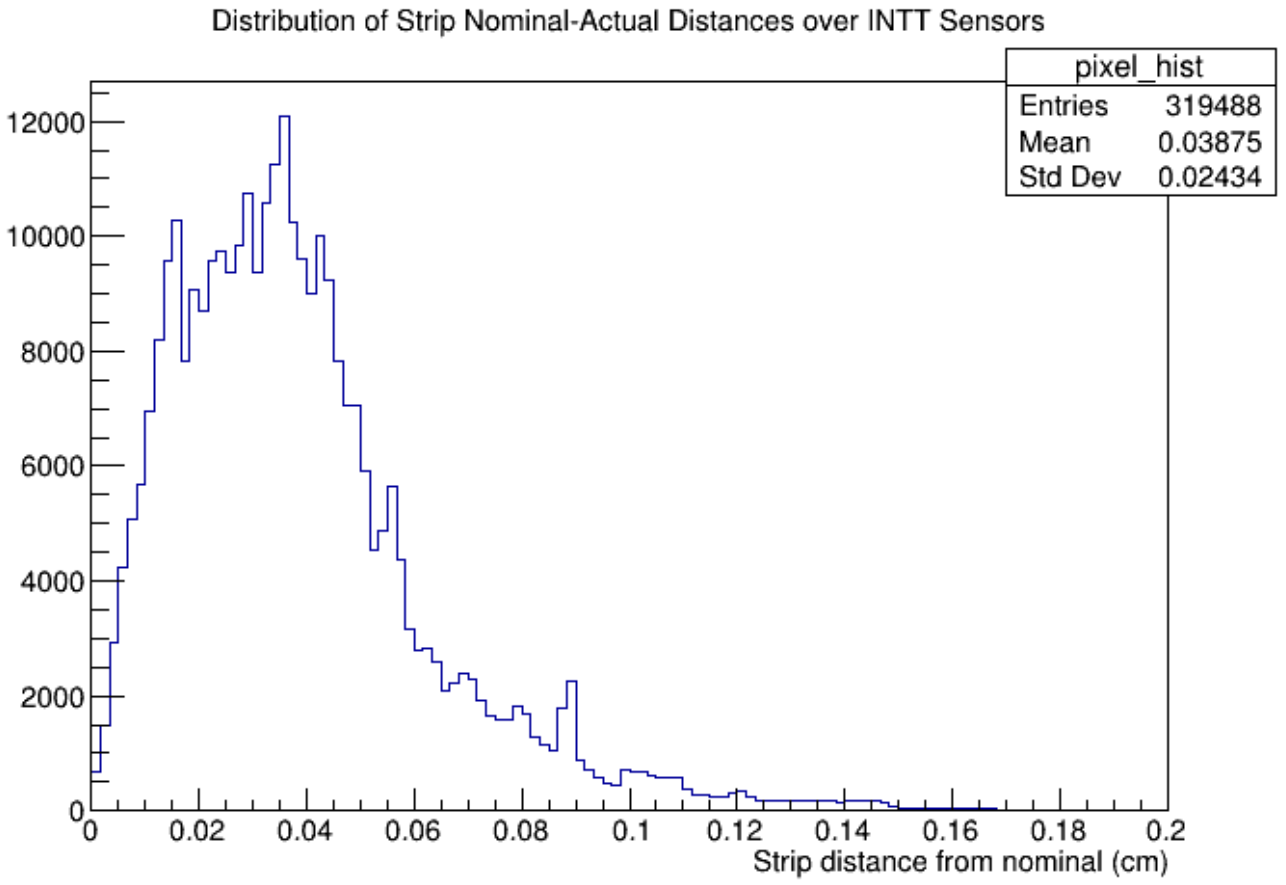
Nominal Ladder Positions



Results


Distribution of Worst-Case Nominal-Actual Distances over INTT Sensors
sensor_hist
Entries 192
Mean 0.05057
Std Dev 0.02555
40
35
30
25
20
15
10
5
0
0
0.02
0.04
0.06
0.08
0.1
0.12
0.14
0.16
0.18
0.2
Strip distance from nominal (cm)

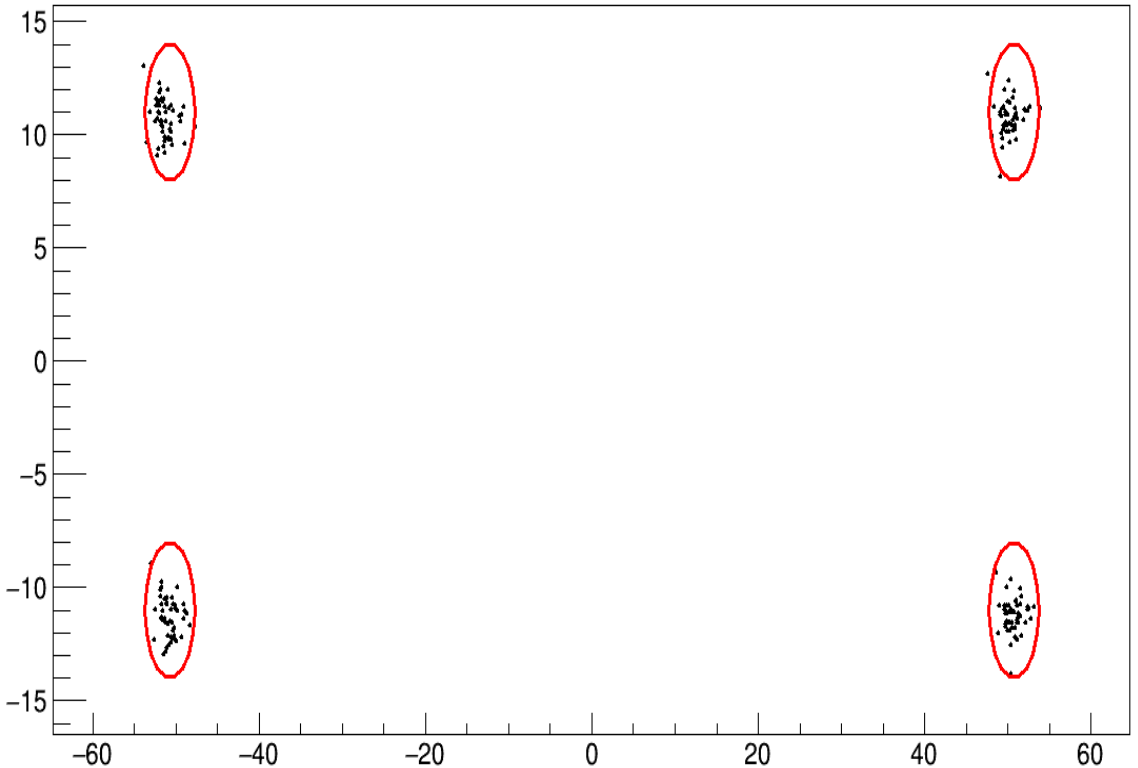
Results


Distribution of Strip Nominal-Actual Distances over INTT Sensors
pixel_hist
Entries 319488
Mean 0.03875
Std Dev 0.02434
12000
10000
8000
6000
4000
2000
0
0
0.02
0.04
0.06
0.08
0.1
0.12
0.14
0.16
0.18
0.2
Strip distance from nominal (cm)

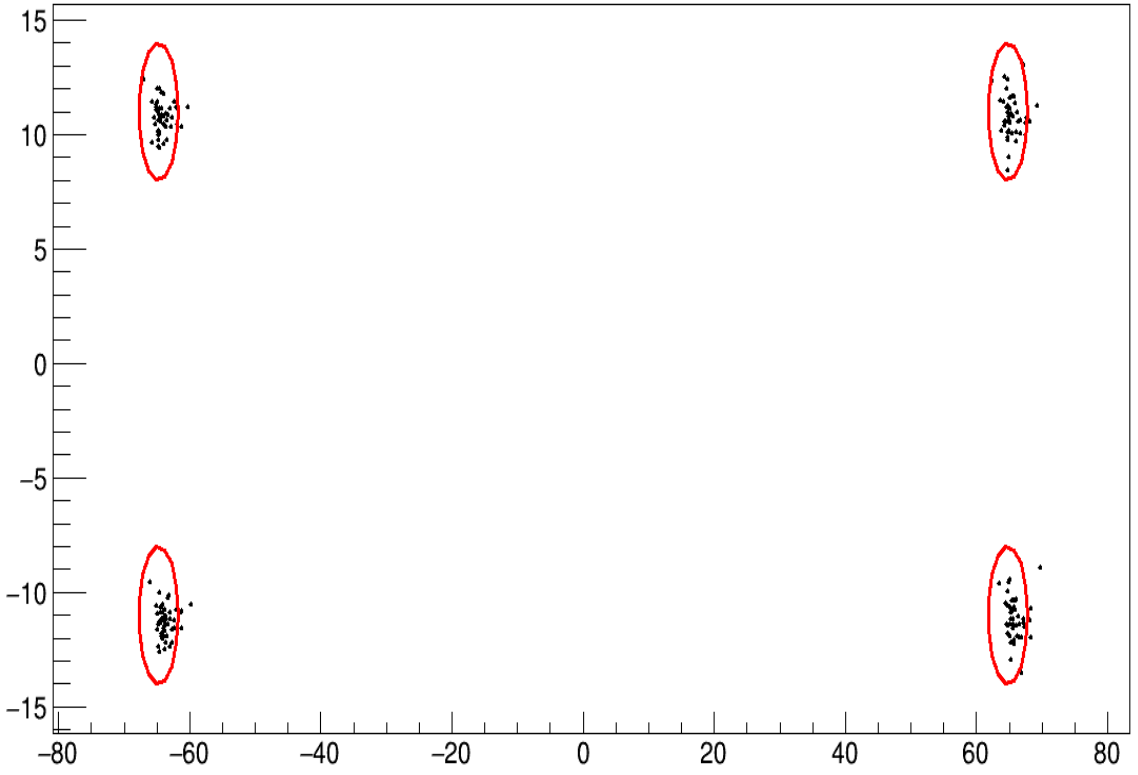
Sensor Distributions

- The following slides show the positions of where the marks were measured relative to the sensor
- The displacements from nominal are exaggerated by a factor of 30x so it is human readable
- Red 1mm circles are plotted around the nominal mark positions (also exaggerated)
- The circles appear elliptical because the scale of the horizontal and vertical axes are different, as the sensors are much longer than they are wide.

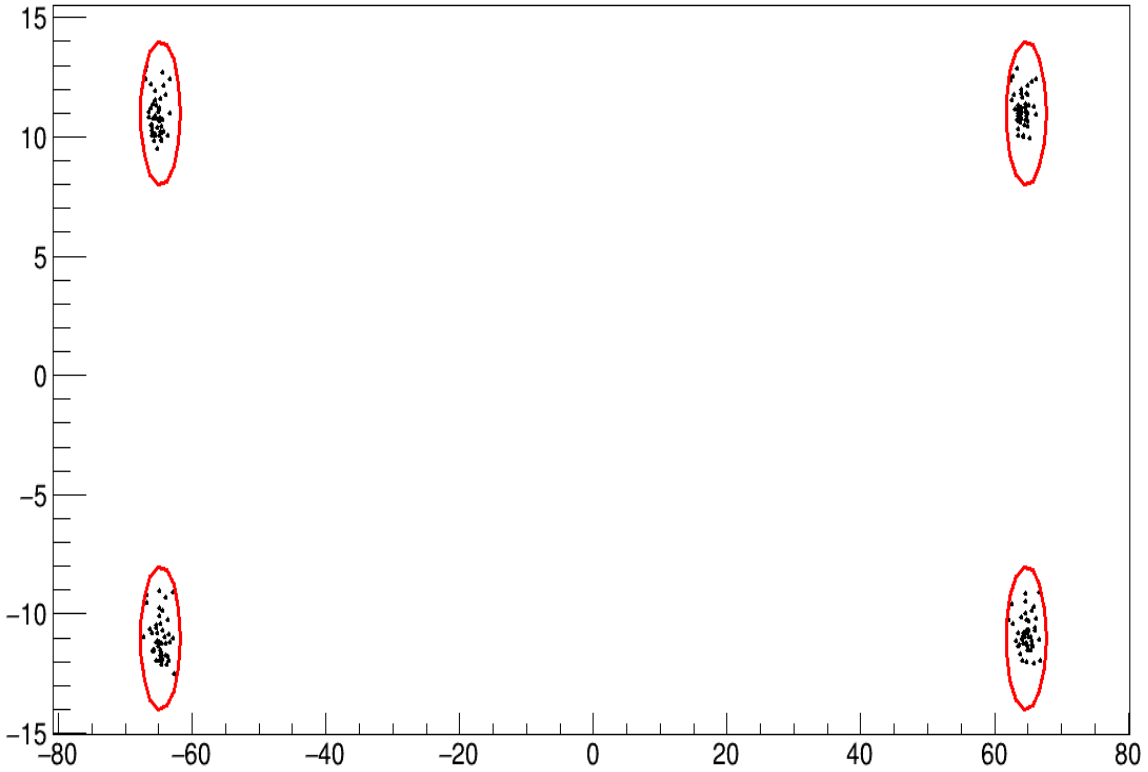
Sensor A



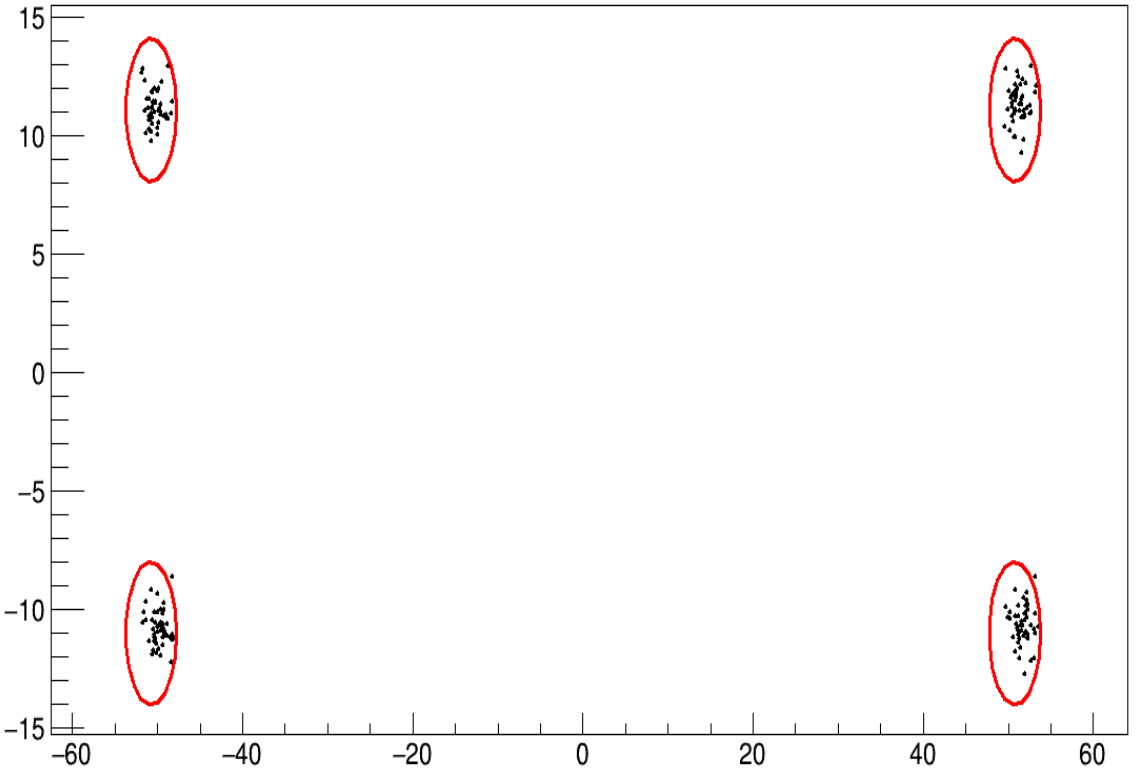
Sensor B



Sensor C



Sensor D



Summary

- Majority of pixels are within **0.7mm** of their nominal positions
- Nearly all pixels are within **1mm** of their nominal positions
- Viewing the physical distribution, marks follow approximately a 2D Gaussian distribution
- Checks:
  - Determined that vertical (sPHENIX y-axis) displacements should be omitted

Future Work

- Include data from the barrel survey
- Format the data for the tracking group
- Potentially re-make plots as needed