Status of Pixel Cosmic Analysis Note (V1.0)

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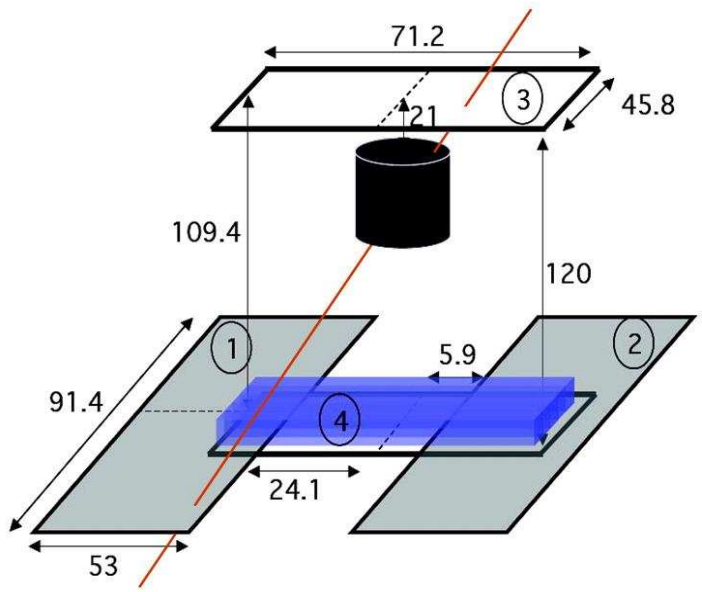
Atlas Pixel Offline Meeting, 5/21/2007

- Introduction (Attilio)
- Pixel EndCap A Cosmic Setup (Marian)
- Noise Studies (Ariel, Christoph, Georges, Daniel)
- Tracking Studies (Weiming)
- Alignment Studies (Weiming)
- Lessons learned (Attilio)
- Conclusion

Executive Summary

This document summarizes the results of the offline analysis for the pixel endcapA system test cosmic data. The setup consists of one pixel endcap of three disks, for a total of 144 modules and 6.6 million channels, about the 8% of the full detector with the goal of exercising the readout system, data taking and testing the offline reconstruction chain. The observed noise occupancy is found to be 10^{-9} after removing all the noisy pixels. Comparison with the detector characterization performed during the detector assembly shows that most of these noisy pixels were already flagged during the production test. The tracking studies, especially the ones related to particles passing in the overlap regions between adjacent modules, have been very useful in spotting problems in our geometry description and can be used for the relative alignment between the adjacent modules. When using the geometry taken from the detector survey, an initial resolution of 21.2 μm is obtained. After a preliminary alignment this improves to 17.8 μm. The difference with the 15.8 μm expected from MC simulation are probably due to residual alignment uncertainties which are under investigation.

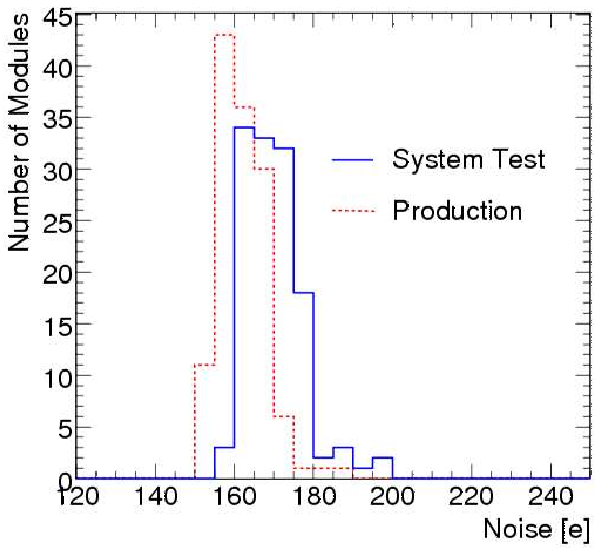
Pixel EndCap Setup



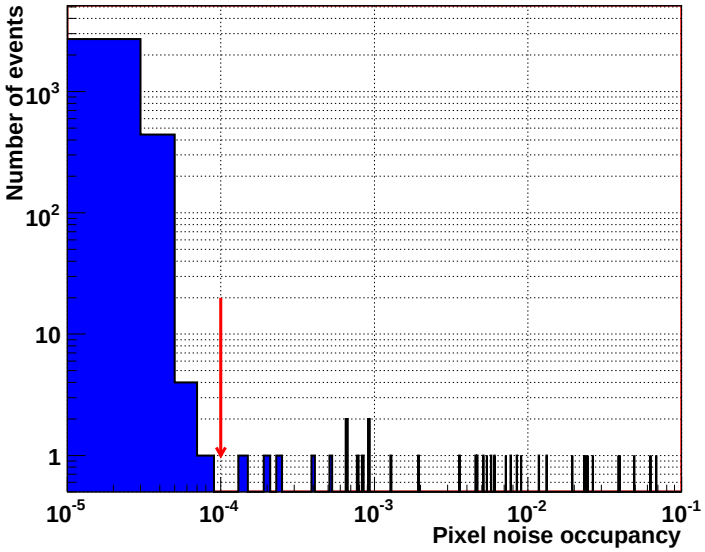
Noise Studies with Different Triggers

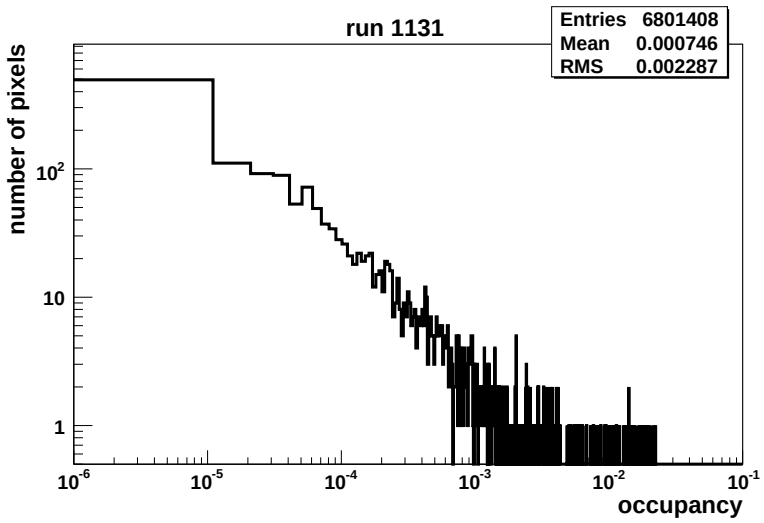
- Noise runs with cosmic trigger
- Noise runs with random triggers
- Noise runs with special setting
- Special Pixel Map

Noise from Threshold Scan



Pixel Occupancy

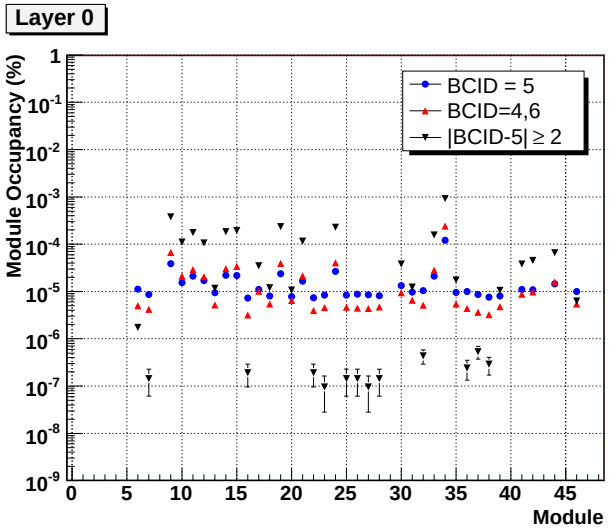


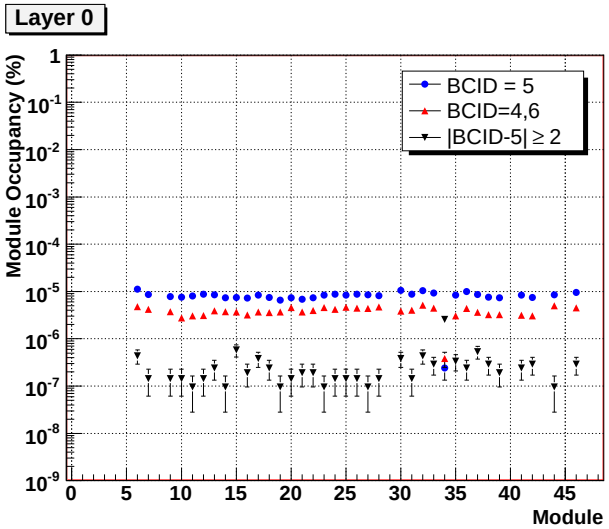


- Pixel occupancies in run 1125 cosmic data (left) and in run 1131 with random trigger (right)

- Requiring $> 10^{-4}$ as noise pixel cuts.

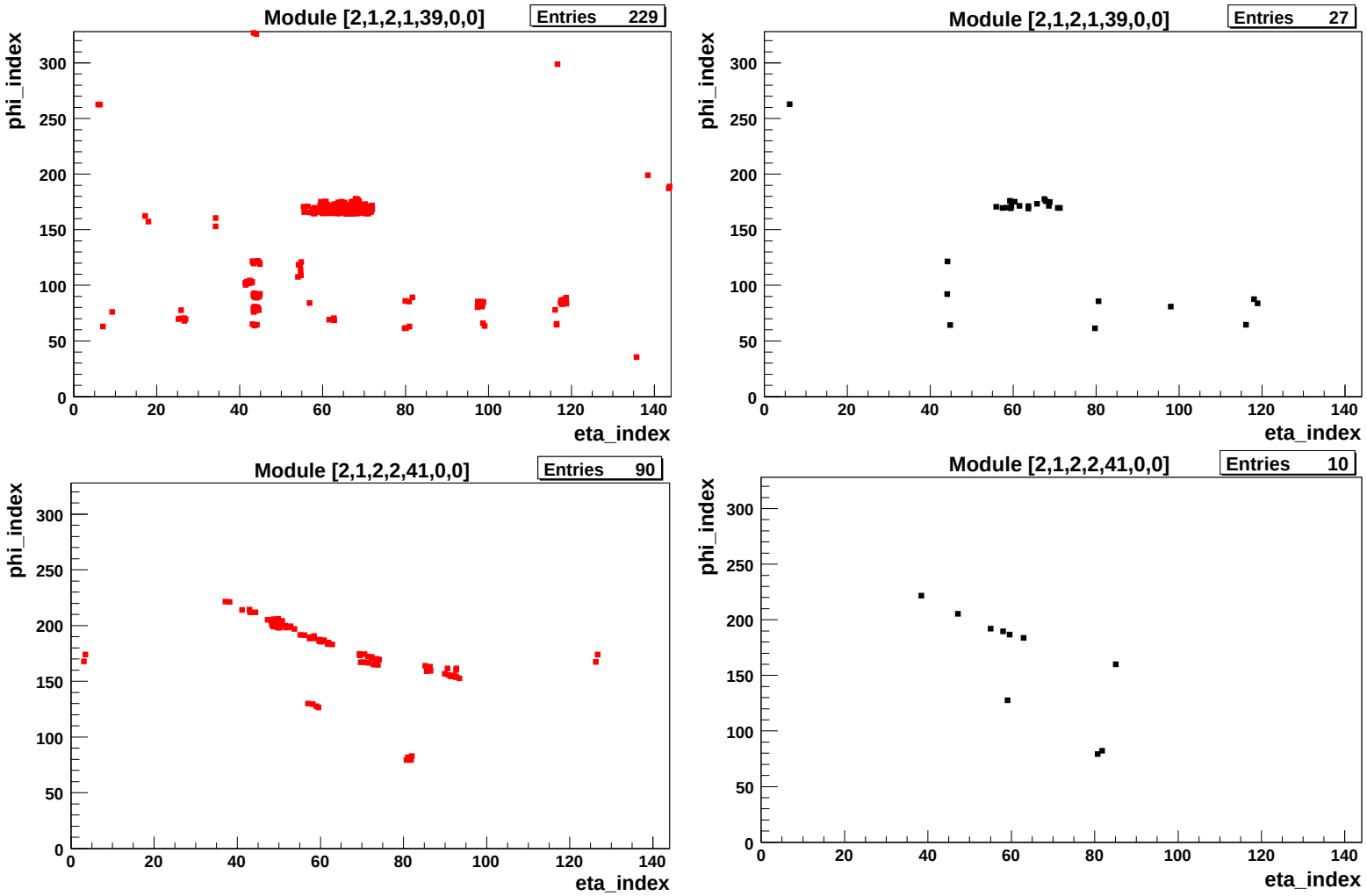
Noise from Run 1125 with Cosmic Trigger





- Module occupency before and after removing hot pixels with occupency $> 10^{-4}$.
- The noisle level is at 10^{-9} for $|BCID - 5| > 2$ (out of time).

Noise from Run 1131 with Random Trigger



- Special pixel is defined with occupency $> 10^{-4}$.
- There are strongly correlated with the production test results during the assembling.

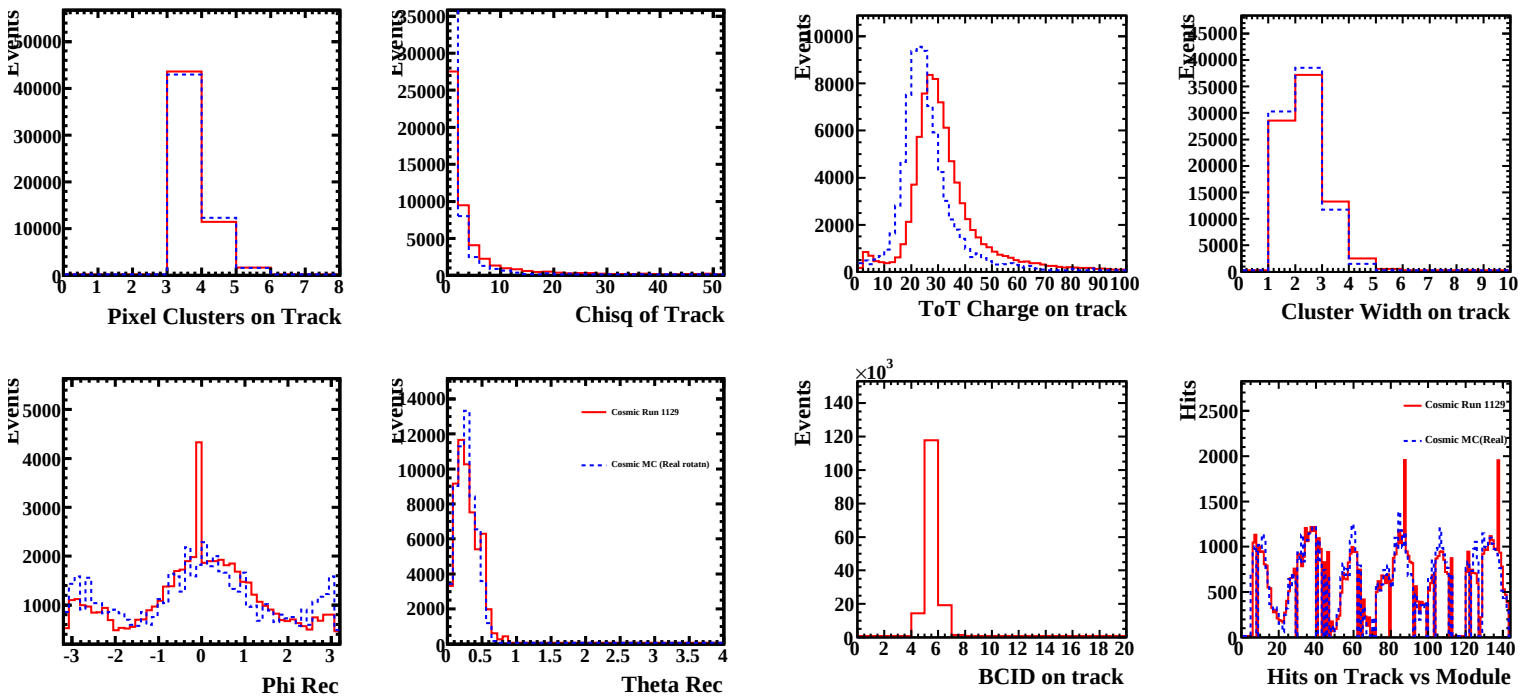
Definition of Status Bits for Special Pixel

bit	meaning	description	numbers of pixels endcap A	detector
0	use code	0 =useful data, 1 =not useful	4938	129231
1	off for data	set to one if pixel is masked by DAQ	326	5908
2	off for calibration	set to one if pixel is masked during Calib.	0	0
8	digitally dead	bit 0 of ModuleAnalysis mask:	71	57345
9	disconnected bump	bit 1 of ModuleAnalysis mask	1528	29511
10	merged bump	bit 3 of ModuleAnalysis mask	173	1437
11	dead with particles	bit 5 of ModuleAnalysis mask:	4173	61852
12	low efficiency	bit 6 of ModuleAnalysis mask:	4255	62731
13	threshold not tunable	bit 11 of ModuleAnalysis mask:(analog dead)	2675	42567
14	ToT not tunable	bit 14 of ModuleAnalysis mask	2543	37257
15	noisy pixel	bit 16 of ModuleAnalysis mask:	17	634
16	unknown dead	any pixel with bit 0 set	0	2144
25	bottom neighbour special	bottom=smaller row number	3179	90192
26	top neighbour special		3179	90192
27	left neighbour special	left=smaller column number	1624	69386
28	right neighbour special		1624	69386
any	special	pixels that have at least one bit set	5627	141189

Class of Noise Pixels in Run 1131

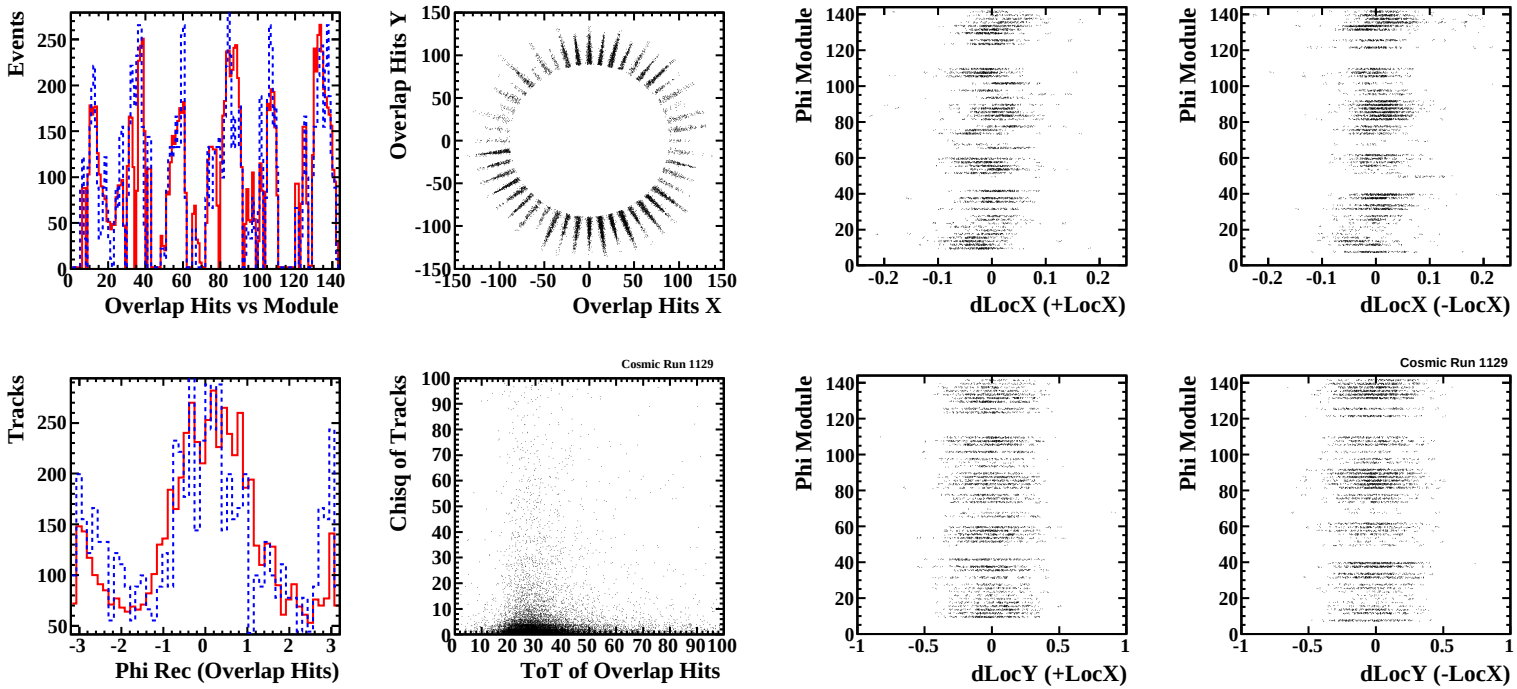
status bit	number of noisy pixels	fraction of all noisy pixels
any bit, special	283	93 %
0, not giving useful data	273	90 %
1, off for data	65	21 %
8, digitally dead	0	0 %
9, disconnected bump	0	0 %
10, merged bump	3	1 %
11, dead with particles	205	68 %
12, low efficiency with particles	205	68 %
13, threshold not tunable	273	90 %
14, ToT not tunable	222	73 %
15, noisy	0	0 %

Tracking Studies

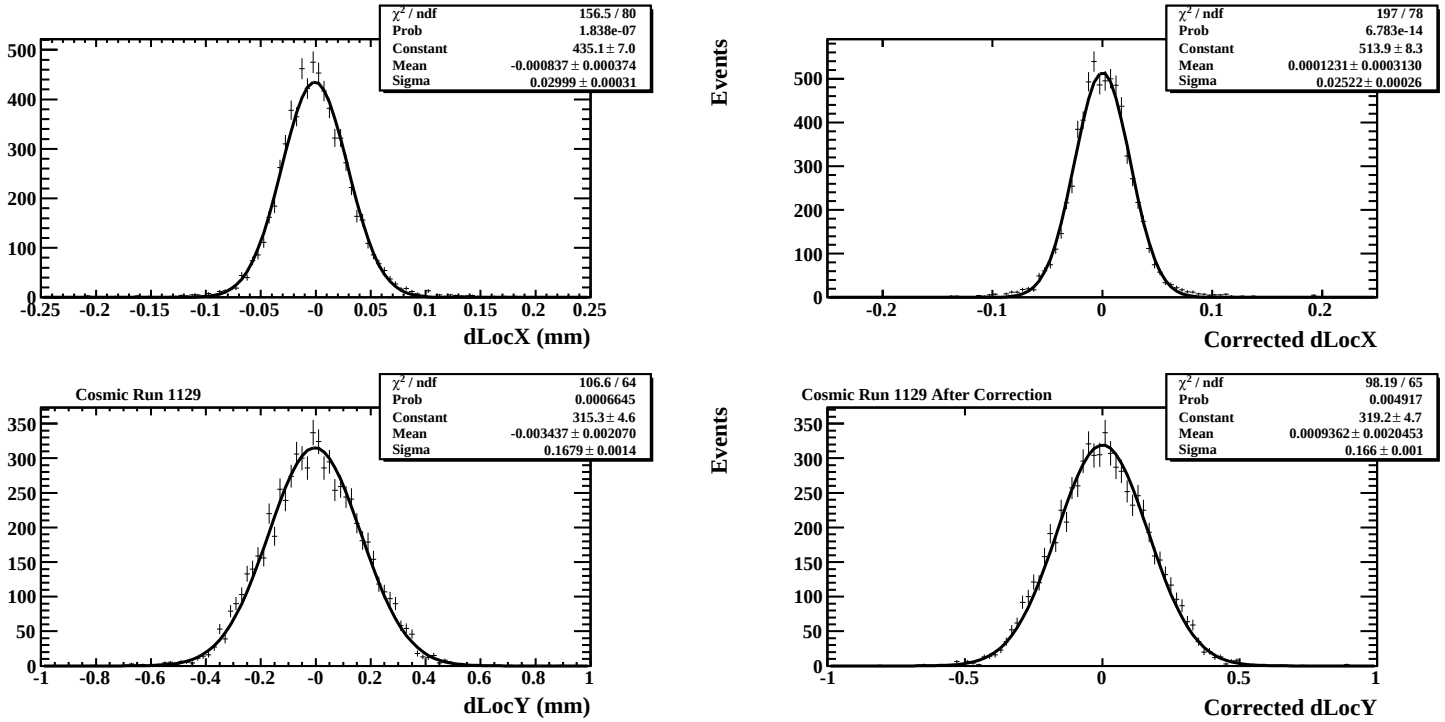
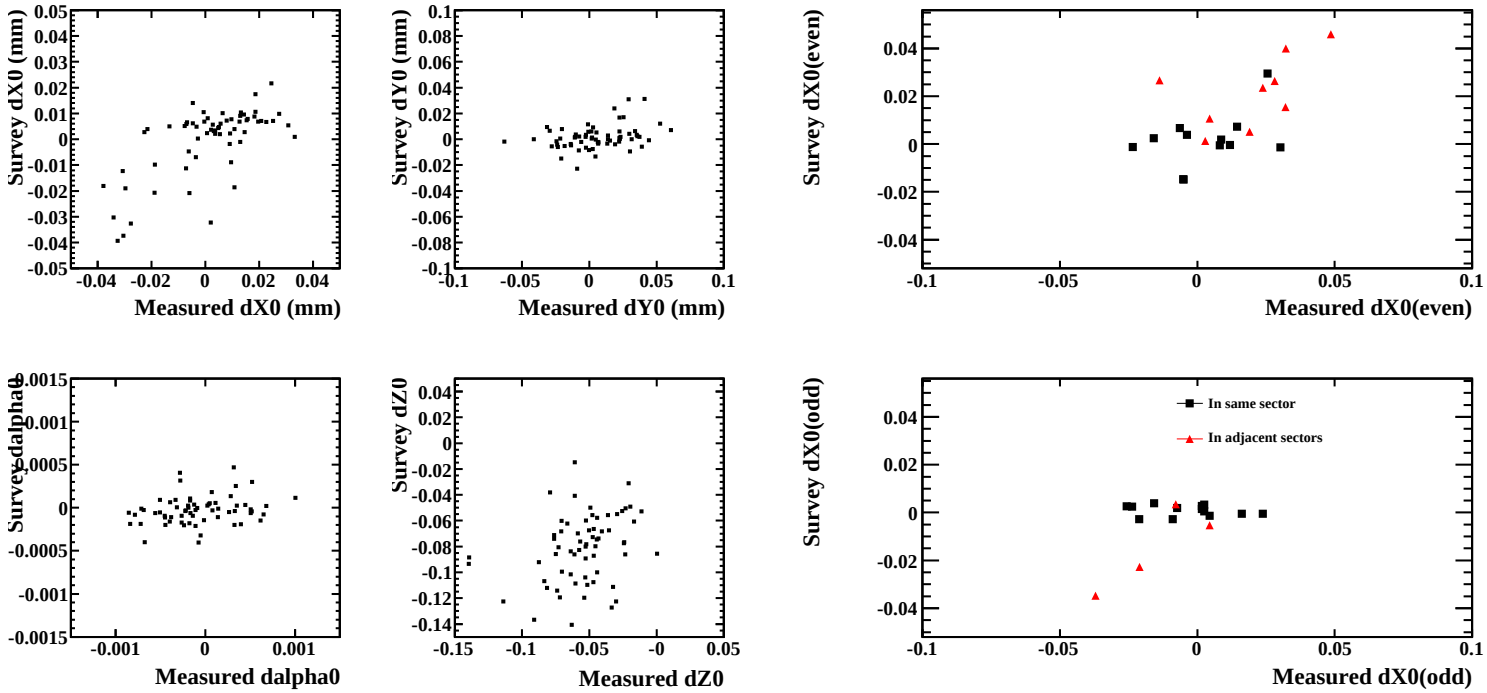


Data Sample	Tracking Rate (%)	Overlap Fraction (%)
Data	2.83 ± 0.01	23.4 ± 0.2
Ideal MC	≈ 6	≈ 28
Realistic MC(disable modules)	3.9 ± 0.1	24.6 ± 0.9

Alignment with Overlap Residuals



Residuals before and after Alignment



Alignment vs Survey