SLHC Sensors at Meson Test

Ryan Rivera
ESE/CD, Fermilab

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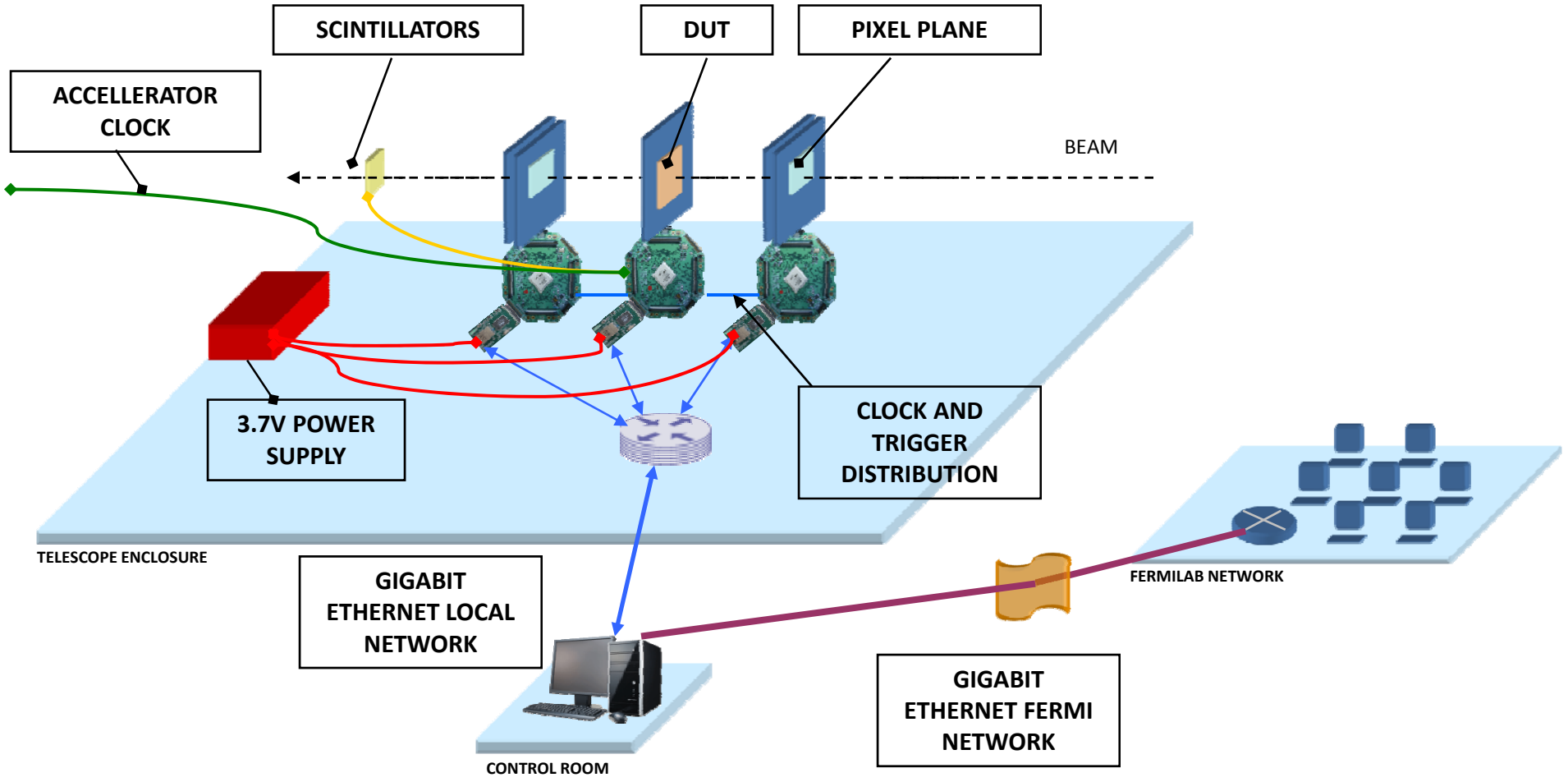
Motivation

- Goal is to test future CMS vertex detector prototypes:
  - Diamond sensors
  - 3D sensors
  - MCz planar silicon sensors
- We compare against the current CMS silicon detector standard:
  - The telescope is made of grade B modules rejected during CMS pixel production.

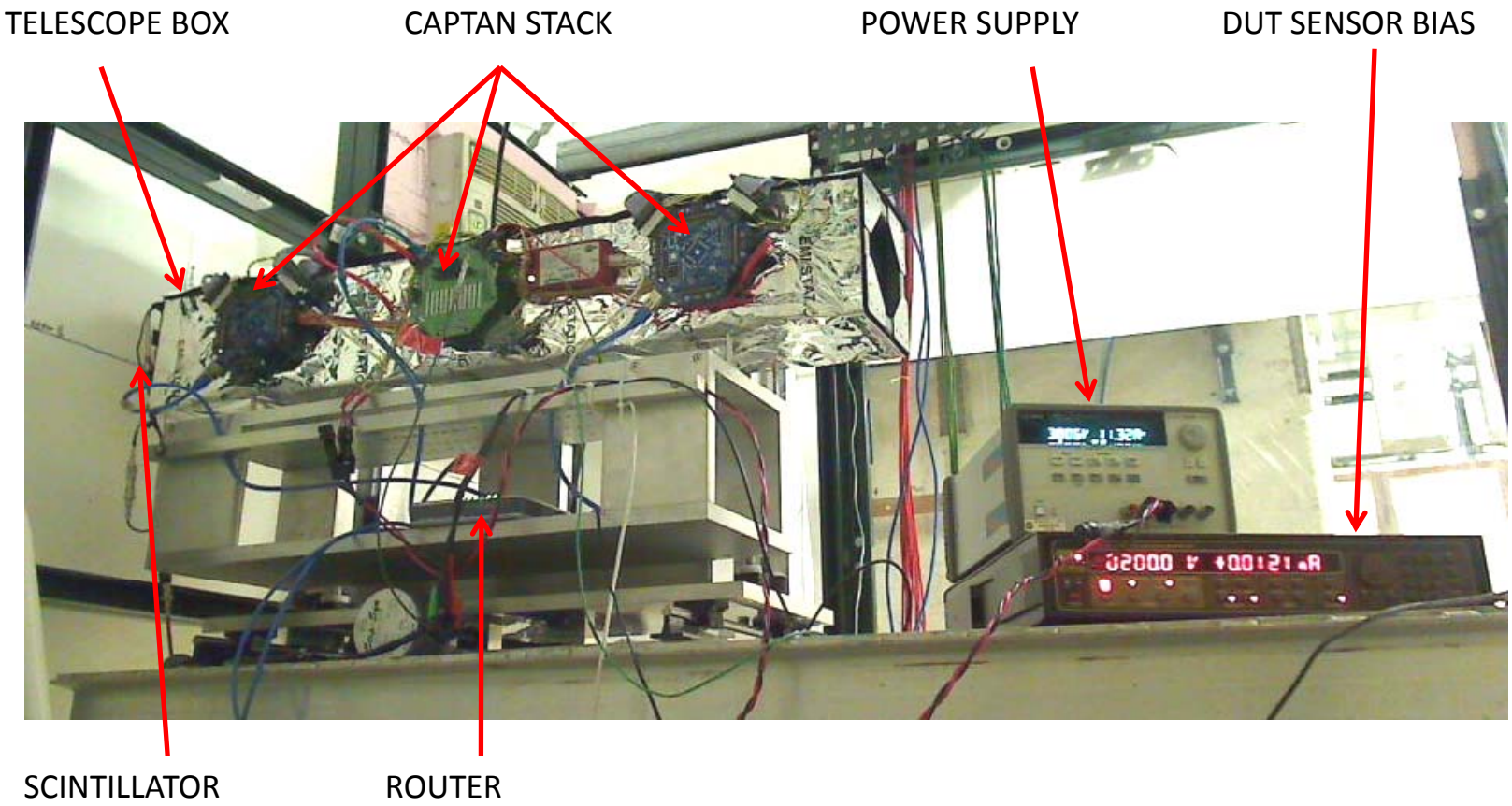
Since Fall 2009…

- Integrated the analysis software into telescope package.
- Expanded the telescope by doubling station count.
- Built a new modular mechanical box that hosts the detectors and electronics.
- Collaborated with universities interested in applicable sensors.

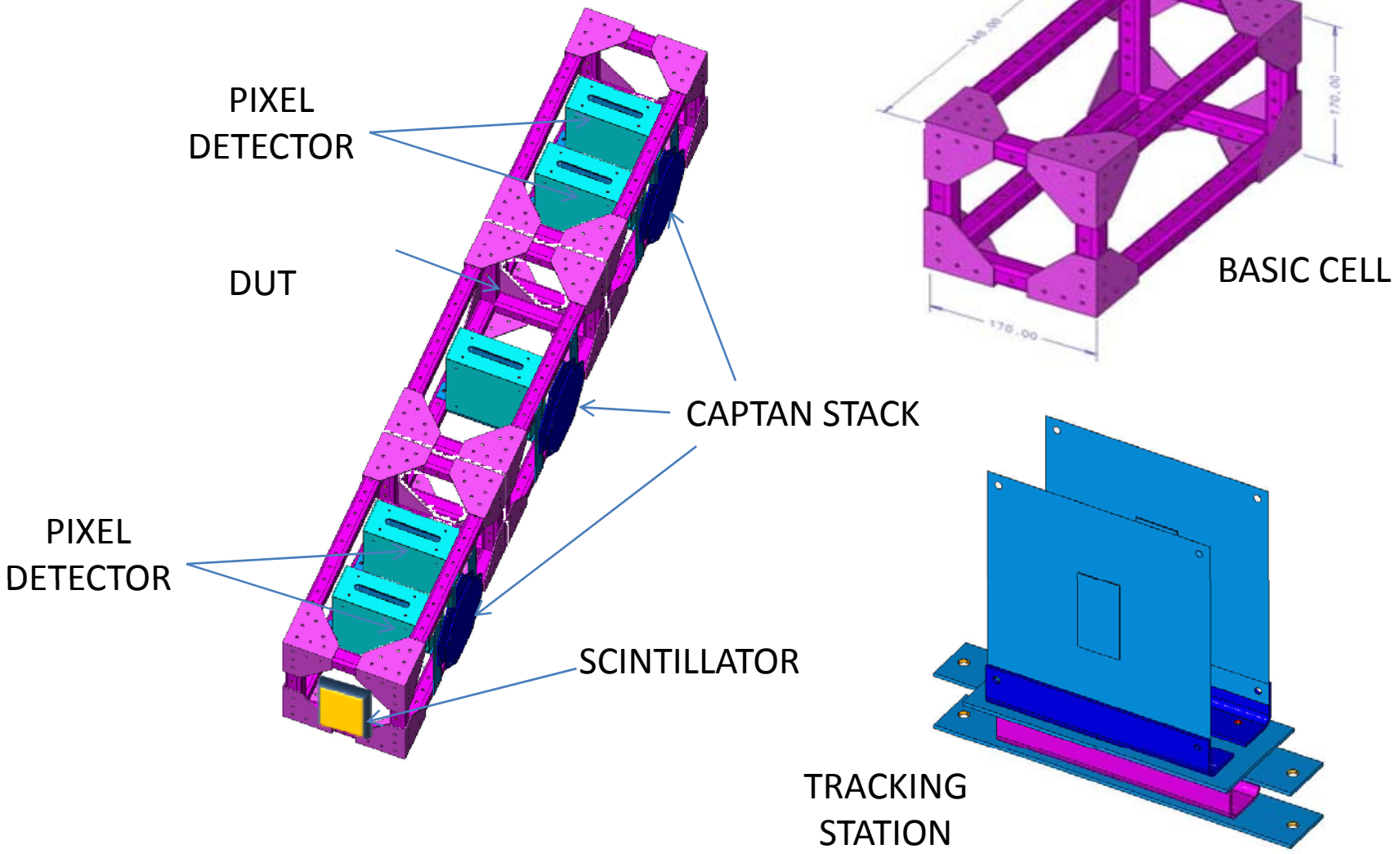
Telescope Overview



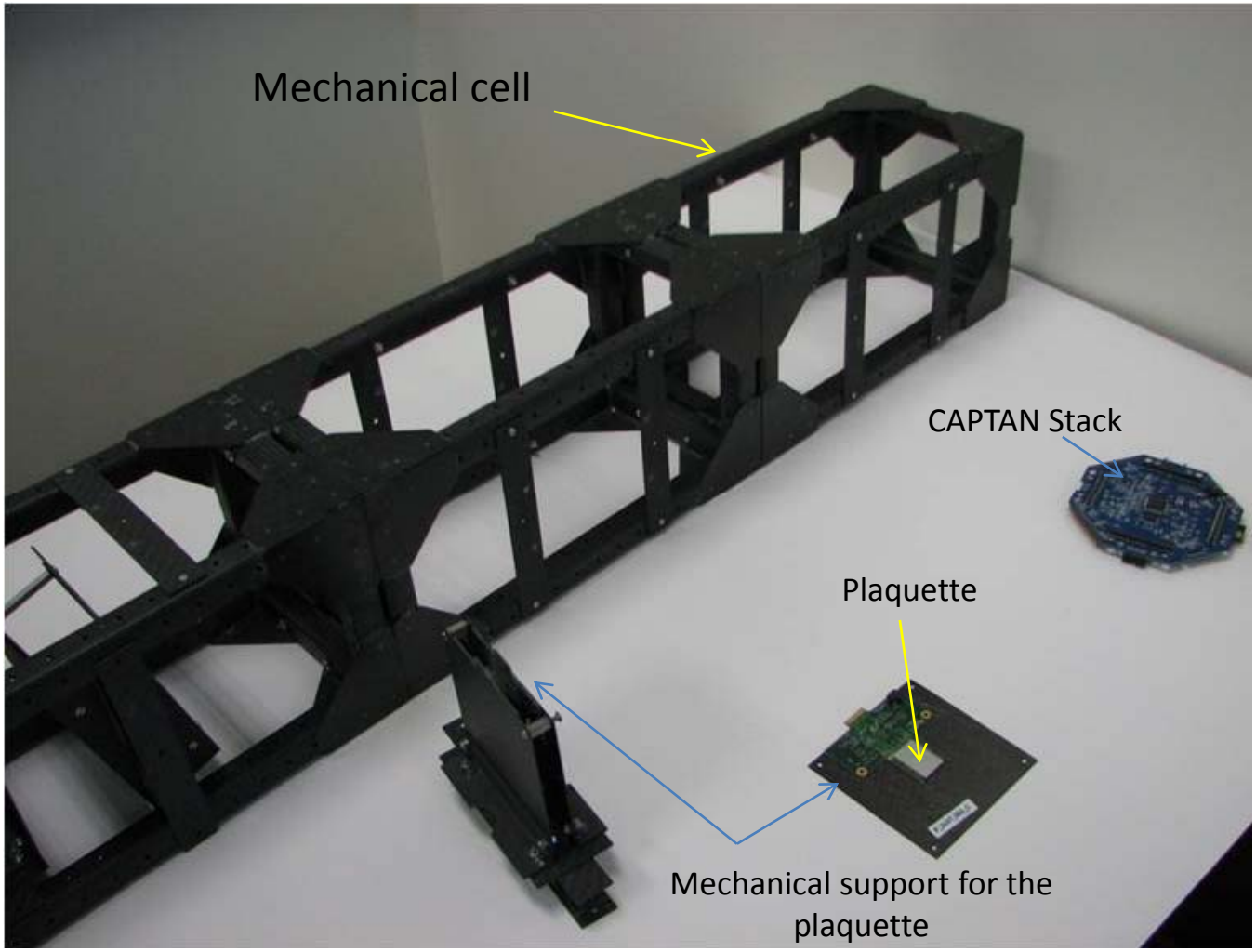
Telescope Overview Cont.



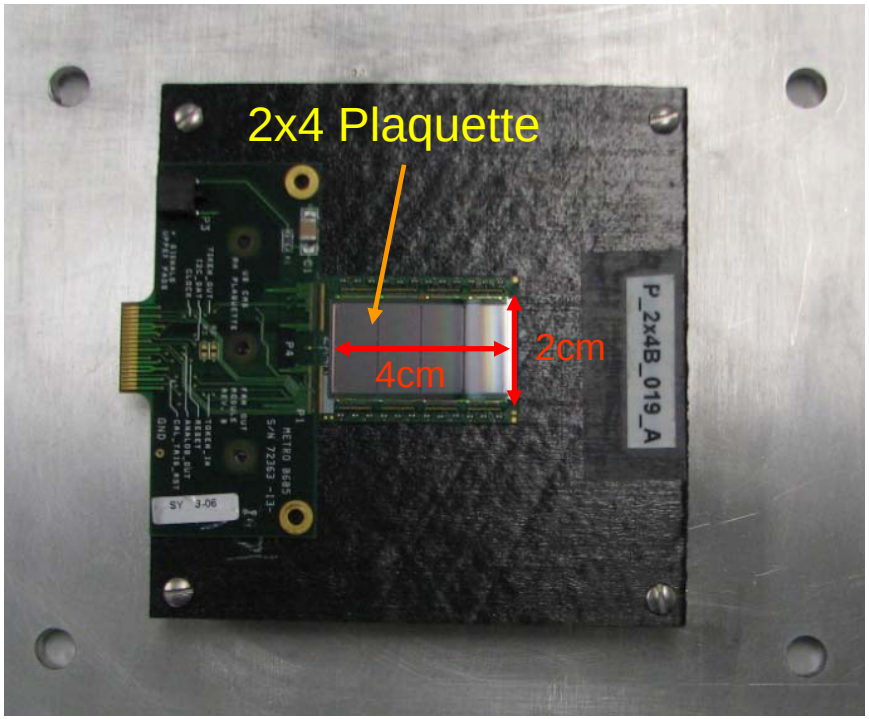
Telescope Overview Cont.



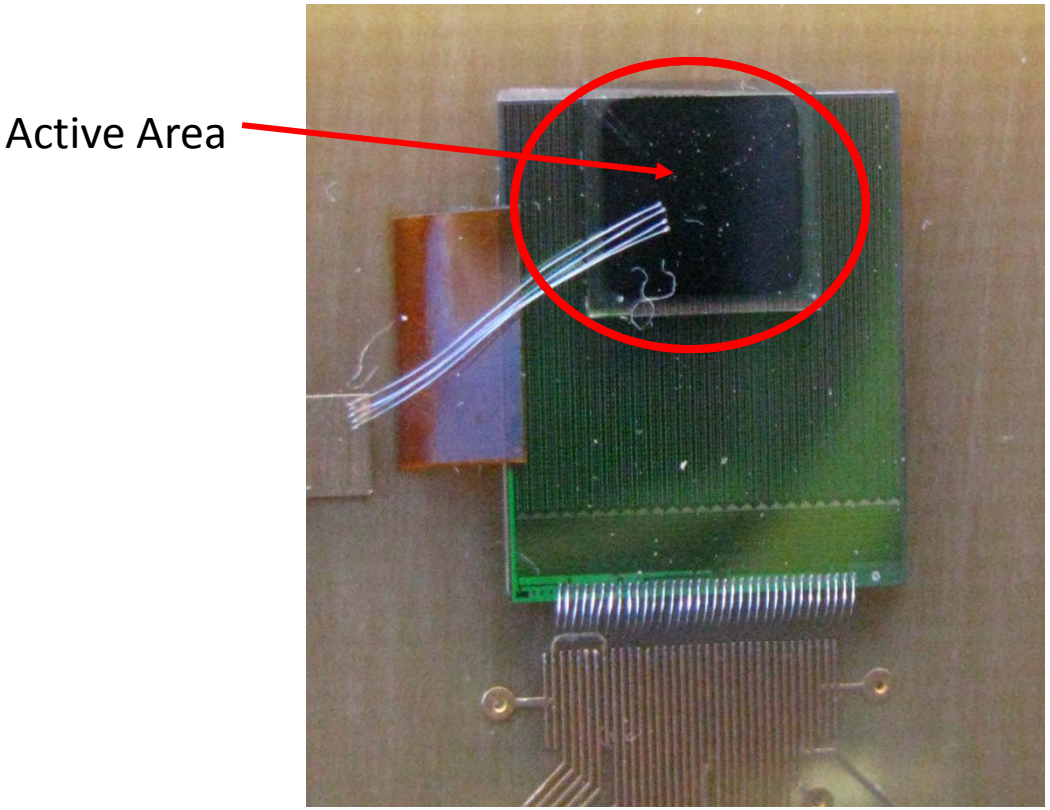
Telescope Overview Cont.



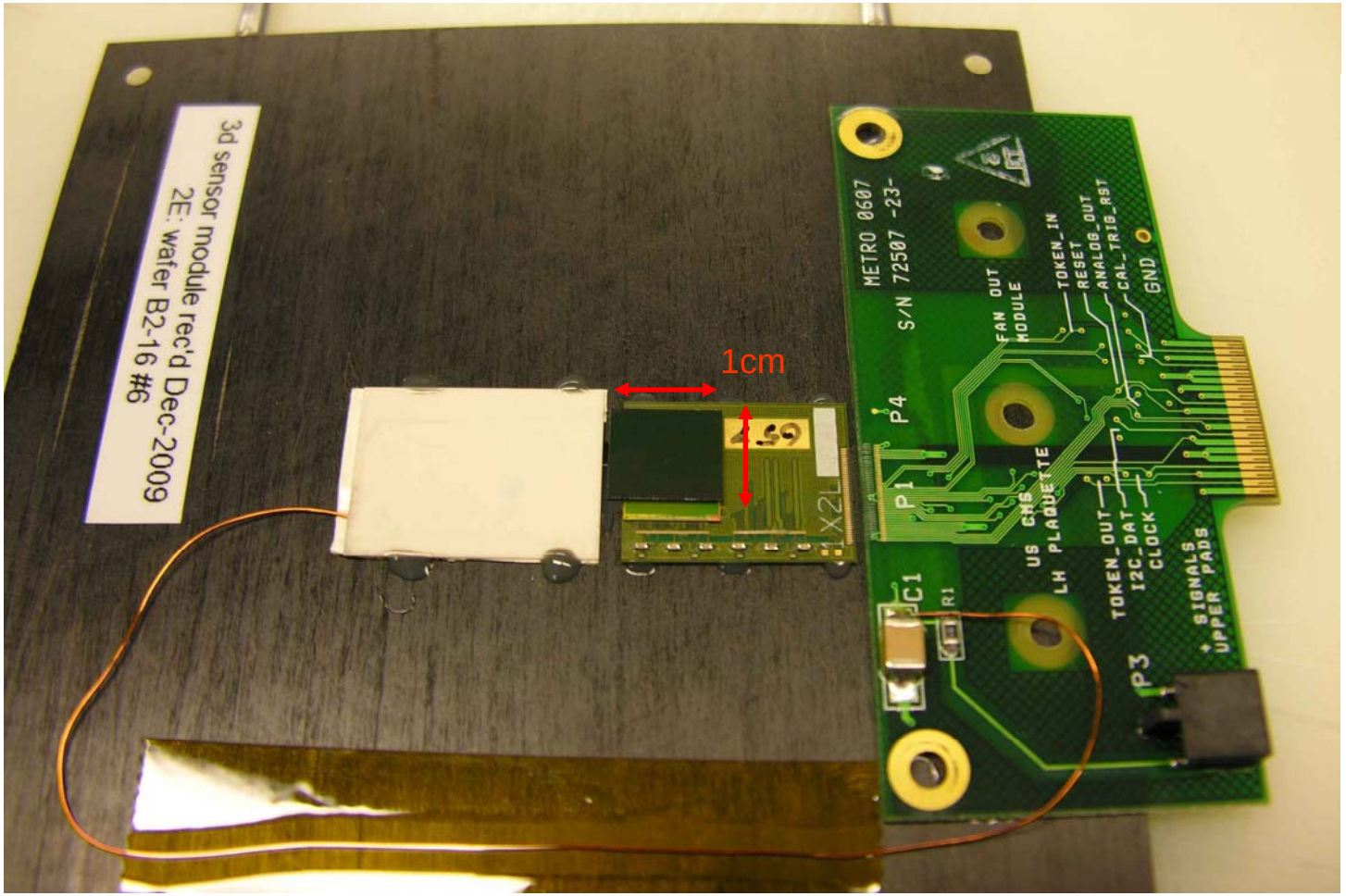
Telescope Silicon Detector



Diamond Detector



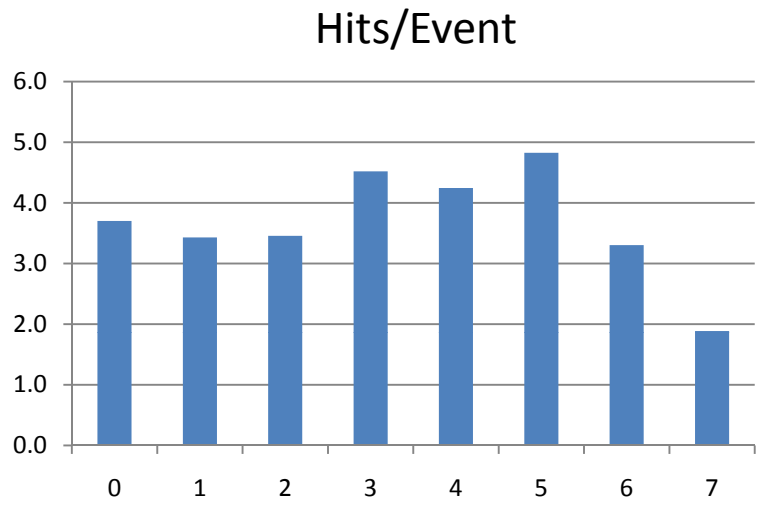
3D Detector

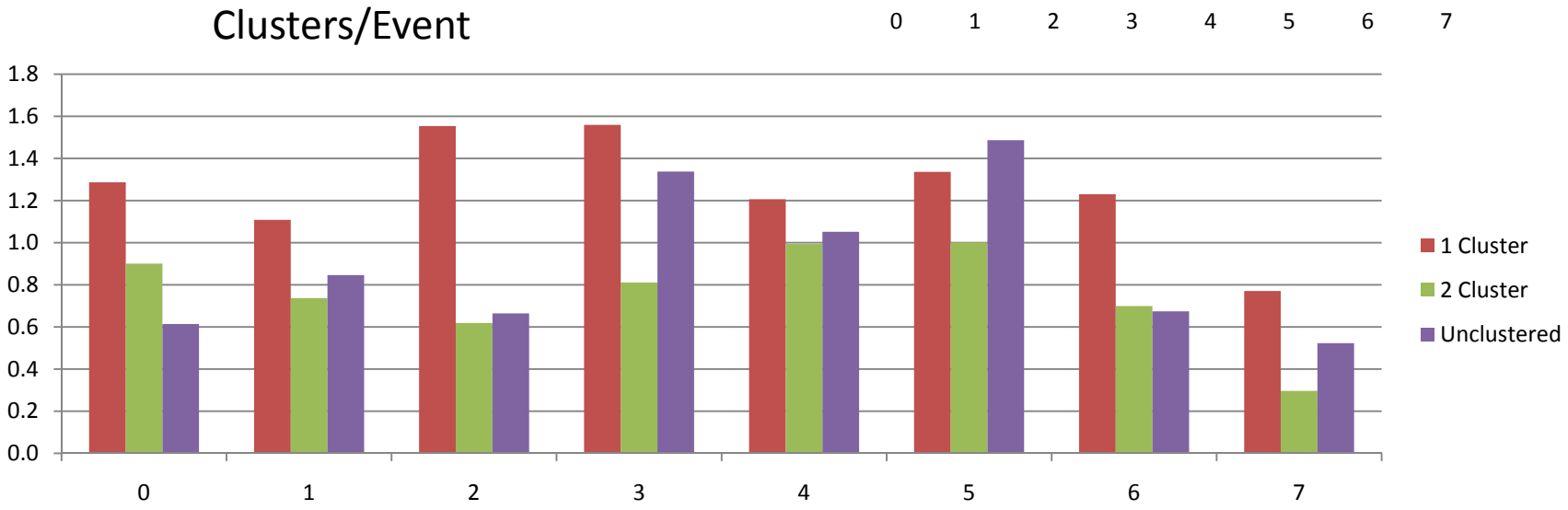

3d sensor module rec'd Dec-2009
2E: wafer B2-16 #6
1cm
1X2L
METRO 0607
S/N 72507 -23-
P4
P1
P3
C1
R1
FAN OUT
MODULE
TOKEN_IN
RESET
ANALOG_OUT
CAL_TRIG_RST
GND
US CMS
LH PLAQUETTE
TOKEN_OUT
I2C_DAT
CLOCK
SIGNALS
UPPER PADS

Telescope Results from a 20-min Run

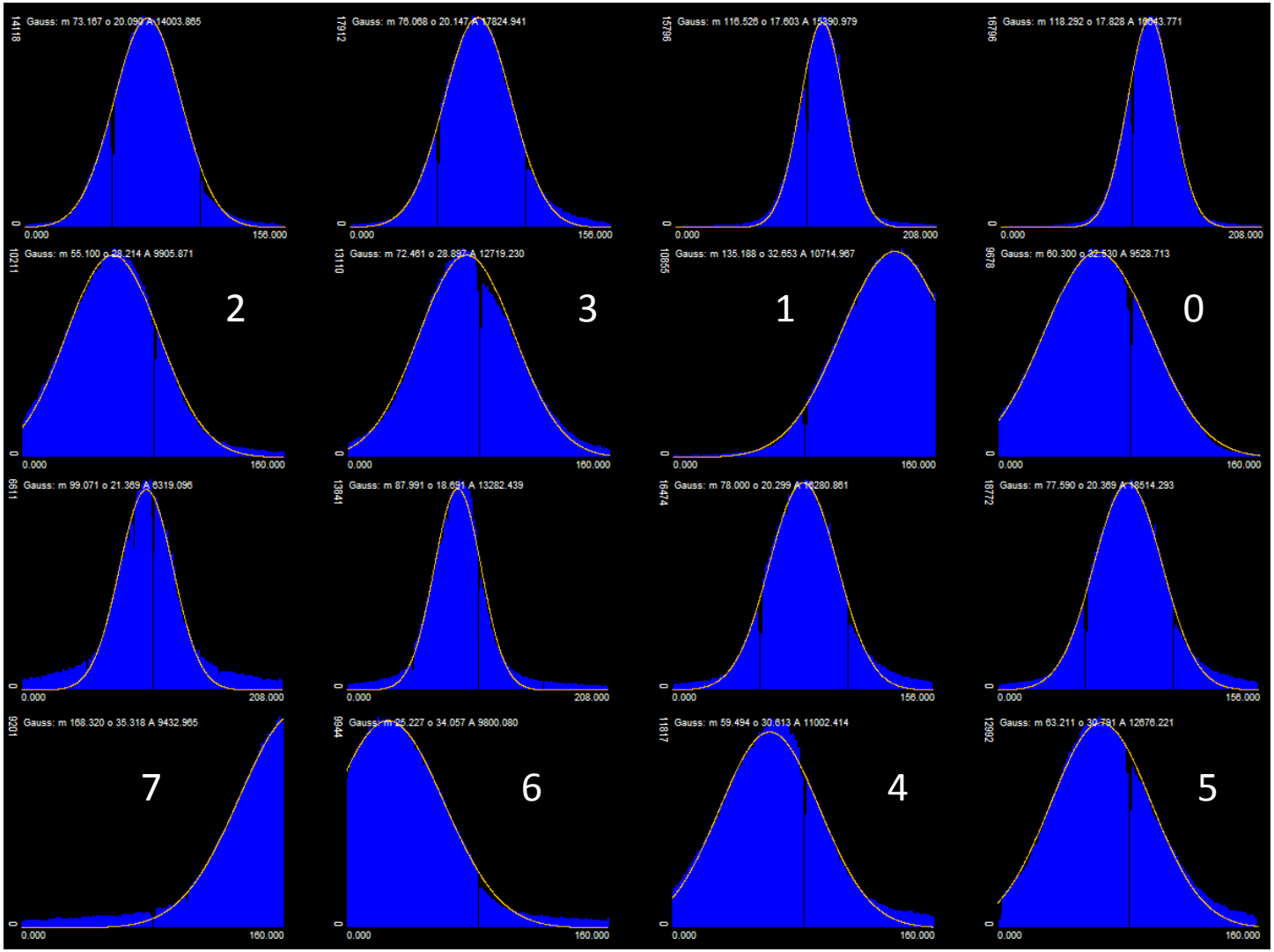
Analysis

- 197,692 events

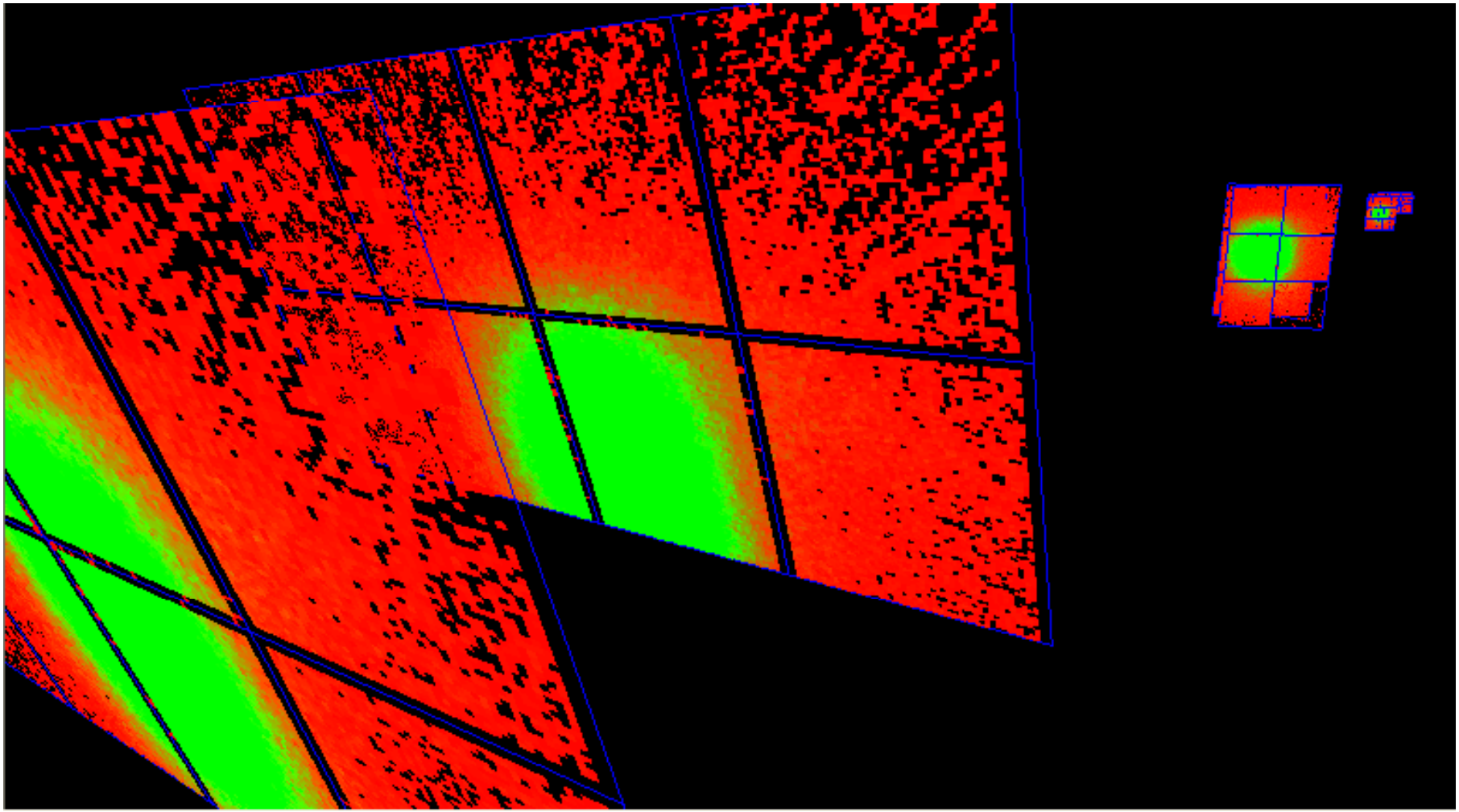




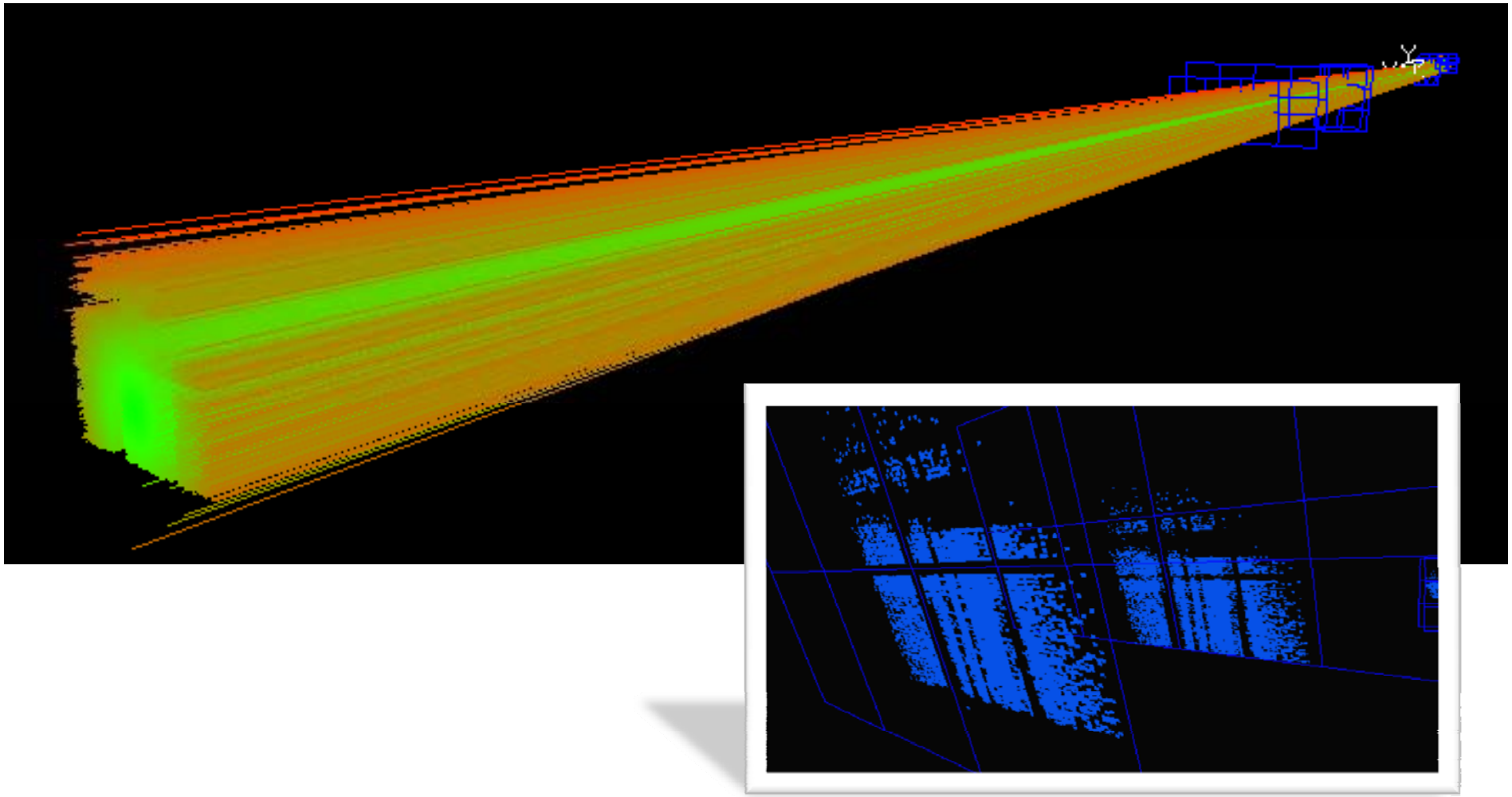
Analysis – Beam Spot



Alignment

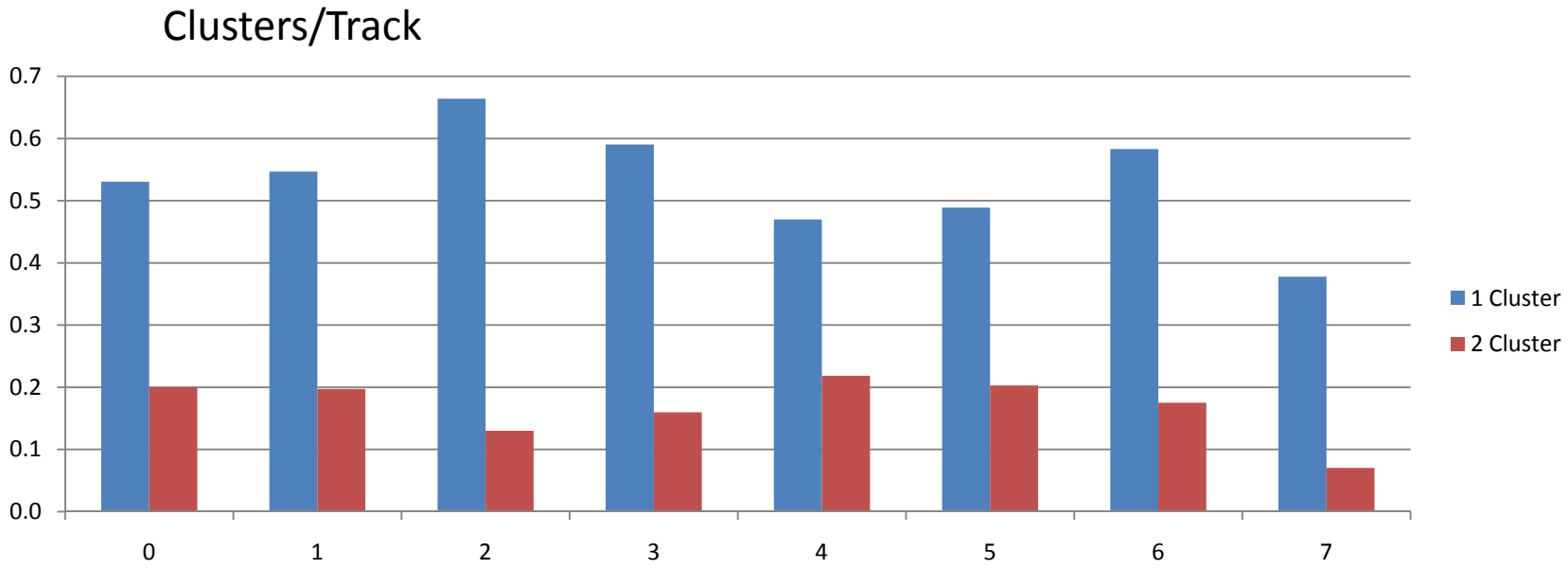


Tracking

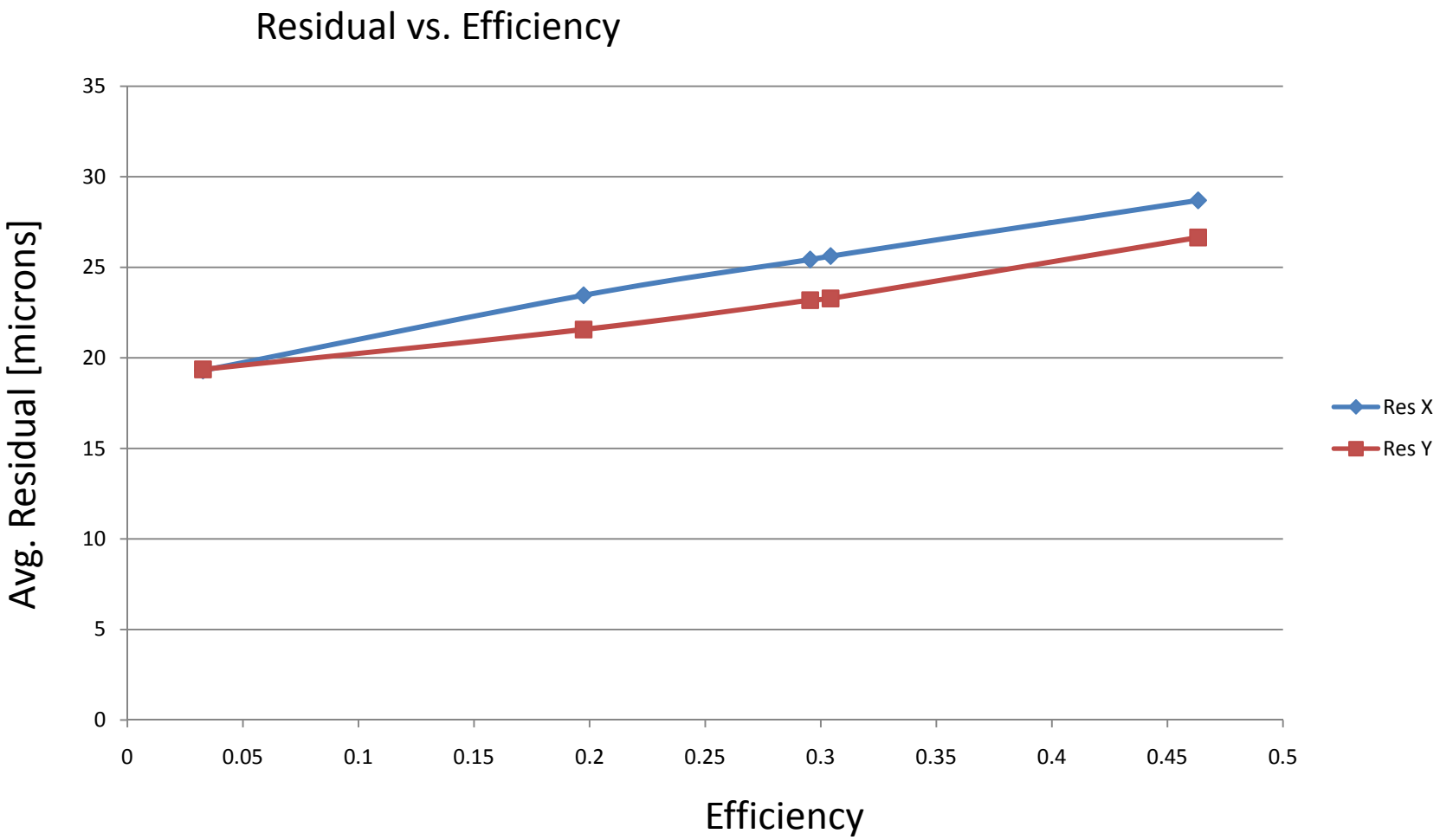


Tracking Cont.

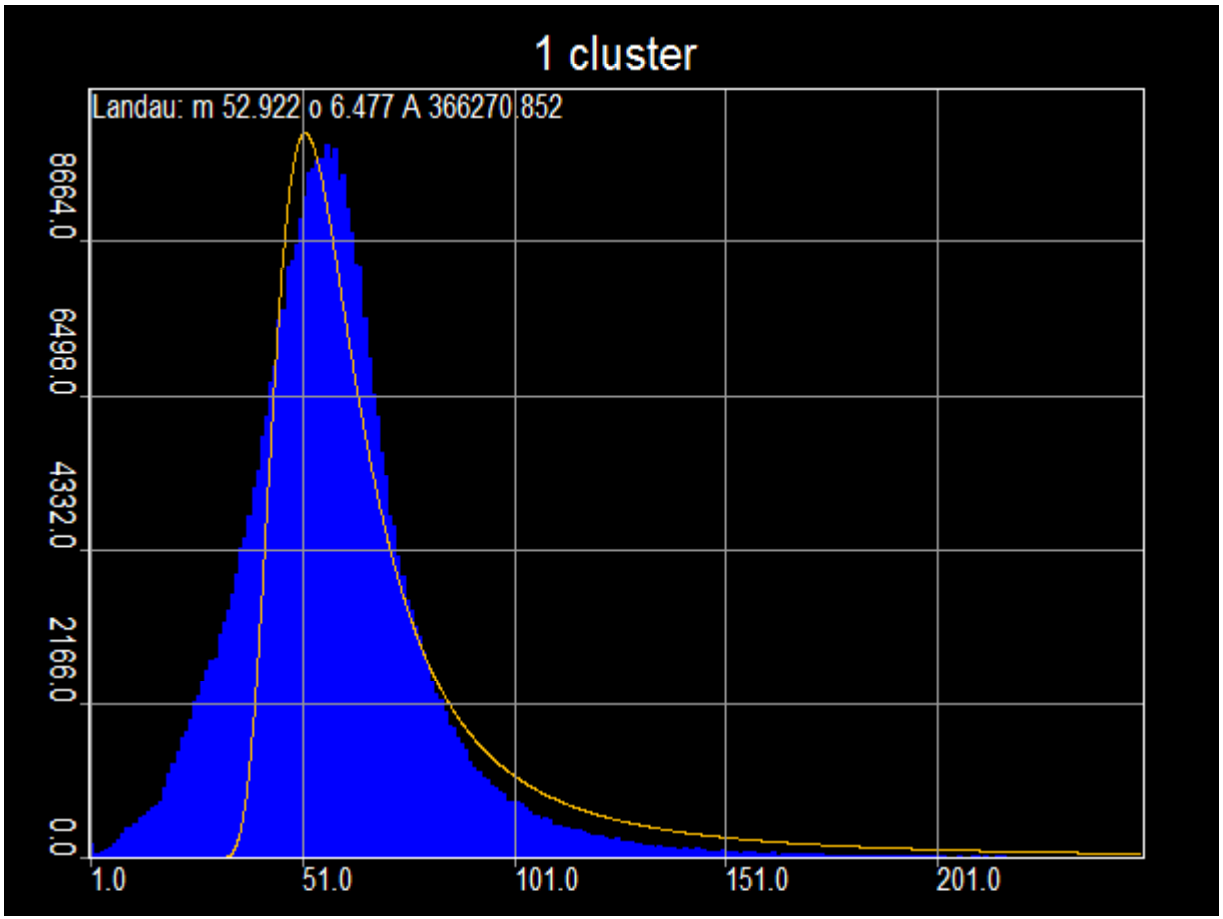
- 95,930 tracks from 197,692 events.
- 48.5 % efficiency.



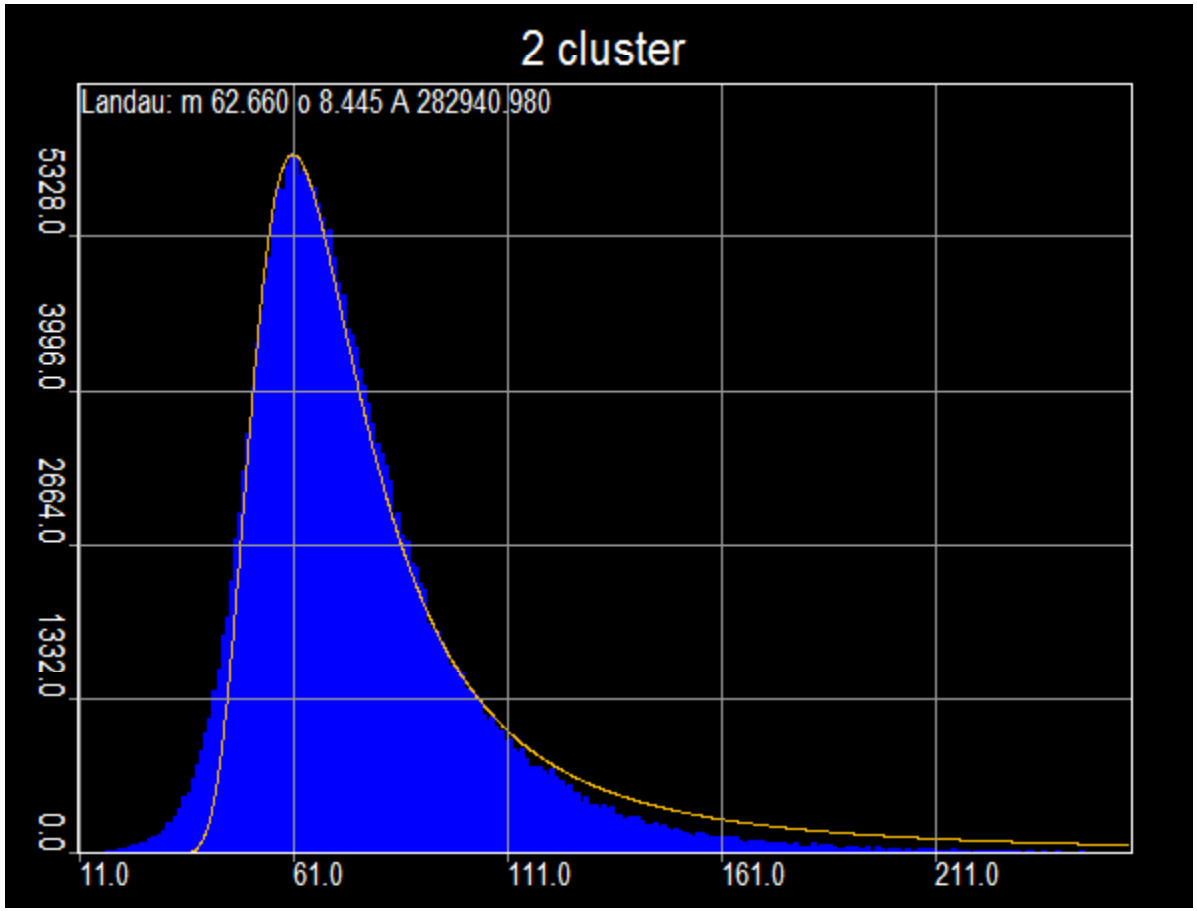
Residuals


Residual vs. Efficiency
Avg. Residual [microns]
35
30
25
20
15
10
5
0
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
Efficiency
Res X
Res Y

Charge Distribution

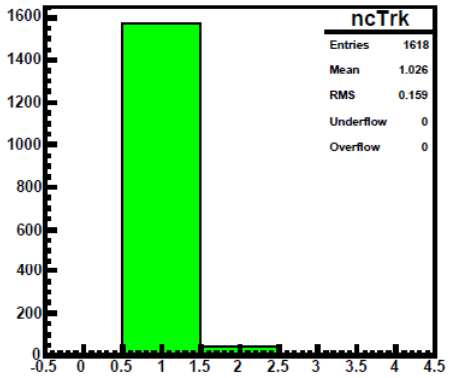


Charge Distribution Cont.

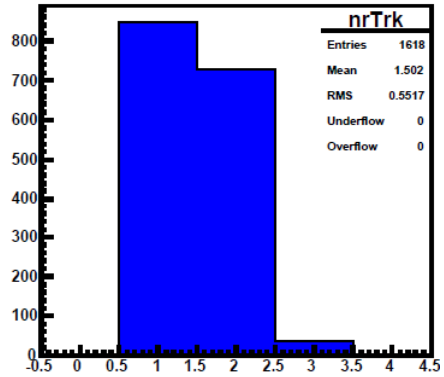


Diamond Sensor Charge Sharing vs. HV

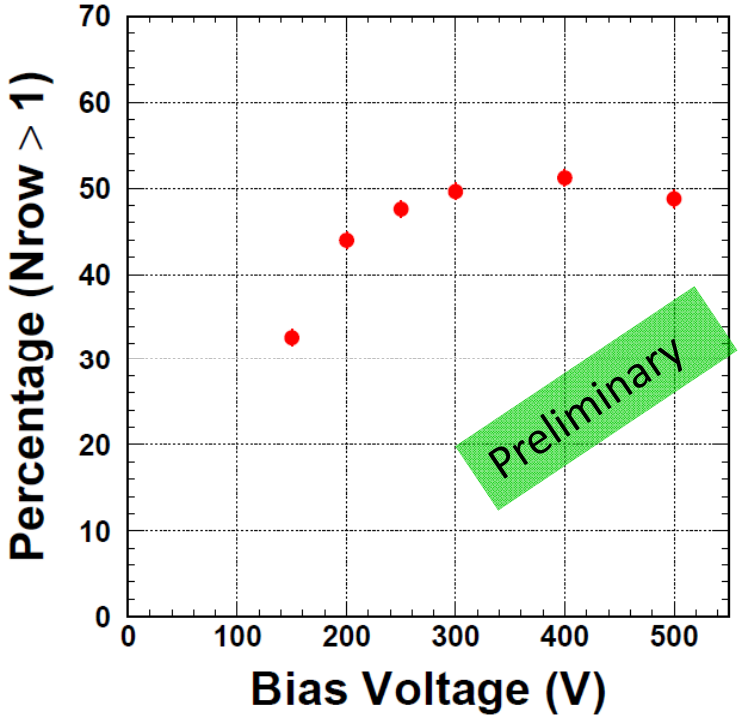
HV = -250 V



Number of Columns per Cluster

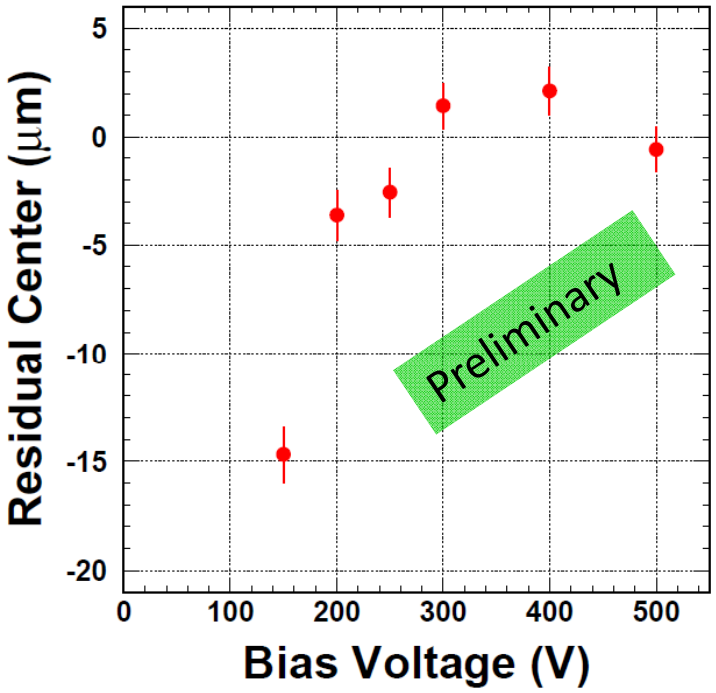


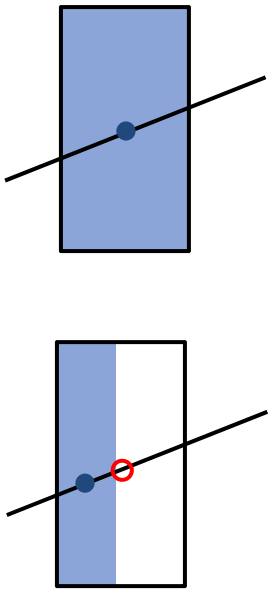
Number of Rows per Cluster



- Sensor rotated to ~ 20° in row direction.
- More charge collected with higher bias HV till saturation.
- Need more work on gain calibration to extract the absolute charge (MPV of Landau distribution).

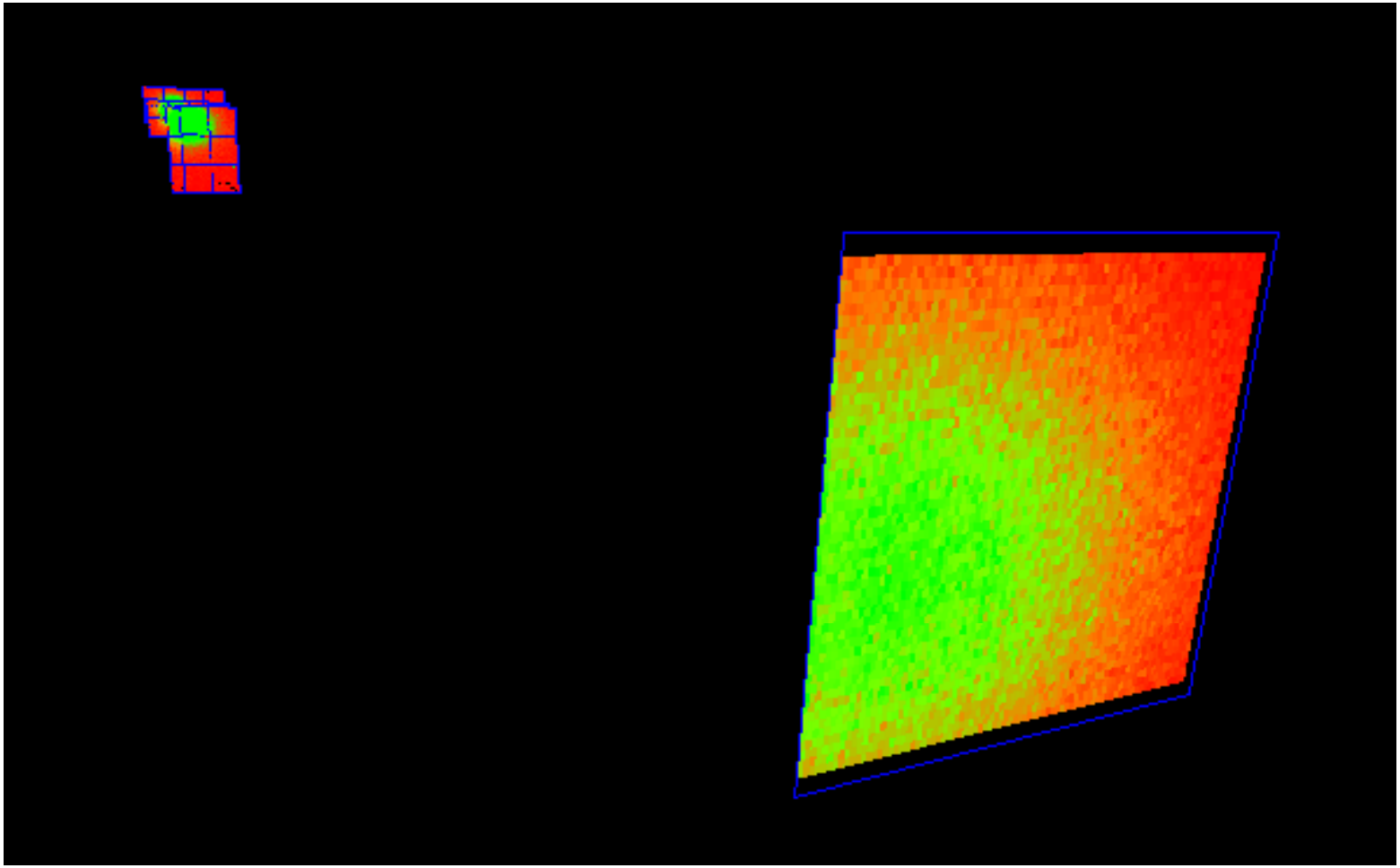
Diamond Sensor Residual Center vs. HV





- Tracks are at ~ 20° with respect to normal of sensor plane in row direction.
- Use the same set of telescope spatial configuration parameters.
- With low bias HV, charges generated near readout electronics can be collected, equivalent to thinner effective sensor. Thus the residual center shifts.
- The maximum possible shift ~ $\tan(\theta)*d/2$ ~ 90 μm.

3D Results

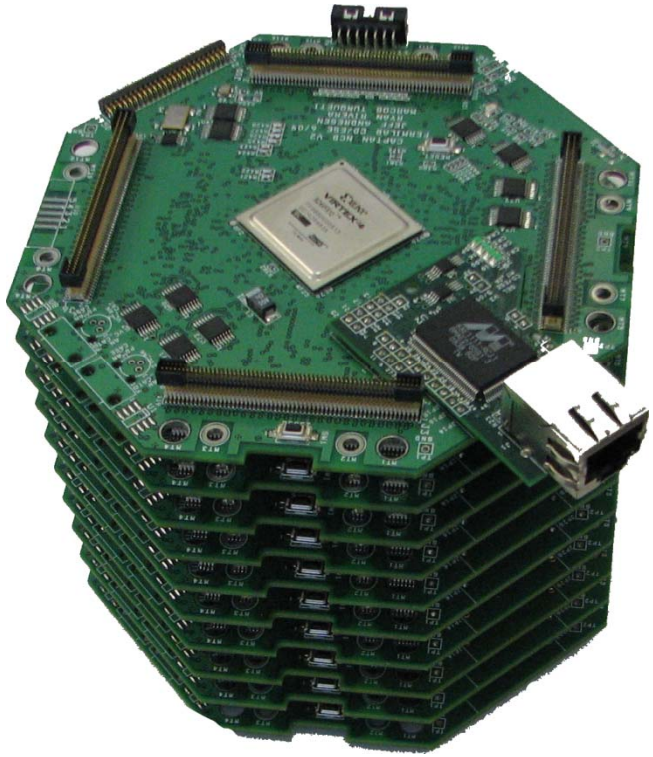


Future Plans

- Analyze data from 3D sensors.
- Augment telescope with higher resolution planes – possibly strips or CCDs.
- Improve charge resolution and analog stability by adding amplifiers.
- Continue to improve usability of telescope software package.

Future Plans – Parallel Processing

- Alignment and Reconstruction done in Real-Time.
- Integrate with xTCA.
- Explore CUDA and compare results.



Contributors

S. Kwan
A. Prosser
L. Uplegger
J. Andresen
J. Chramowicz
A. Kumar
P. Tan
J. Wang (Syracuse)
M. Artuso (Syracuse)
I. Osipenkov
A. Todri
C. Lei
S. Bose
Z. Wan
A. Zatserklyaniy
J. Yun
E. Alagoz (Purdue)
O. Koybasi (Purdue)