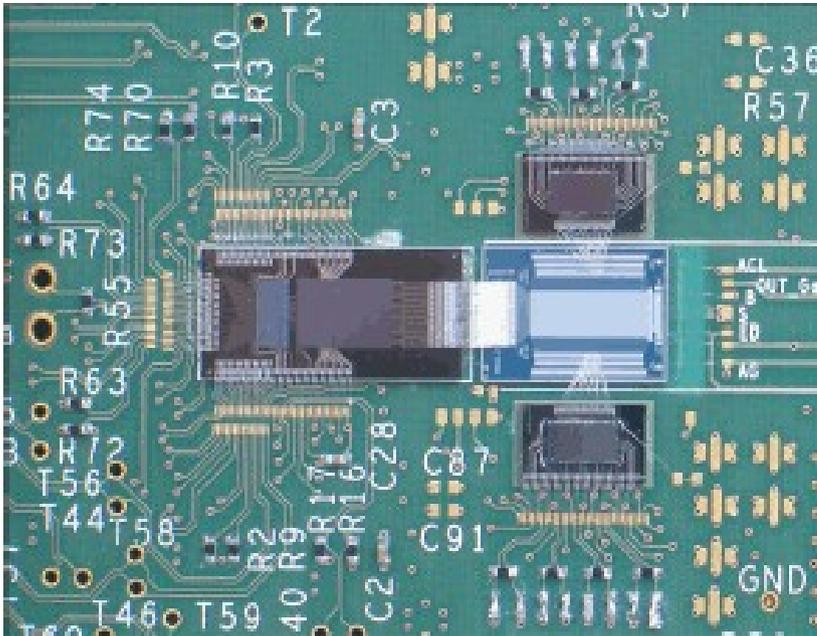


Analysis of Test Beam and Source Measurements with Hybrid 4.1

Benjamin Schwenker
Universität Göttingen

Test Beam 2010

In November 2010 Hybrid 4.1.01 in test beam at Cern SPS



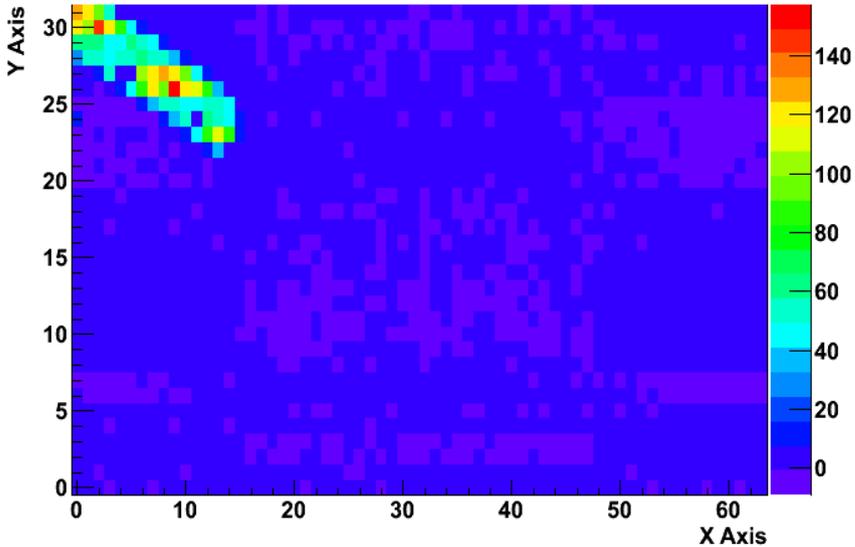
Hybrid 4.1.01: 2xSwitcherB, DCDB and DCDB-RO



EUDET Telescope + Hybrid 4.1.01

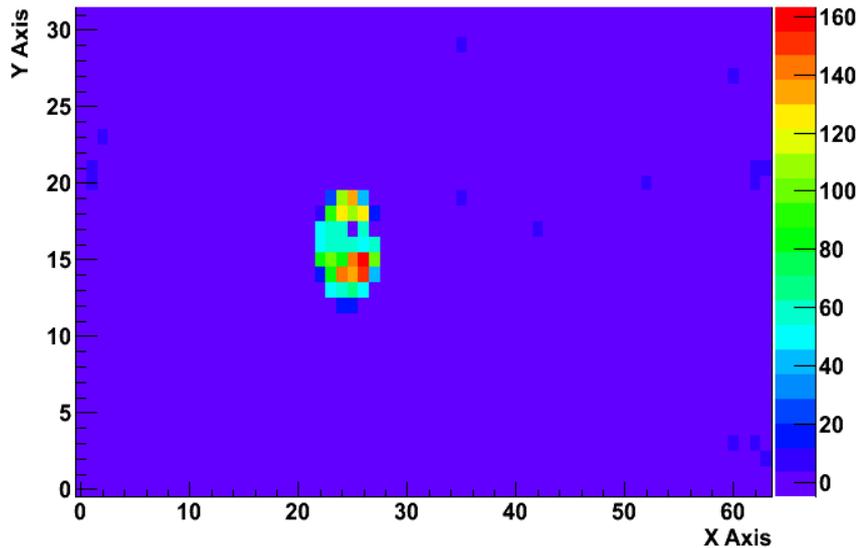
Event Gallery

Evt:25929 Mod:0



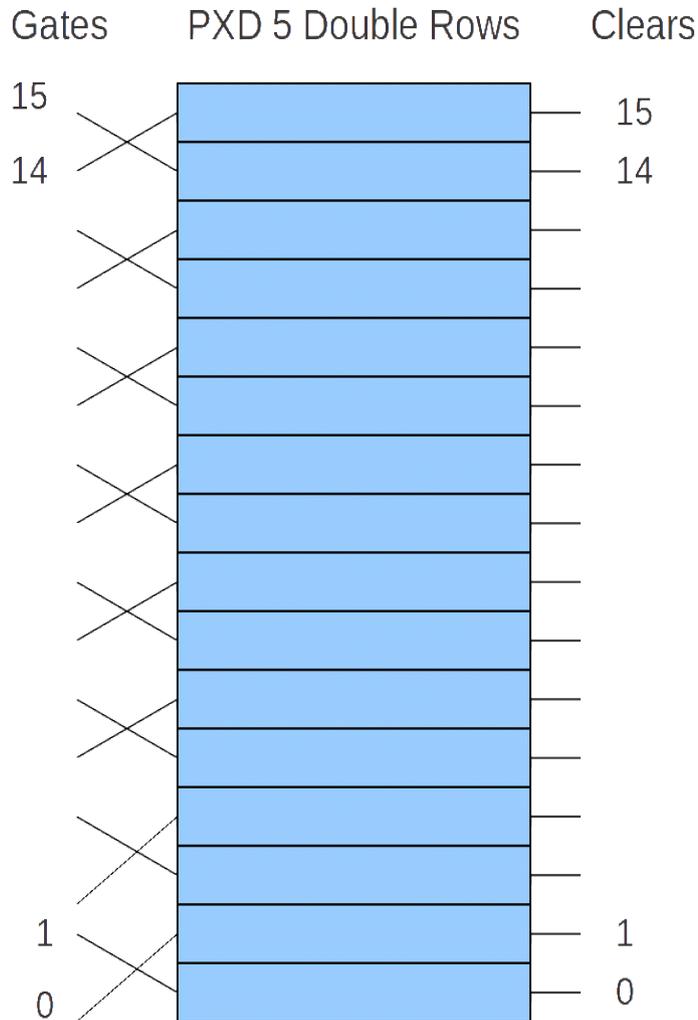
- Hybrid 4.1.01 integrated into EUDET telescope and EUDAQ.
- DEPFET operated for several days with telescope (→ tracking possible).
- Learned a lot about data reconstruction and analysis with new system.
- Identified major bug in bonding plan of hybrid.

Evt:13308 Mod:0



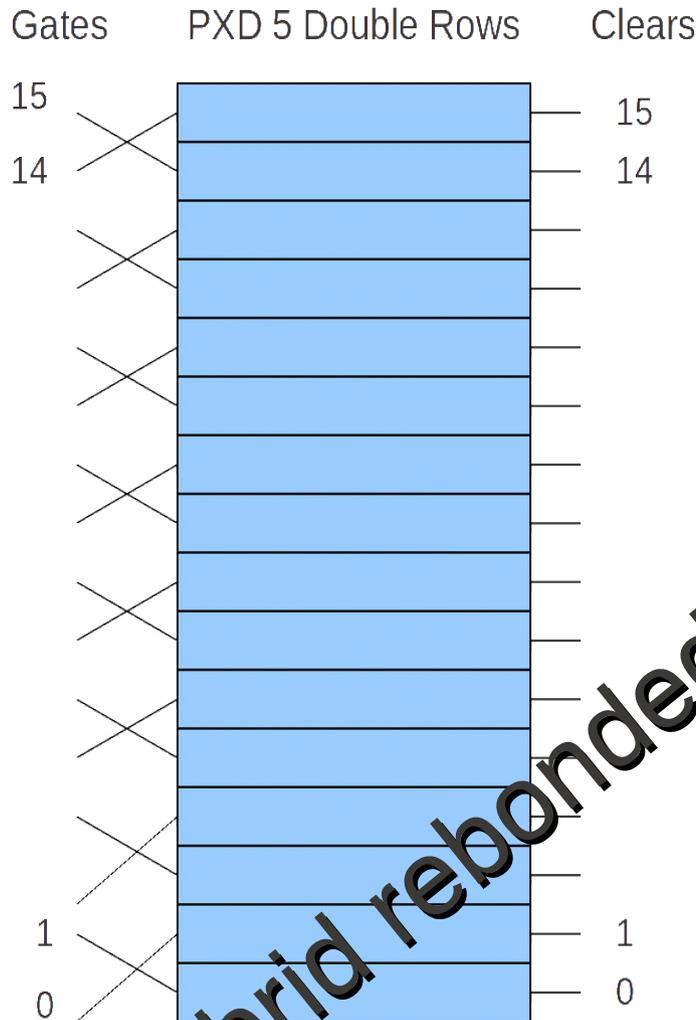
[Nuclear Interactions in DEPFET]

Bonding Mismatch



- Wire bonds from gate switcher to sensor gates were crossed!
- Clear pulses are always applied in gate off state → inefficient clearing → high drain currents → uncomfortable DCDB settings and too low V_{gs} .
- Operating Sequence:
 - 1) Switch on SWB channel gate 0 → read signals from matrix double row 1.
 - 2) Switch on SWB channel clear 0 → clear matrix double row 0.
 - 3) Switch on SWB channel gate 1 → read signals from matrix double row 0.
 - 4) Switch on SWB channel clear 1 → clear matrix double row 1.

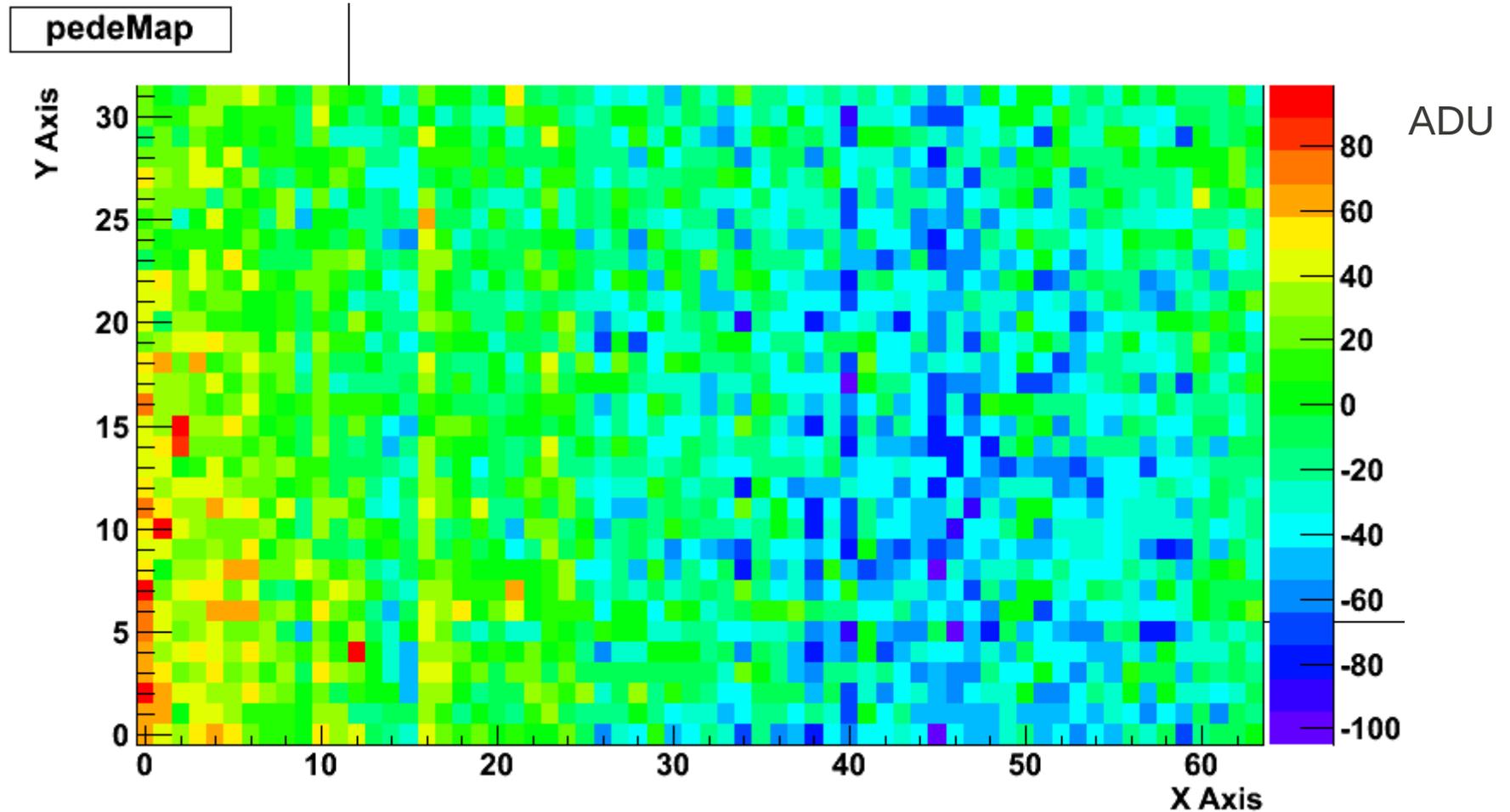
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Hybrid rebonded last week. Problem Solved.

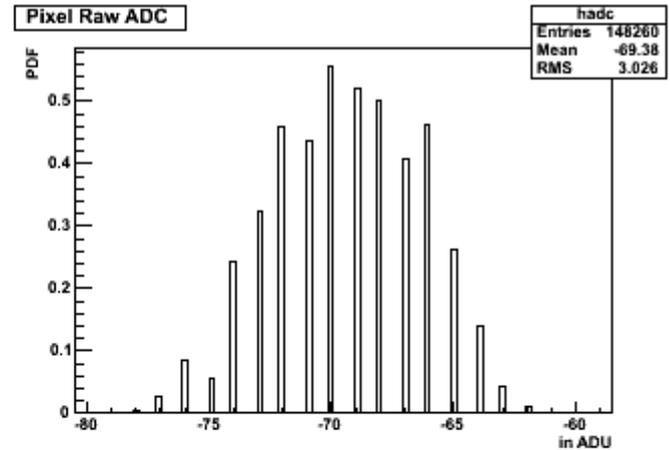
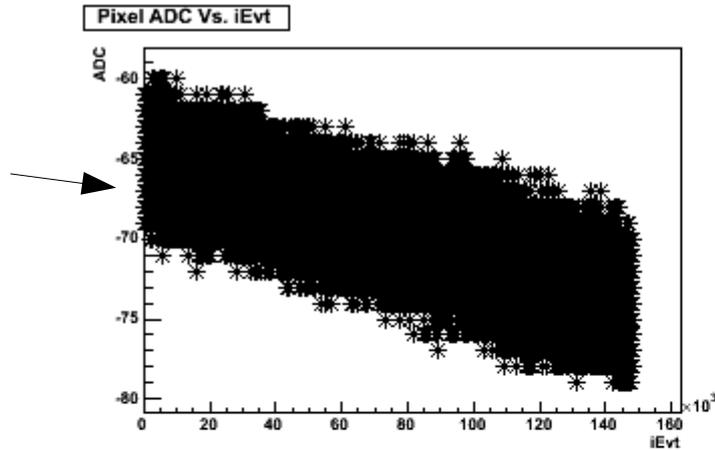
Pixel Pedestals



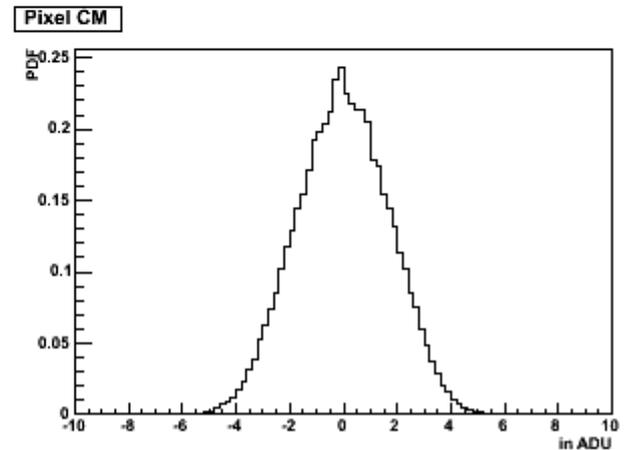
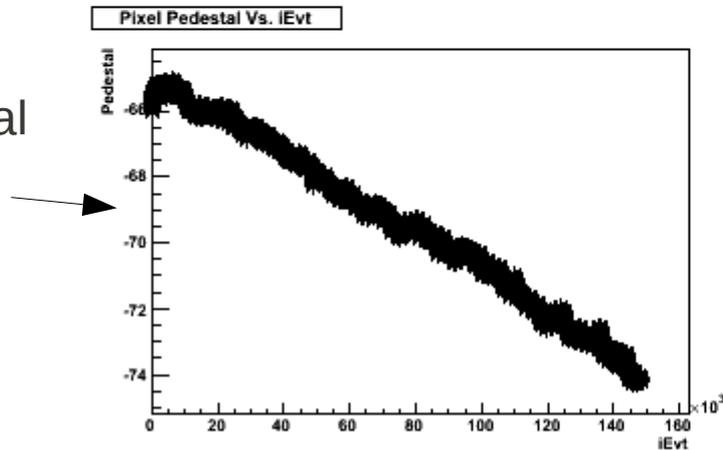
- Total range of pedestal dispersion is ~ 180 ADU or $\sim 10\mu\text{A}$.
- LSB is 60 ± 5 nA.
- Dynamic range of ADC's is 256ADU.
- **DCDB offset DAC not used, but clearly needed.**

Pedestal Drift

Pixel raw ADC data

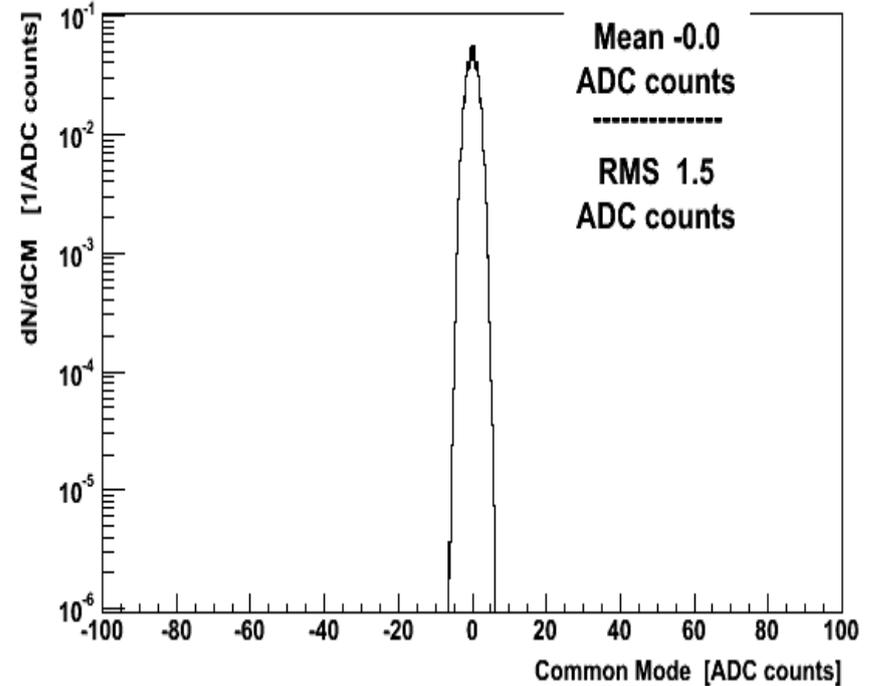
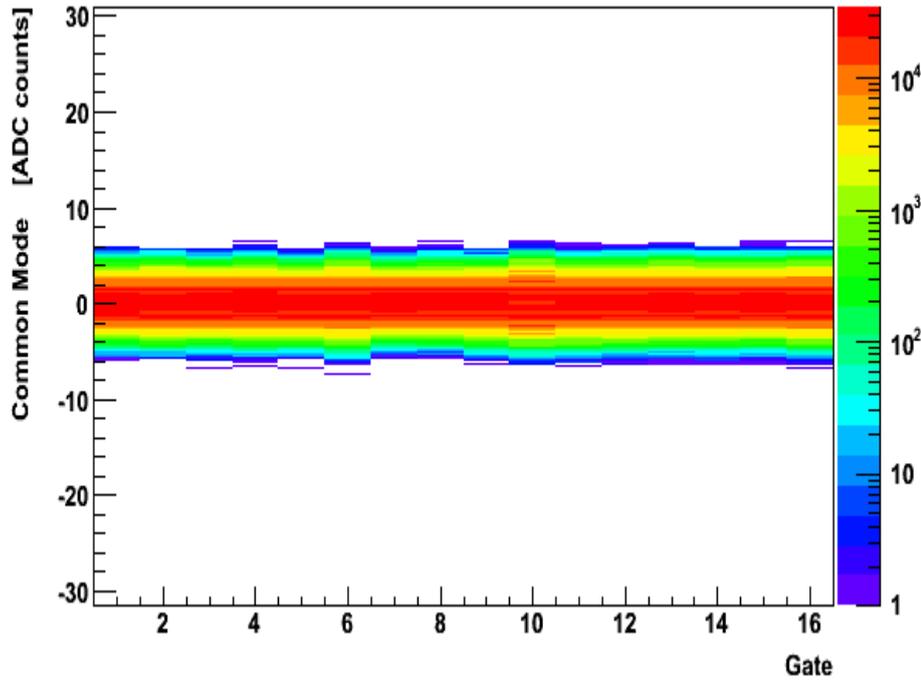


Dynamic pixel pedestal



One of the first runs after starting the system. All pixel pedestals drift ~ 10 ADU. Temperature change is $\sim 5^\circ\text{C}$.

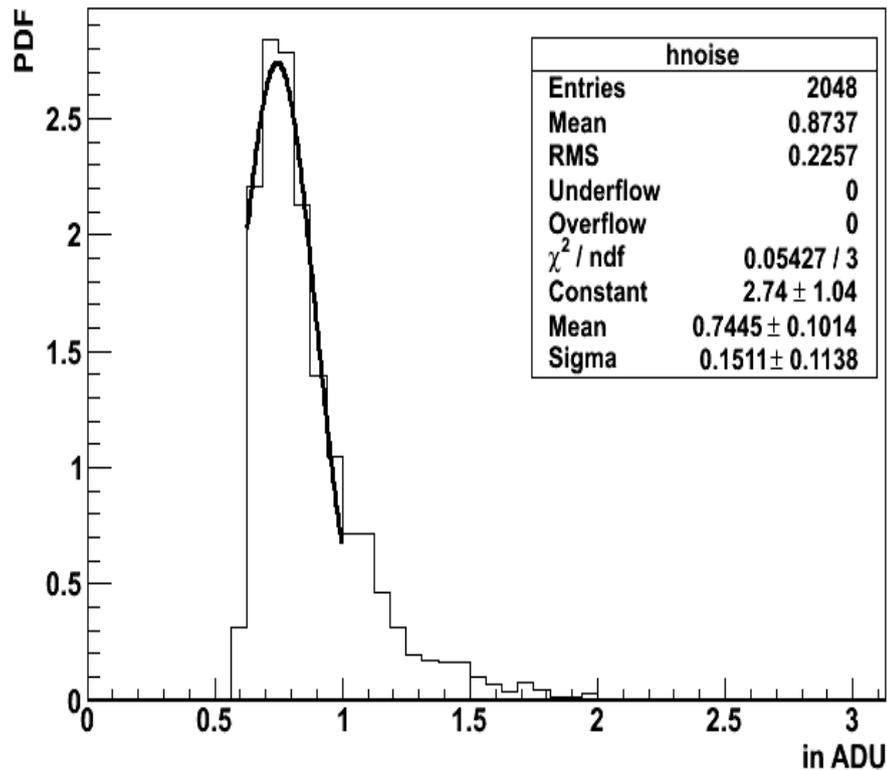
Common Mode



- Common mode correction applied after pedestal subtraction.
- Common mode is median of all signals from a gate.

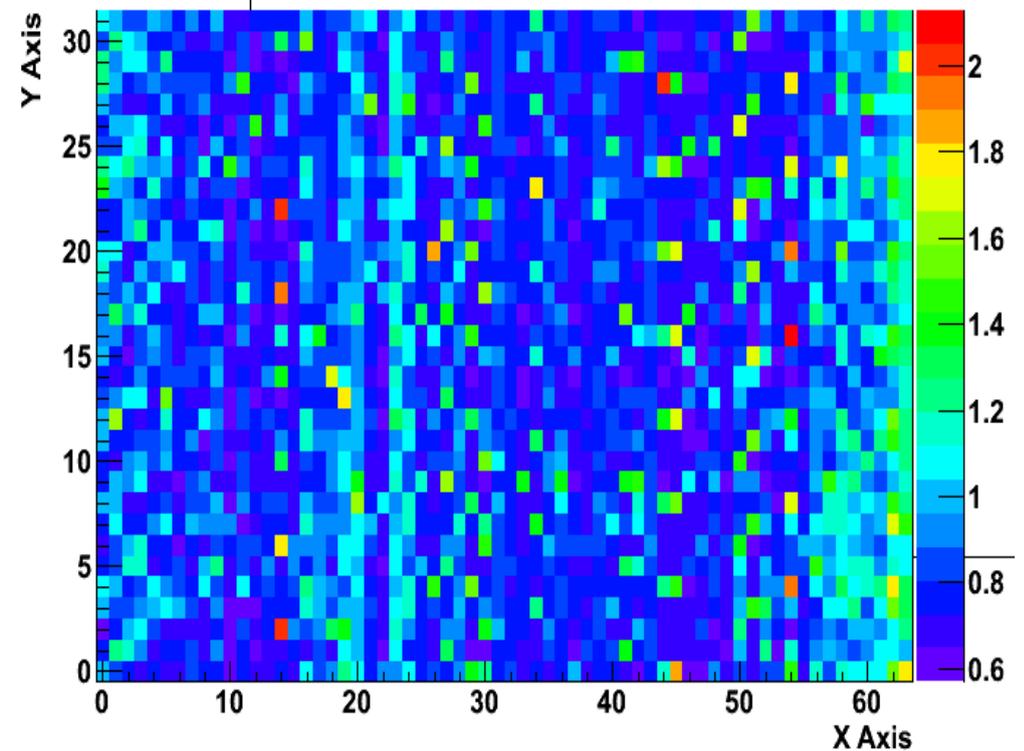
Pixel Noise

Pixel Noise



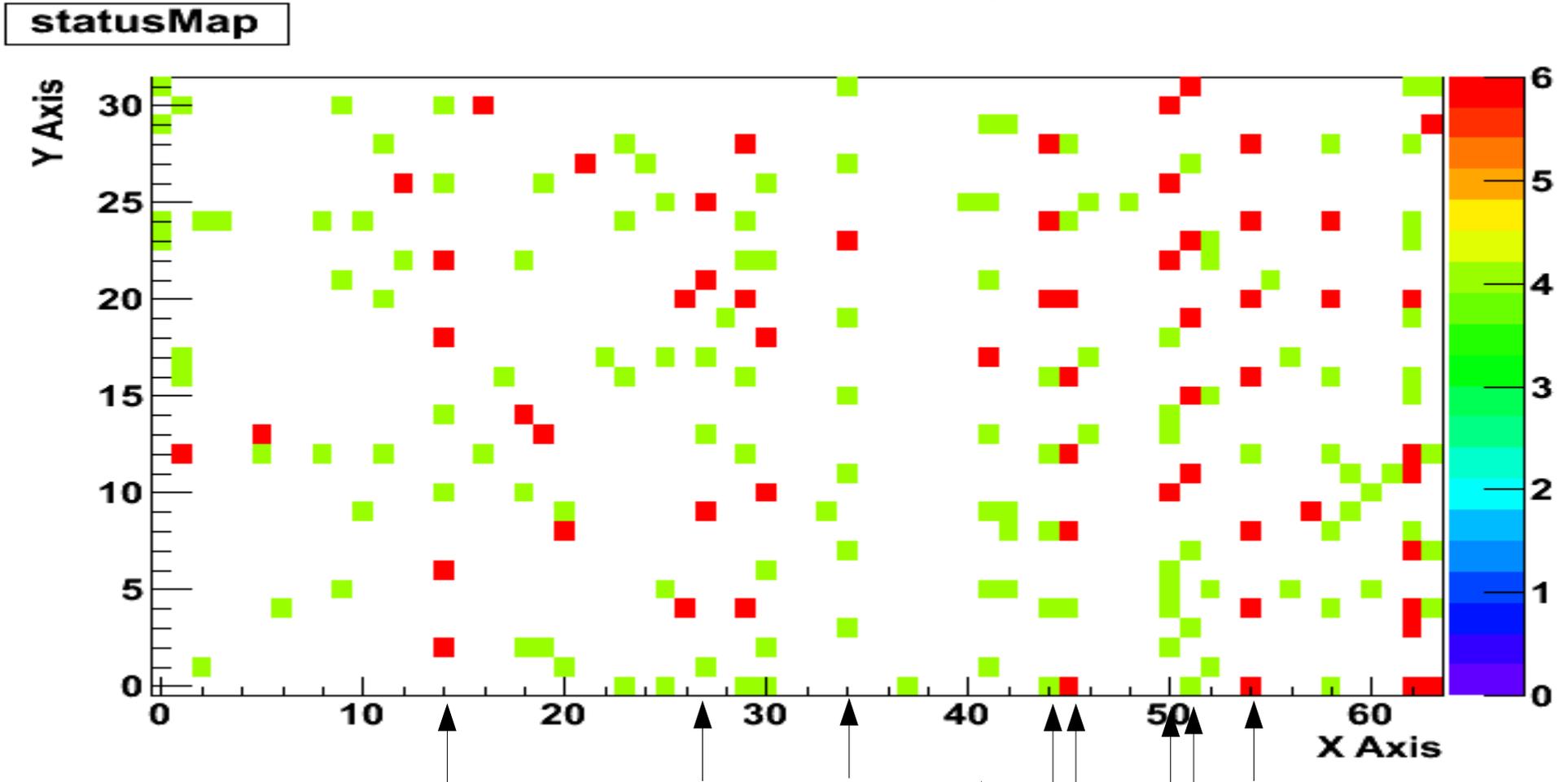
Most probable pixel noise is 0.8ADU or 50nA.

noiseMap



Bad pixels show clear pattern: reappear every 4th pixel row → ADC!!

Status Map



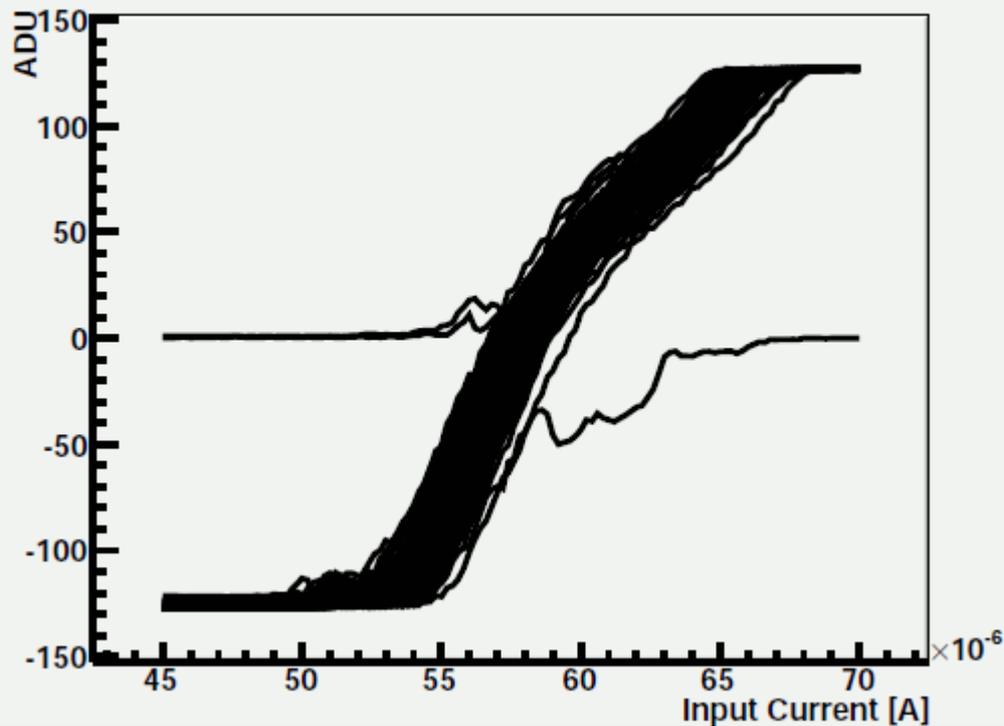
Green : "HOT" Red : "HOT && NOISY" : Very bad ADC curve

- ~ 4% of channels are broken.
- DCDB measurements (Jochen Knopf) locate problem in broken ADC's.

ADC Transfer Curves

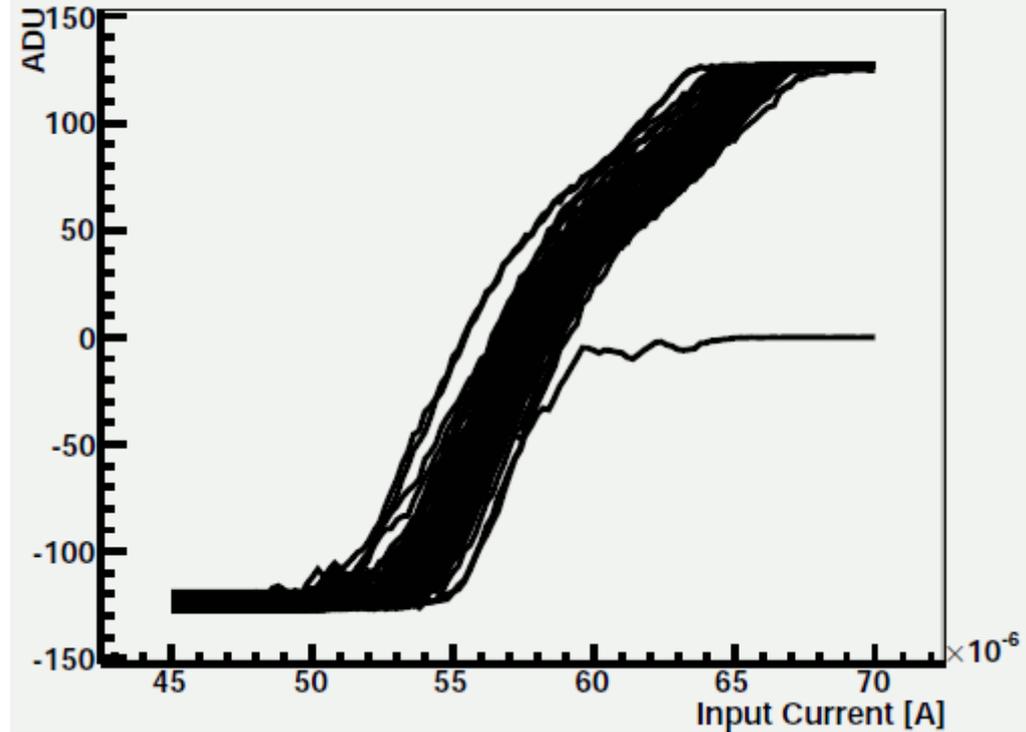
Characterization of DCDB chip on Hybrid 4.1.01: Settings used in TB, not optimized

All rawMean Curves in Dataset



DCDB Column 4

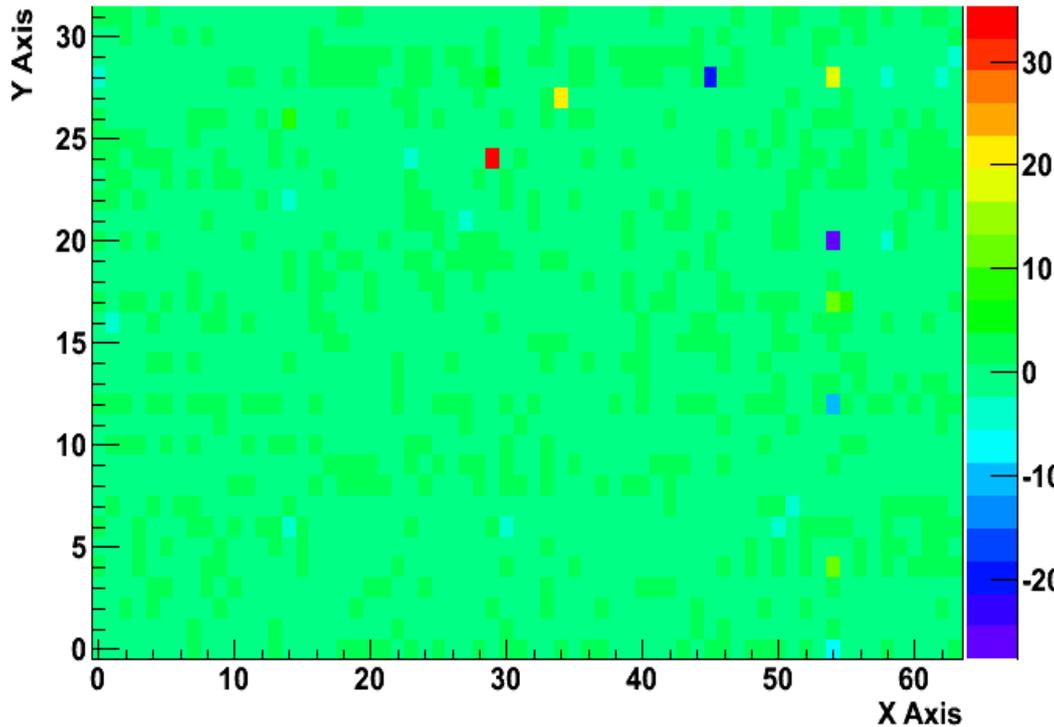
All rawMean Curves in Dataset



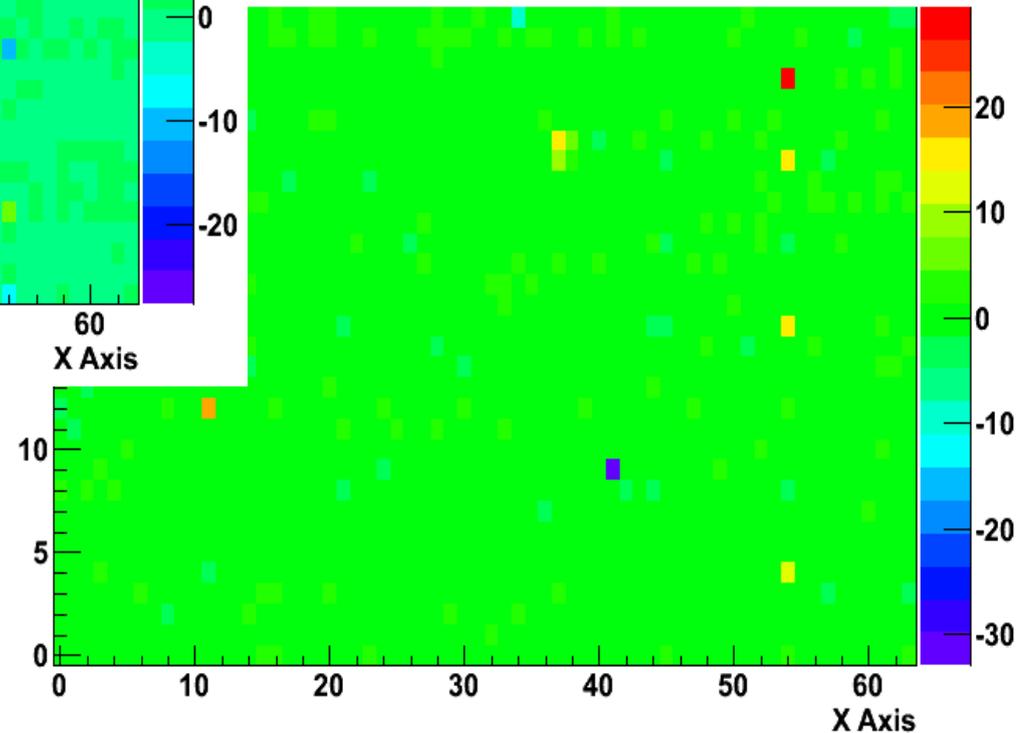
DCDB Column 3

Cd 109 Measurements

Evt:67496 Mod:0



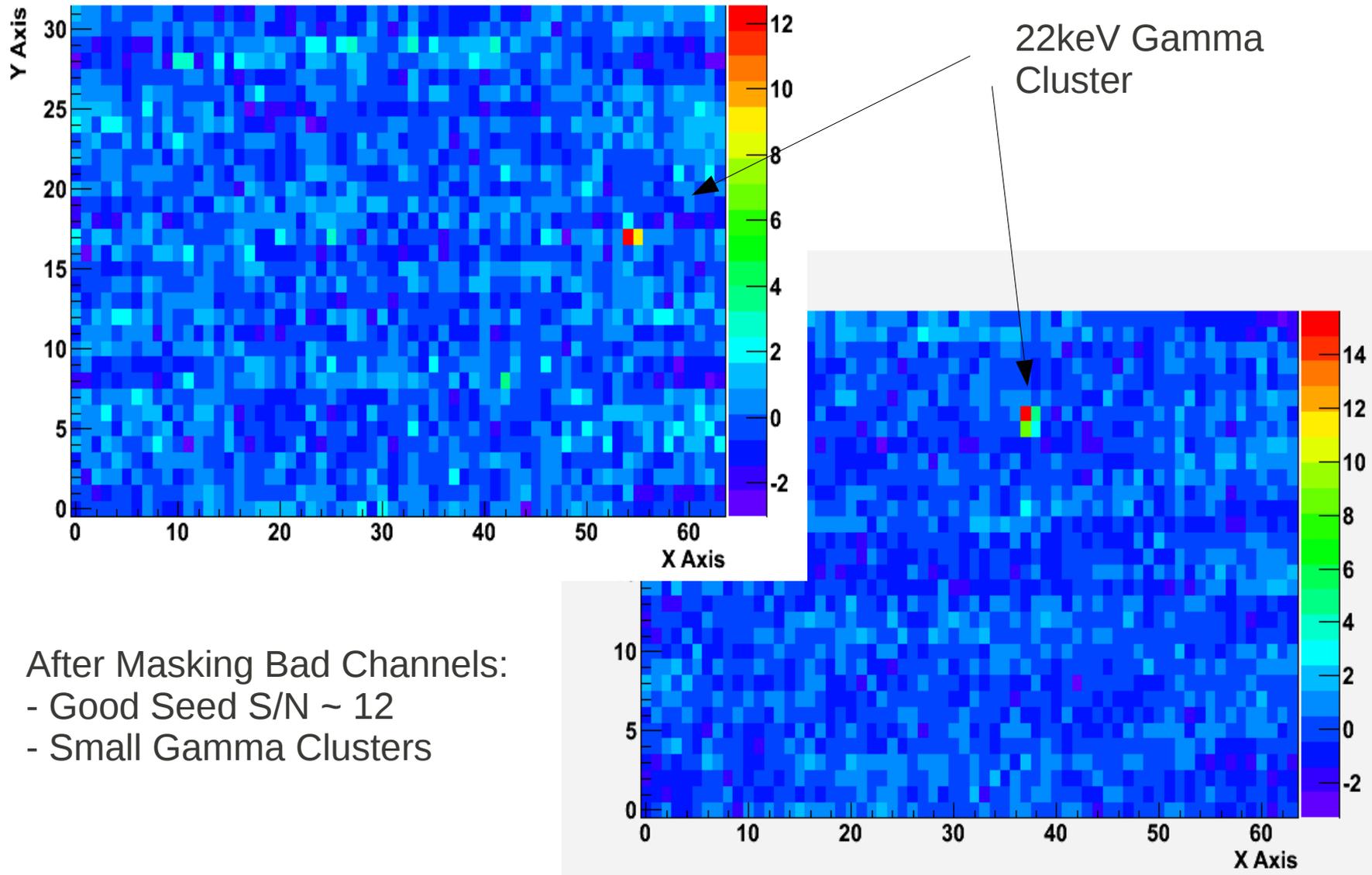
Preprocessed Event Data:
- Pedestal Subtraction
- CM Correction
- **All Channels; No Mask!!!**



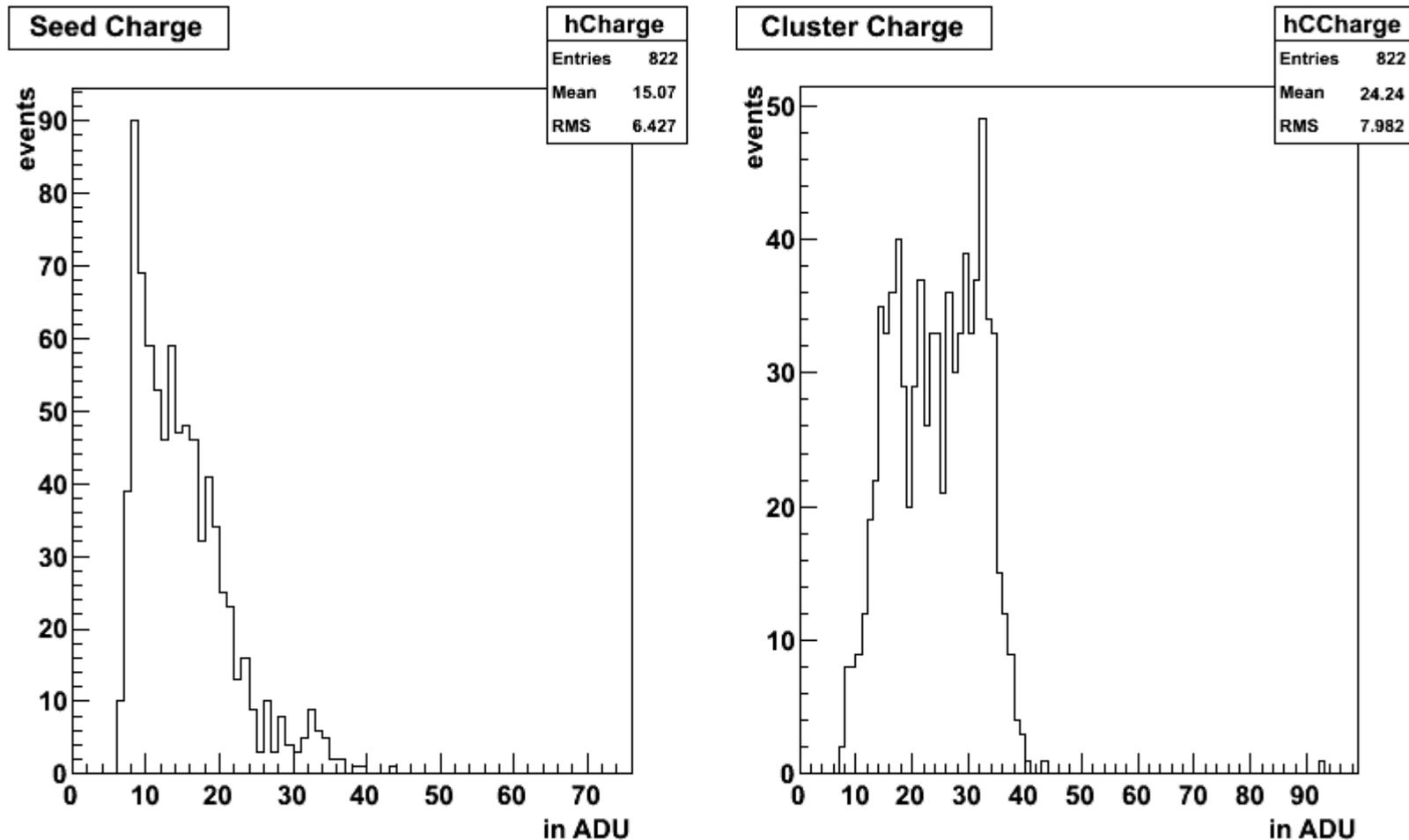
Many bad channels/pixels covering broad signal range.

Cd 109 Measurements II

Evt:67496 Mod:0



Cd 109 Spectra - Prelim.



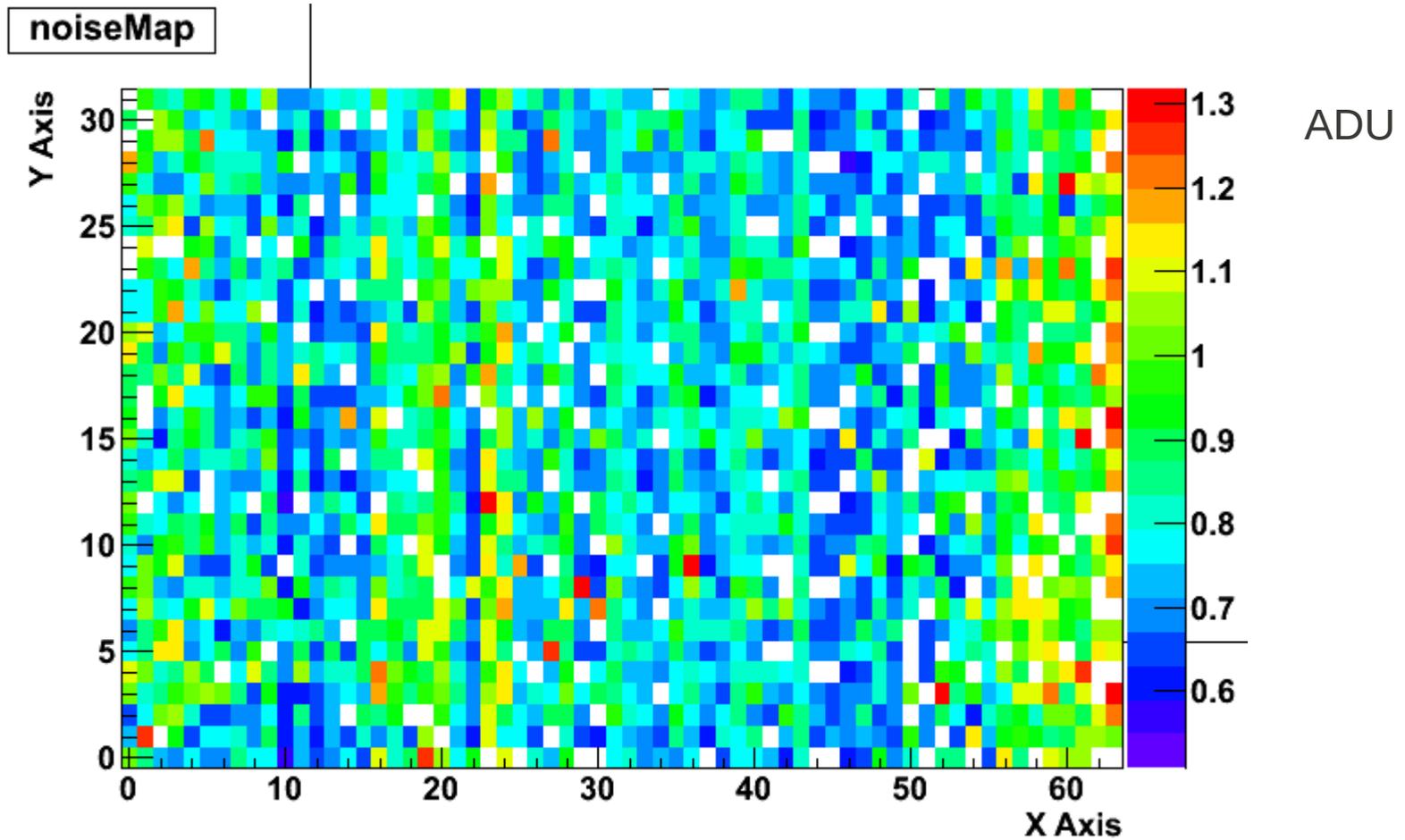
22keV gammas produce ~6000 electrons. Cluster peak of ~30ADU corresponds to $Gq \sim 300\text{pA}$ and DCDB noise ~150 ENC.

Conclusions

- TB2010 data is strongly affected by bonding mismatch:
 - But: we did measure particle hits → Hybrid working.
 - Hardware/Software integration is done.
- First source measurements with rebonded Hybrid 4.1.01:
 - Large pedestal dispersion → Offset DAC needed
 - Non optimal DEPFET working point → V_{subin} too weak
 - DCDB achieves $G_q \sim 300\text{pA/e}$, compared to 350pA/e
 - Bad ADC channels → can be masked for testbeam/source
 - Temperature sensors near active area would help.

Backup Slides

Noise Map II



Masking bad channels, color scale around MPV

Pedestal Histogram

