BERKELEY LAB

UNIVERSITÄT BONN

RD53A – PIXEL CHIP

# READOUT SYSTEM COMPARISON & INJECTION TIMING MEASUREMENT

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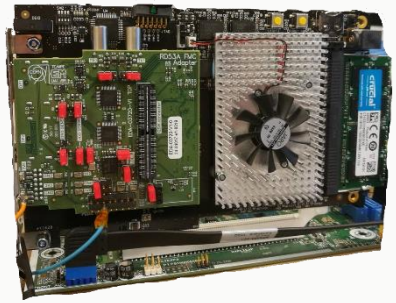
# COMPARISON STRATEGY

- Verification of measurement consistency of two independent readout systems

**BDAQ53**

&

**YARR**



- What should be checked:
  - Is the s-curve fitting identical in both systems?
  - Is the raw data interpretation identical in both systems?
  - Is the chip configuration identical in both systems?

# S-CURVE FITTING TEST

Simulated Scurves:

Threshold: 1500

Noise: 50

BDAQ53 - Analysis

Simulated S-Curves:

Threshold: 1500.00

Noise: 47.19

YARR - Analysis

Simulated S-Curves:

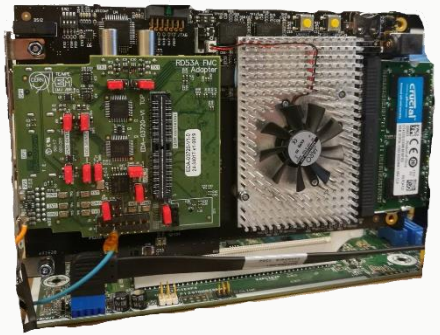
Threshold: 1500.09

Noise: 49.99

Slight difference in noise!

# RAW DATA INTERPRETATION TEST

YARR - Hardware



BDAQ53 - Analysis

Occupancy:
114 *10^6

Δ Occupancy = 3 *10^6 !
→Tot = 0 was ignored by YARR

YARR - Analysis

Occupancy:
111 *10^6

FIXED

# CHIP CONFIG AND TUNING TEST

- How identical are the two setups?
- Can BDAQ53 tunings run with YARR and vice versa?

- Wrote conversion tool for BDAQ53 to YARR scan configuration
- Wrote conversion tool for YARR output to BDAQ53 output data

- Tuned chip 0x0C95 with BDAQ53 and ran threshold scan with YARR
- Tuned chip 0x0C95 with YARR and ran threshold scan with BDAQ53

# THRESHOLD TUNING COMPARISON

| Tuning | Threshold Scan | Mean Threshold | Sigma Threshold | Mean Noise | Sigma Noise |
|---|---|---|---|---|---|
| BDAQ53 (1500e-) | BDAQ53 | 1654e- | 47e- | 66e- | 7e- |
| BDAQ53 (1500e-) | YARR | 1725e- | 97e- | 72e- | 11e- |
| YARR (1500e-) | BDAQ53 | 1519e- | 78e- | 66e- | 7e- |
| YARR (1500e-) | YARR | 1528e- | 82e- | 71e- | 9e- |

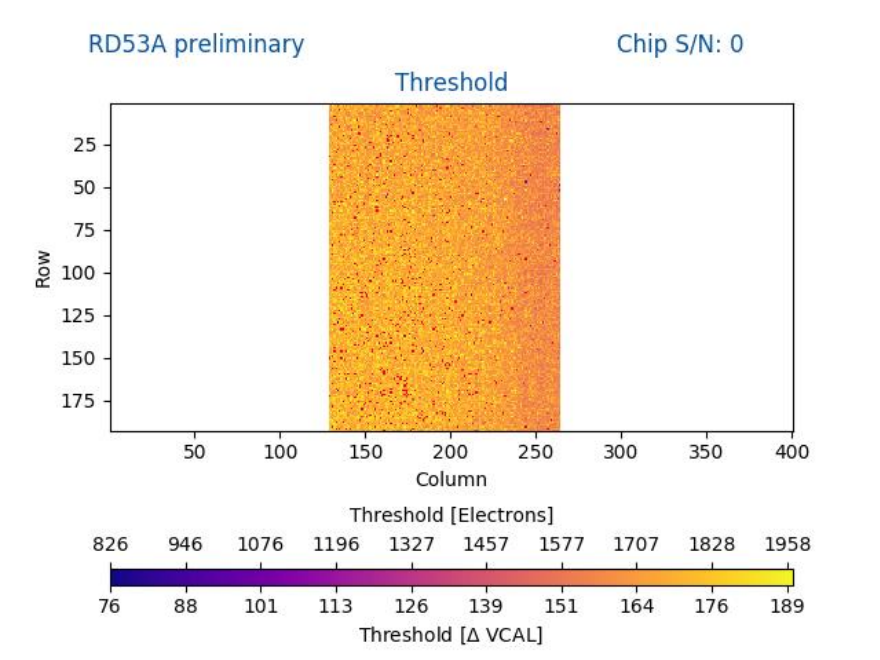
# COMPARISON STATUS

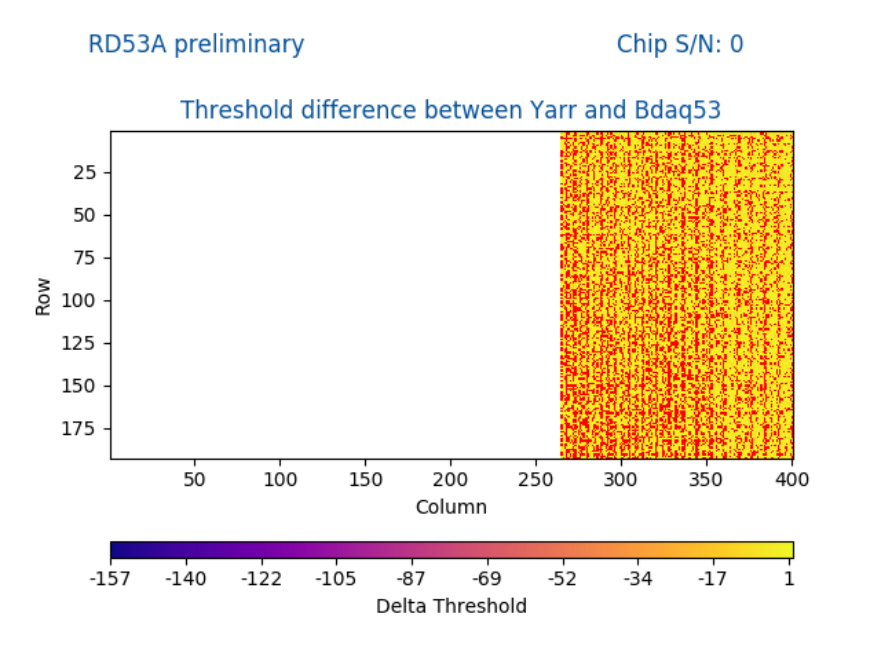
| Checked: | Observation |
|---|---|
| TDAC-bit mapping | Identical |
| Mask mapping | Identical |
| Injection frequency | No effect |
| Injection mask | No effect |
| Register mapping | Identical |
| Current/Voltage Offset | Not Observed |

- Most promising observation is injection timing difference

→Currently working on implementation of YARR like threshold scan in BDAQ53

# INJECTION DELAY



# VERIFICATION POINTS

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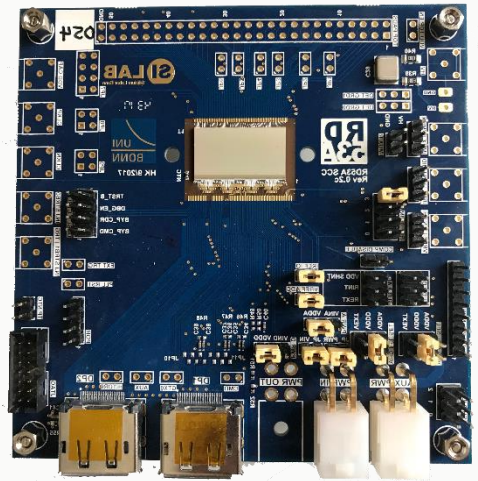
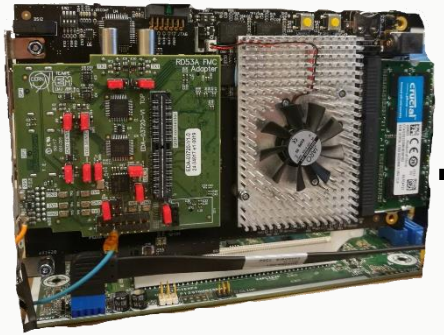


BDAQ53

PC

YARR



Comparing Raw Data & Configuration (Ongoing)

Comparing Interpreted Data & Fitting (Done)

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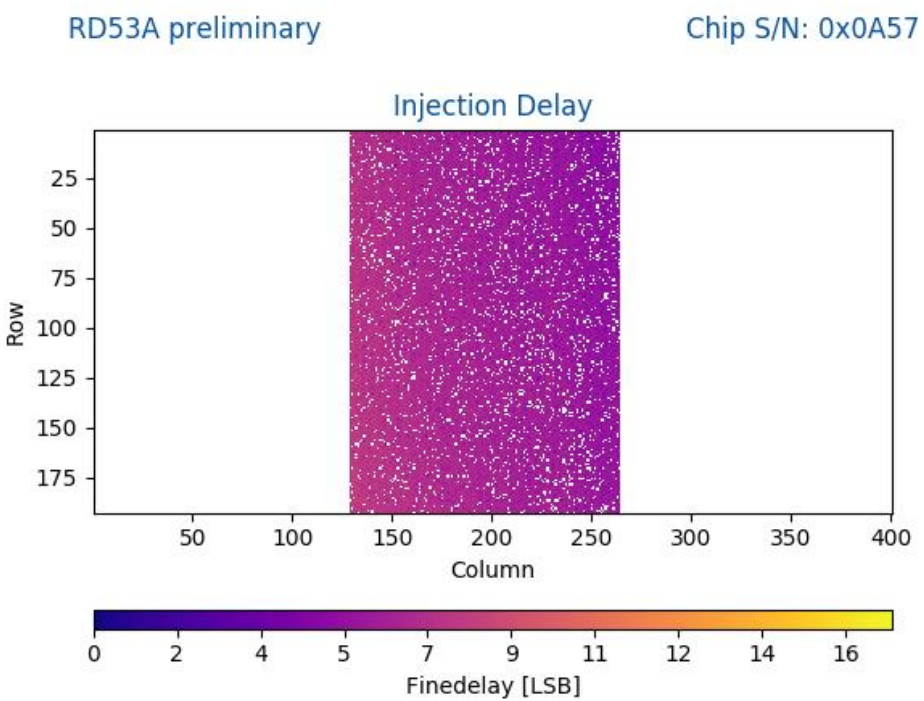
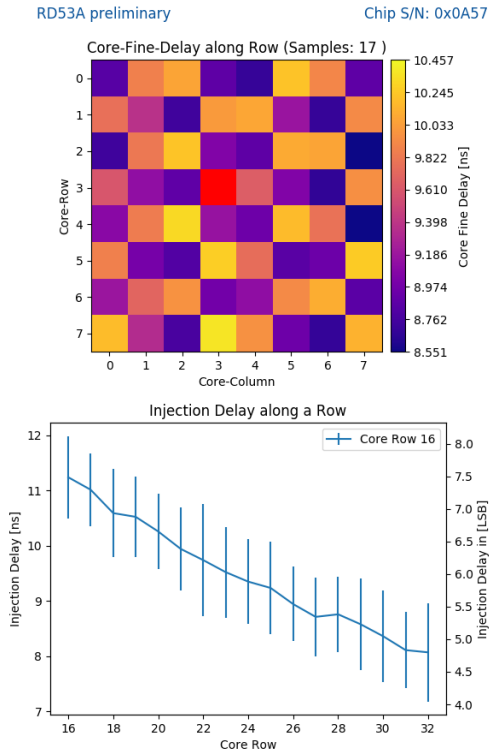
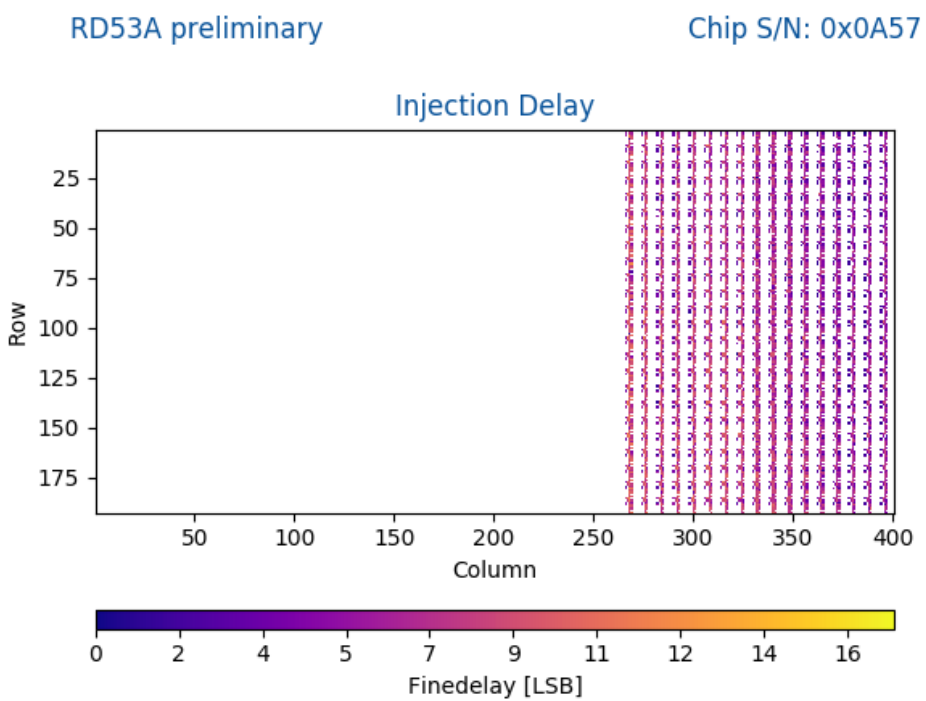
## Injection Timing

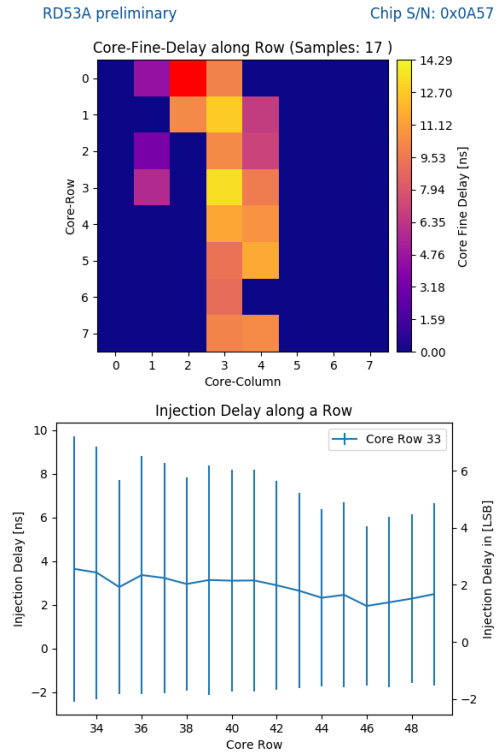
# TIMING LINEAR FRONT END



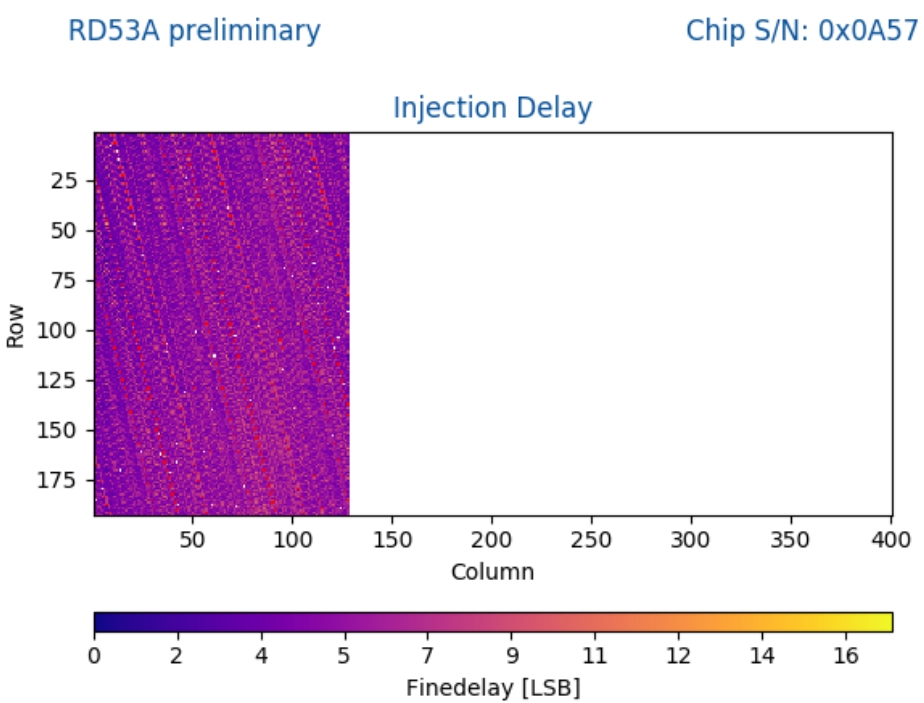



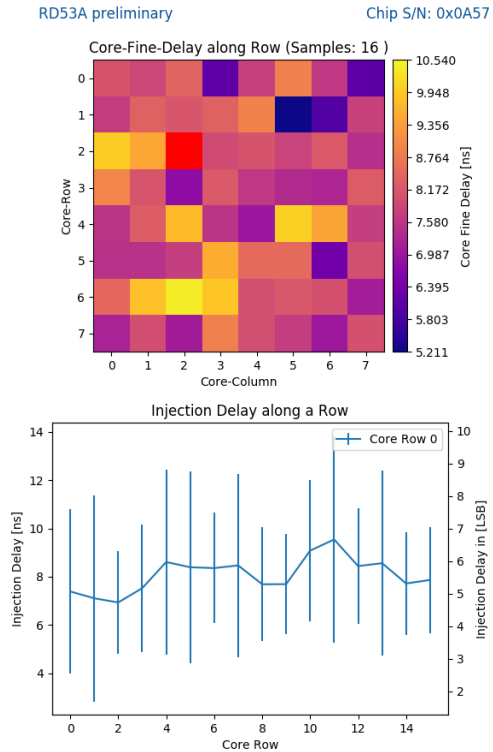
# TIMING SYNCHRONOUS



# TIMING SYNCHRONOUS FRONT END

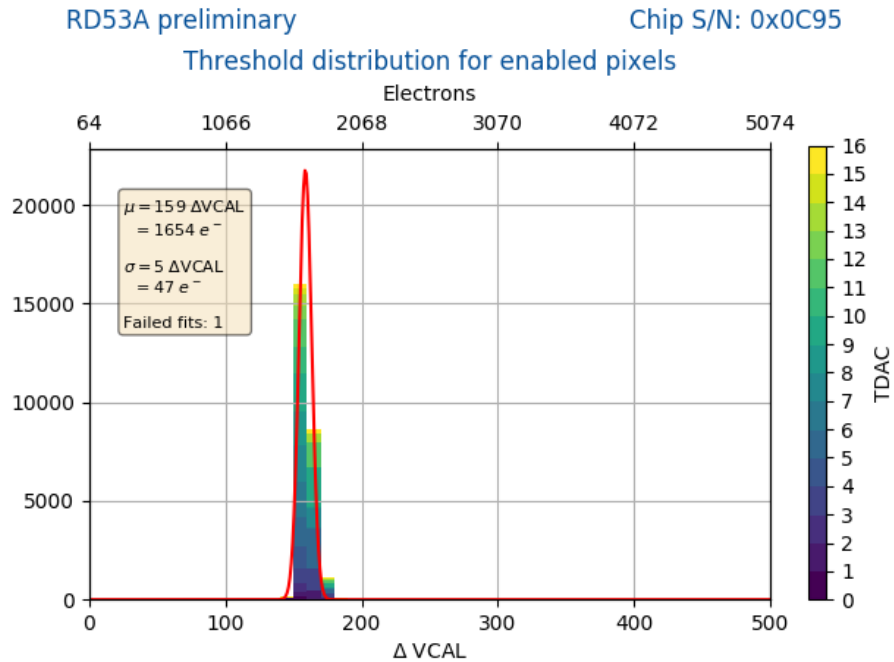


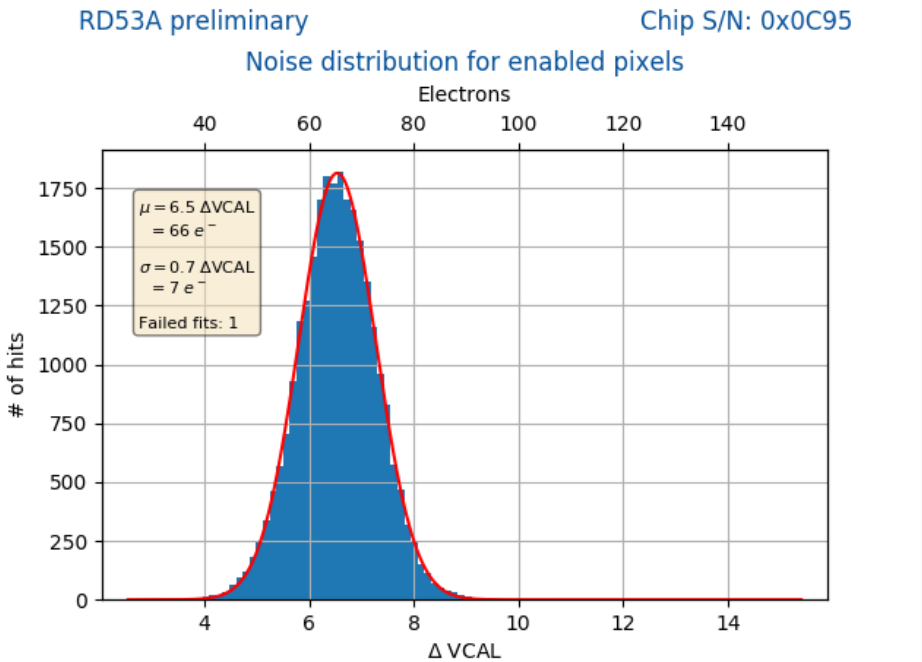



# RD53A

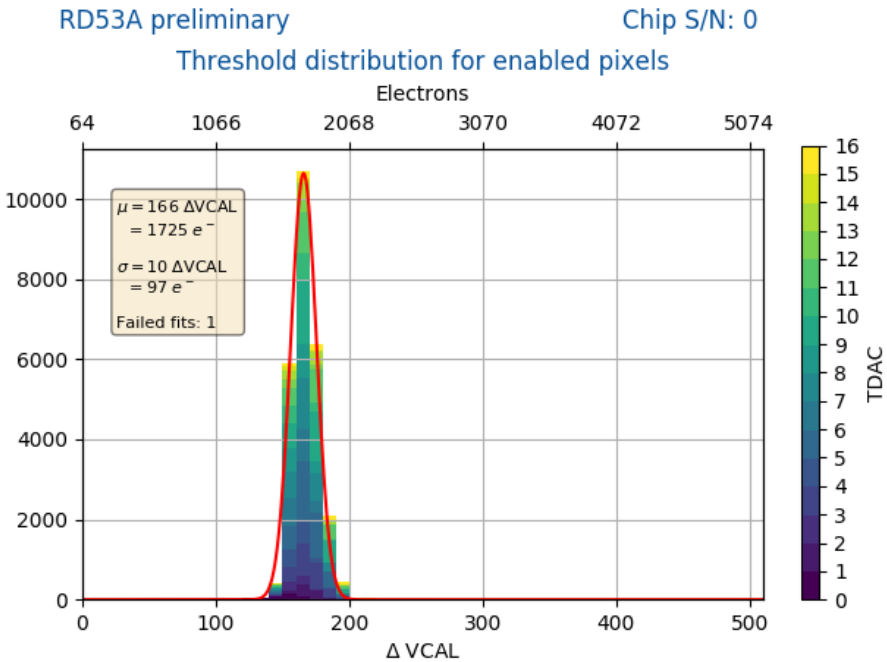
Appendix

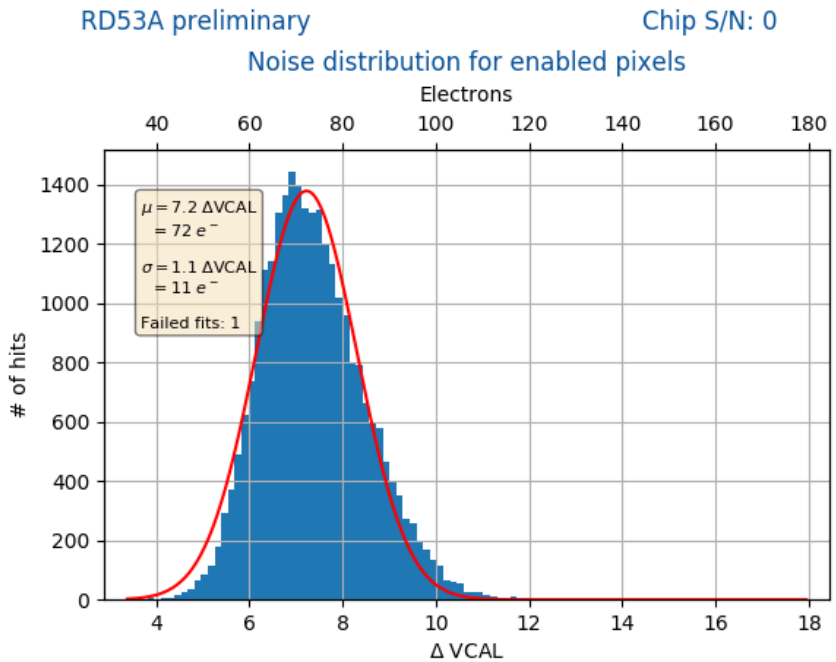
# TUNED THRESHOLD SCAN BDAQ - BDAQ



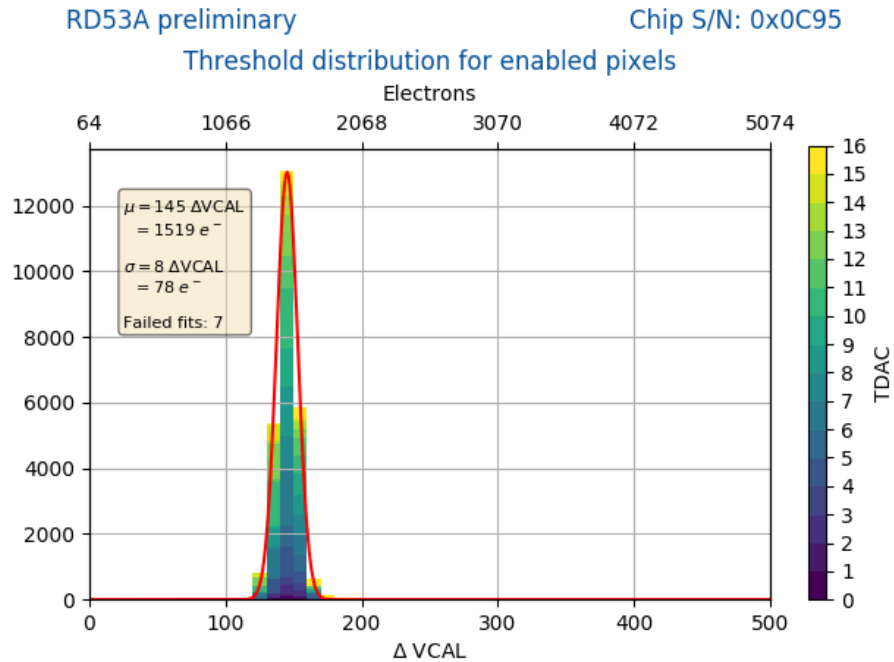



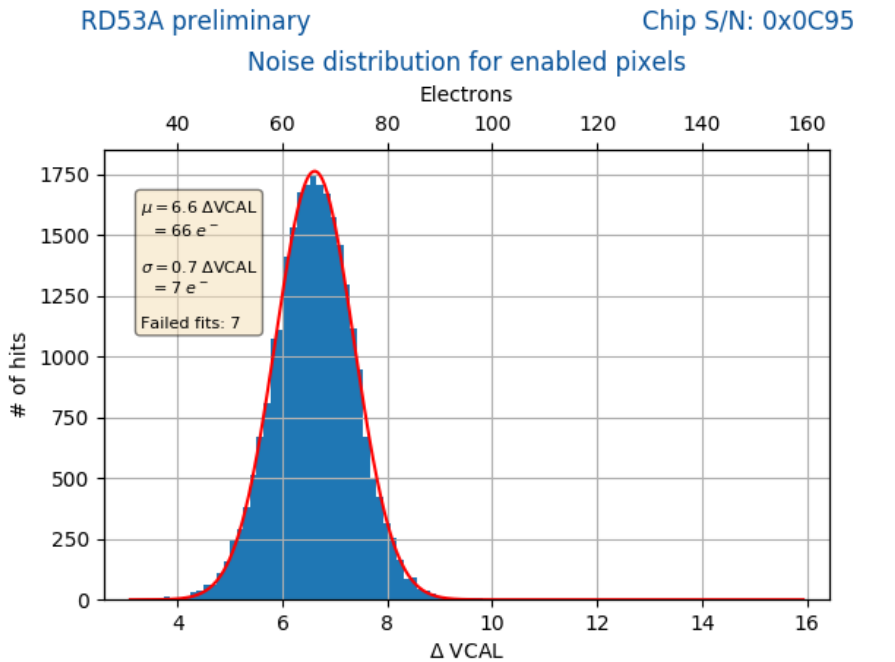
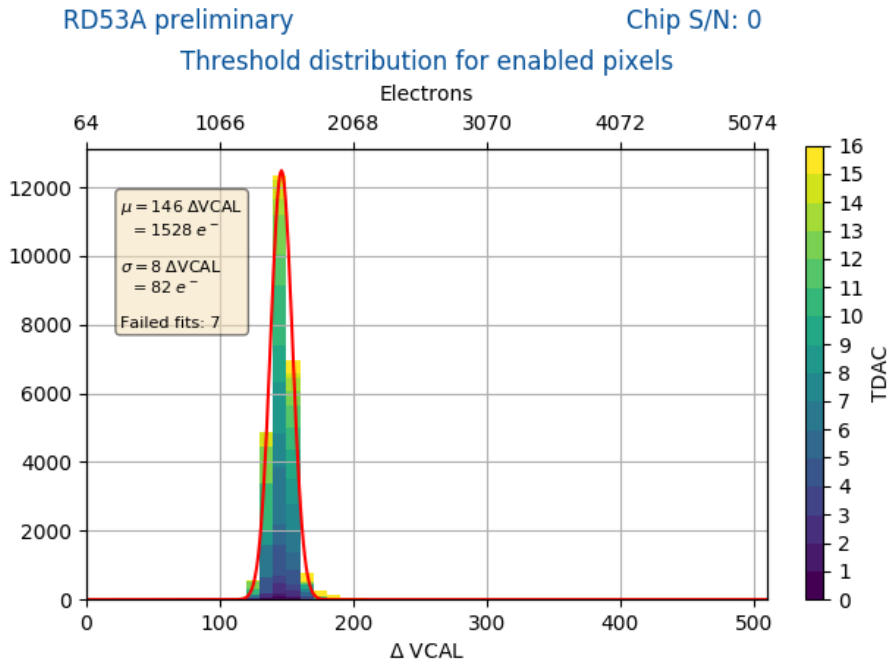
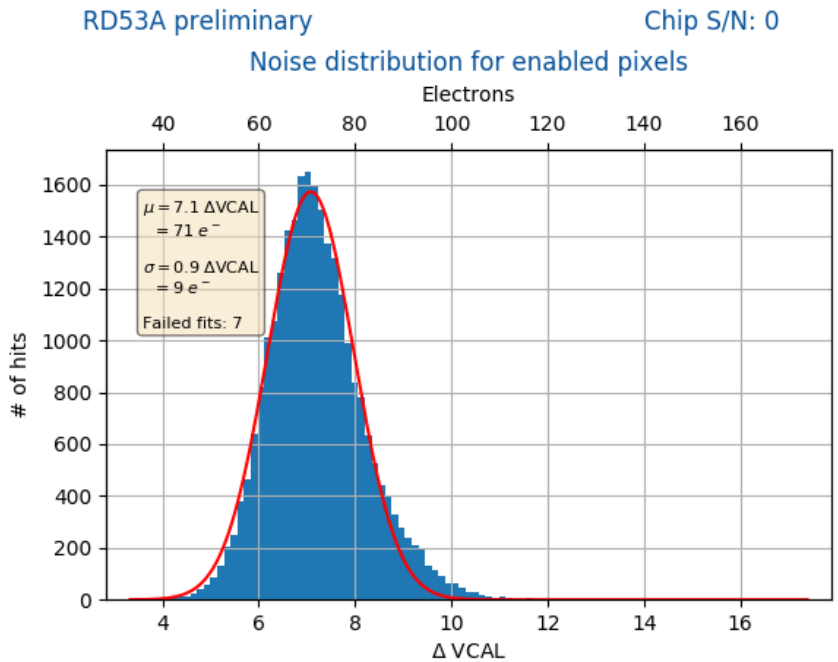
# TUNED THRESHOLD SCAN BDAQ - YARR



# TUNED THRESHOLD SCAN YARR - BDAQ






# TUNED THRESHOLD SCAN YARR - YARR