FastCCD Update 25 July 2008

Camera back together after a couple of weeks of repairs …

PROBLEMS NOTED

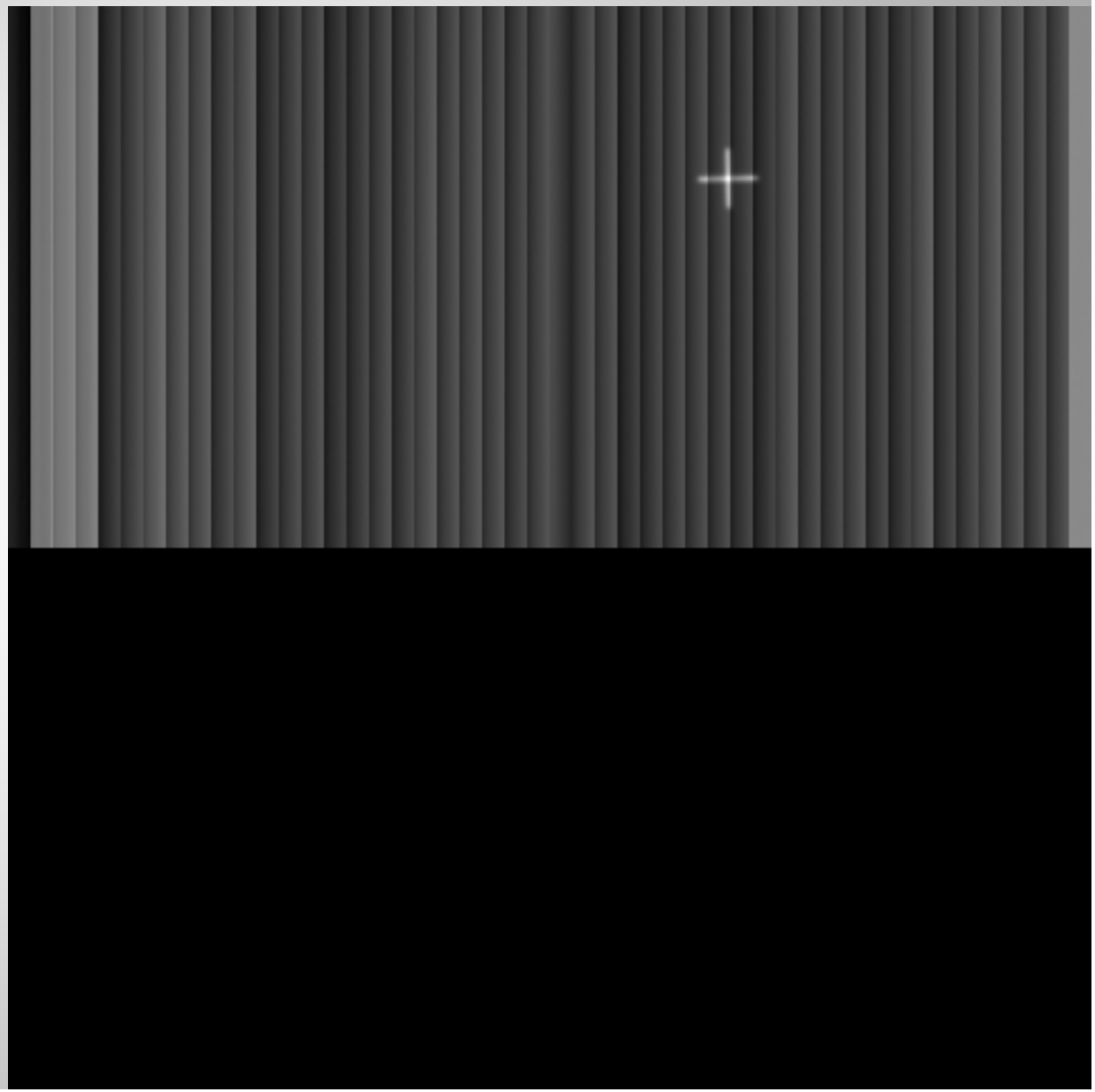
- Every 16th channel dead
- Crosstalk (in groups of 4 channels)
- Problems with "bottom half" readout
- Correlated noise: too much

CURRENT STATUS

- Bonding map error → fixed, and channels re-bonded
- Demonstrated to be due to small-size array components (R&C). Goes away with "staggered" discrete components. Some fraction of existing board re-done
- Being worked on at ANL and LBL
- Still a problem: need to look at power supplies

Back to the Cross

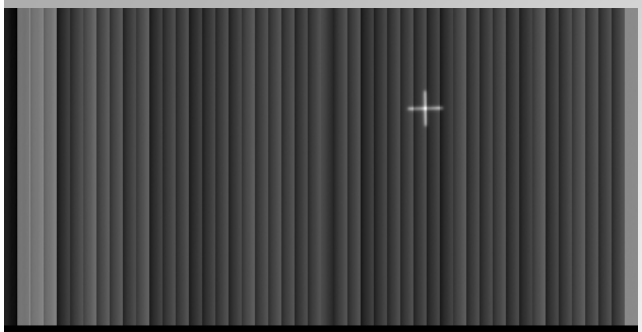
Top channels



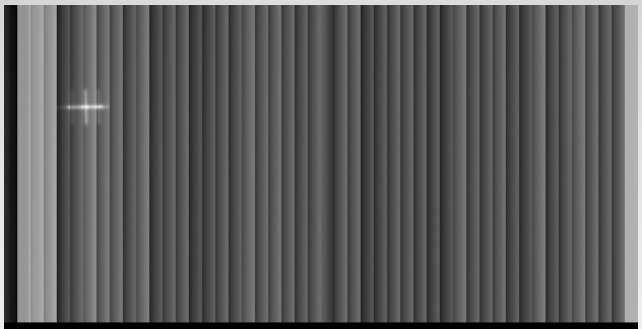
Bottom channels
(not drawn)

125 MHz clock
2 µs Horiz. Cycle
T = -40 C

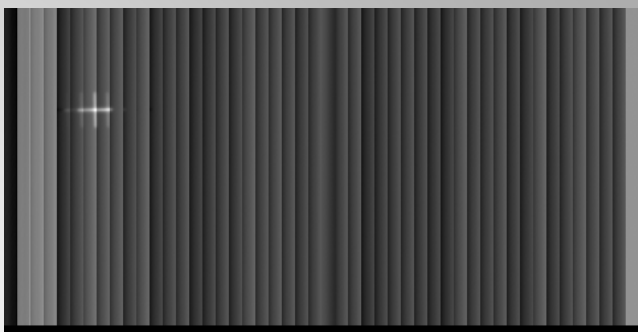
The Cross



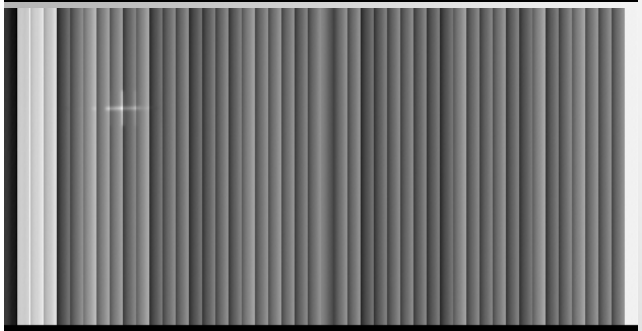
test2p2



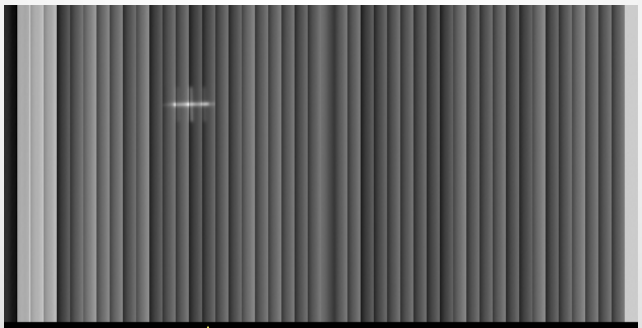
test2p3
All the way up



test2p4
+½ turn

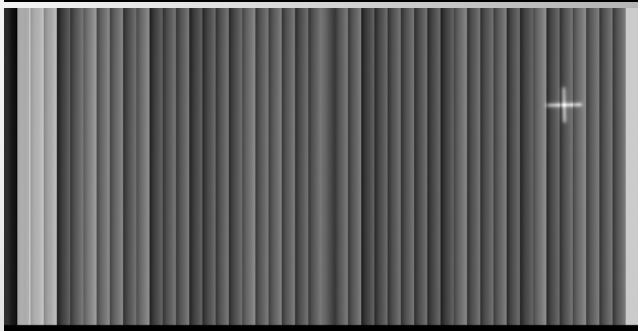


test2p5
+3x½ turn



Chan 16

test2p7



test2p9

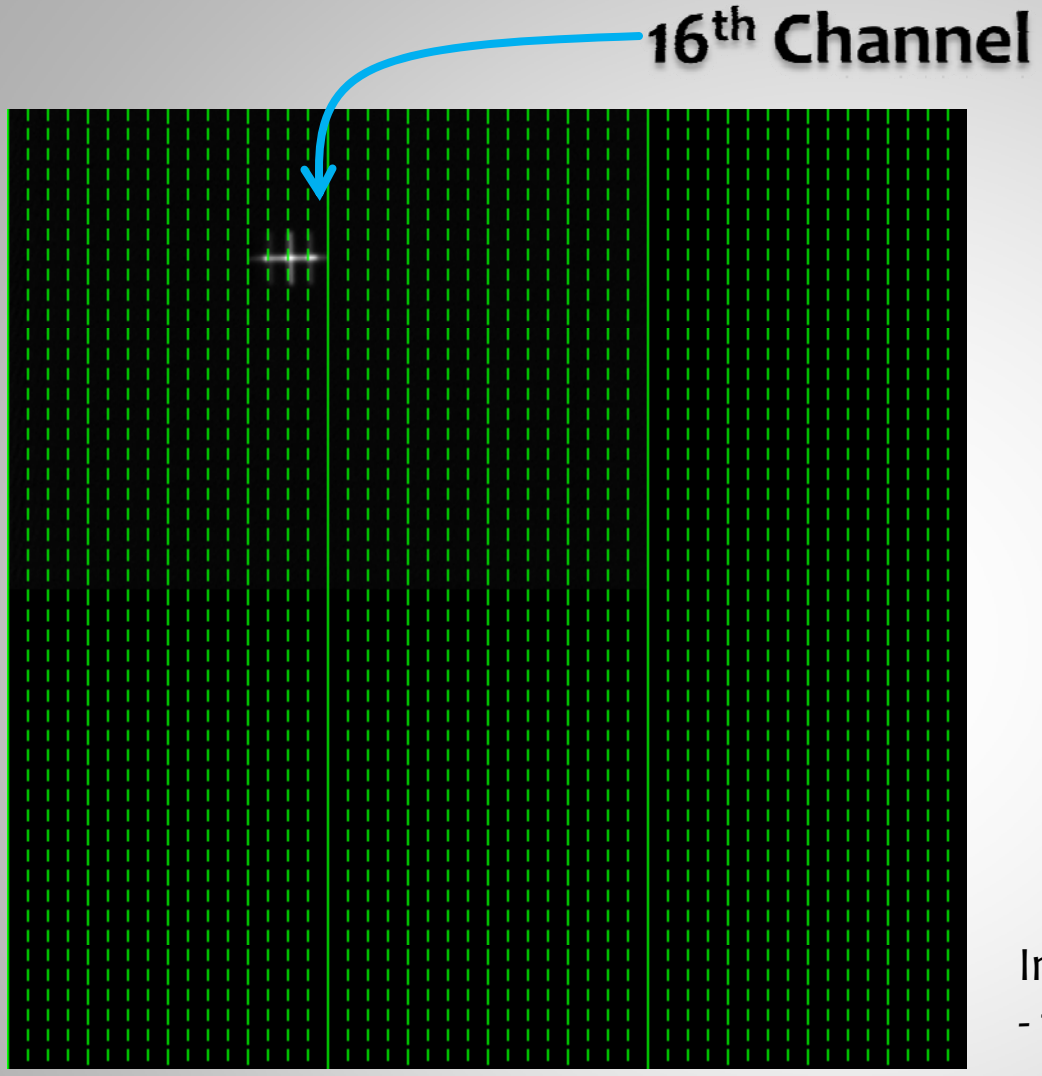


Image test2p7
- test2p9

☑ **Data seen in 16th channel after bonding fix. Documentation error.**

Crosstalk

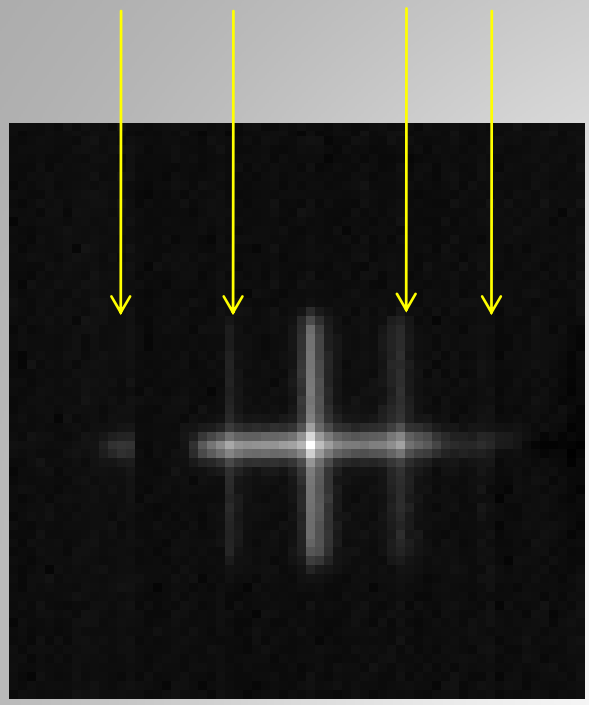


Image test2p5
- test2p2

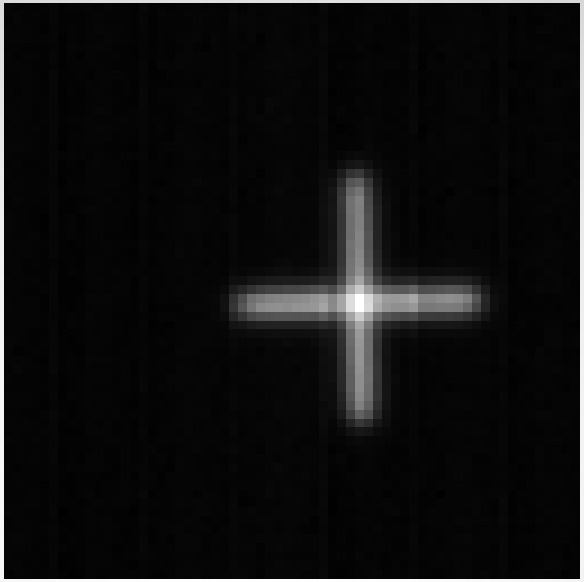


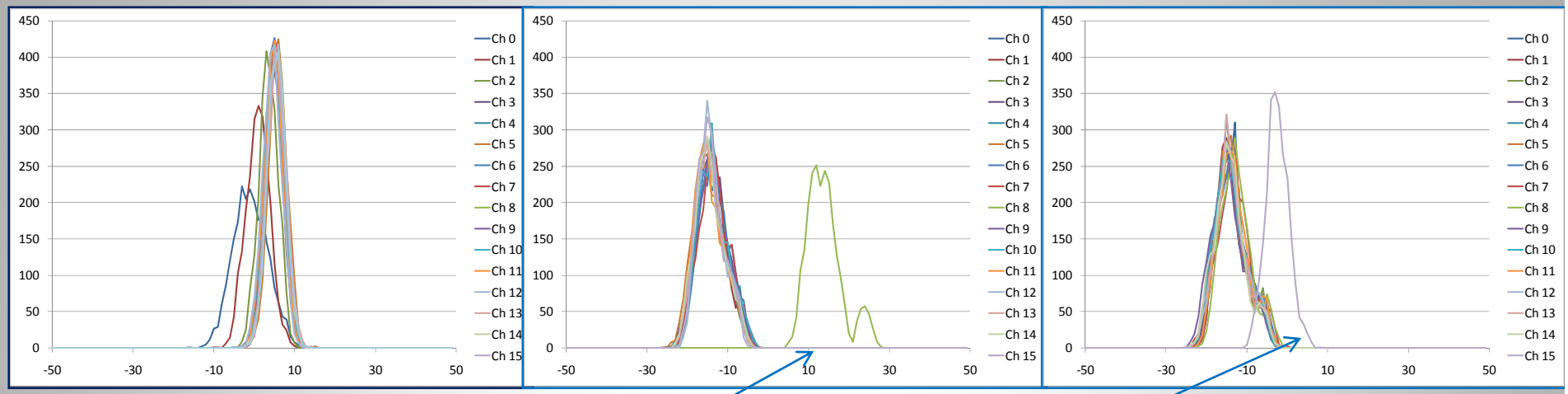
Image test2p9
- test2p5

No crosstalk fix on this part of the readout board

Crosstalk fix made on this part of the readout board

☑ **Crosstalk understood (will still require care on new PCB layout)**

Pedestals (noise level)



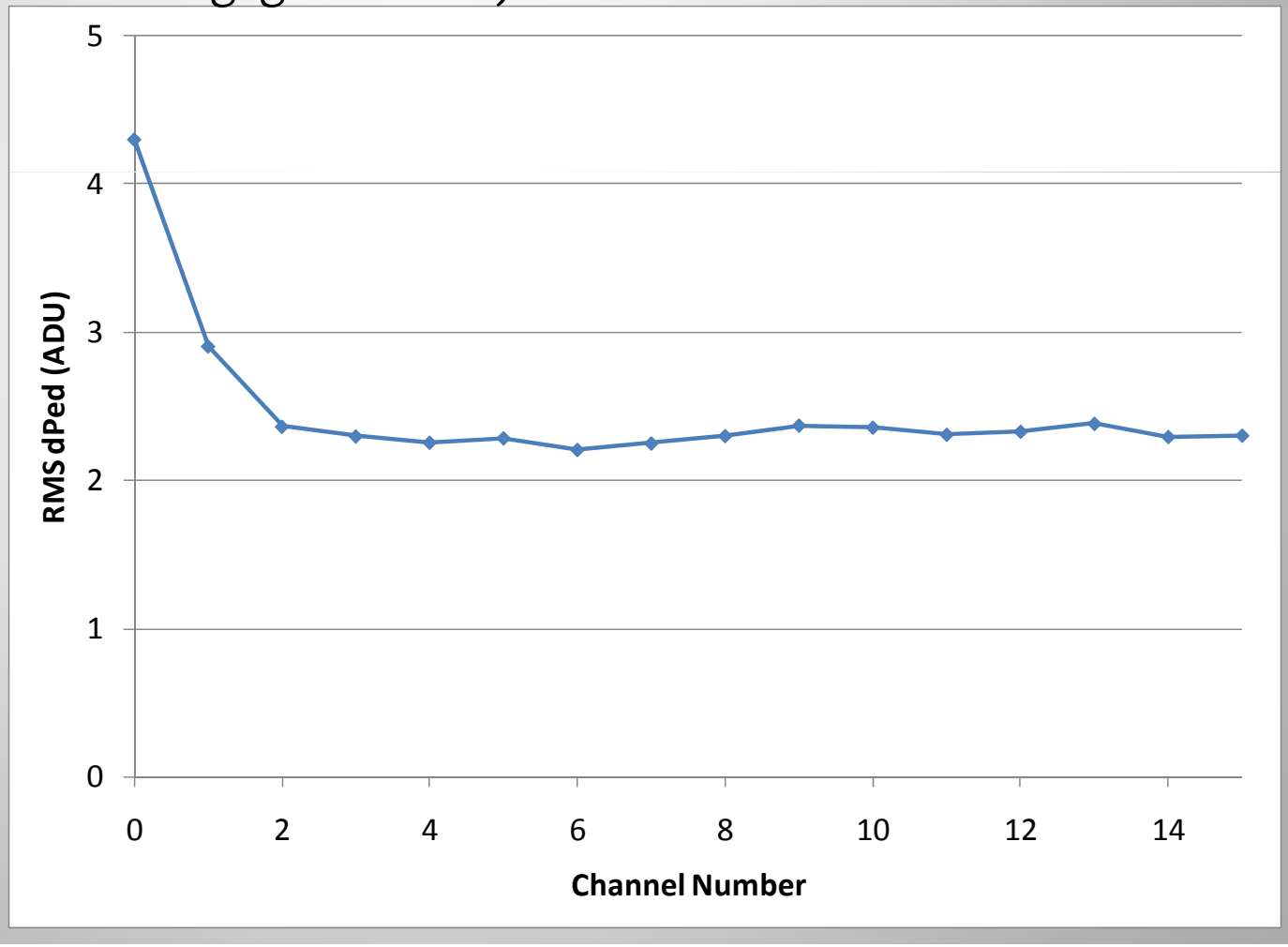
FCRIC1 FCRIC2 FCRIC3

FCRIC2, Chan 7 and FCRIC3, Chan 15 do not respond to light (may be a CCD problem or a wire bonding problem). They both have the same pedestal widths, so the noise is given by the chip (or power supply).

It looks rather Gaussian (in most cases) so that would suggest that we don't have a whole lot of pickup. But we expect ~35 µV of noise

More Noise

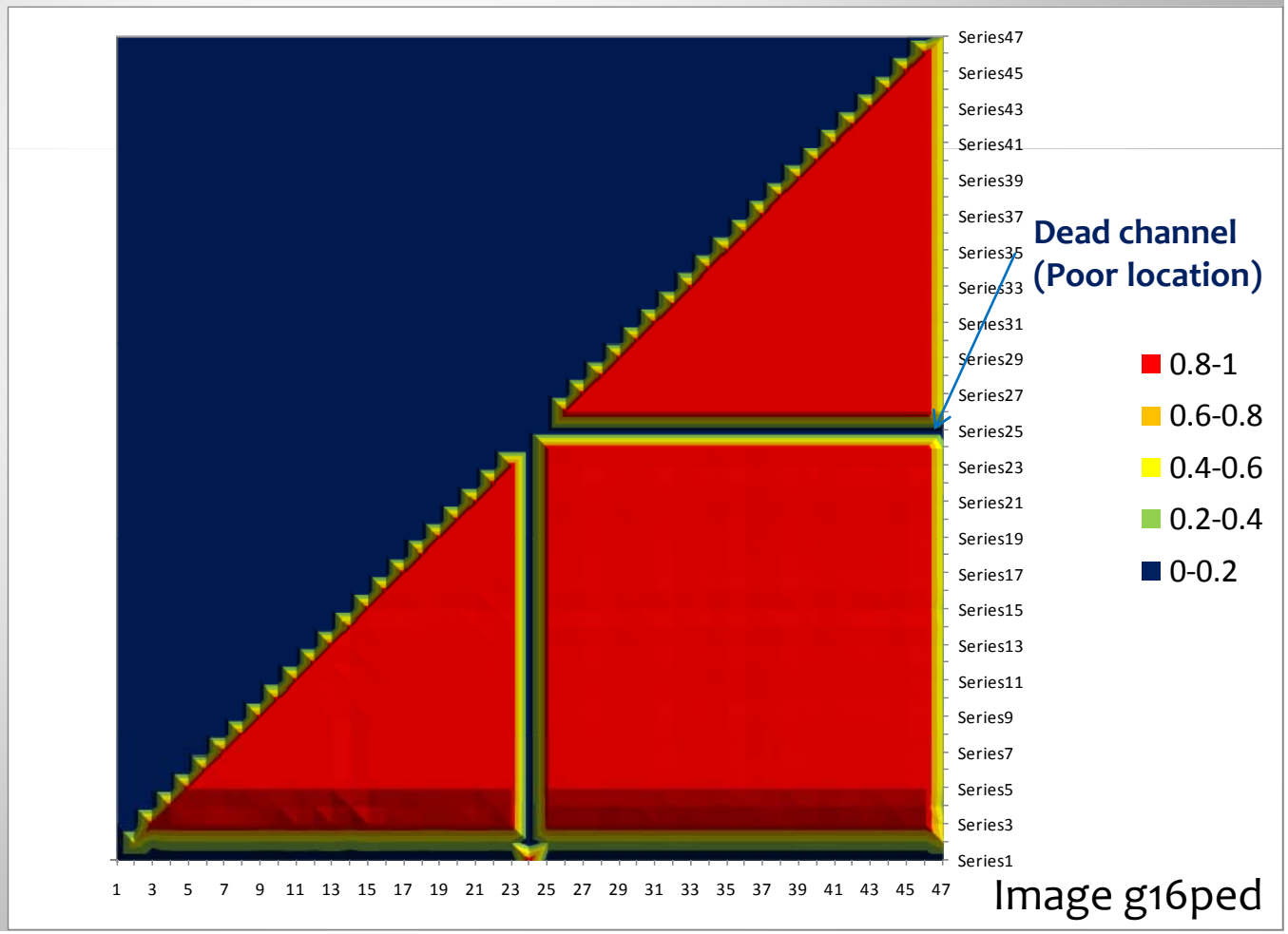
RMS for the difference of two images for each channel of FCRIC #1
RMS should be √2 x Noise → Noise ~1.5 ADU (on "forced x8") 1 ADU ~ 30 e^-
→ Noise ~ 45 e^- or 160 eV (should be better) [180 μV, should get 35 μV, but quantization error is not negligible on X8)



Correlated Noise

Plotted here is the cross-correlation between the different FCRIC channels for a dark image. (Because the cross-correlation is symmetric, only ½ of the plot is occupied). This shows we have some sort of correlated noise problem

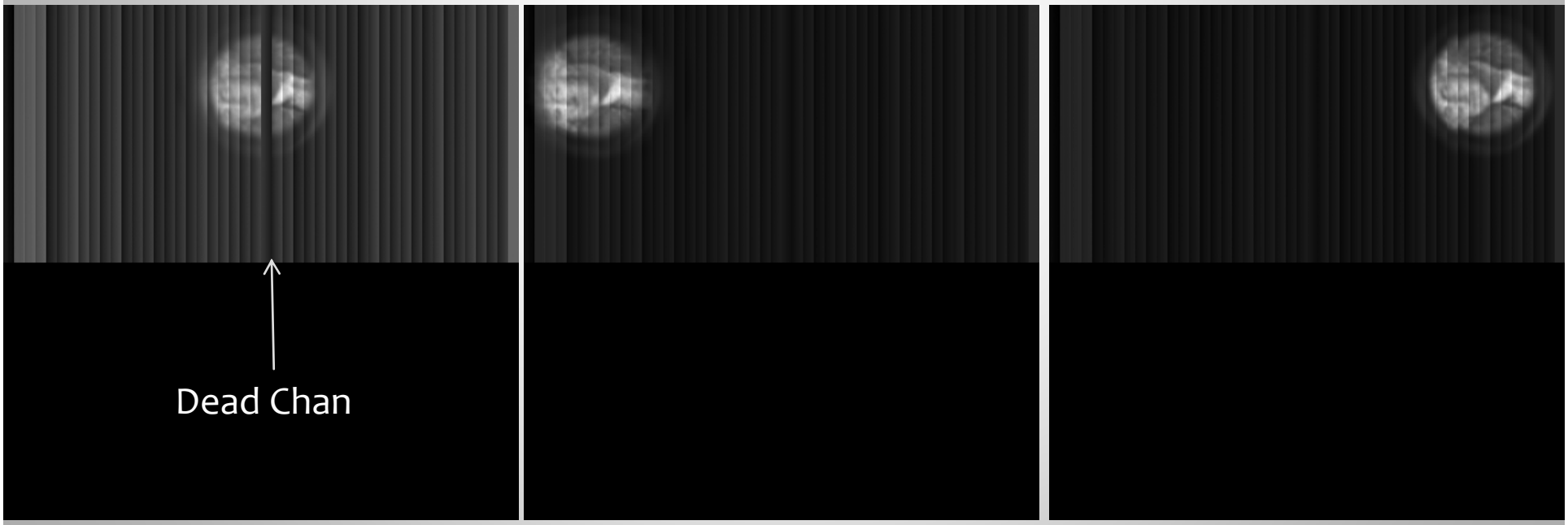
Each channel has 10 x 240 pixels. The cross-correlation looks at the correlation between pixel k of channel m and pixel k of channel n, both of which are digitized at the same time, over the 2400 pixels in a readout channel

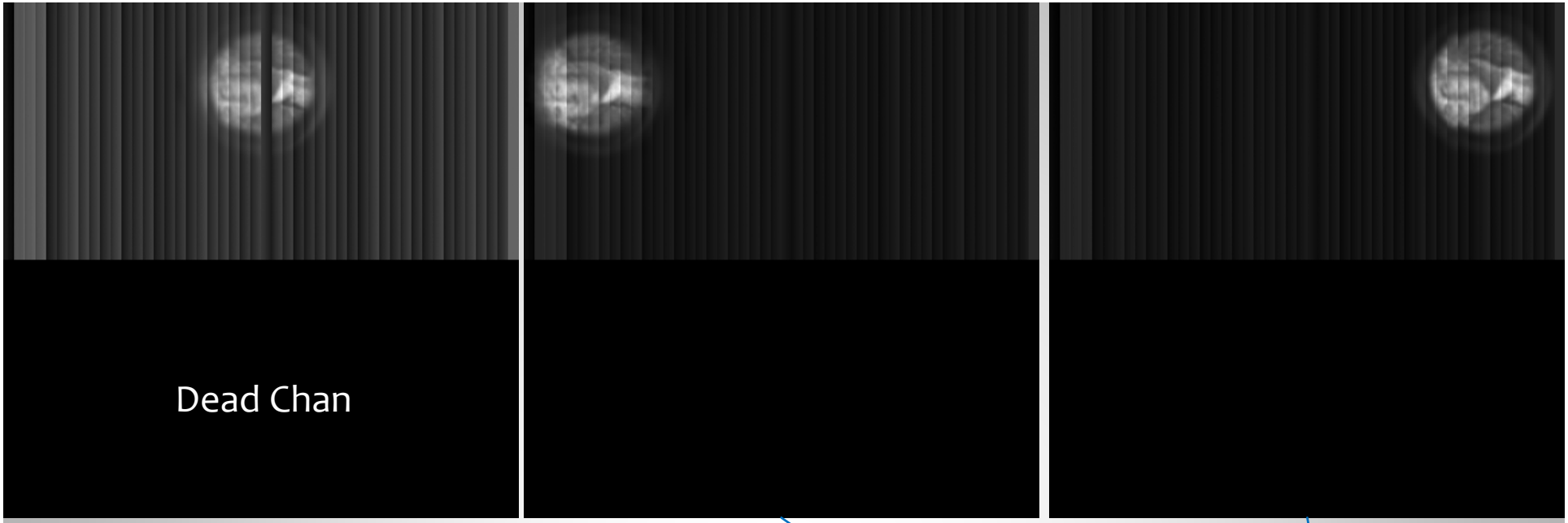


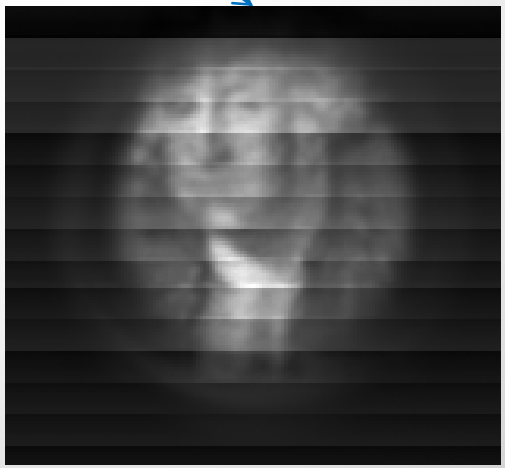
Crosses are boring

Print this on a piece of white paper, and replace the cross with it

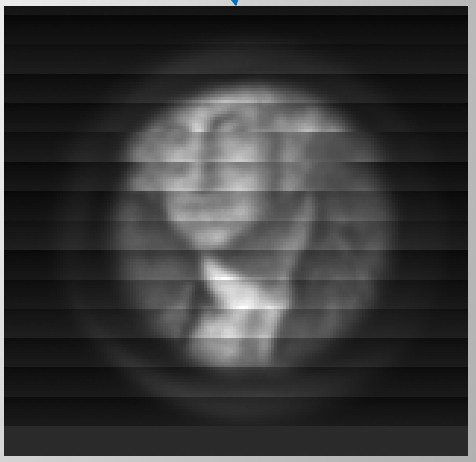
Our optics projects this





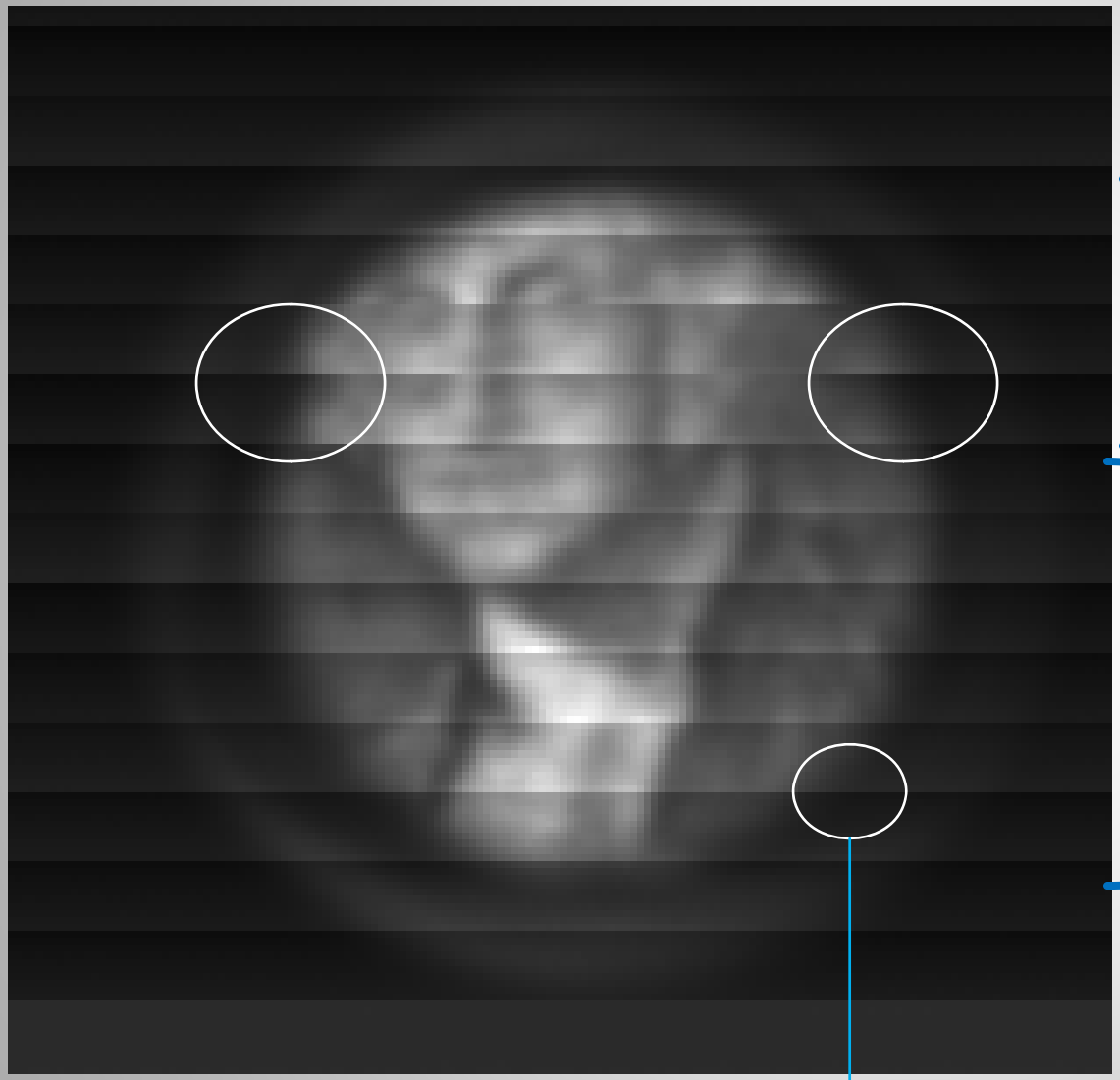


Crosstalk region



Crosstalk partly repaired region

Evidence of Partial Cross-talk Fix

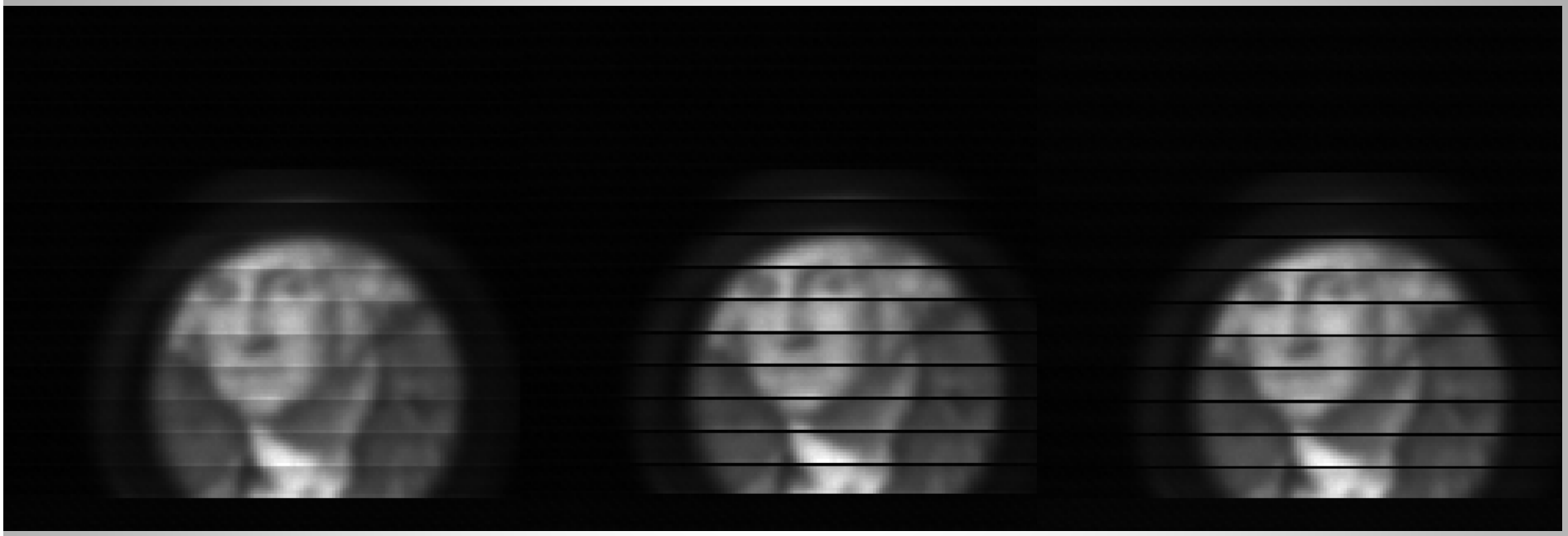


Severe crosstalk
George has two noses!
Crosstalk not repaired here

Looks ok
Crosstalk repaired

What's this?

"Stripe" – is this incorrect pipeline delay?



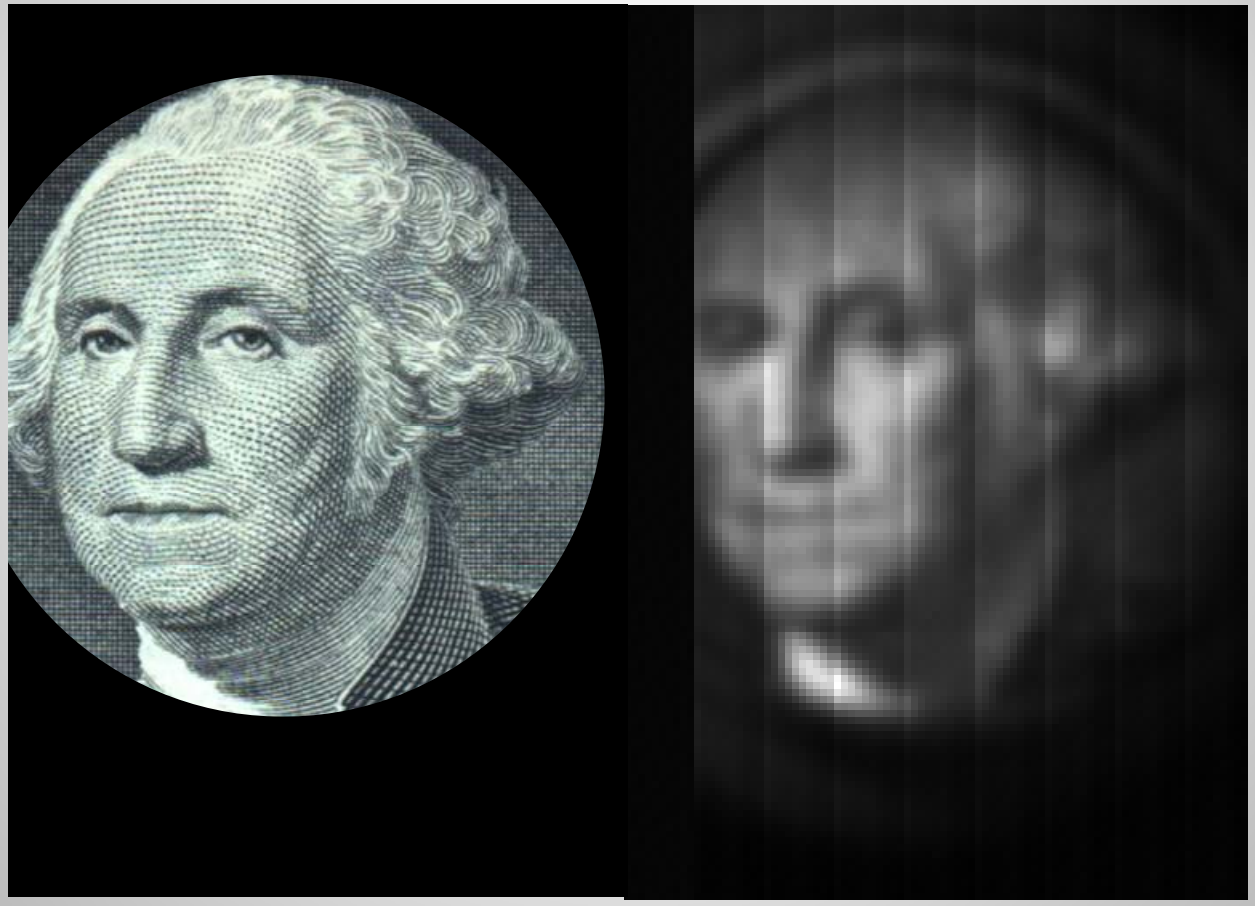
Pipedelay=7
(nominal)

Pipedelay=6

Pipedelay=8

No, I didn't use the wrong value for the pipeline delay, there is some sort of "edge effect" (or my drawing program does something incorrect at the edges)

Getting there, by George



Next Steps

- Get the bottom half working
- See if there's a dead FCRIC there, and replace it if needed
- Investigate the couple of dead channels. Could it be bonding? (The yield so far, all things considered, is not so bad!)
- Correlated noise – look at power supplies

- When possible, do the "sensitivity analysis" and optimize the parameters (voltage and timing).

- Optimize vertical clock timing (we've been ignoring that)
- Demonstrate high rate. Right now, we read really fast. But we `trigger slowly`. We need to implement high frame rate.