(Preliminary) Characterization of the AuxTel (ITL) sensor

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Kirk Gilmore, Tony Johnson, Claire Juramy,
and probably more people

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Aims

- Optimize the operating conditions for the CCD
  - Clocking, voltages, …
- Characterize the chip & read-out chain(s):
  - Non-linearity
  - Brighter-fatter

Operations

- Tony and Kirk (+?) are taking data in Tucson
- Pierre Antilogus transfers those to Lyon from time to time
- Some people in France look at it
- Feedback is provided
  - So far, the most important one was Claire providing the “3-s sequence”, which hopefully improves things.
- At some point, mirroring this data from Tucson to NCSA will happen.

This presentation

Only studied the data sets consisting of flats:

- CTE optimization : Kirk patrolled a whole range of “serial voltage values” (serial up, serial down, and output gate), with a flatfield illumination.
- PTC : 10 biases, then a ramp up to full saturation, 10 more biases
- These data sets were taken using two different sequencers (aka CCD readout clocking)
  - A “2-s” sequencer (old-fashioned)
  - A brand-new “3-s” sequencer, to be optimized.

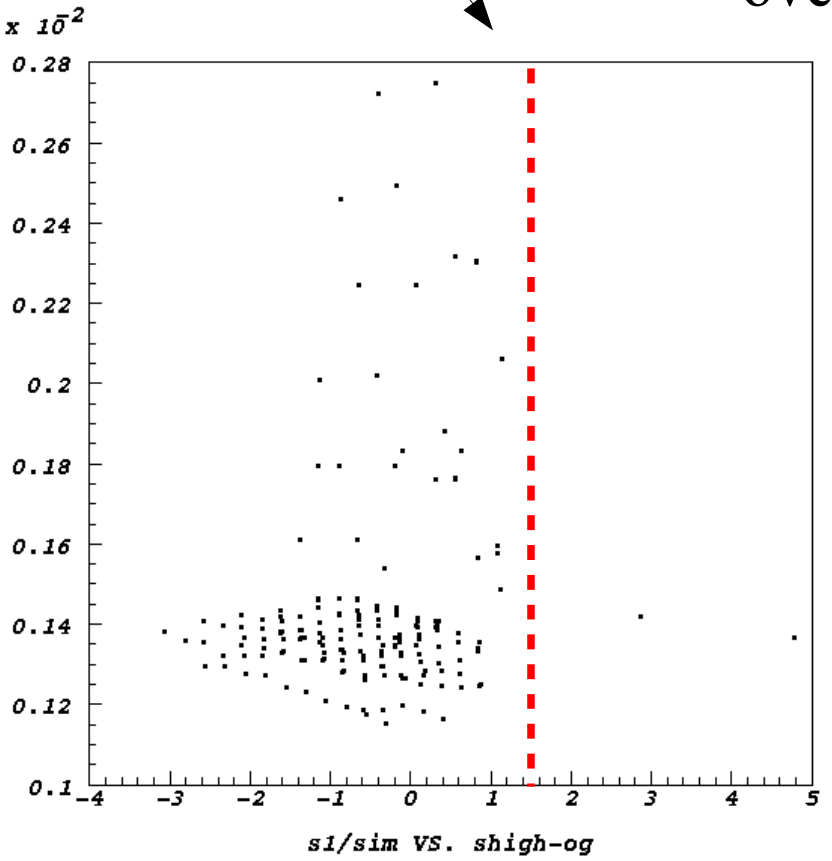
CTE scan

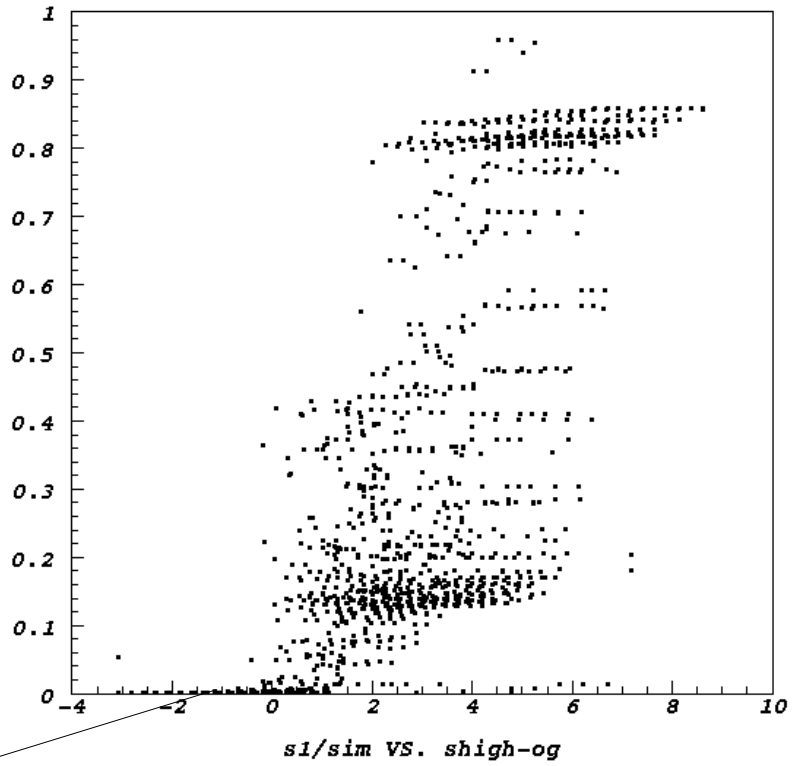
- It was performed using the the (old) 2-s sequencer, integrating with 1 phase up. On ITL sensors, this causes “dipoles” (bad thing).
- The data are flats with ~25 k electrons.
- The optimization consists in finding which conditions deliver the smallest possible first overscan pixel (on average).
- Can then look at other properties.
- Will have to redo that with the 3-s sequencer.

CTE scan (2)

Project recommended values

Fraction of flat in the first overscan pixel





S_+-OG

The optimum delivers ~0.14% trailing charge. The "3-s" sequencer might do better.

CTE scan (3)

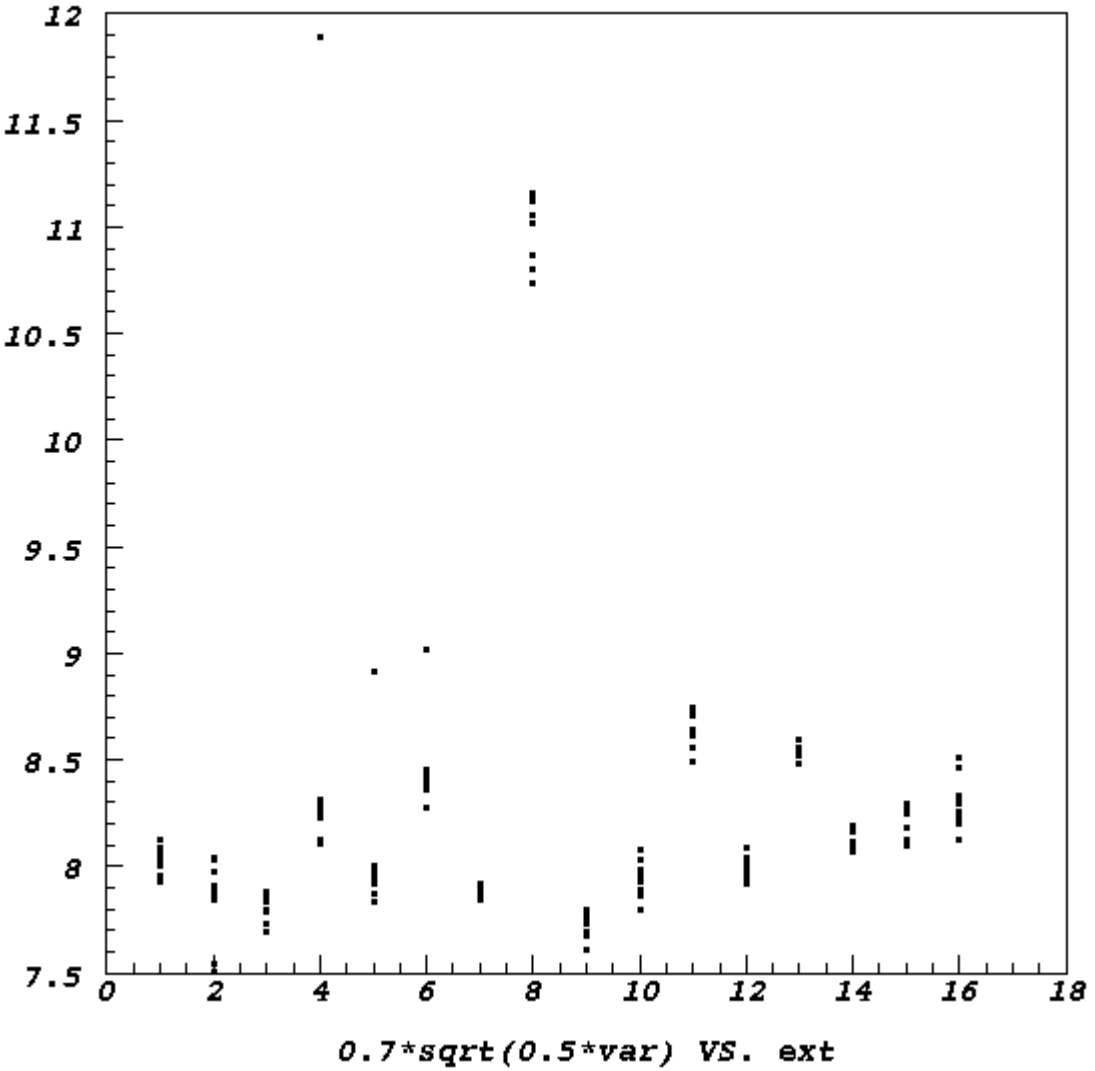
- If you look at this data, without knowing what it is intended for, you will be horrified. Most of the images are just scarry.
- Next move: redo something similar with the (currently-) adopted sequencer
- Chose a set of operation values
- Acquire one PTC (or more!) under the chosen values to check if the trailing charge is linear w.r.t input.

PTC

- Only use the files taken with the 3-s exposure.
- The sequence is:
  - 10 biases
  - 91 flat pairs (up to deep into saturation)
    - ~70 usable for PTC
  - 10 biases
- Two immediate problems:
  - The biases are unstable
  - There is significant non-linearity (at least from the ASPIC)

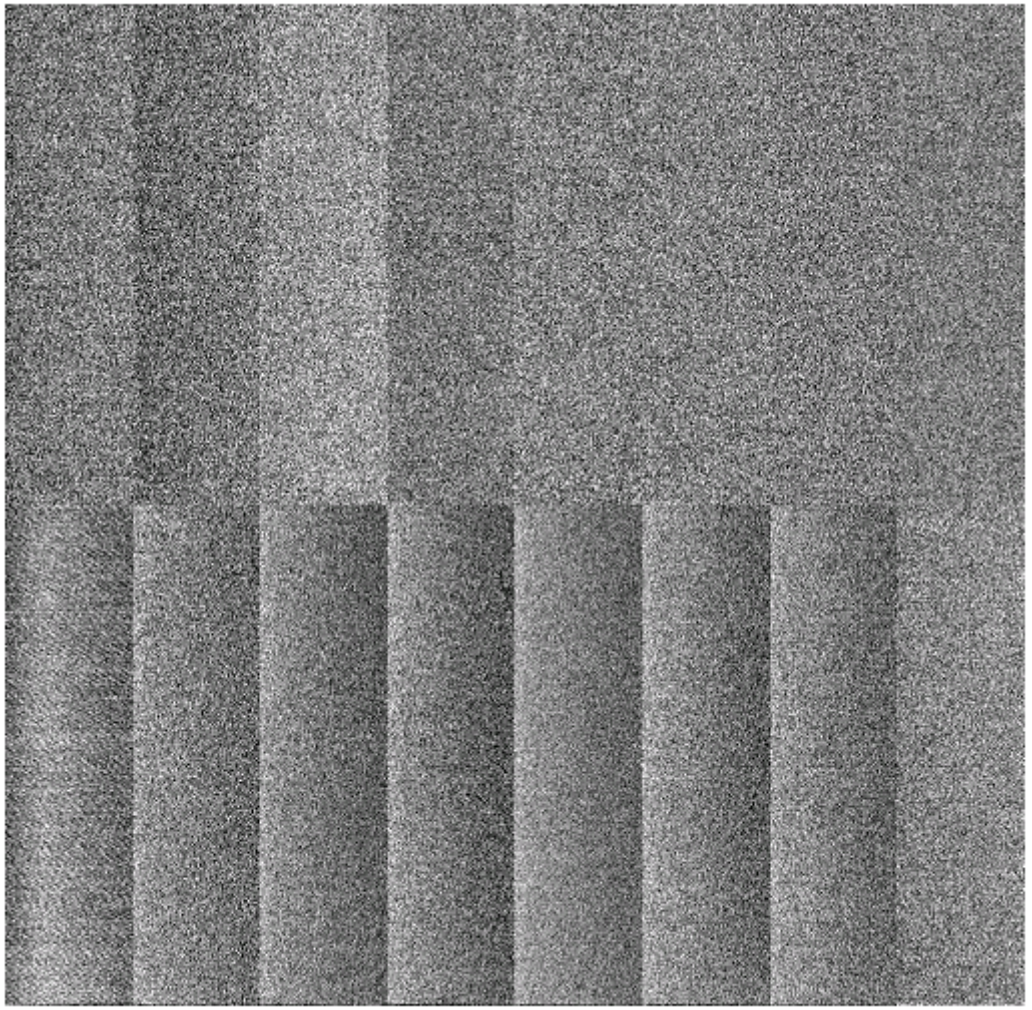
Read noise

I have not looked what the outliers are



bias differences

Exposures: ats_exp_0_AT_C_20180922_000{219,409}.fits



There was 3 h between exposures (with a lot of collected charge).

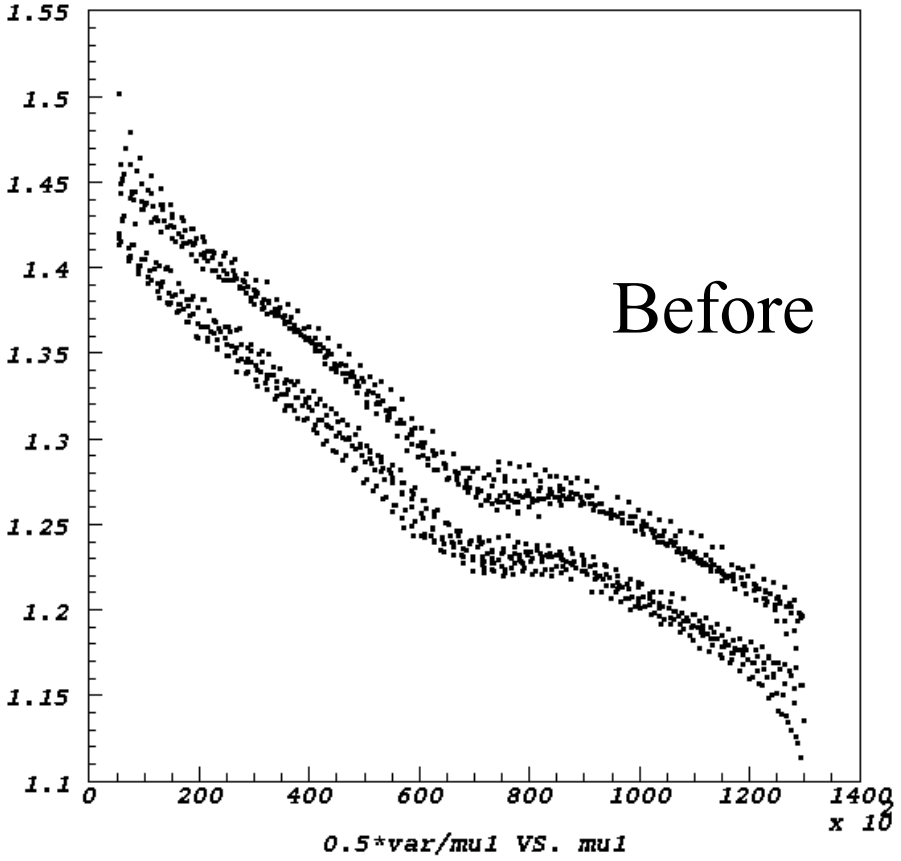
The pedestal varies (OK)

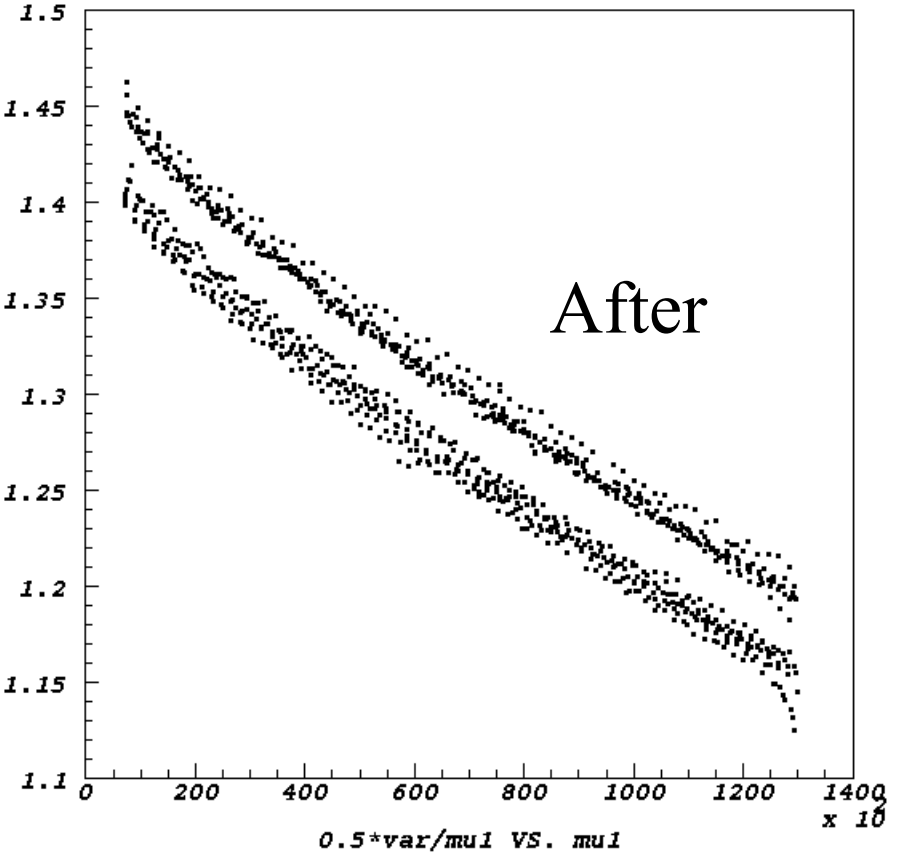
The shape of the bias varies
which is (very) bad

Current approach:
Ignore data below 5 ke

Non linearity correction

PTC's of all channels : Var/average of flats vs average



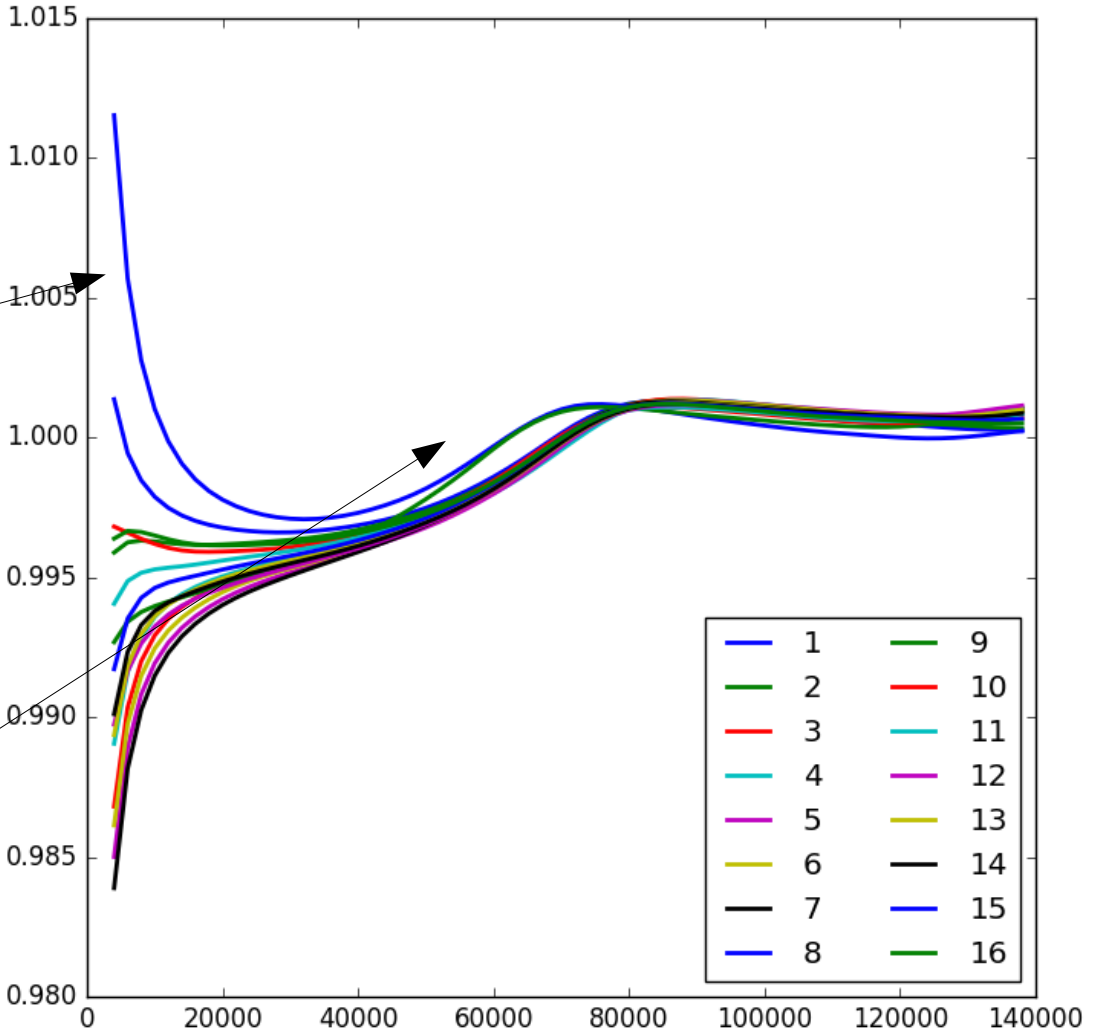


Just using the exposure time reported in the header.

Non linearity correction

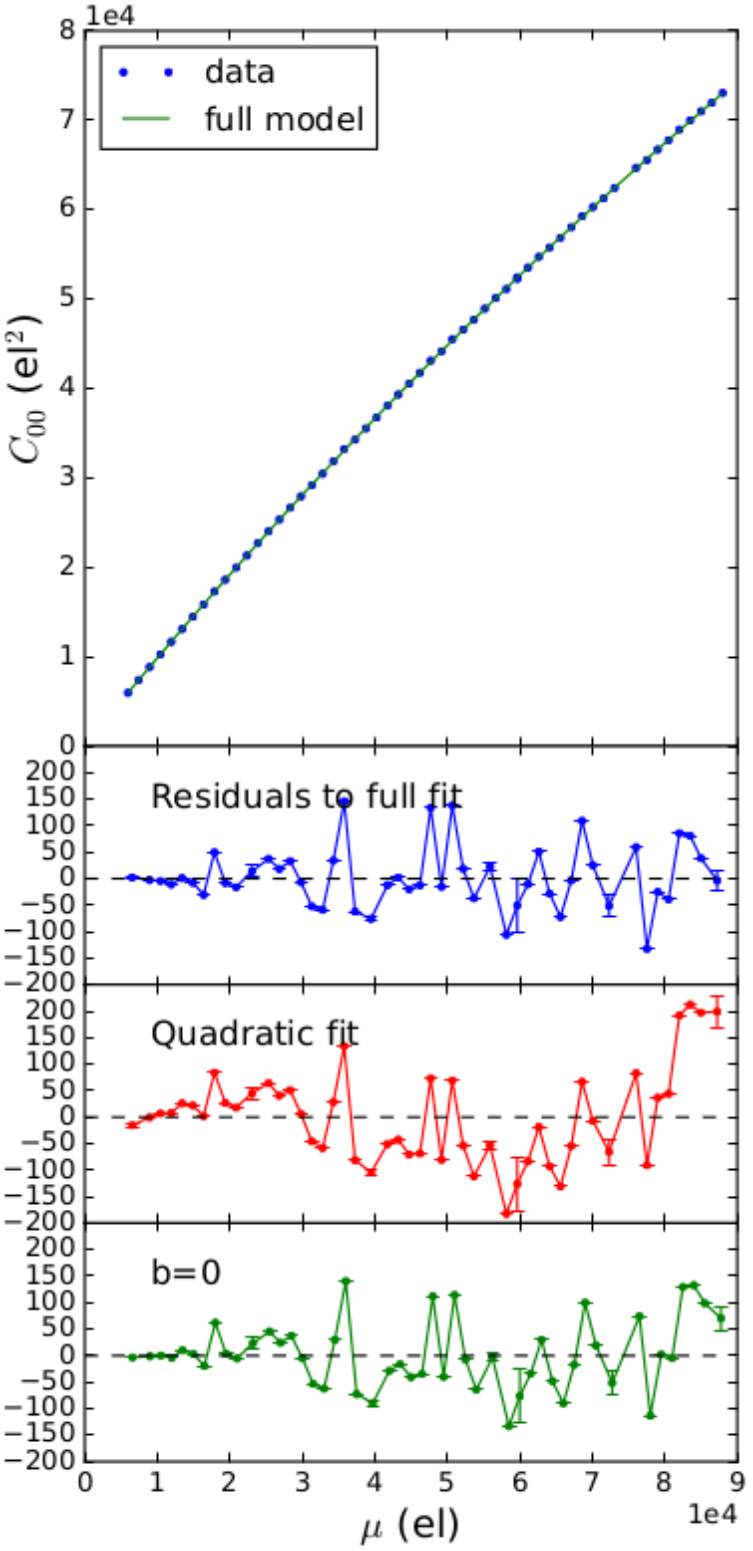
I suspect that these are artefacts from the poor way I am subtracting the pedestal.
But Kirk has shown similar low-flux non-linearities

This wiggle is due to the ASPIC



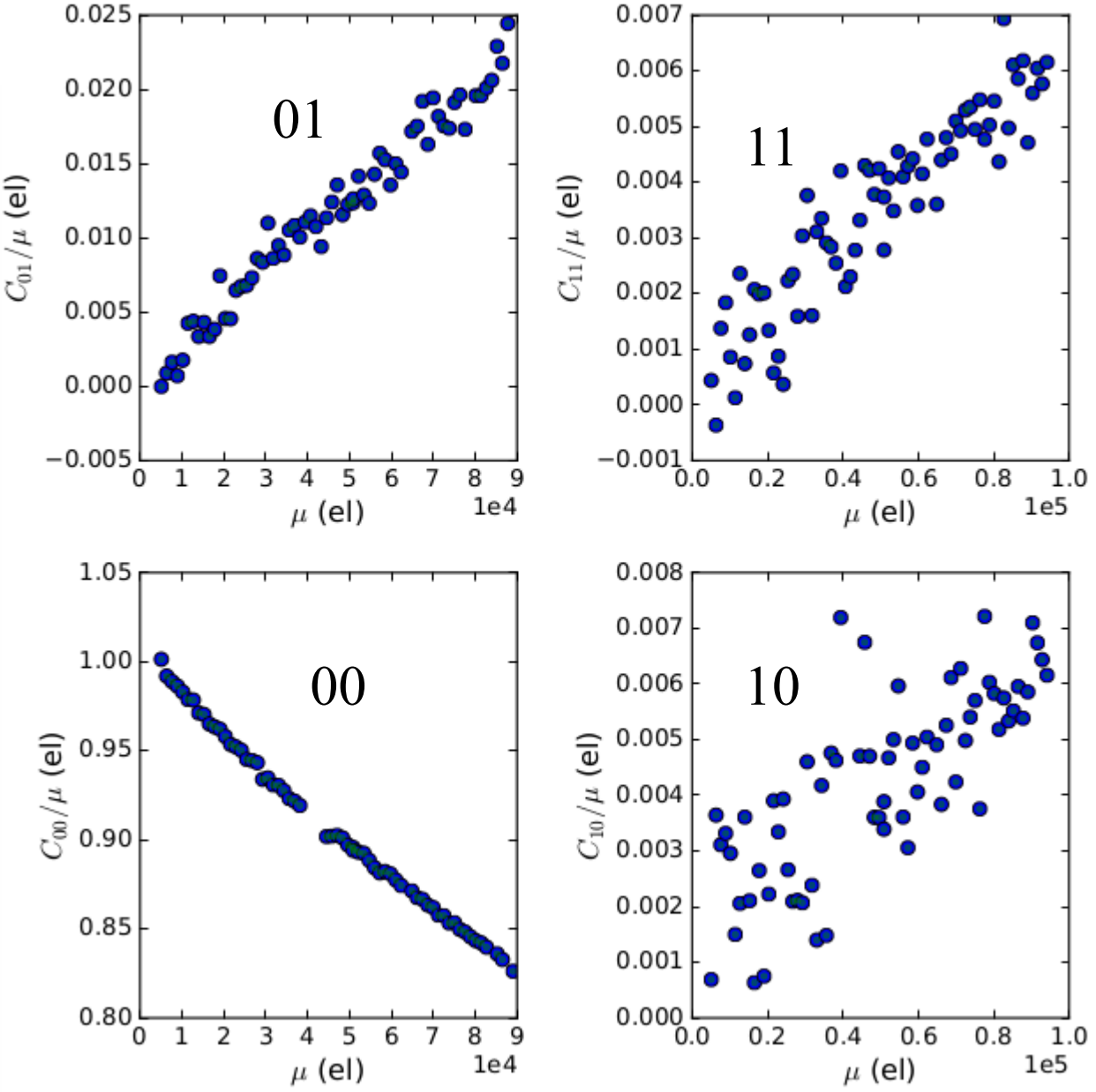
PTC of channel 1

- Residuals at the 0.2% peak to peak.
- Not sure they are significant.
- The “b=0” fit refers to the usual linear interaction model.
- The “full fit” is slightly more flexible.



Covariances

- Channel 10

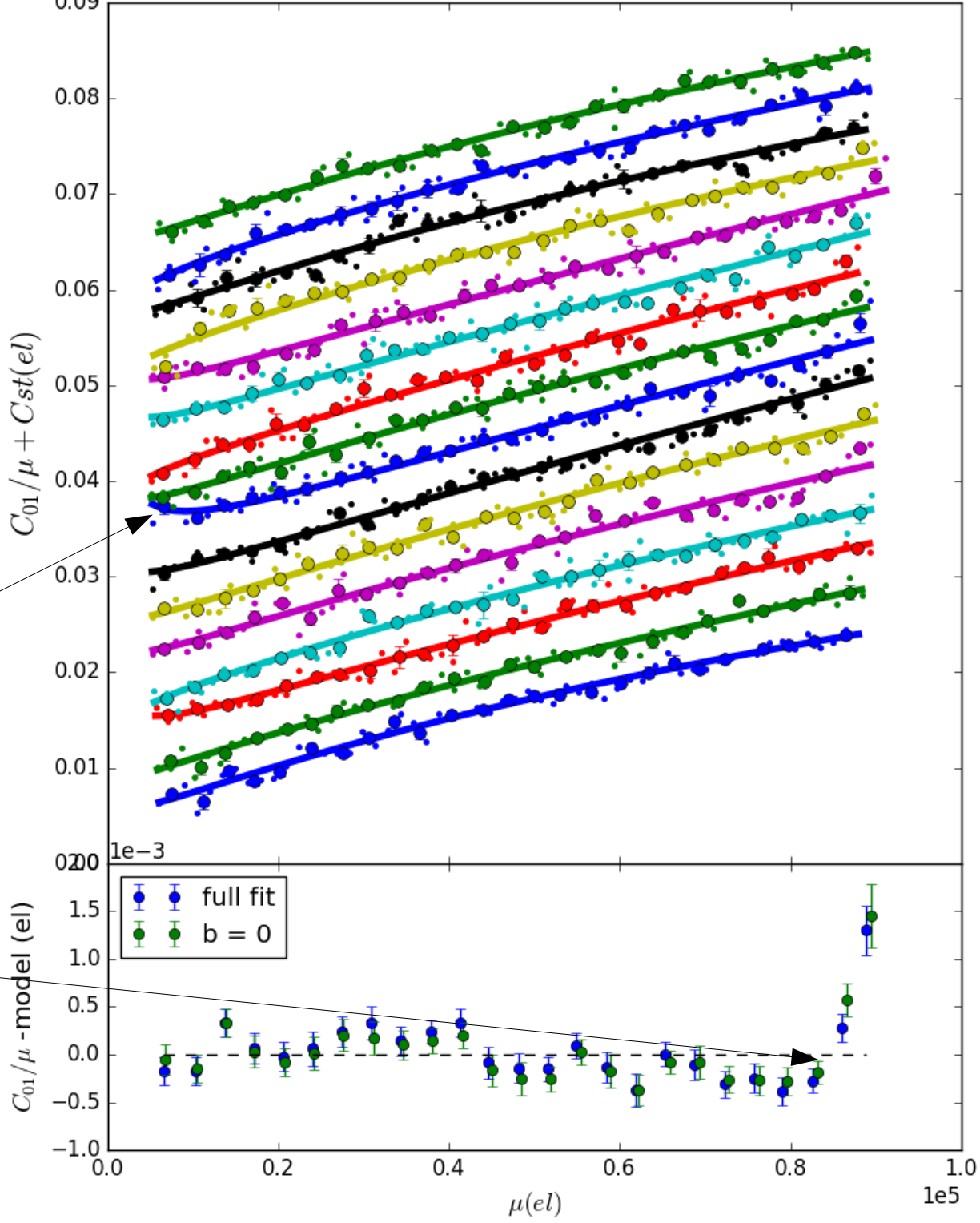


C01 for all channels

Channels are pretty similar, as expected

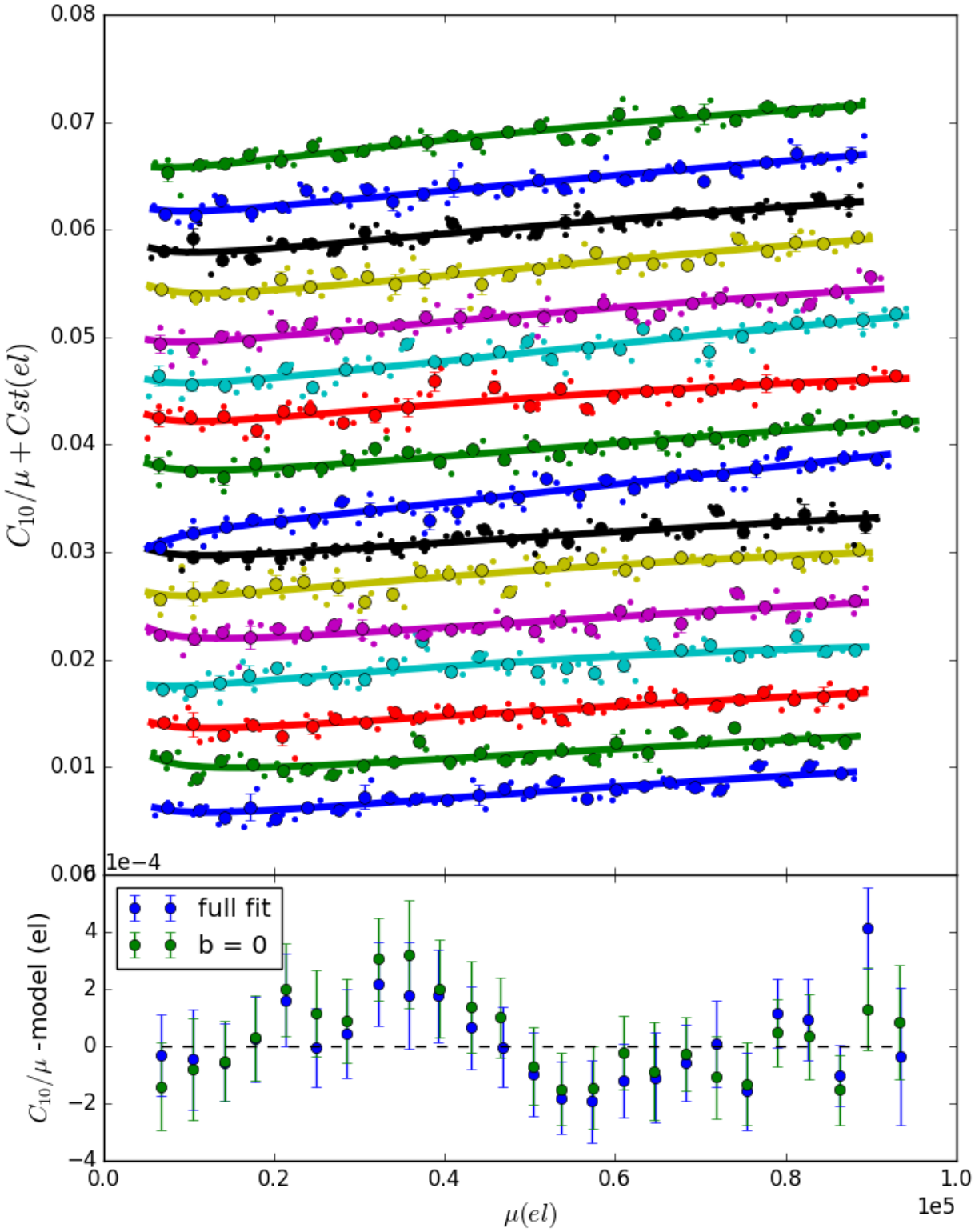
Artefacts from Non-linearity correction ?

Bleeding starts at ~ 85 ke



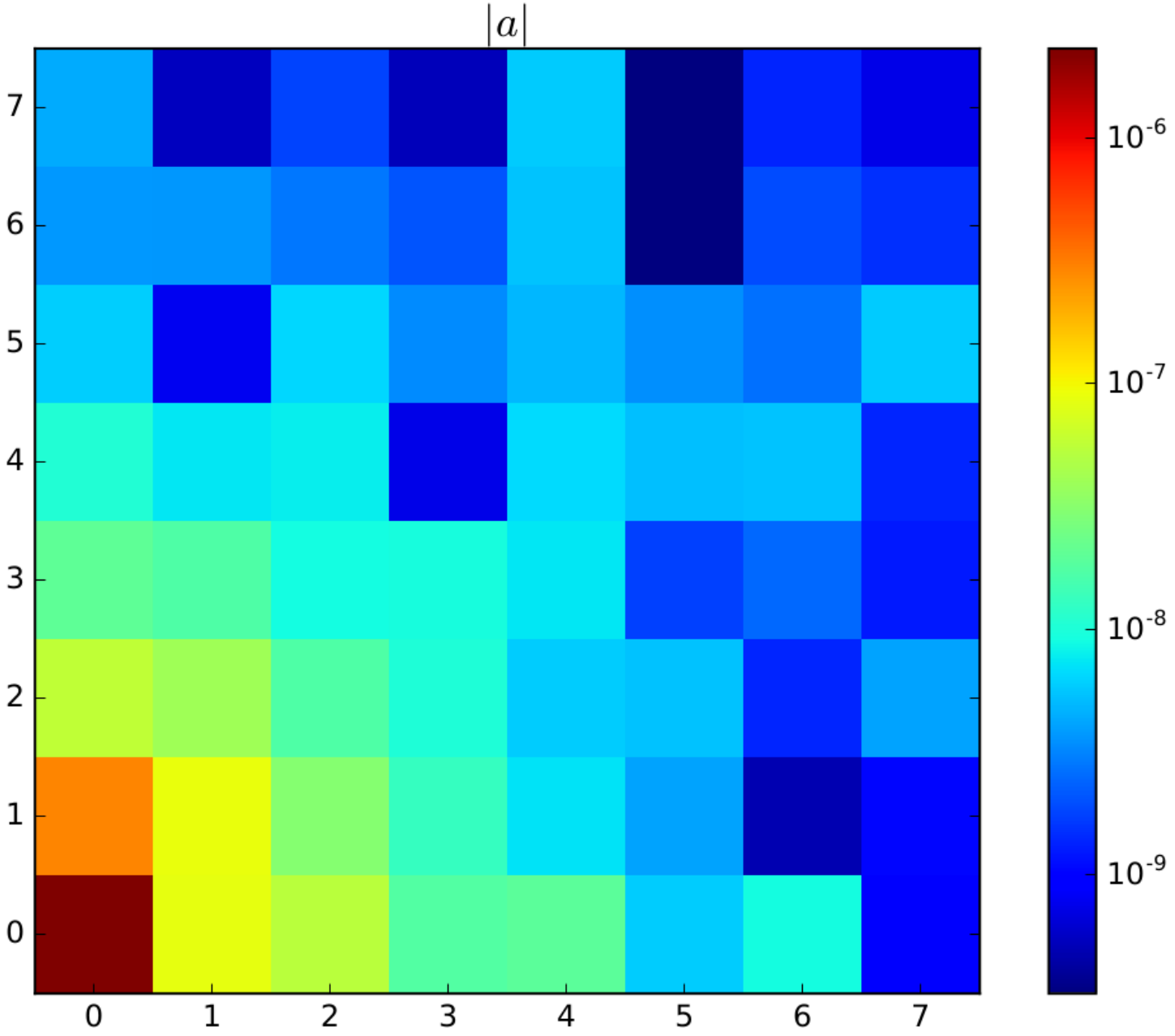
C10 for all channels

Shapes are slightly different
Why ?



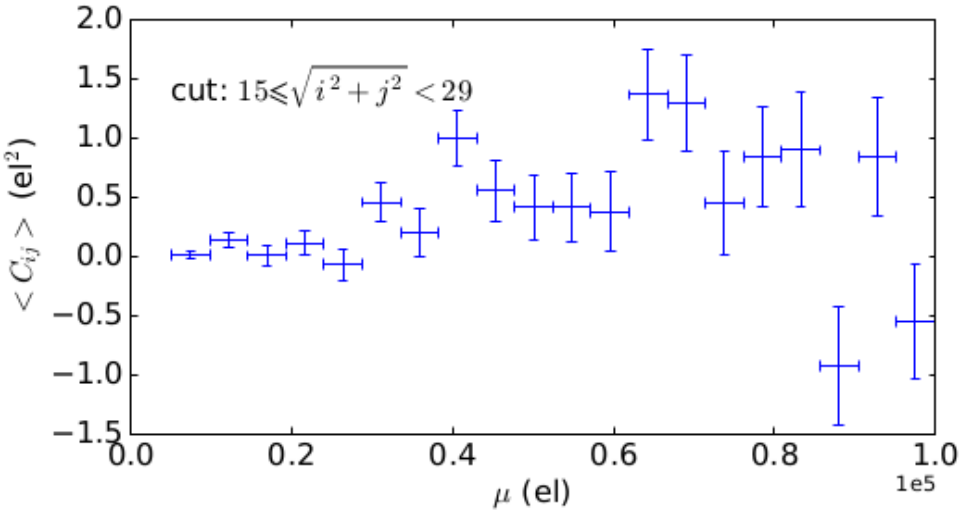
Area alterations as measured

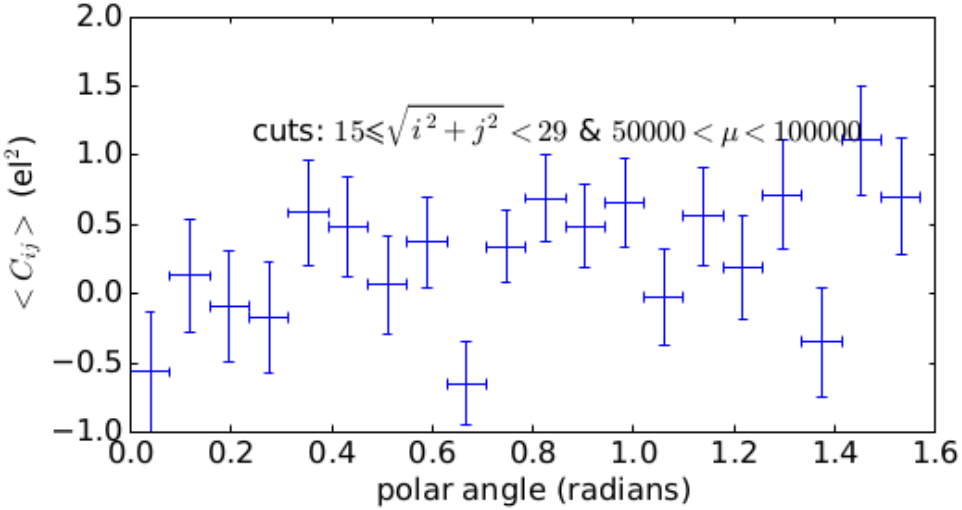
Makes sense !



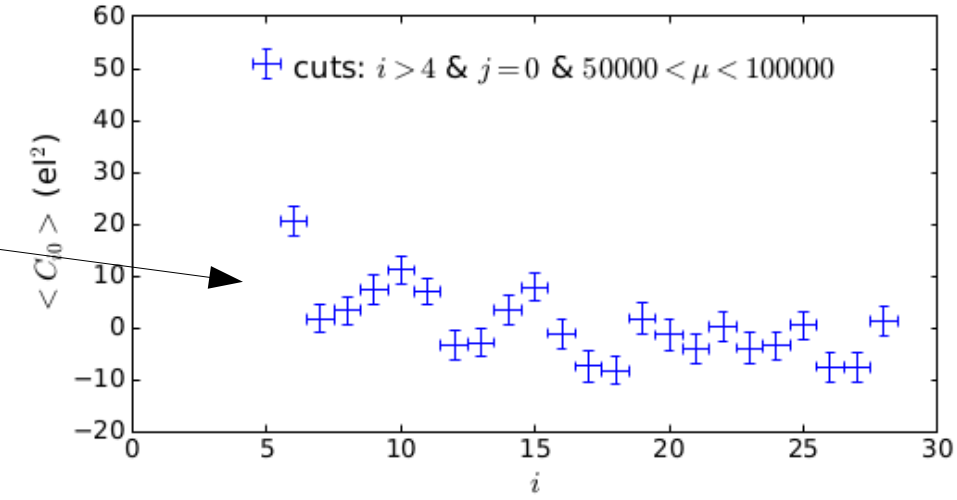
Distant correlations

- Should be ~0
- Independent of flux
- ~ isotropic





Pickup ?



Summary/conclusions/outlook

- We have usable data flowing out from Tucson. This is very good news.
- We have a preliminary PTC, which shows some intriguing features.
- My proposal (mostly BF oriented):
  - Find some acceptable sequence/working point for the chip.
  - Check/solve the bias unstability
  - Acquire many PTC's