Pixel test board

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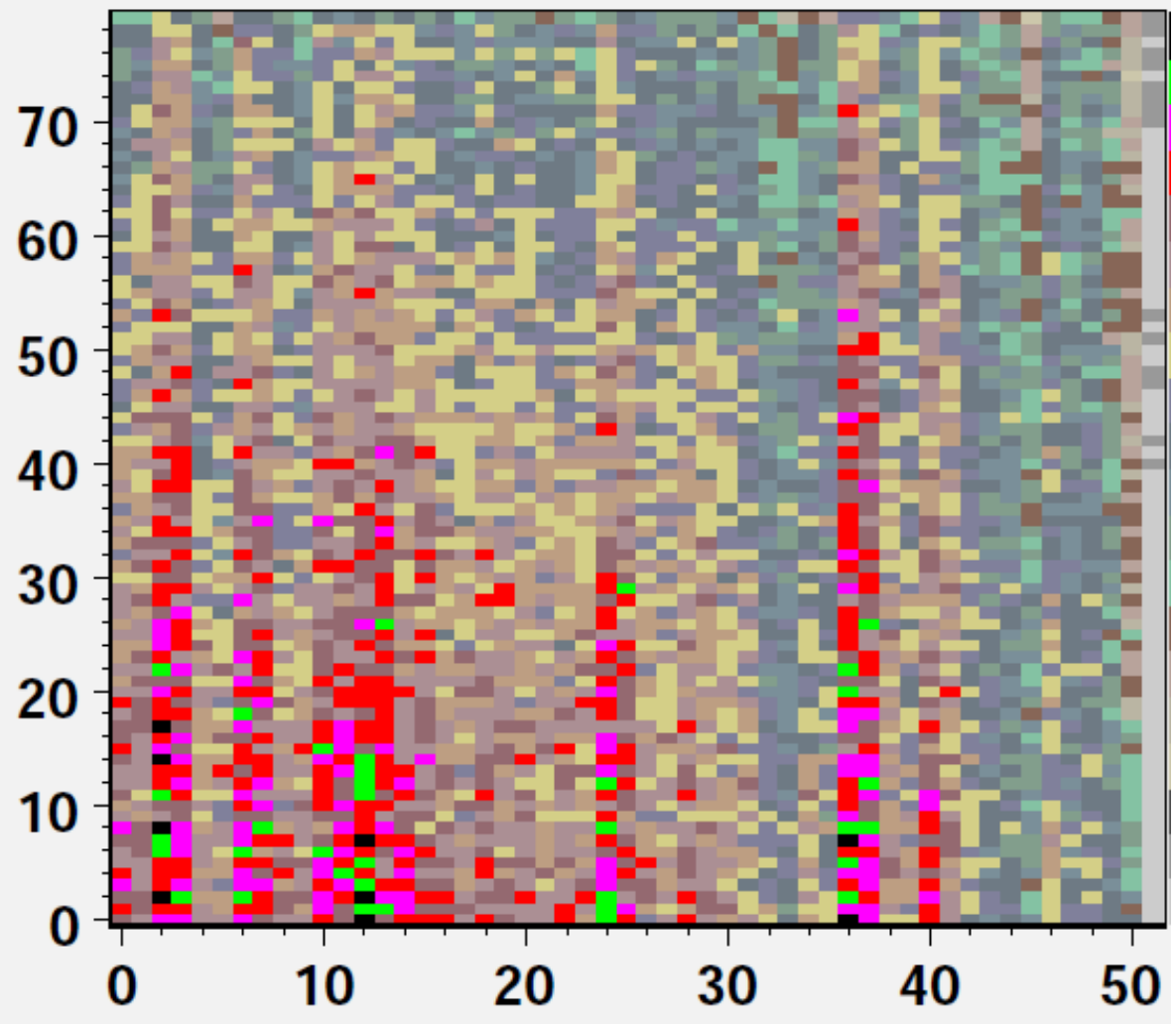
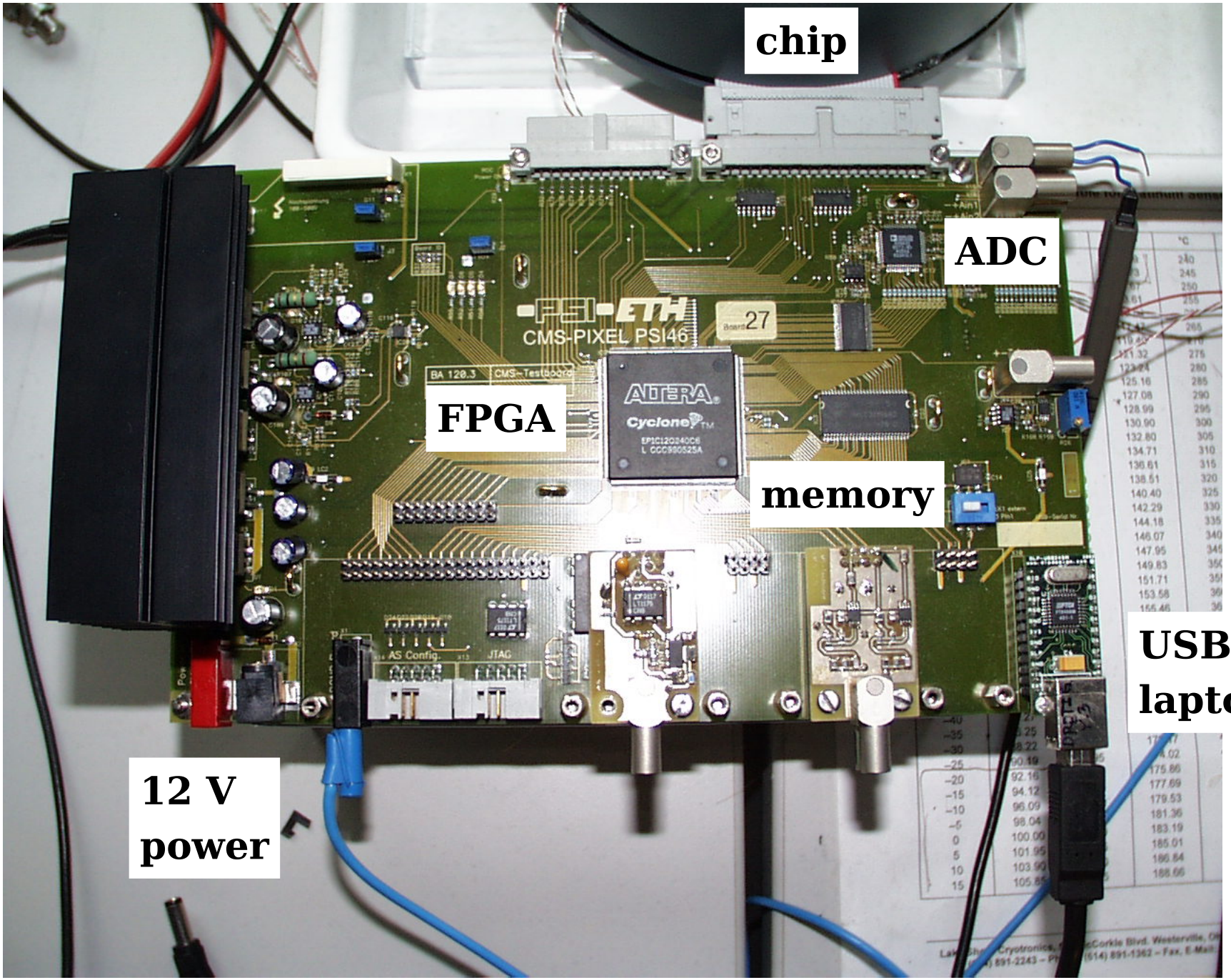
CMS Tracker Upgrade 23.2.2011

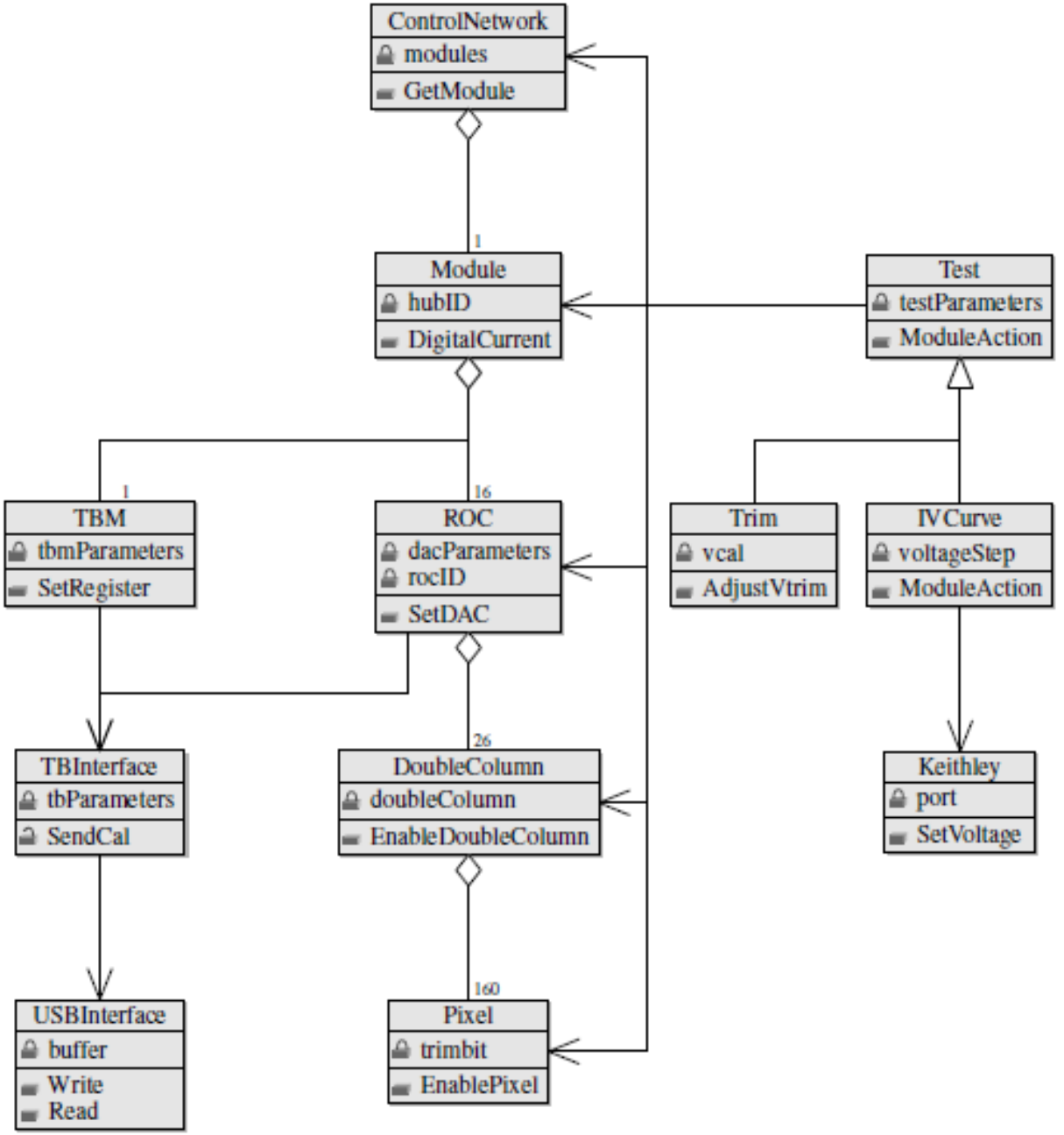


- Pixel testboard
  - hardware
  - software
- psi46 chip
- first plots

pixel test board (Beat Meier, PSI)



psi46expert software

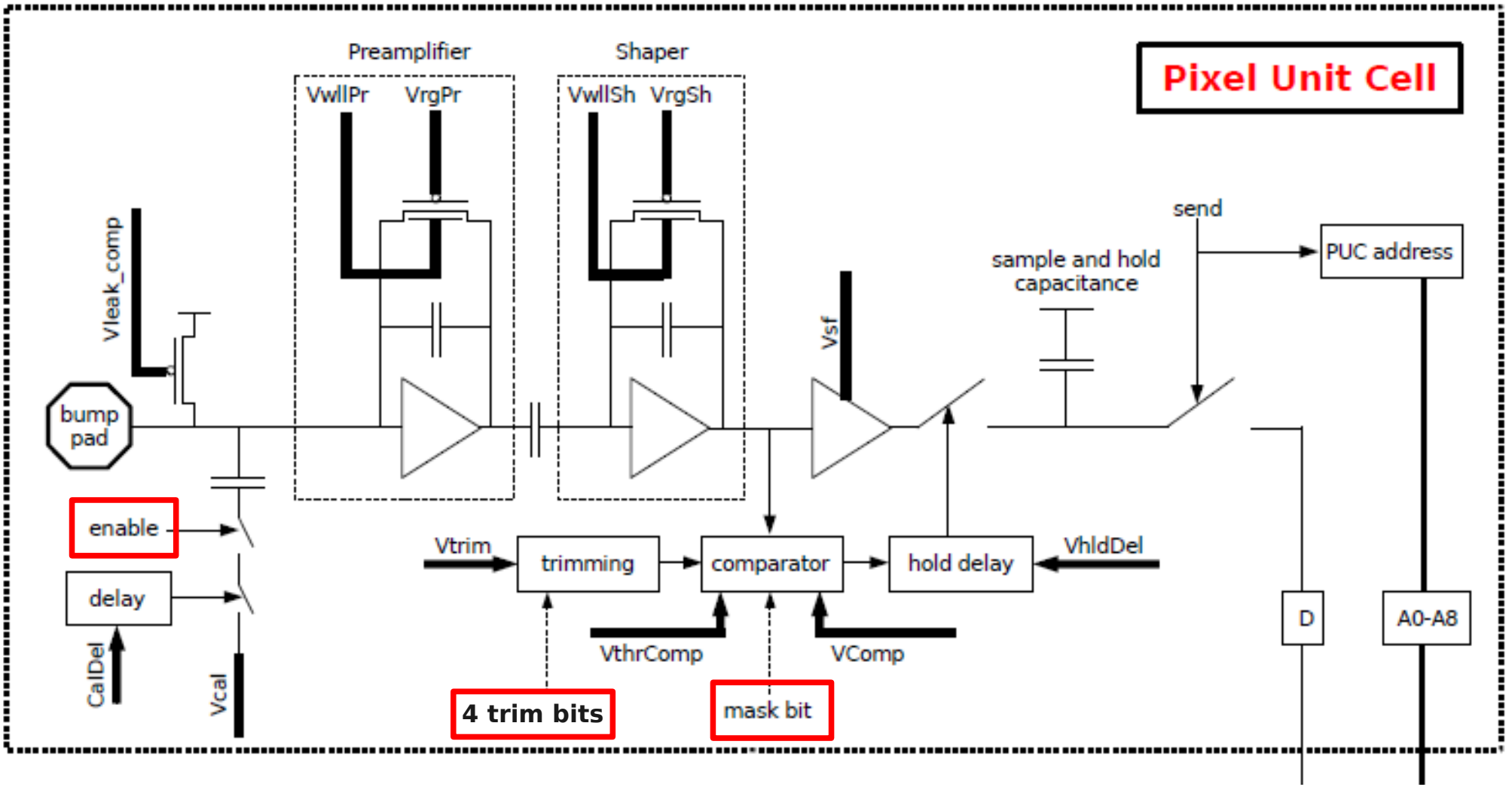


- c++ class library.
- Written by Peter Trüb (ETH, 2005-2007) for Scientific Linux 32 bit.
- Now compiled with g++ 4.4.5 under Ubuntu 10.10 64 bit.
- USB interface required some changes (long → int).
- Lot's of code – only a small portion explored so far...

Configuration

- Configuration files for test board and readout chip imported from PSI:
  - board name,
  - define single chip setup (no TBM),
  - run in 40 MHz mode,
  - set 28 DACs and Control Registers on the ROC,
  - define timing sequence: reset - cal - trigger – token,
  - read and load pedestal and trim values.

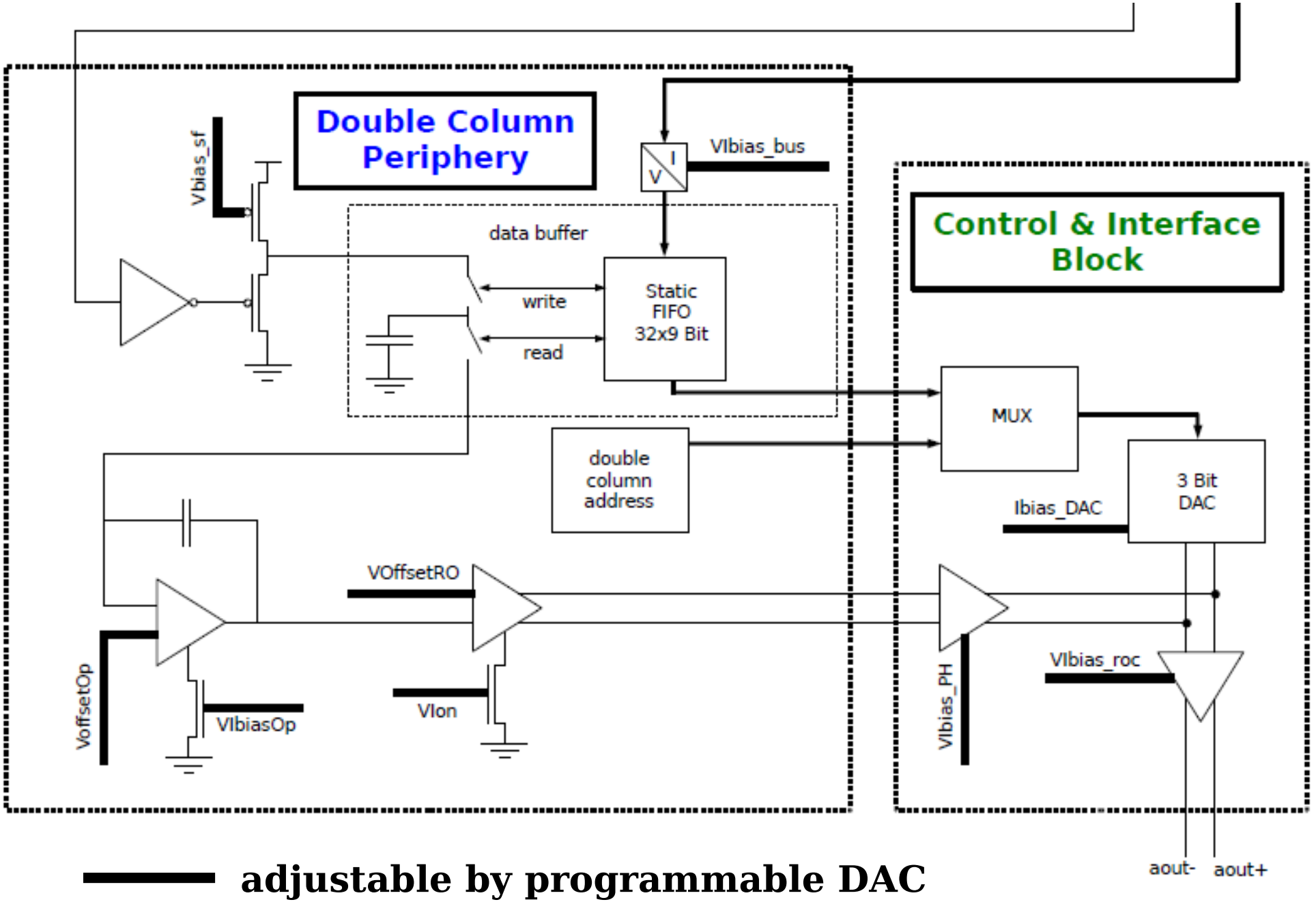
psi46 pixel readout chip



adjustable by programmable DAC, per ROC

programmable register, per pixel

psi46 pixel readout chip



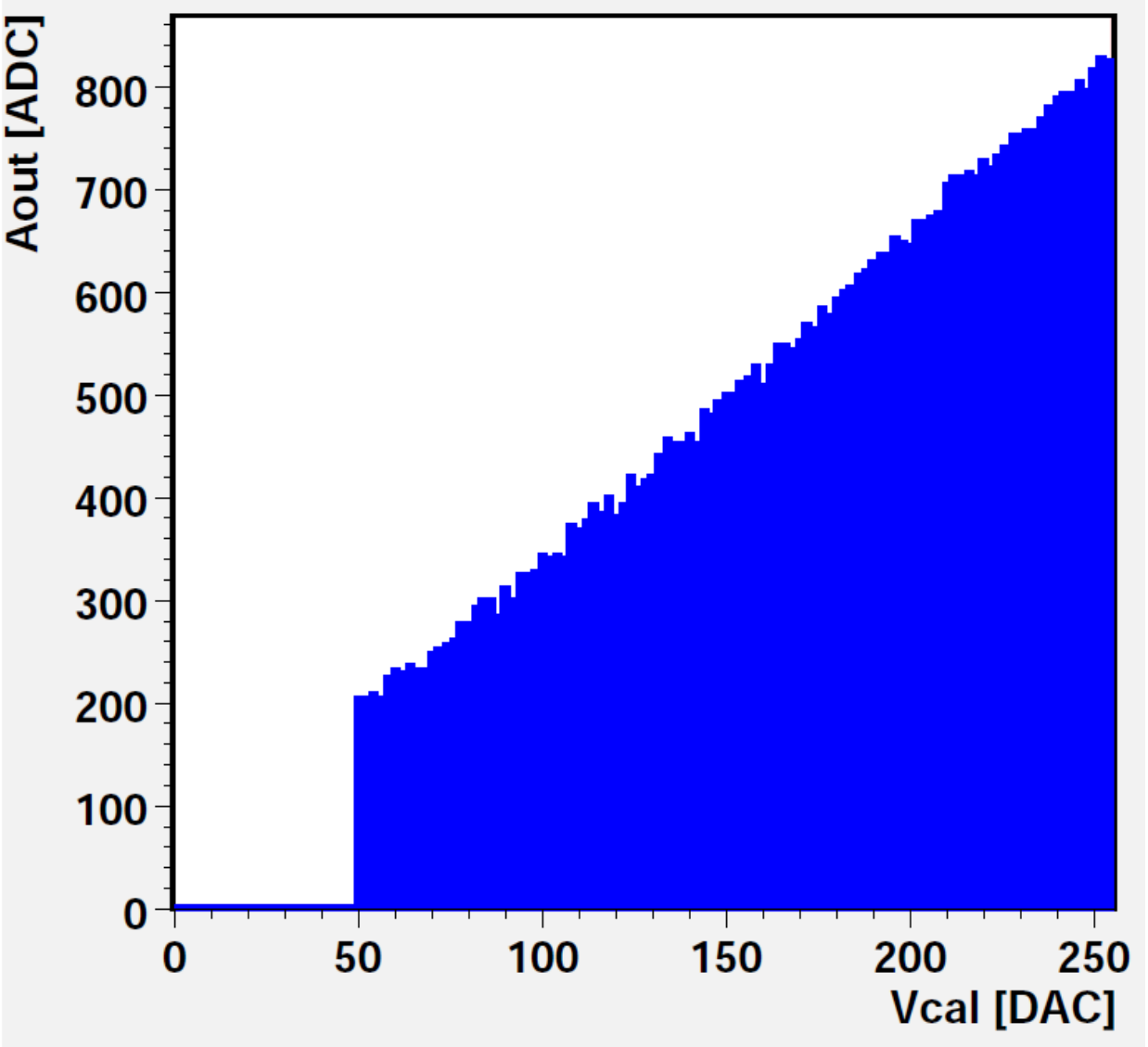
adjustable by programmable DAC

psi46 DACs

1	Vdig	6
2	Vana	150
3	Vsf	160
4	Vcomp	10
5	Vleak_comp	0
6	VrgPr	0
7	VwllPr	35
8	VrgSh	0
9	VwllSh	35
10	VhldDel	130
11	Vtrim	7
12	VthrComp	124
253	CtrlReg	0
254	WBC	20

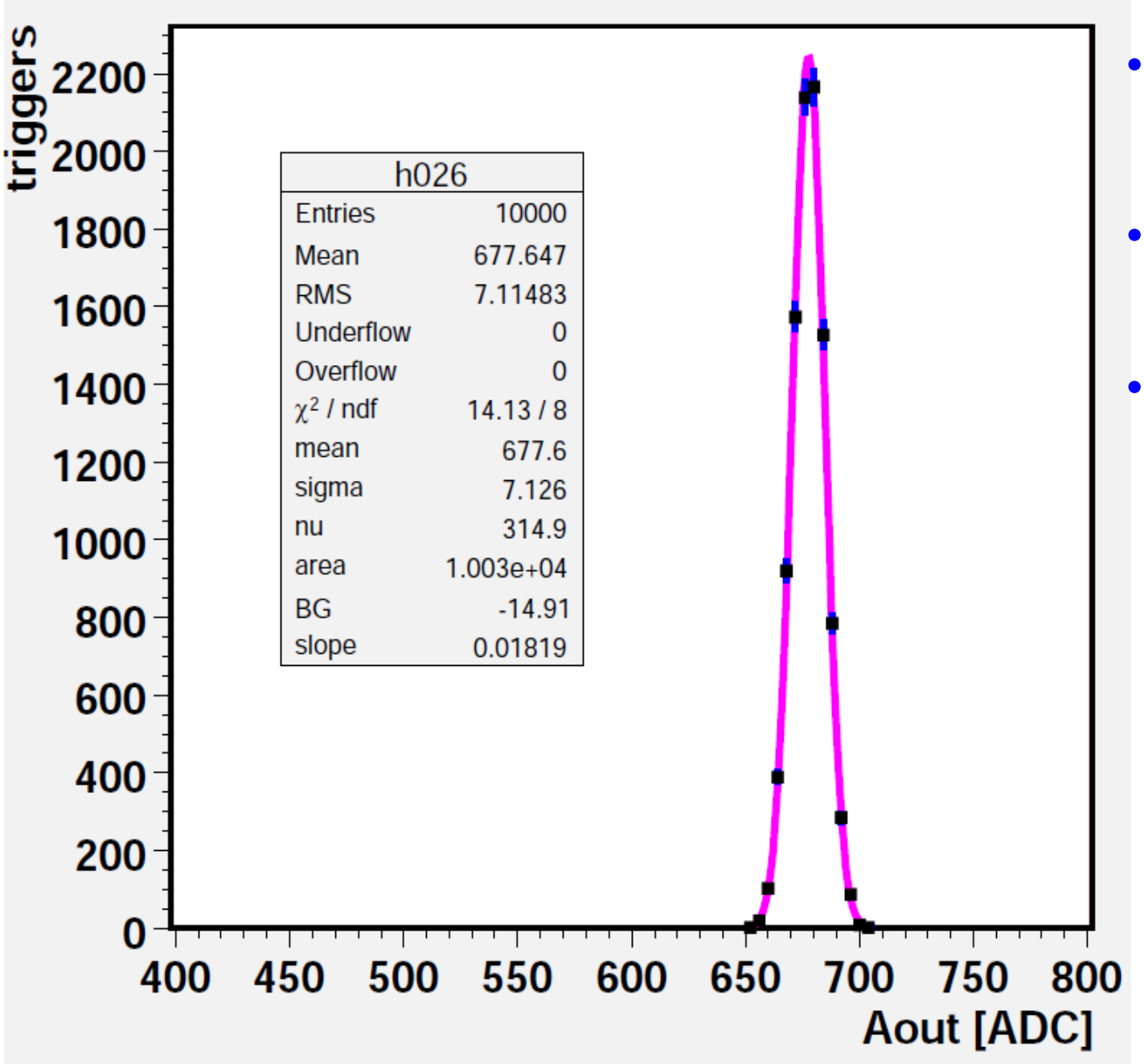
13	VIBias_Bus	30
14	Vbias_sf	10
15	VoffsetOp	55
16	VIbiasOp	115
17	VOffsetR0	120
18	VIon	115
19	VIbias_PH	130
20	Ibias_DAC	122
21	VIbias_roc	220
22	VIColOr	100
23	Vnpix	0
24	VSumCol	0
25	Vcal	200
26	CalDel	125
27	RangeTemp	0

pulse height vs test pulse



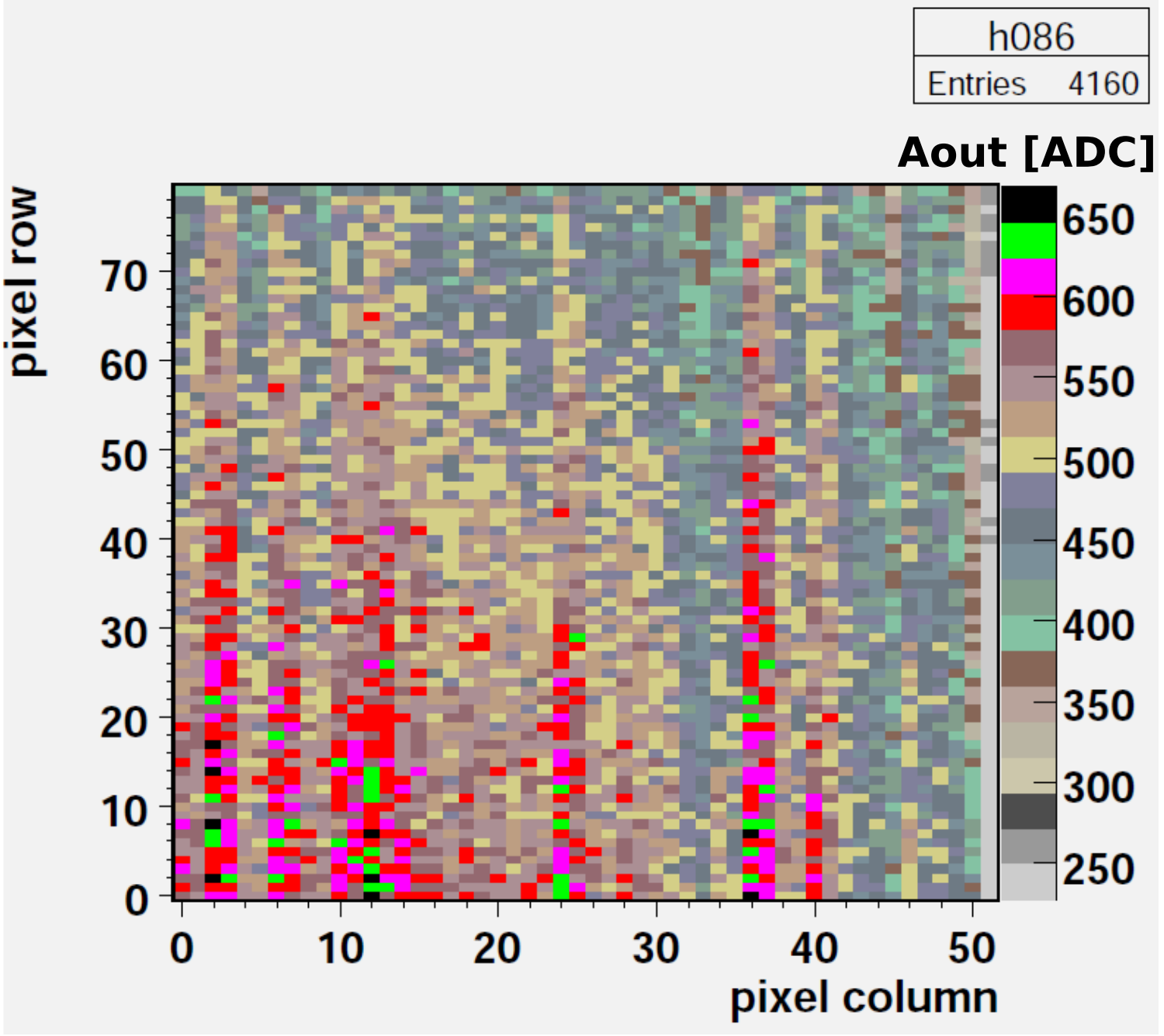
- One sample per point: some noise
- Below threshold for Vcal < 50:
  - can be varied with VthrComp.
- Roughly linear Aout vs Vcal.
- Need X-ray source for gain calibration…

one pixel with test pulse



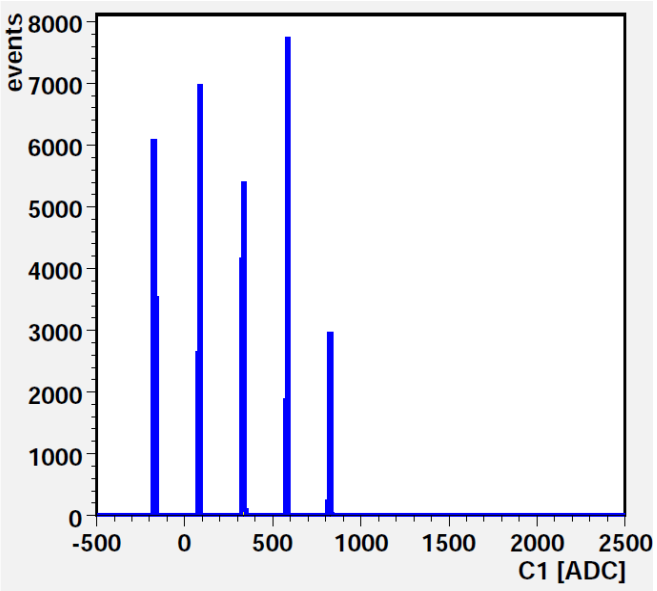
- 10k triggers:
  - at 100 Hz = 100 s.
- Calibrate 200 small DAC = 13'000 e (PSI).
- Width = 7 ADC counts:
  - thermal noise,
  - perfect Gaussian,
  - 135 e (no sensor).

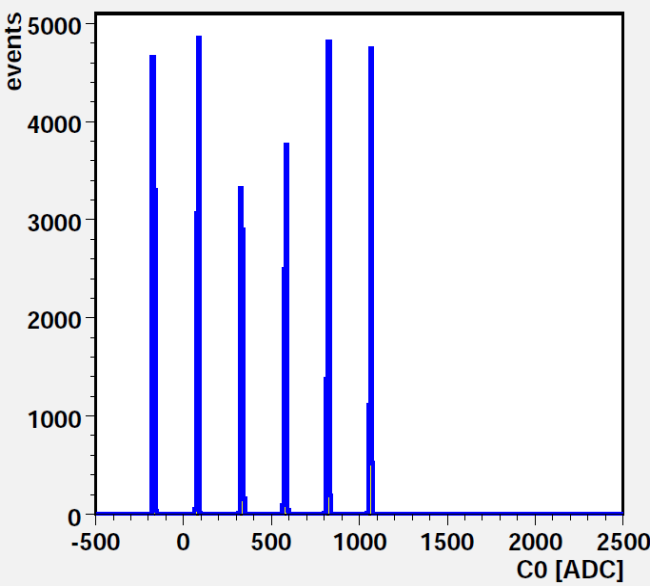
Pixel map



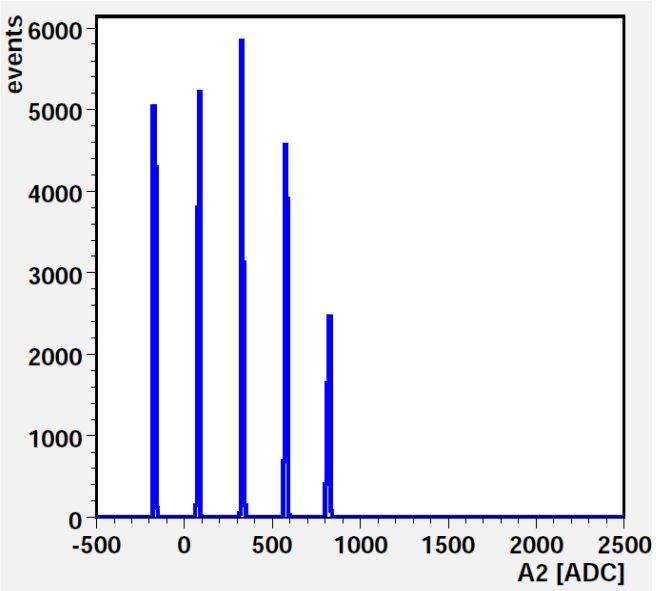
- 52 × 80 = 4160 pixel per chip.
- Vcal = 200 DAC
- VthrComp = 80
- Strong pulse height variation:
  - gain?
  - timing?

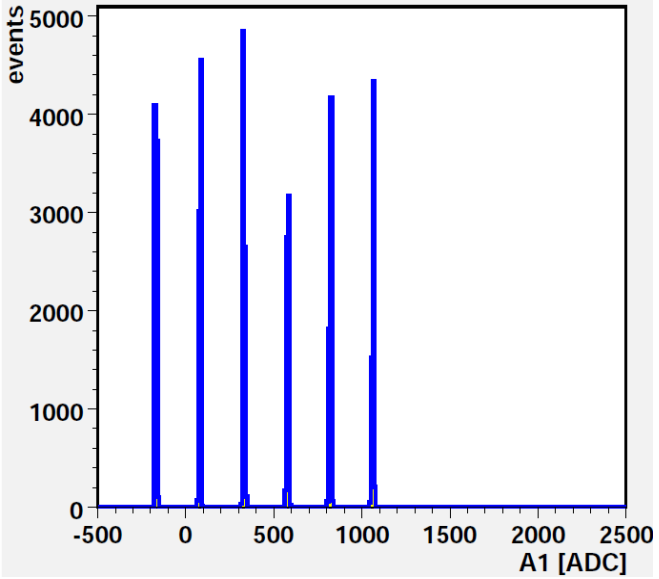
Pixel address

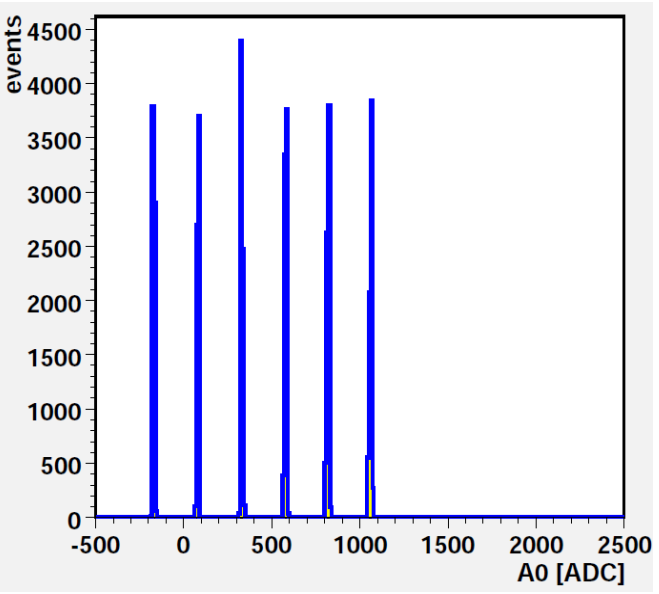




Pixel address in 5 data:
C1,C0 d-columns 0..25
A2, A1, A0 rows 0..159
each with 6 analog levels (2.5 bit).
All well separated.







Summary

- Pixel test board has been taken into operation under Linux
  - seems to work well with 64 bit Ubuntu.
- Single psi46 readout chip tested (without sensor):
  - Registers and DACs can be programmed,
  - analog readout works, with ADC on the test board.
- Lots of things to be explored and tested:
  - timing, threshold trimming, ranges for DAC settings...
- Later:
  - single chip with sensor
  - test bump bonding
  - X-ray source
  - -20ºC
  - test beam