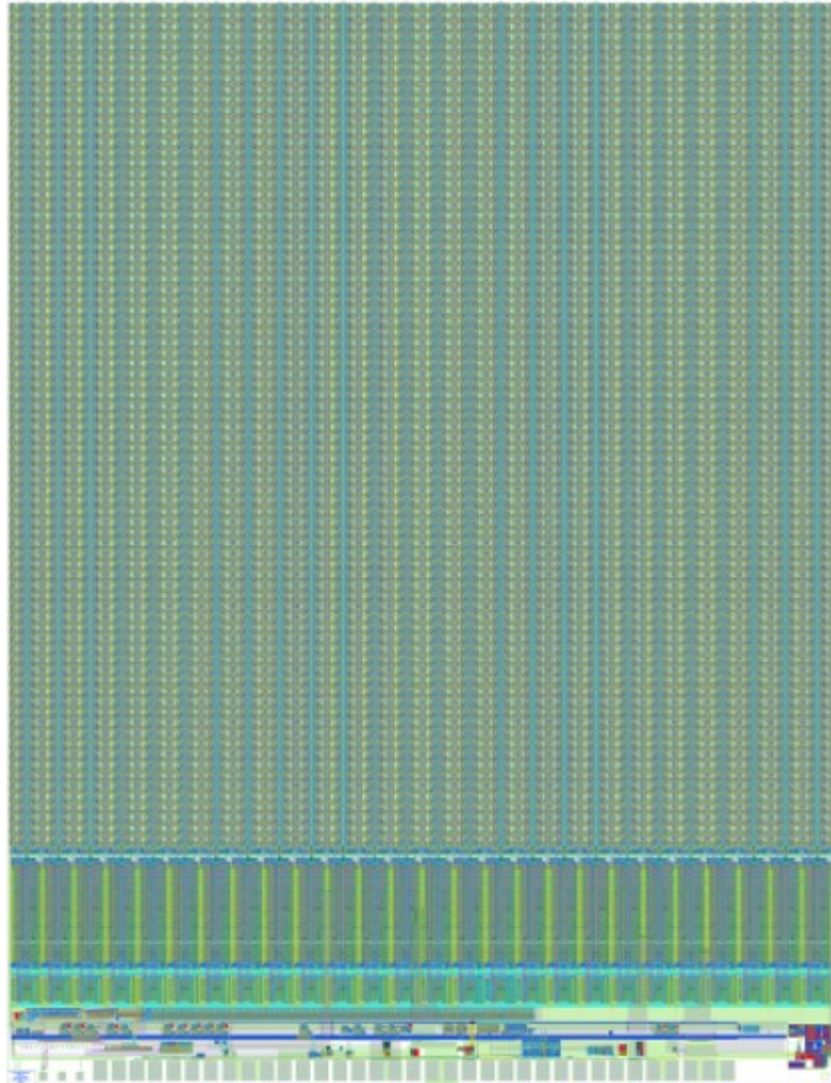


Irradiated digital ROCs

Ganna Dolinska, Ievgen Korol, Daniel Pitzl, DESY
3.5.2013

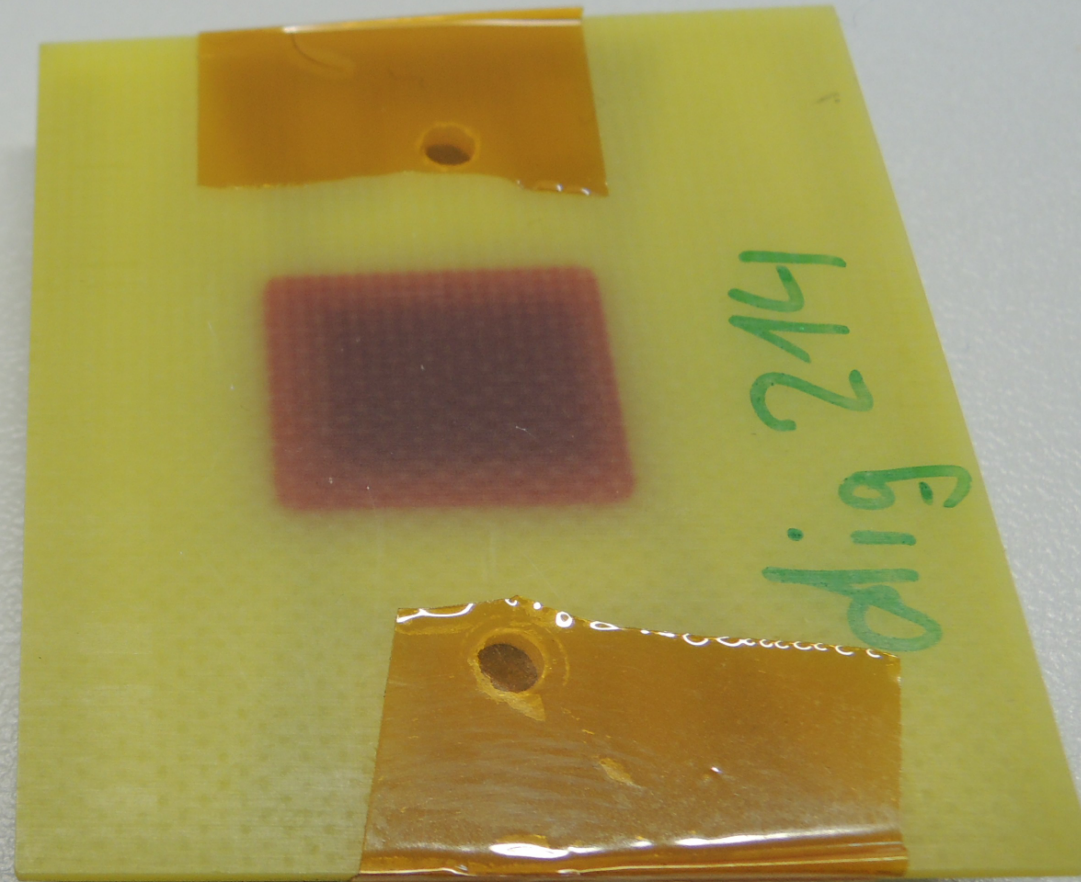
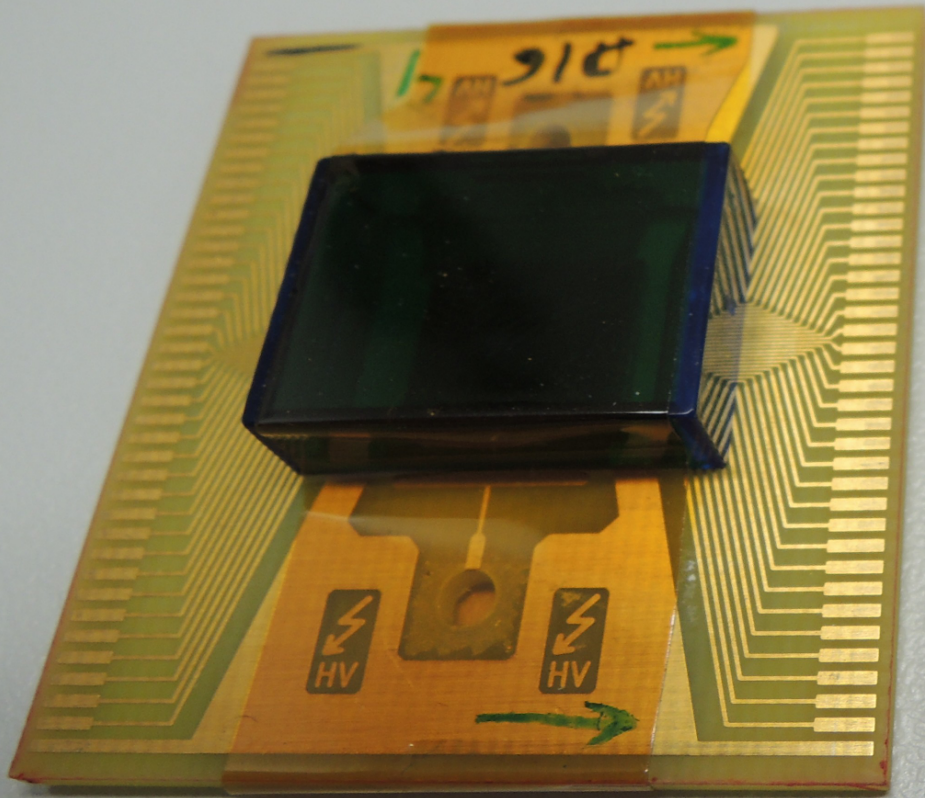


- KIT irradiation: 38 and 113 MRad
- Lab results:
 - S-curves
 - time walk
 - gain

ROCs irradiated at Karlsruhe p Zyklotron

204 dig: 37.5 MRad

214 digtrig: 113 MRad



Al mask opening visible on PCB

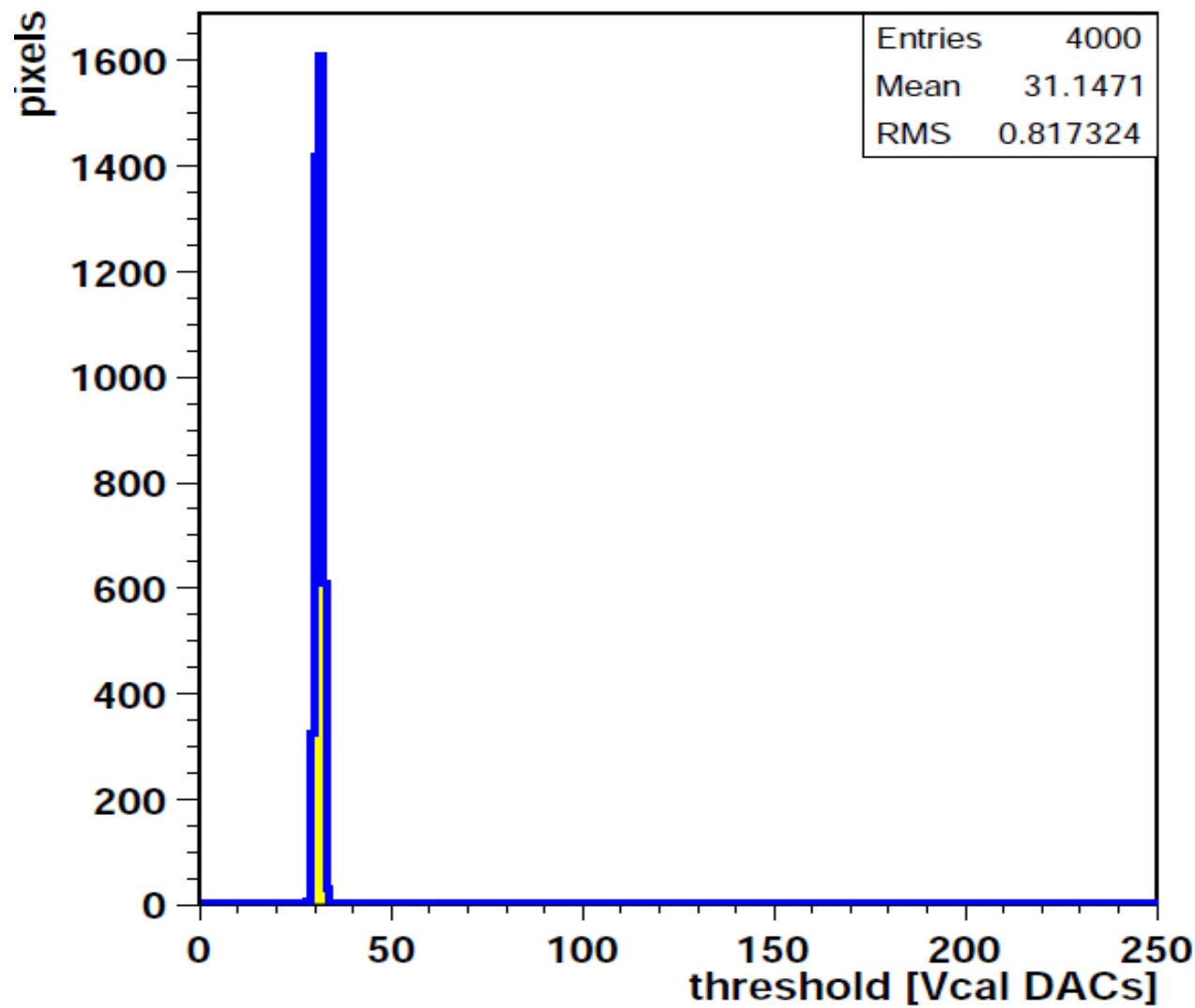
Chip214
psi46digtrig
(old comparator)

DAC parameters for chip 214

1	Vdig	9	14	Vbias_sf	8
2	Vana	138	15	VoffsetOp	48
3	Vsf	255	17	VOffsetR0	145
4	Vcomp	12	18	VIon	50
7	VwllPr	60	19	Vcomp_ADC	120
9	VwllSh	0	20	VIref_ADC	70
10	VhldDel	252	22	VIColOr	100
11	Vtrim	251	25	Vcal	199
12	VthrComp	165	26	CalDel	119
13	VIBias_Bus	20	253	CtrlReg	0
			254	WBC	101

Low thresholds after irradiation

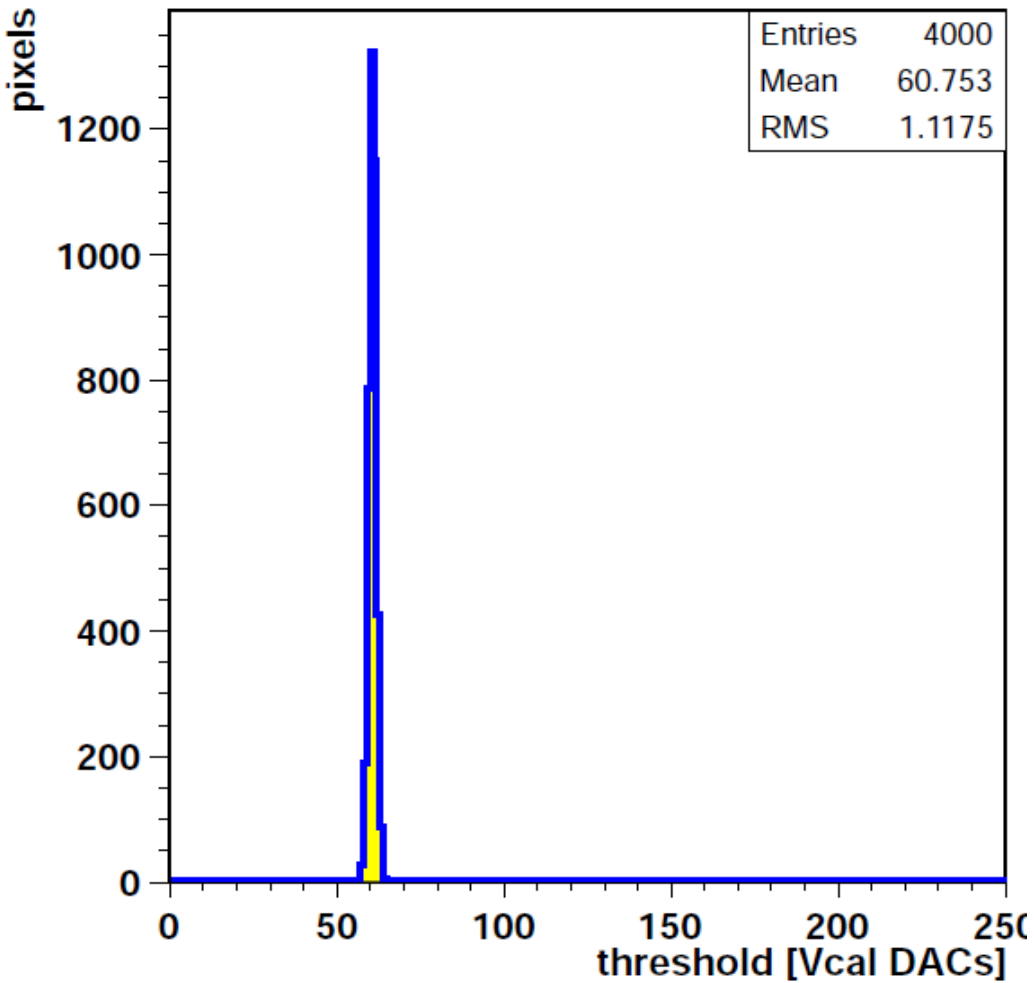
113 MRad



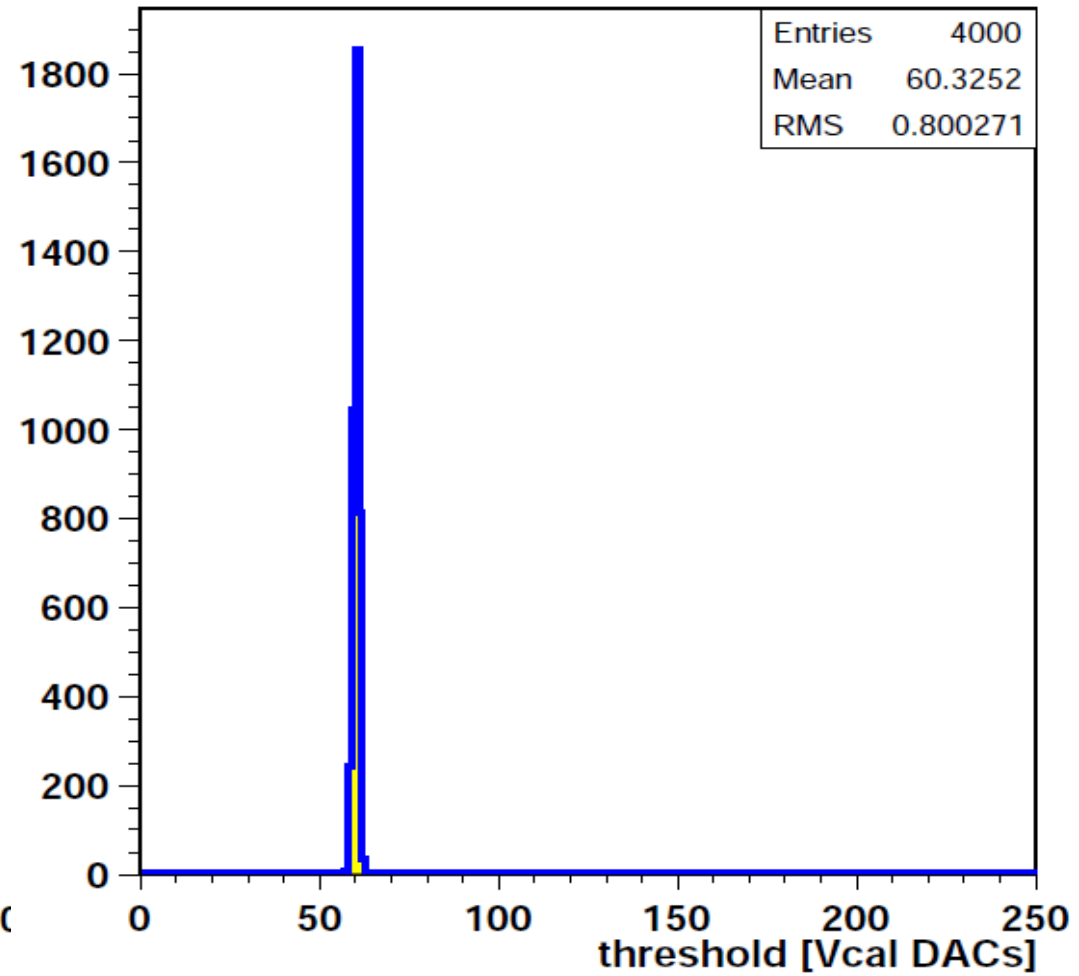
- **chip214:**
 - Ia 50 mA
 - standard trim procedure
 - **trim 30**
 - **narrow threshold distribution**

Threshold (trim 60), chip214

0 MRad

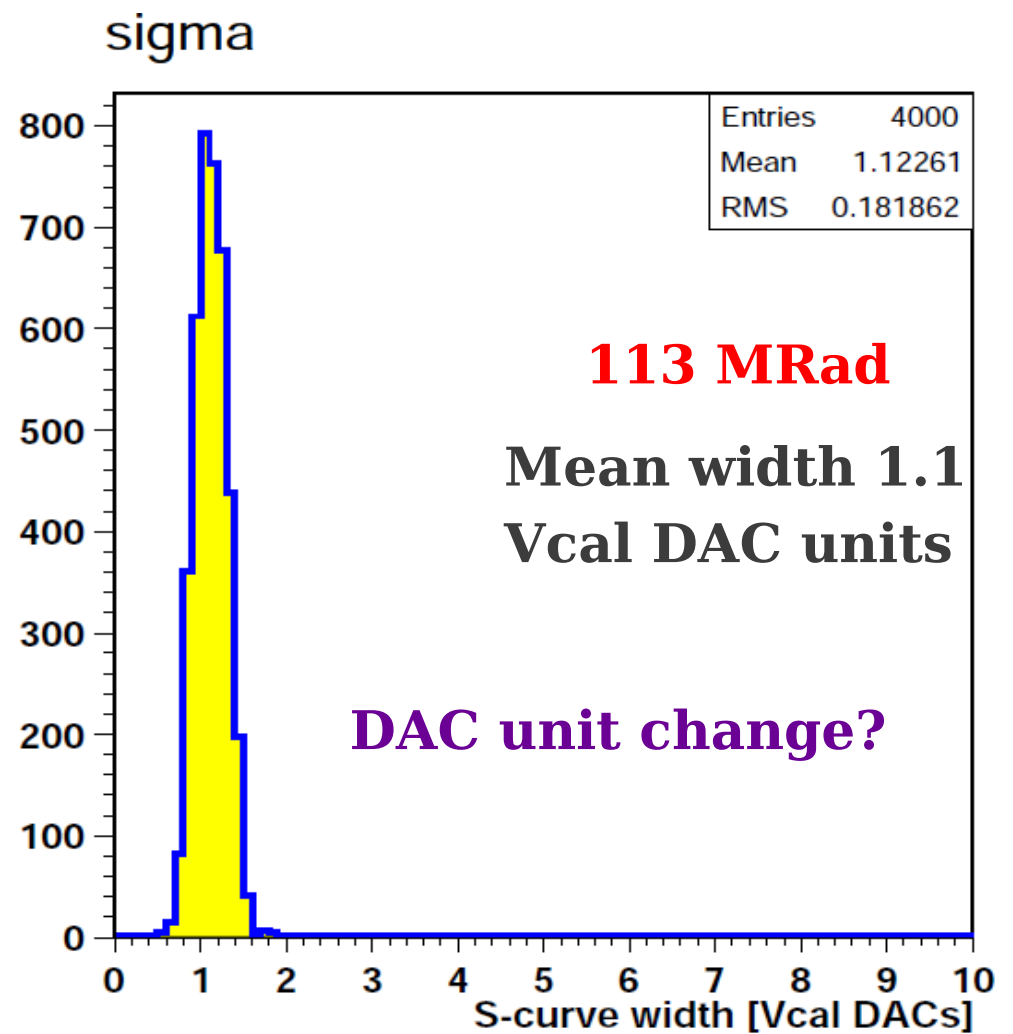
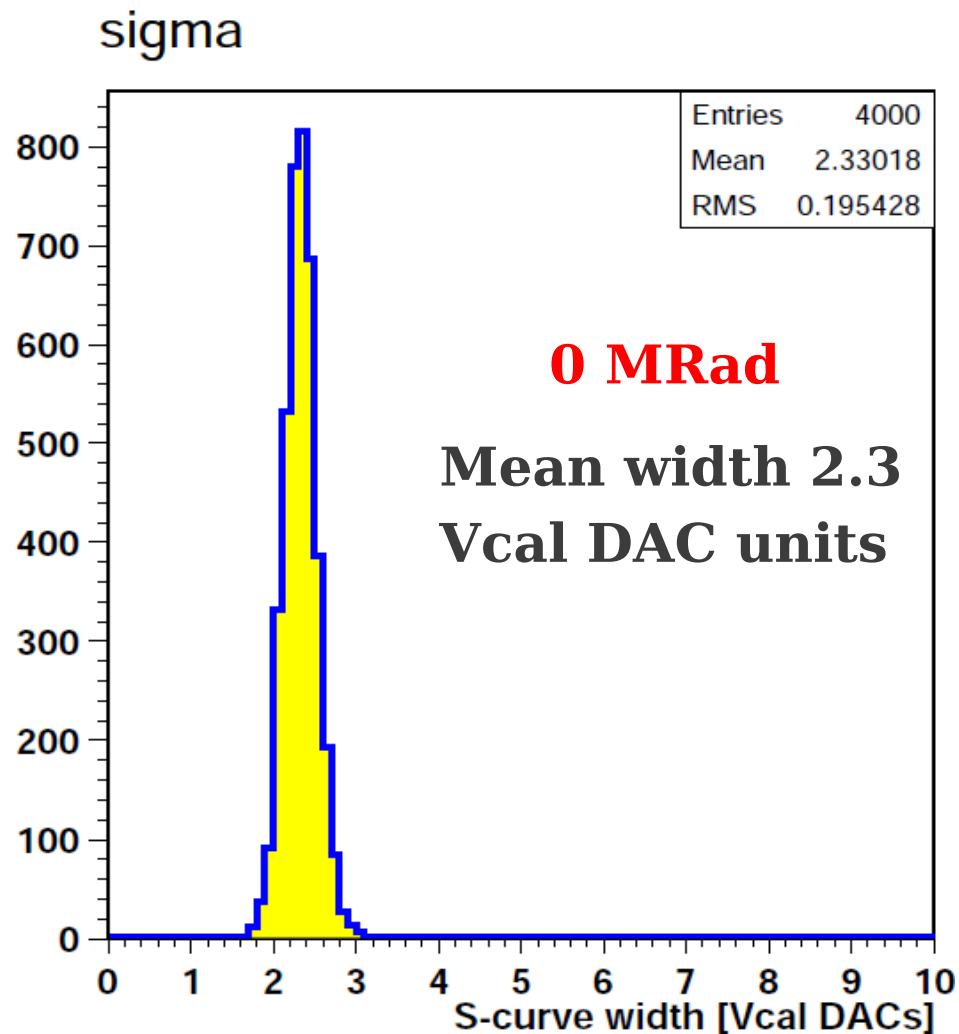


113 MRad



Ia = 50 mA

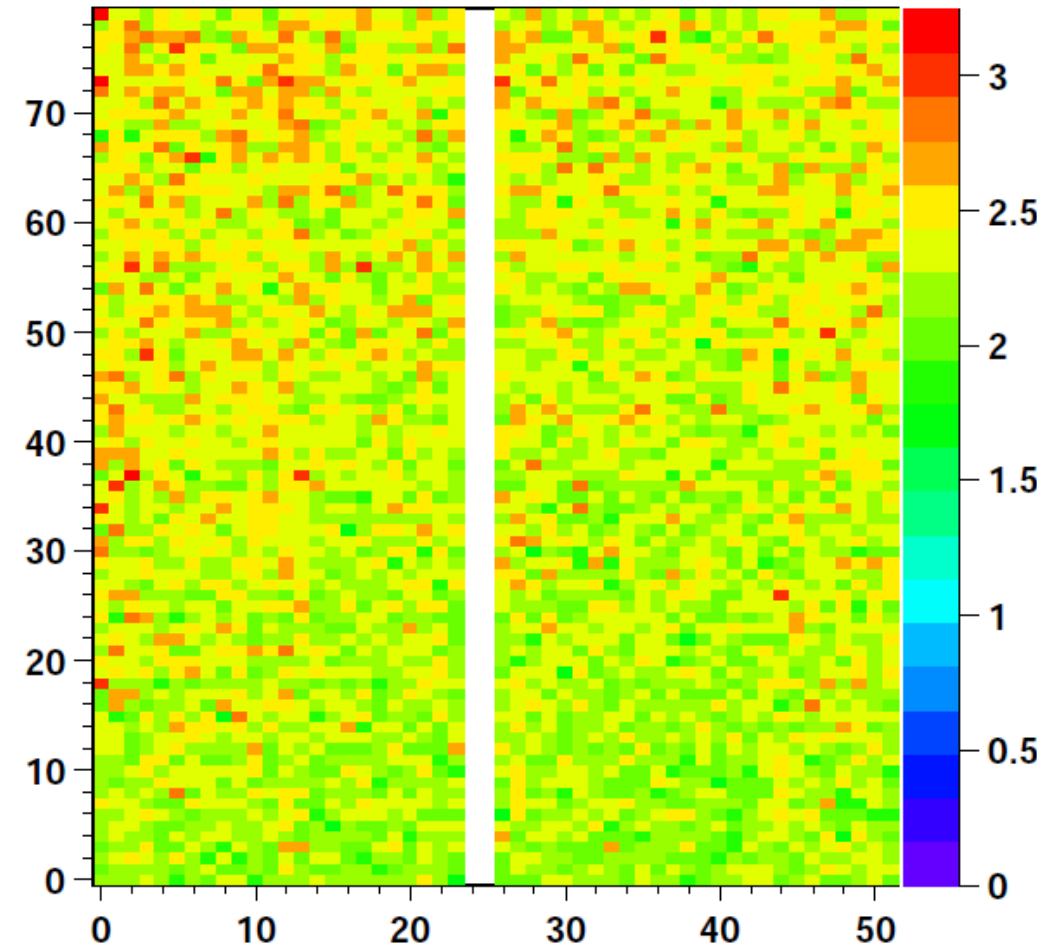
S-curve width, chip214



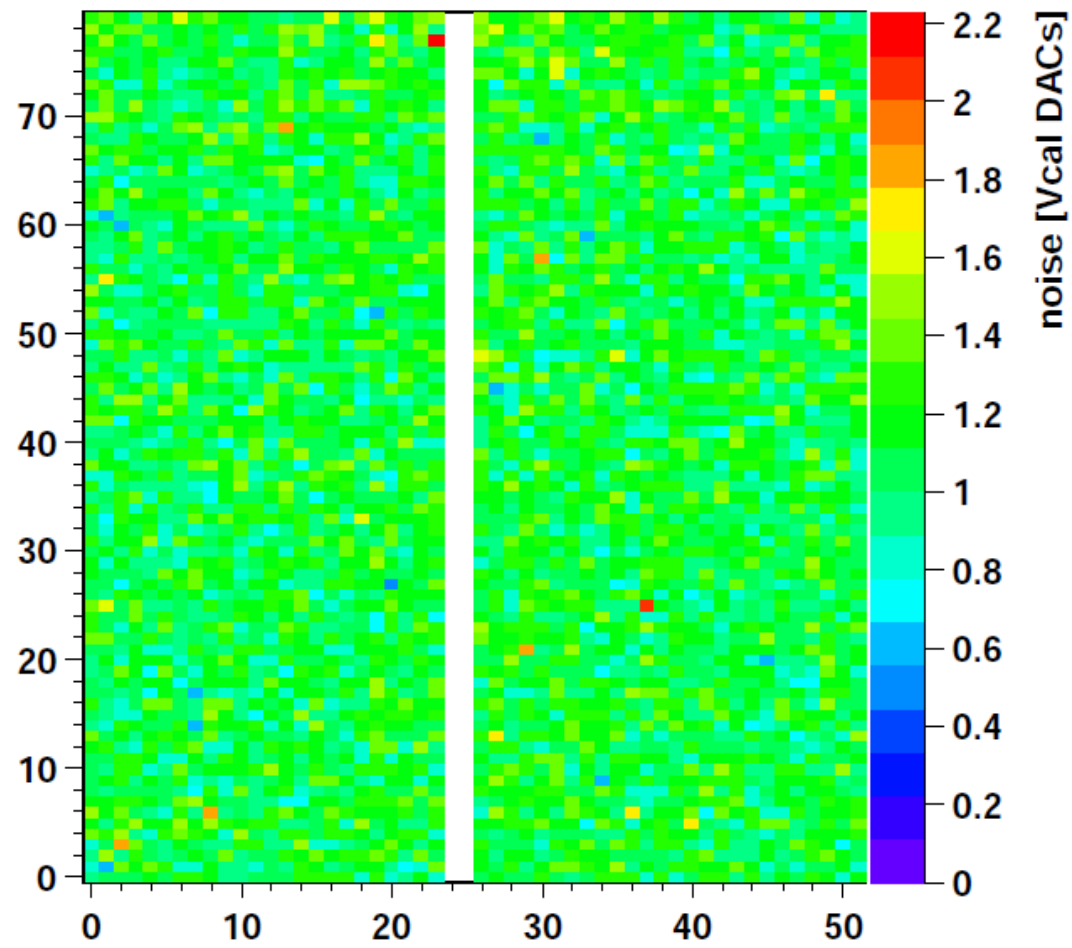
Ia = 50 mA

Noise map, chip214

0 MRad



113 MRad

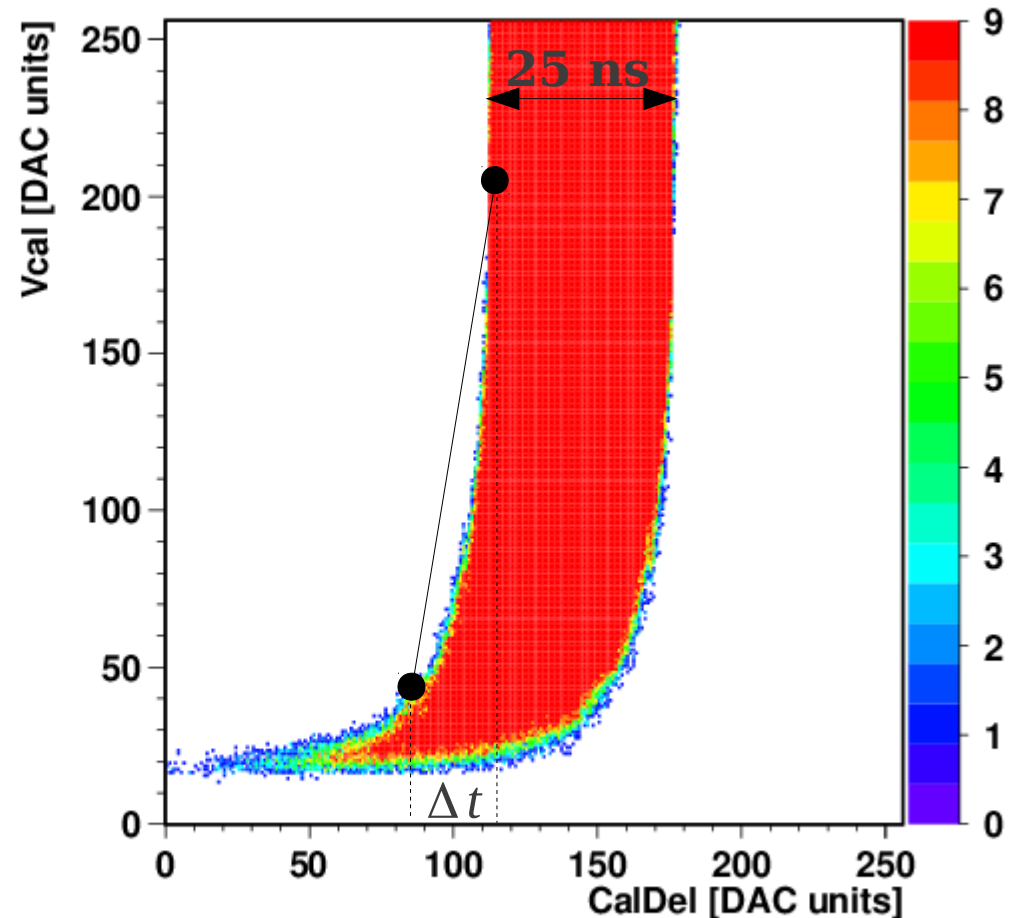


Ia = 50 mA

Timewalk plots, chip214

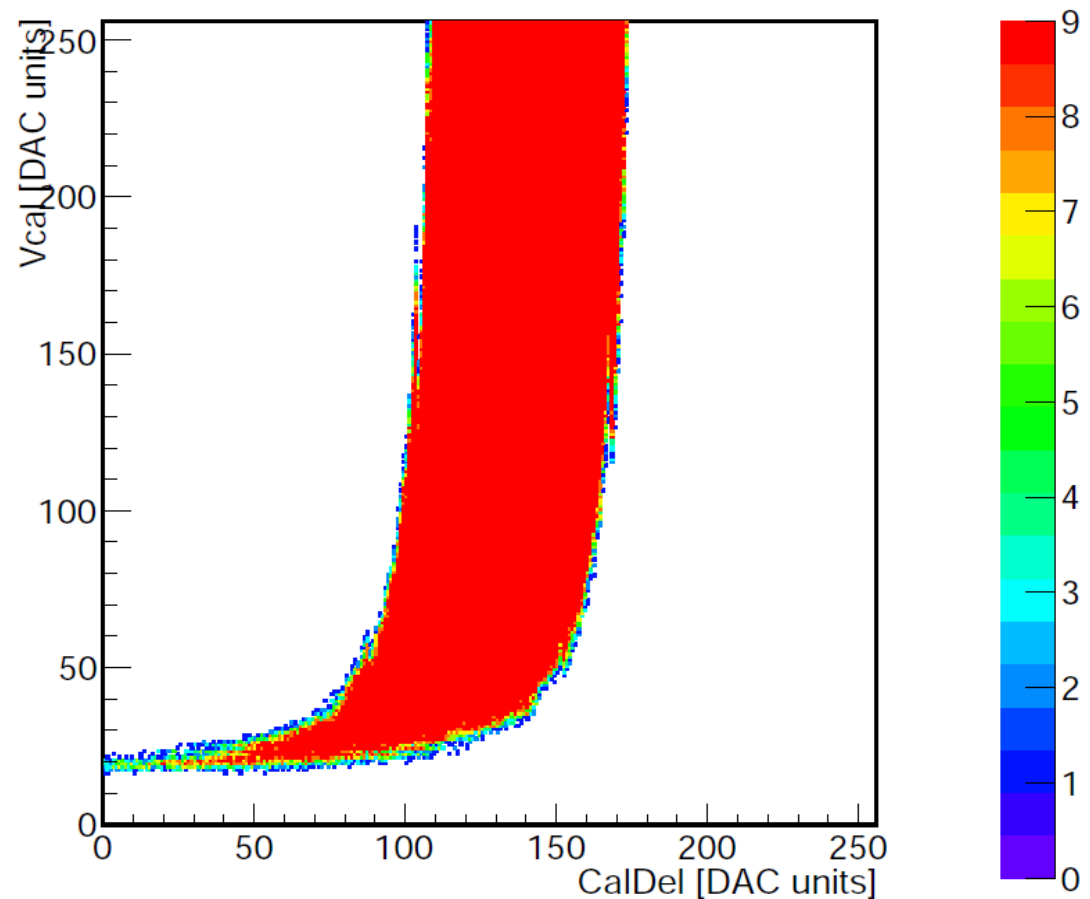
0 MRad

VcalCalDel_c22r22_C0



113 MRad

VcalCalDel_c22r22_C0



Mon Nov 5 14:31:17 2012

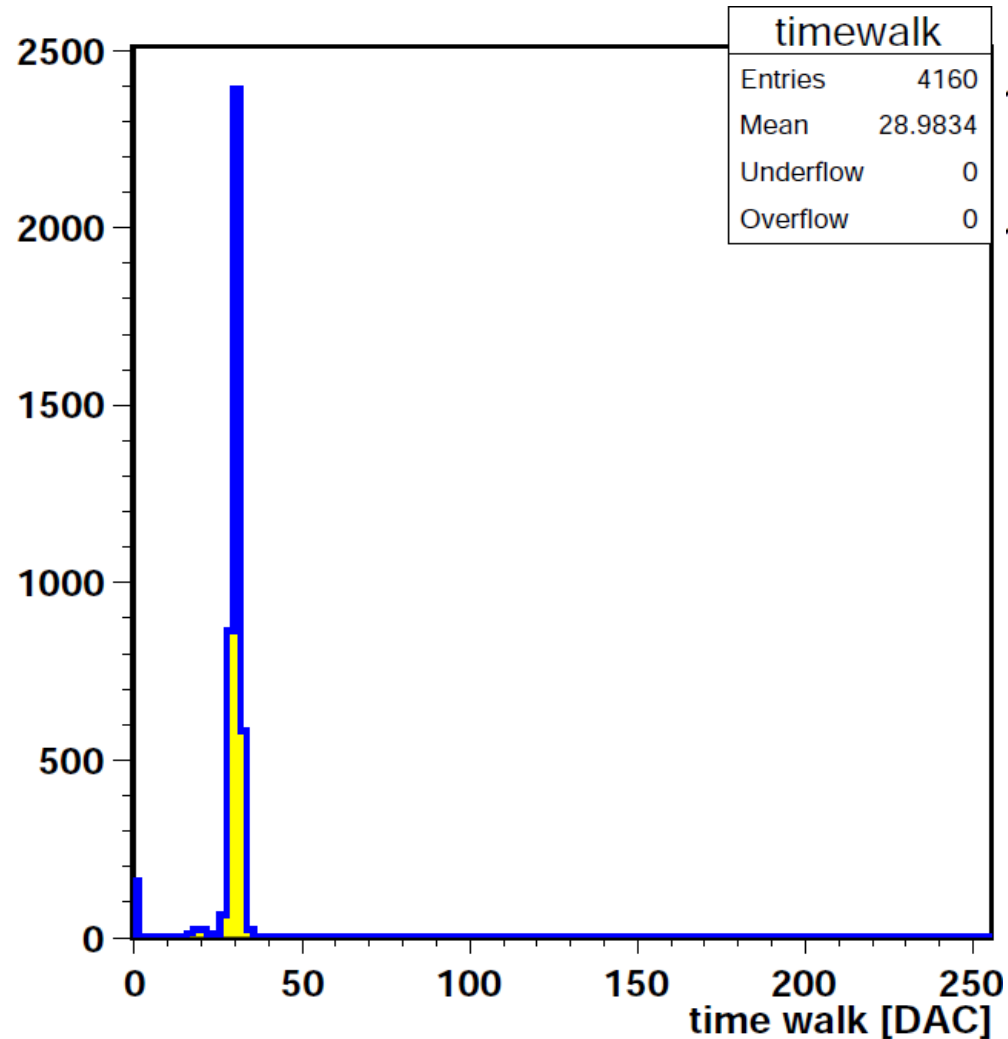
Time calibration: 60 DAC units = 25 ns

Our definition:

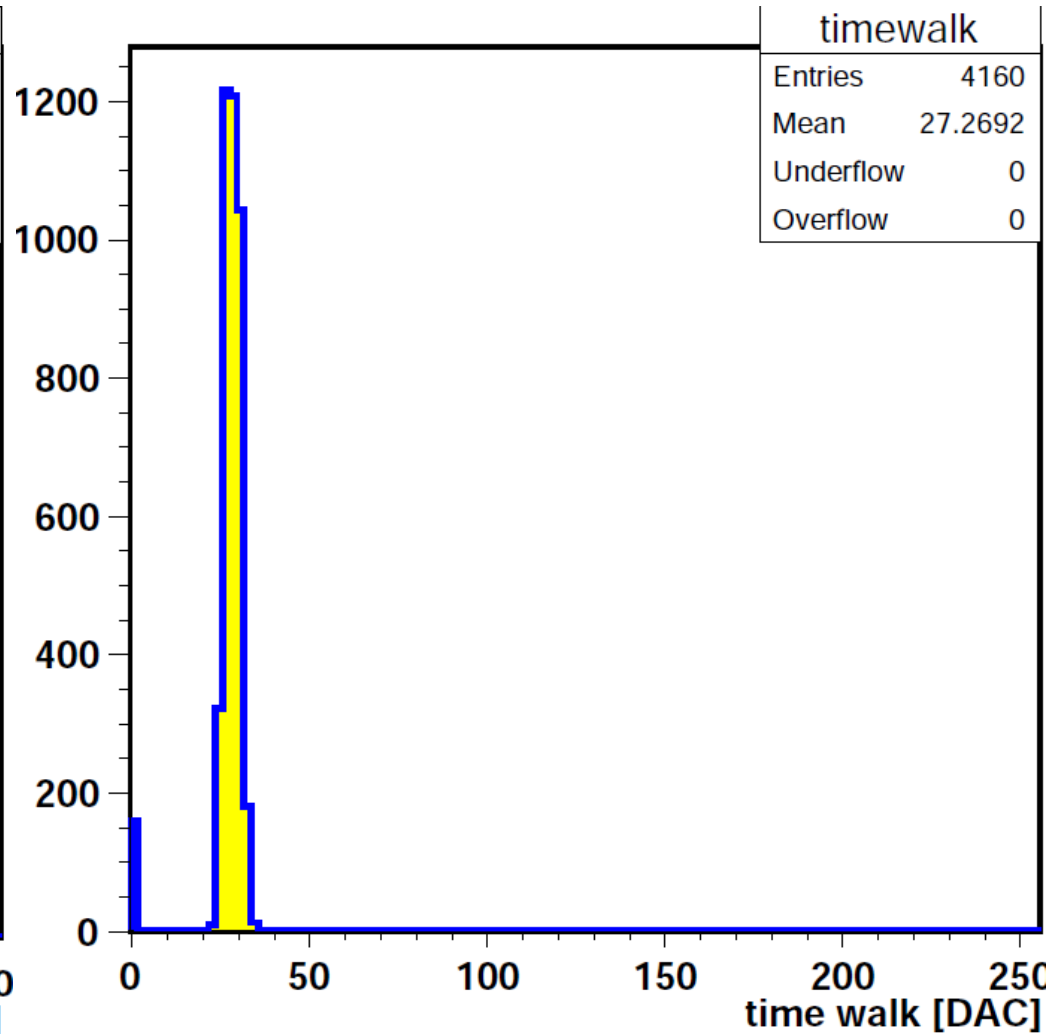
timewalk = left edge (Vcal 200) - left edge (Vcal 40)

Timewalk, chip214

0 MRad



113 MRad

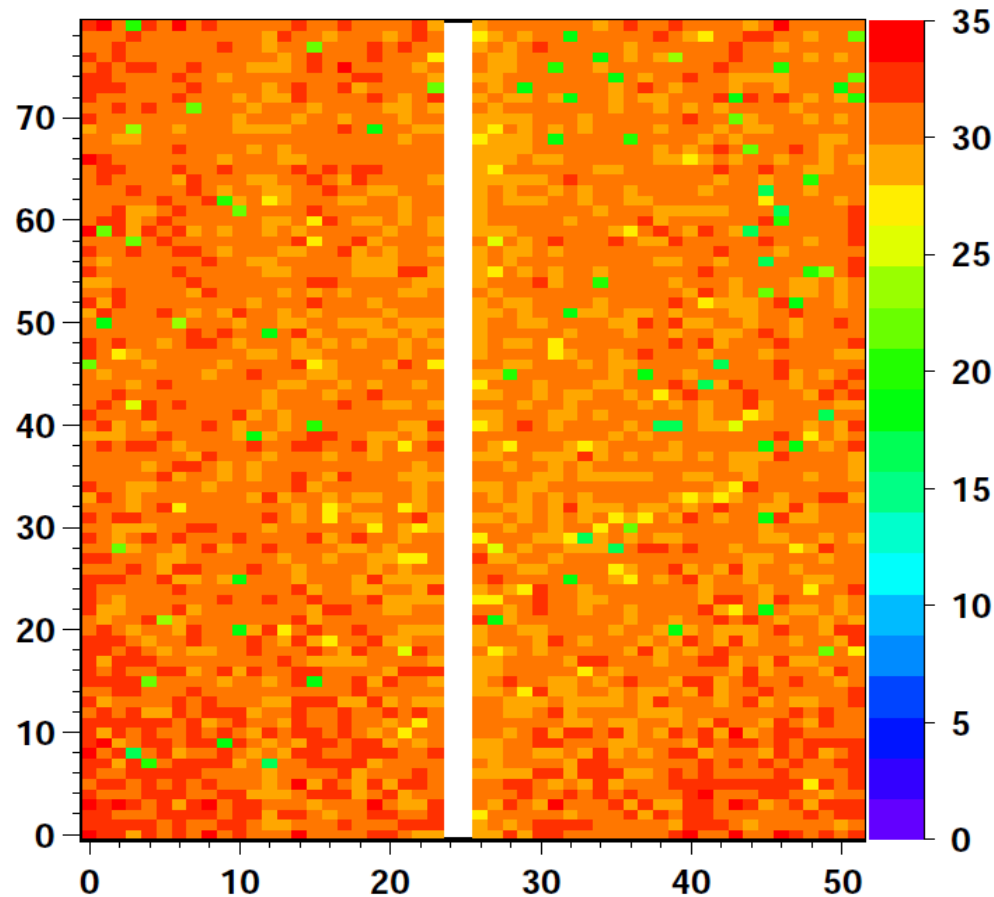


Ia = 50 mA

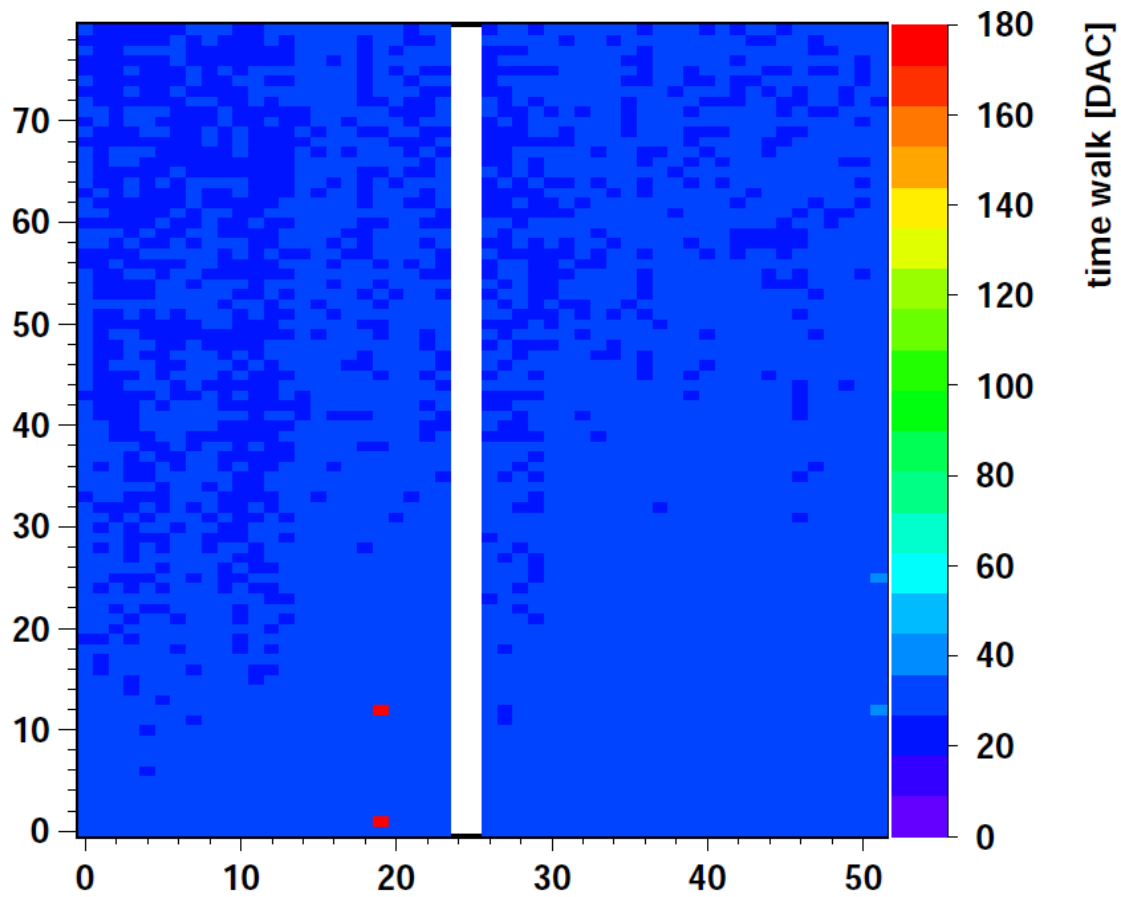
Timewalk less than 0.5 BC

Timewalk map, chip214

0 MRad

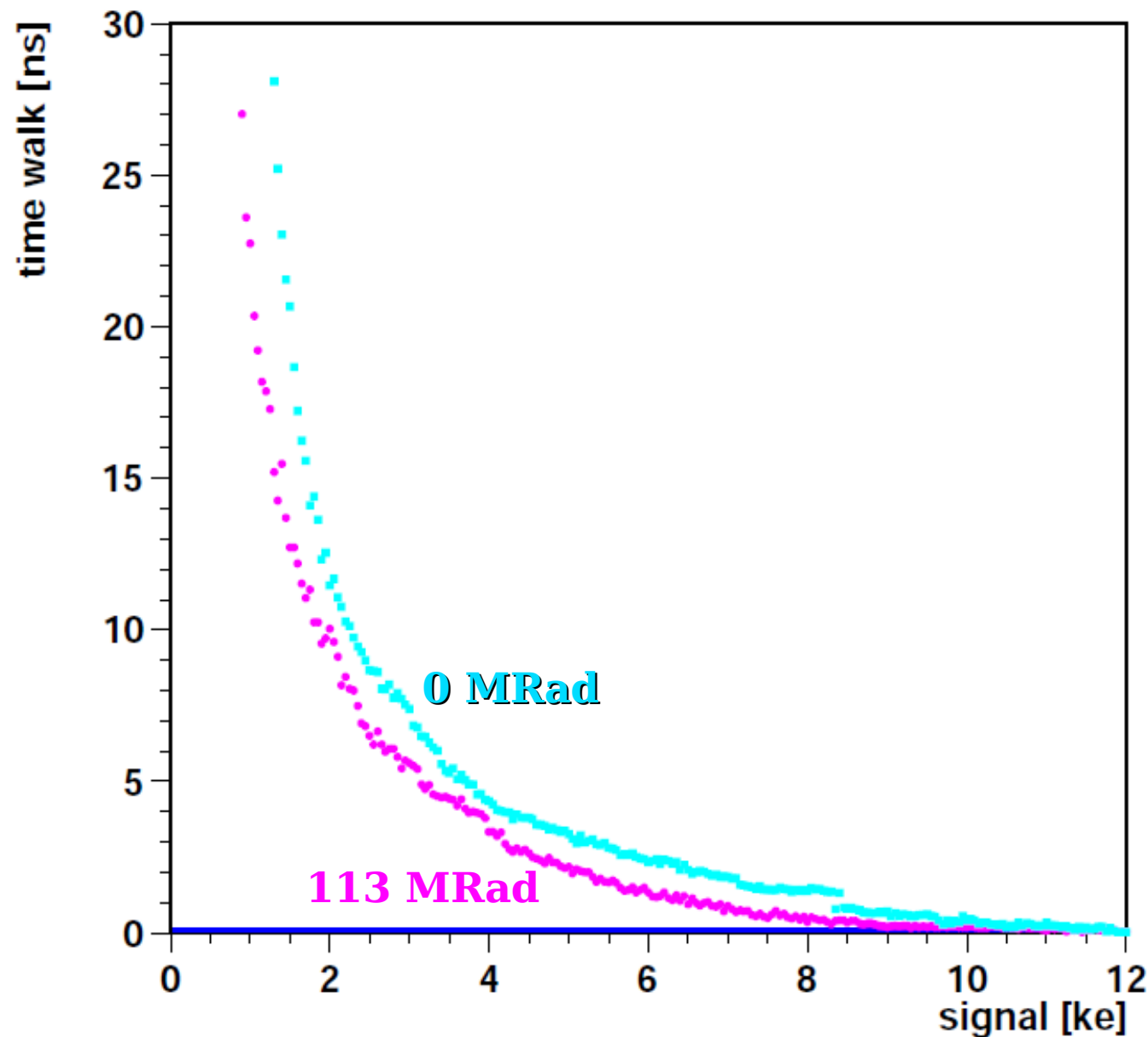


113 MRad



Ia = 50 mA

Compare timewalk



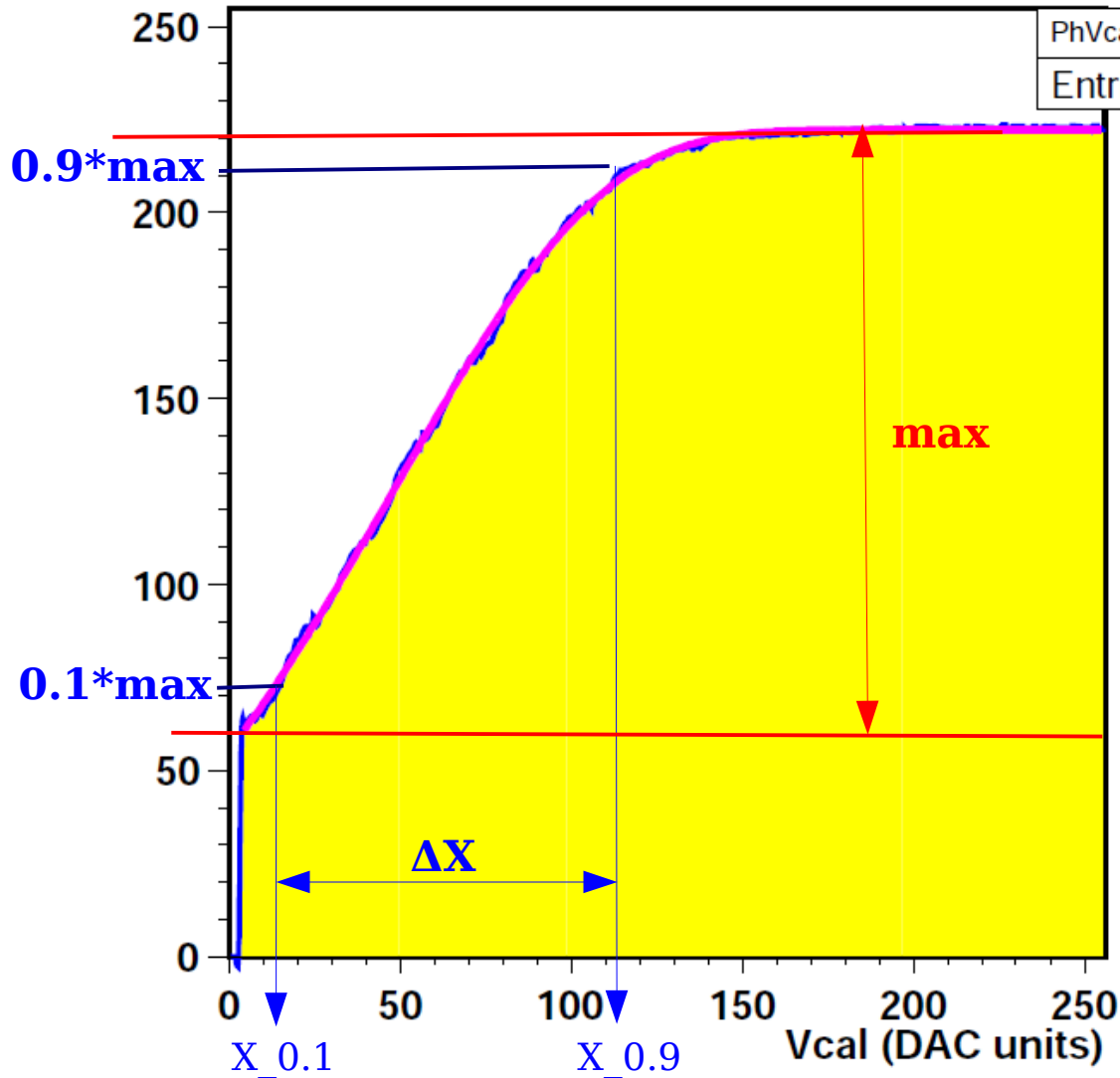
- **psi46digtrig chip 214**
- **no sensor**
- **113 MRad dose**
- **pixel (11, 23)**
- **trim 30**

- **psi46digtrig chip 214**
 - **no sensor**
 - **0 MRad dose**
 - **pixel (11, 23)**
 - **trim 30**

**Assume 50e per Vcal
DAC for signal**

Pulse height saturation

PhVcal_c00r06_C0



Measure PH vs Vcal

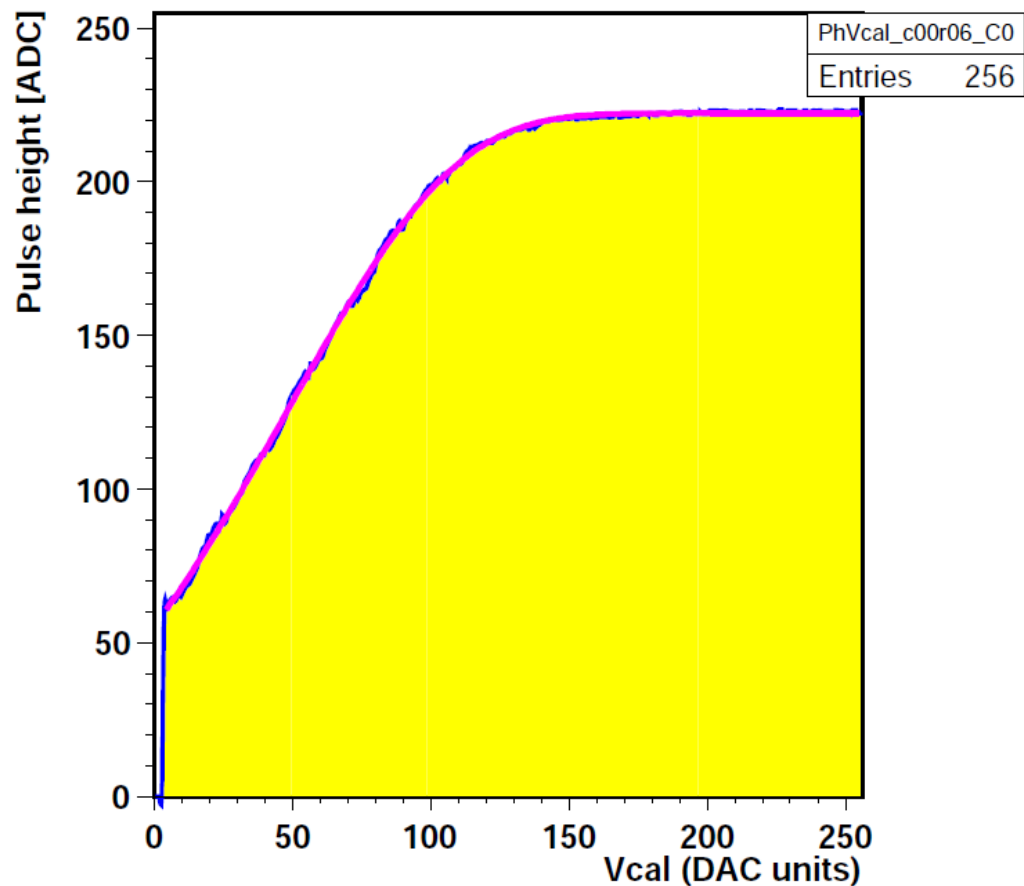
Fit - Weibull

10% to 90% range - ΔX

PhvsVcal before and after

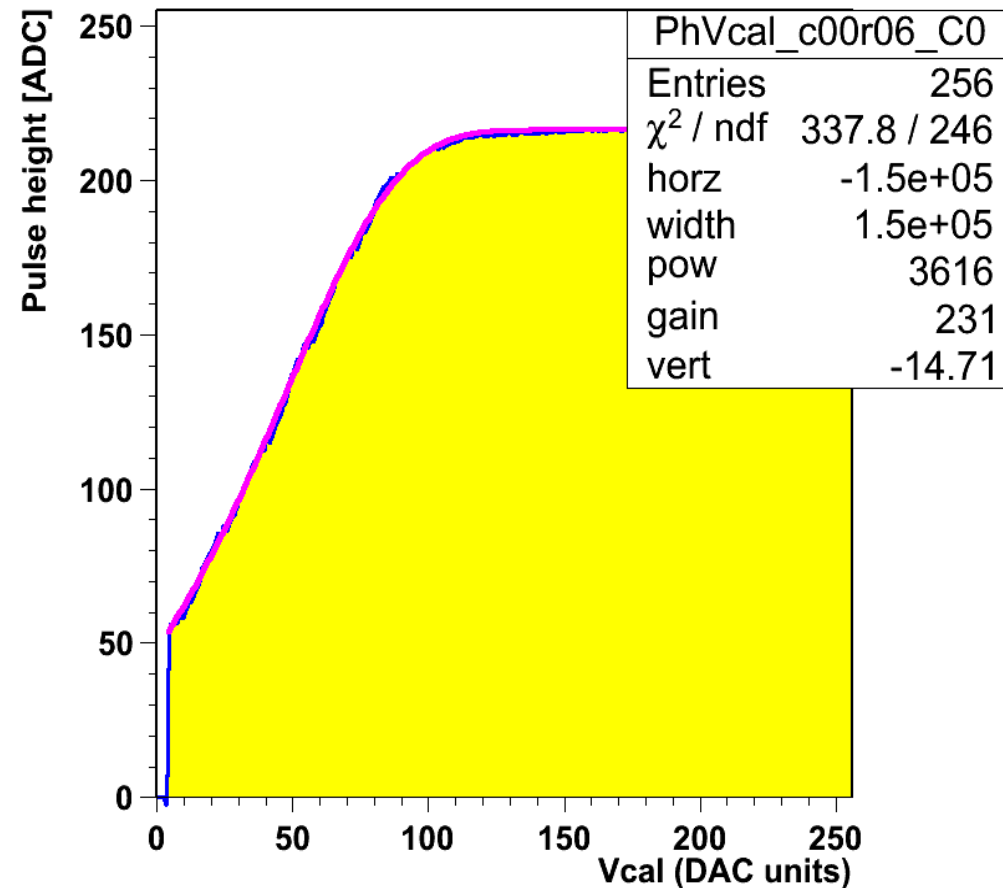
0 Mrad

PhVcal_c00r06_C0



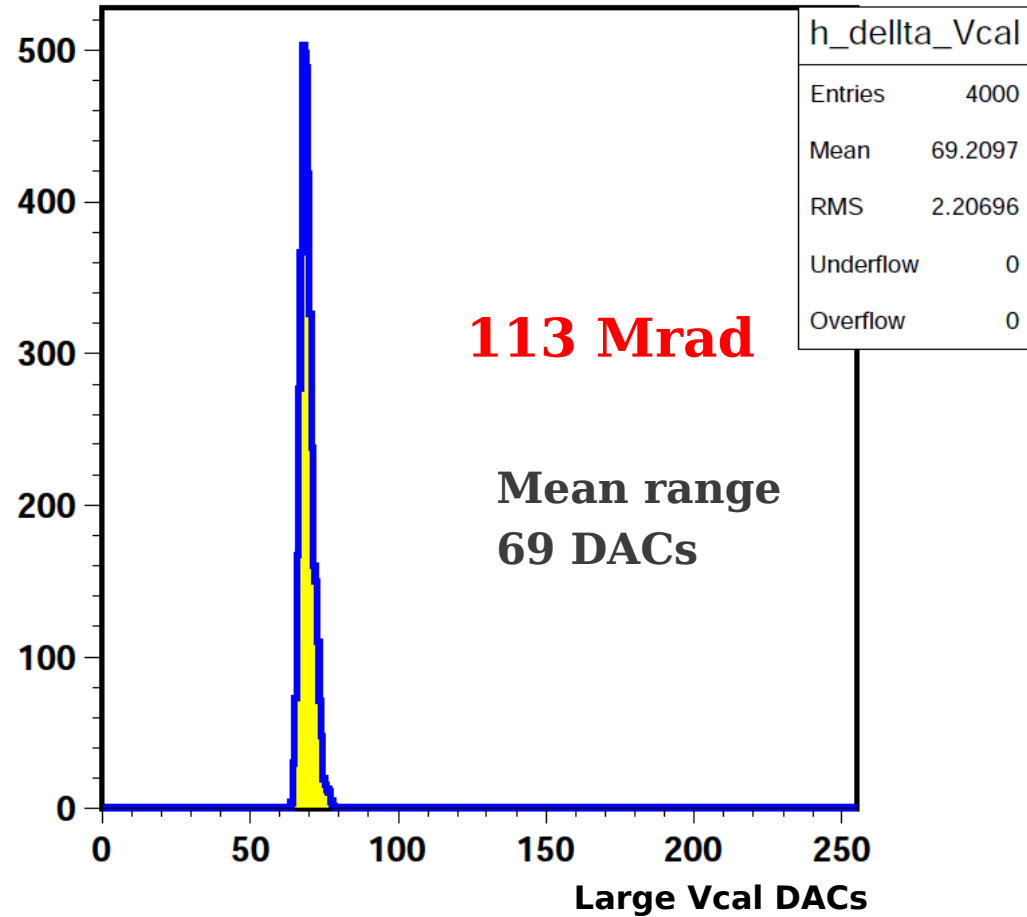
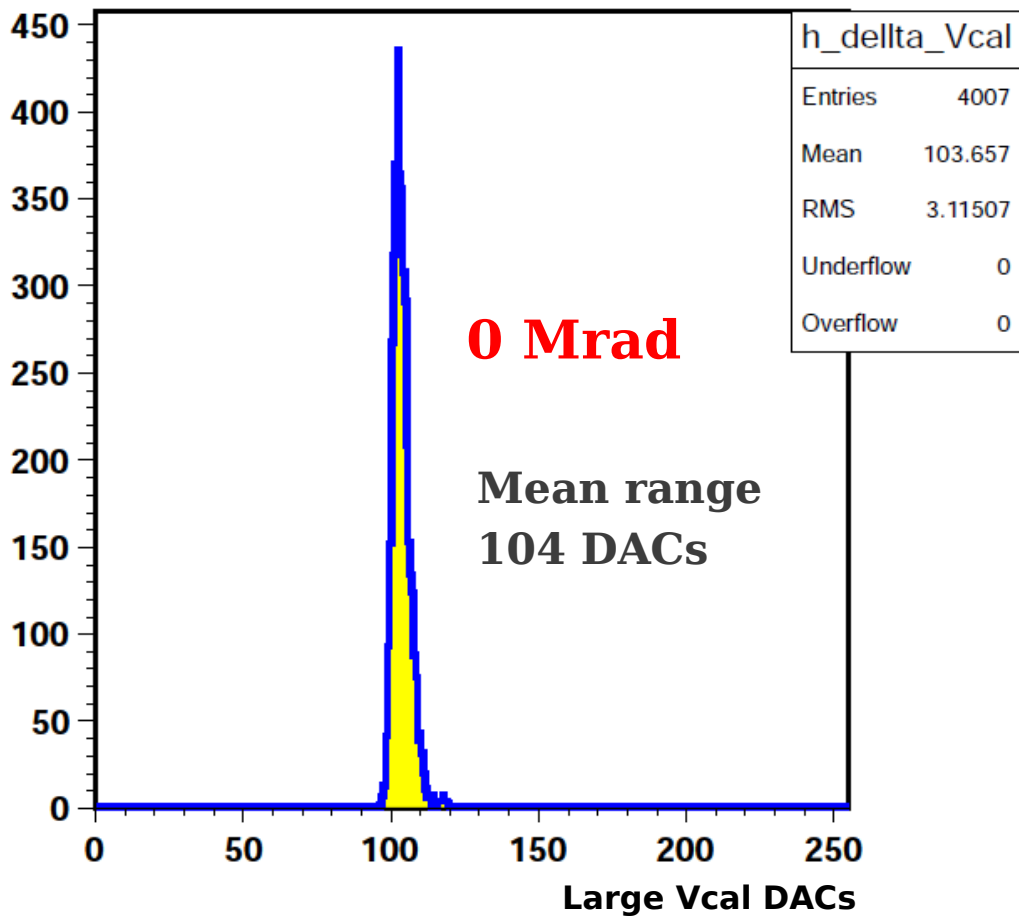
113 Mrad

PhVcal_c00r06_C0



Thu Apr 25 12:34:03 2013

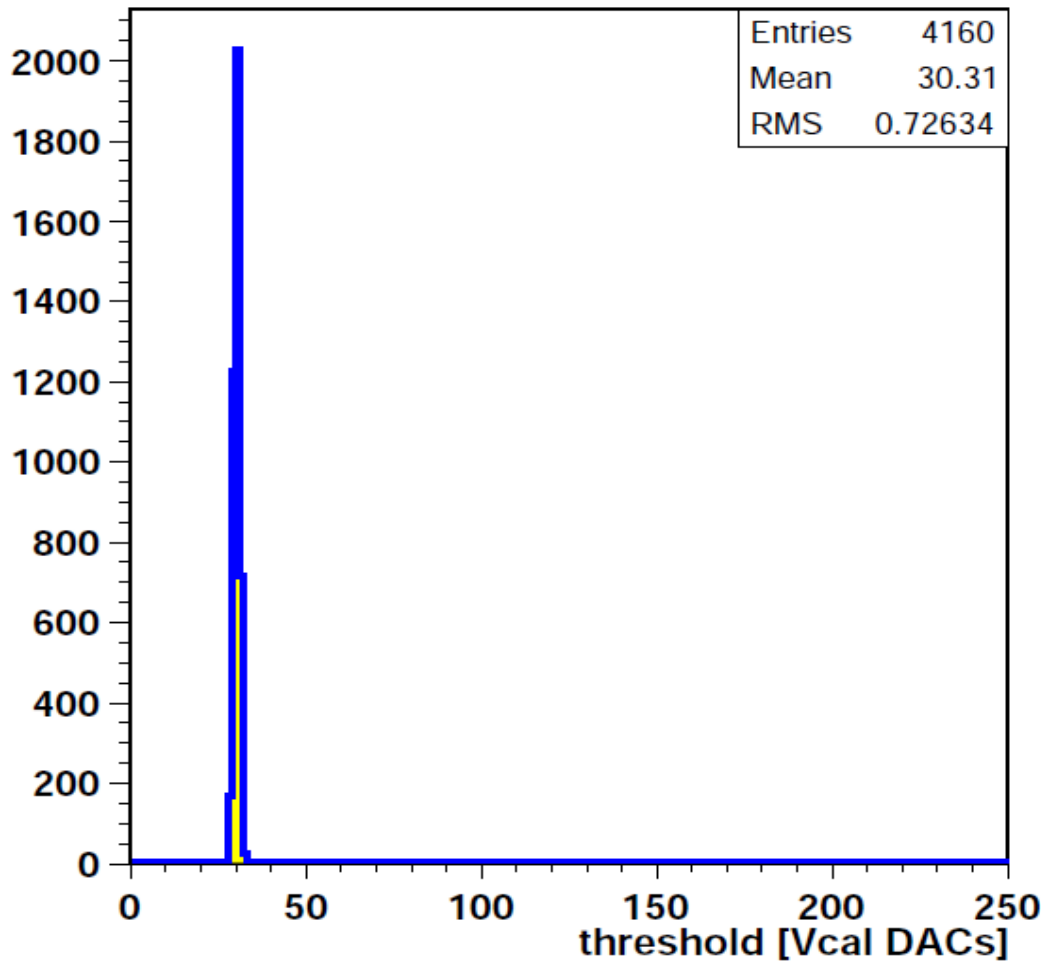
10% to 90% linear range, chip 214



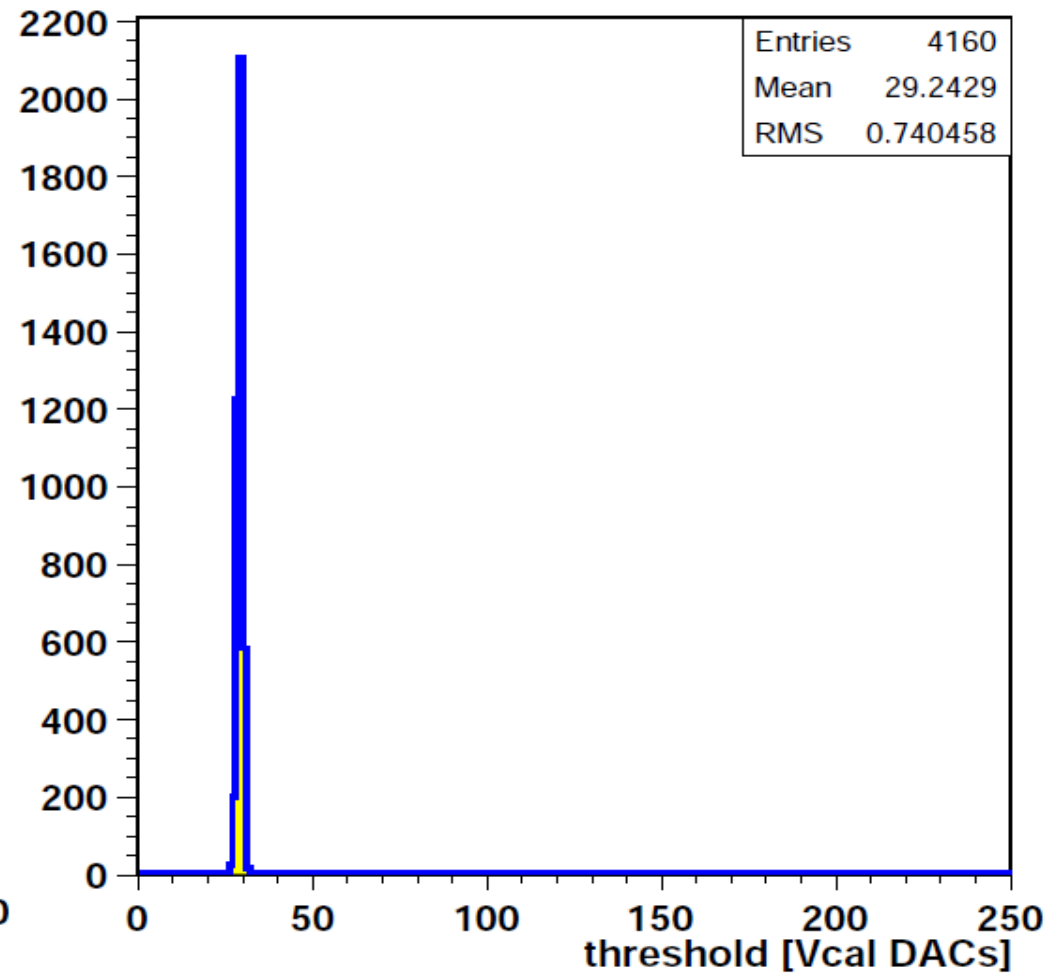
Chip204

Threshold (trim 30), chip204

0 MRad

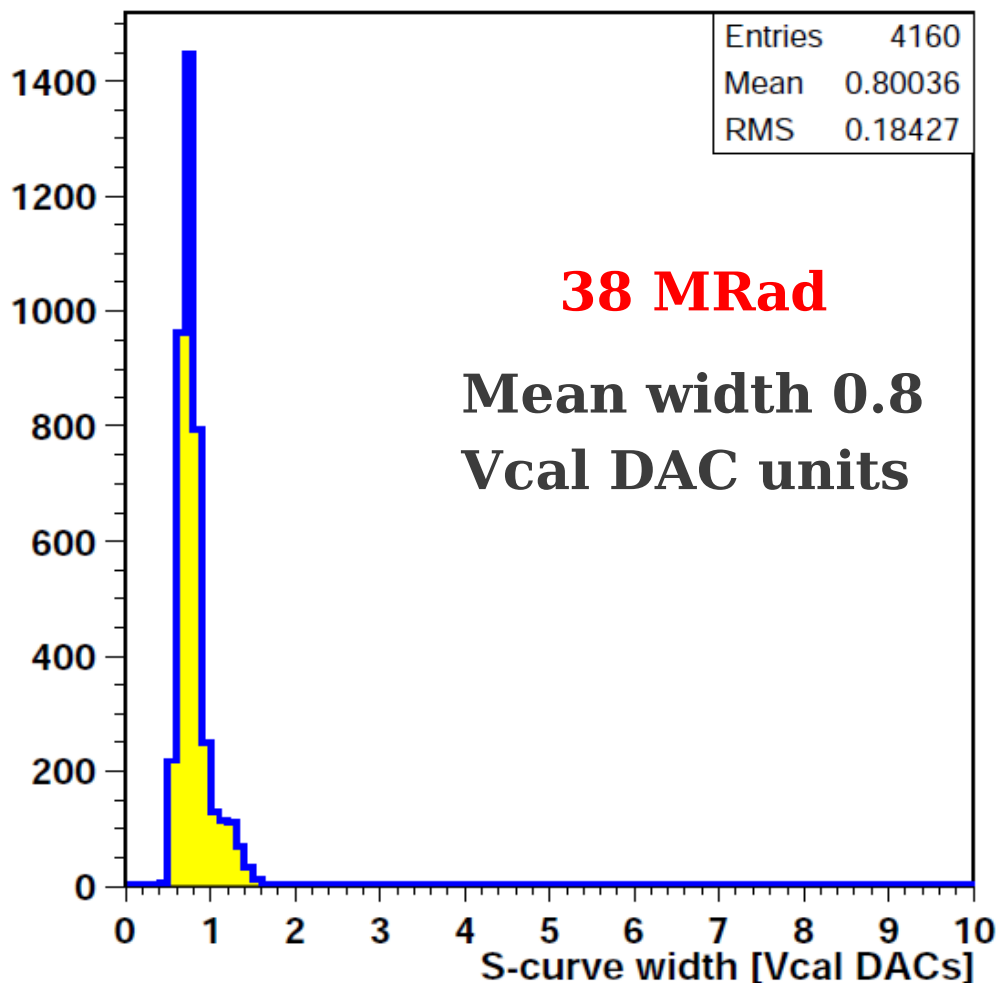
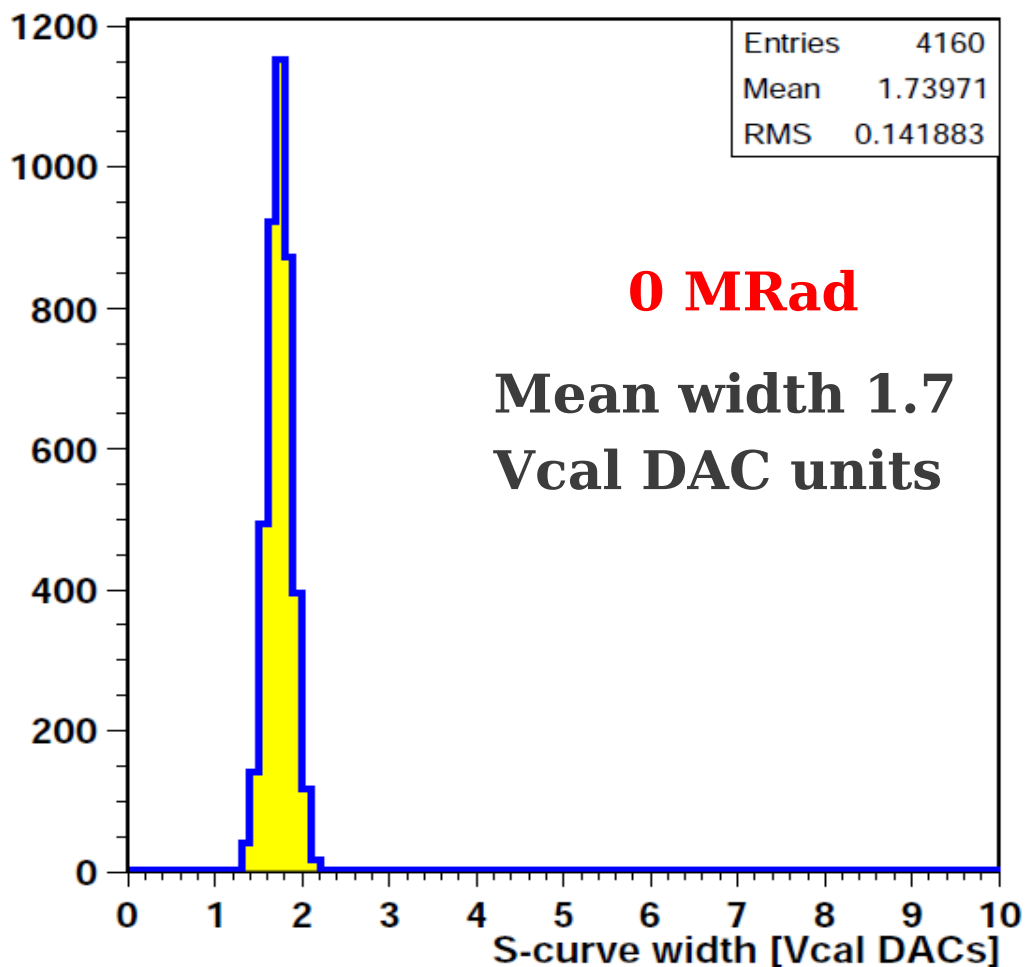


38 MRad



Ia = 25 mA

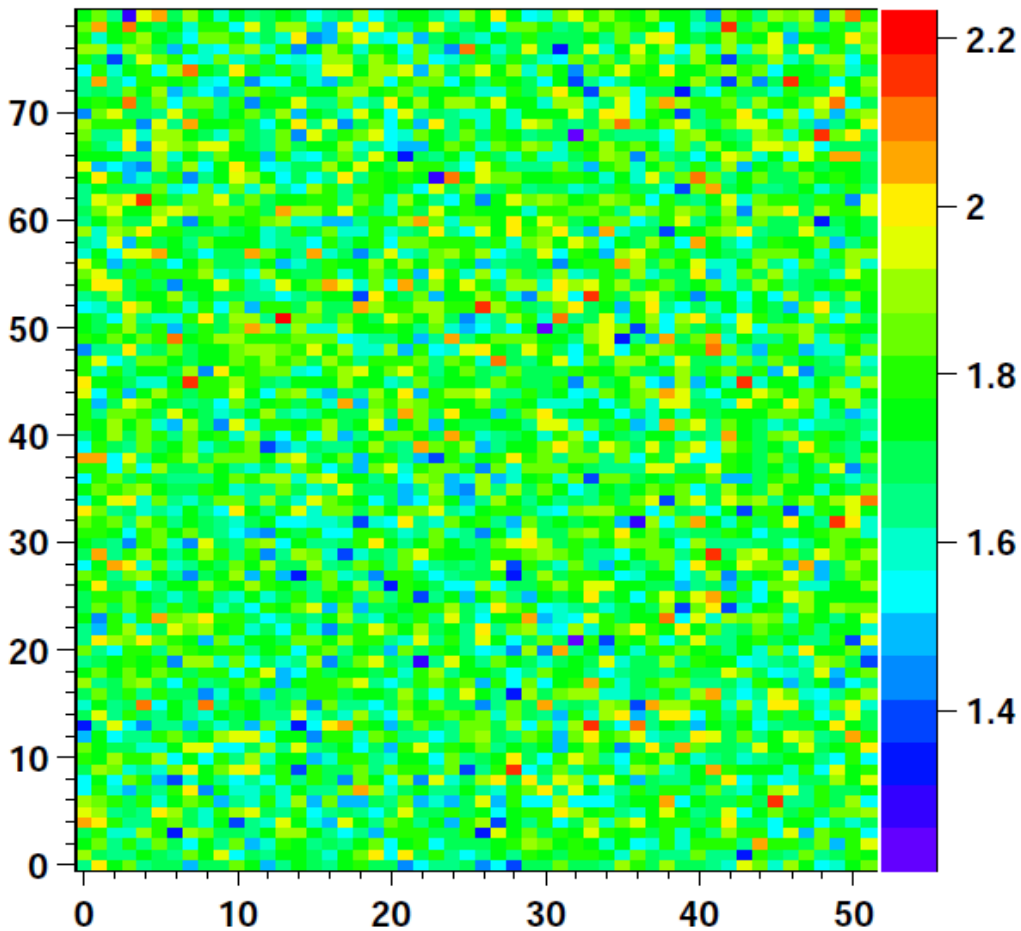
S-curve width (trim 30), chip204



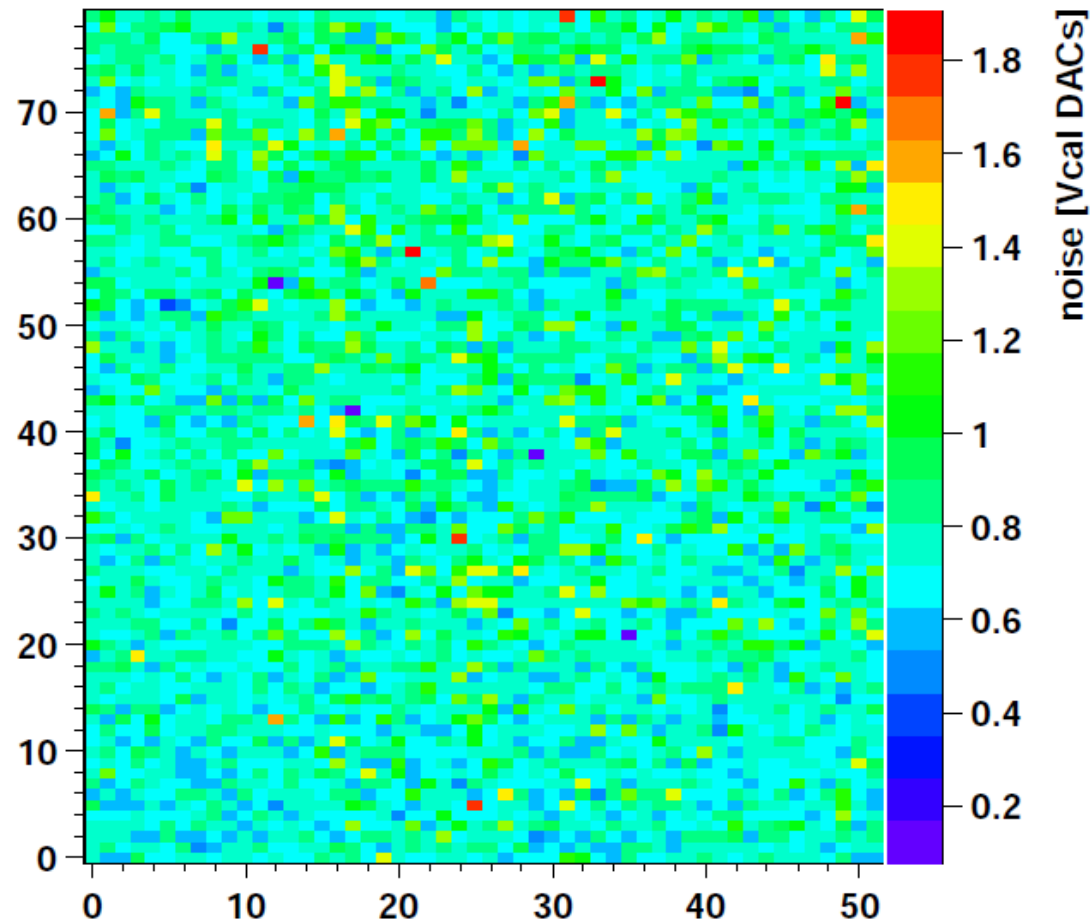
$I_a = 25 \text{ mA}$

Noise map (trim 30), chip204

0 MRad



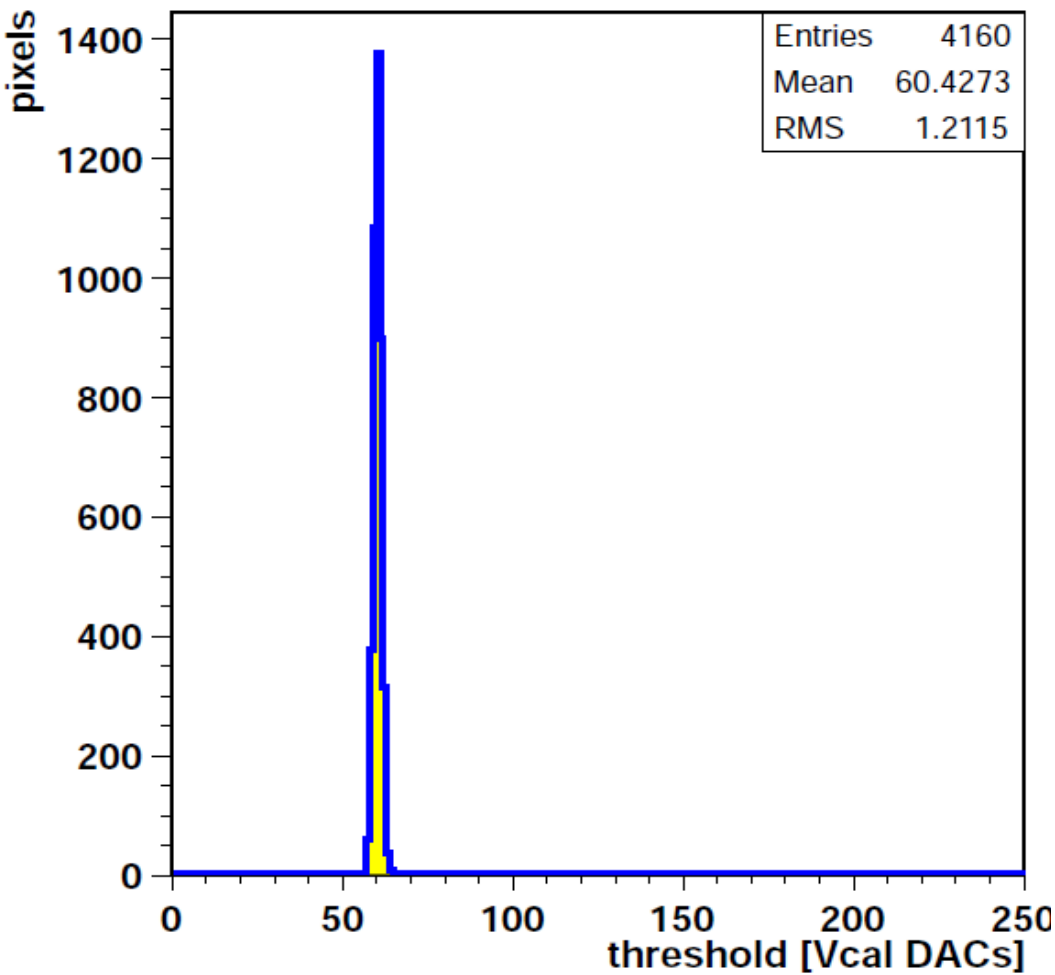
38 MRad



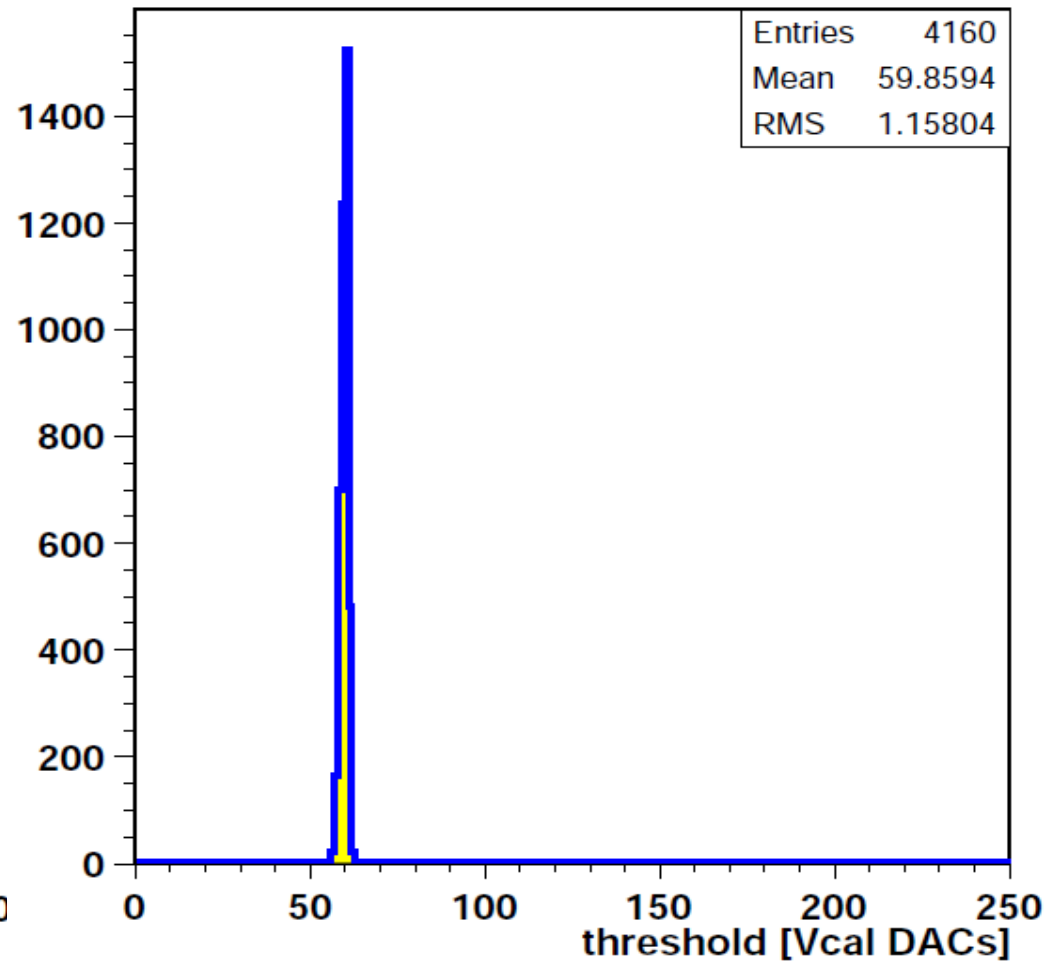
$I_a = 25 \text{ mA}$

Threshold (trim 60), chip204

0 MRad



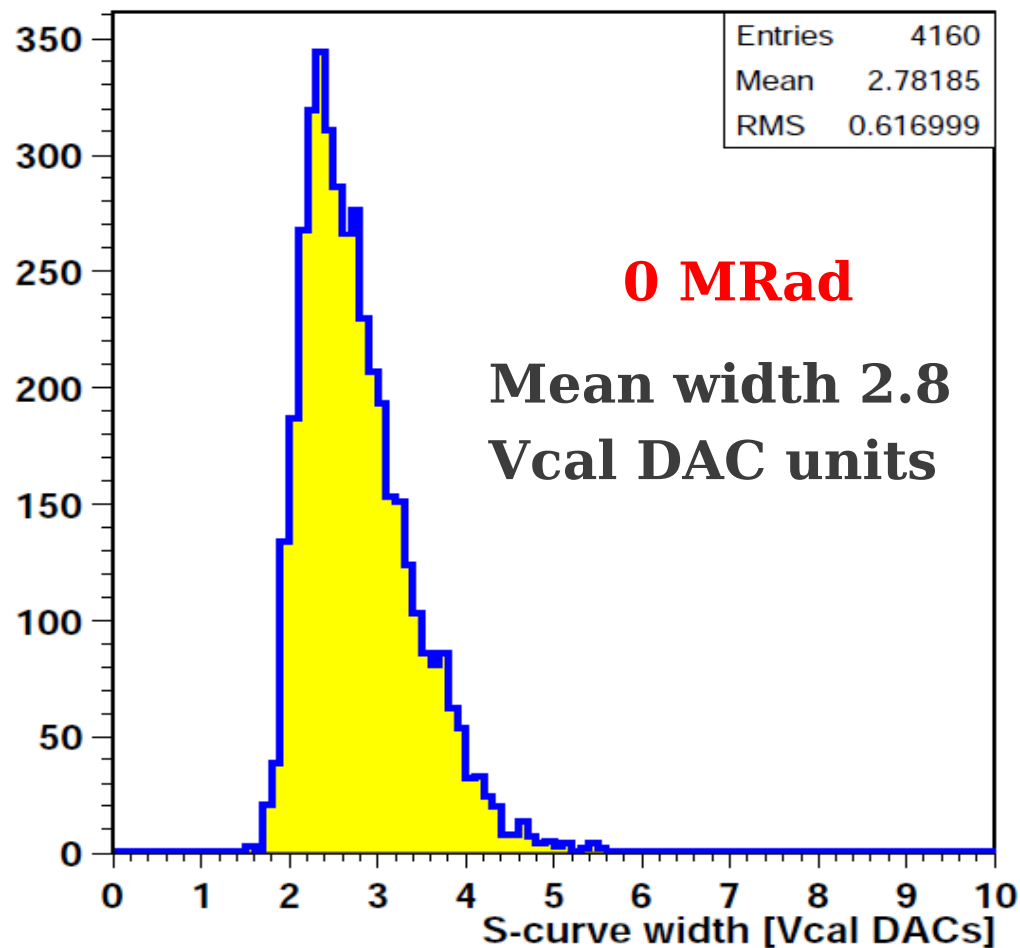
38 MRad



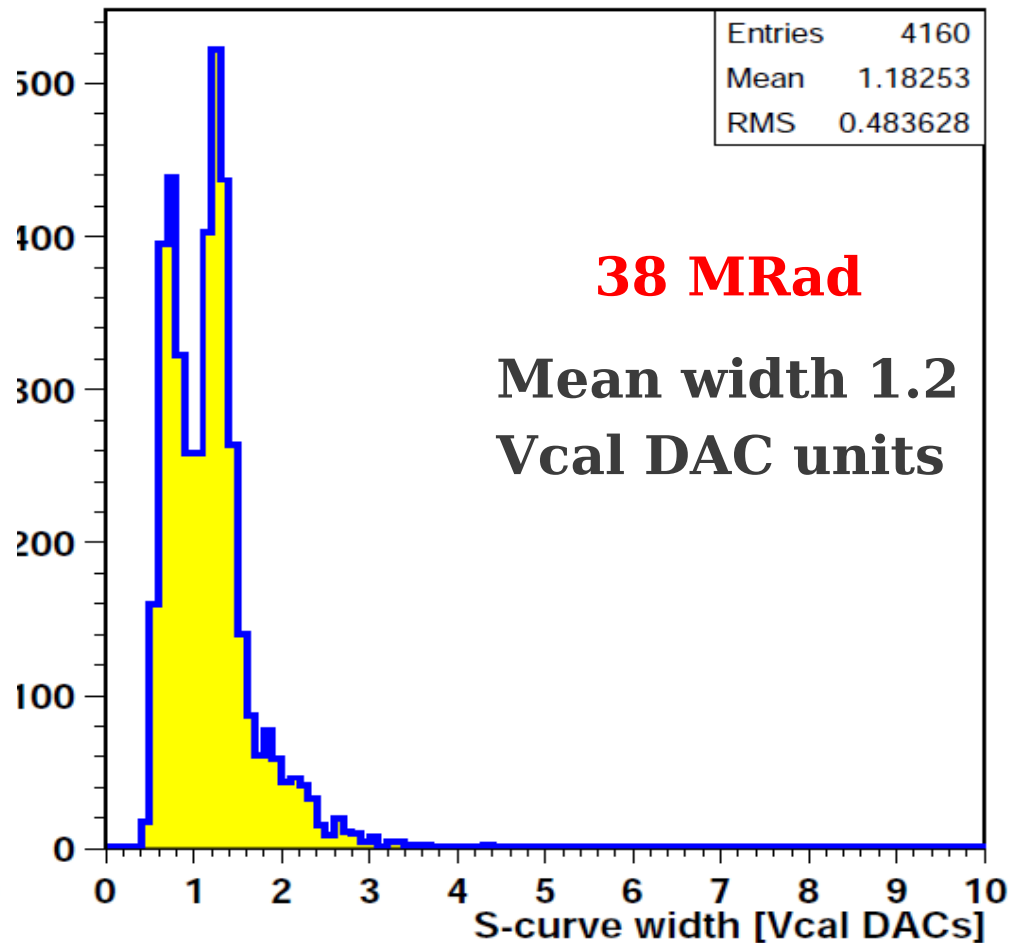
Ia = 25 mA

S-curve width (trim 60), chip204

sigma



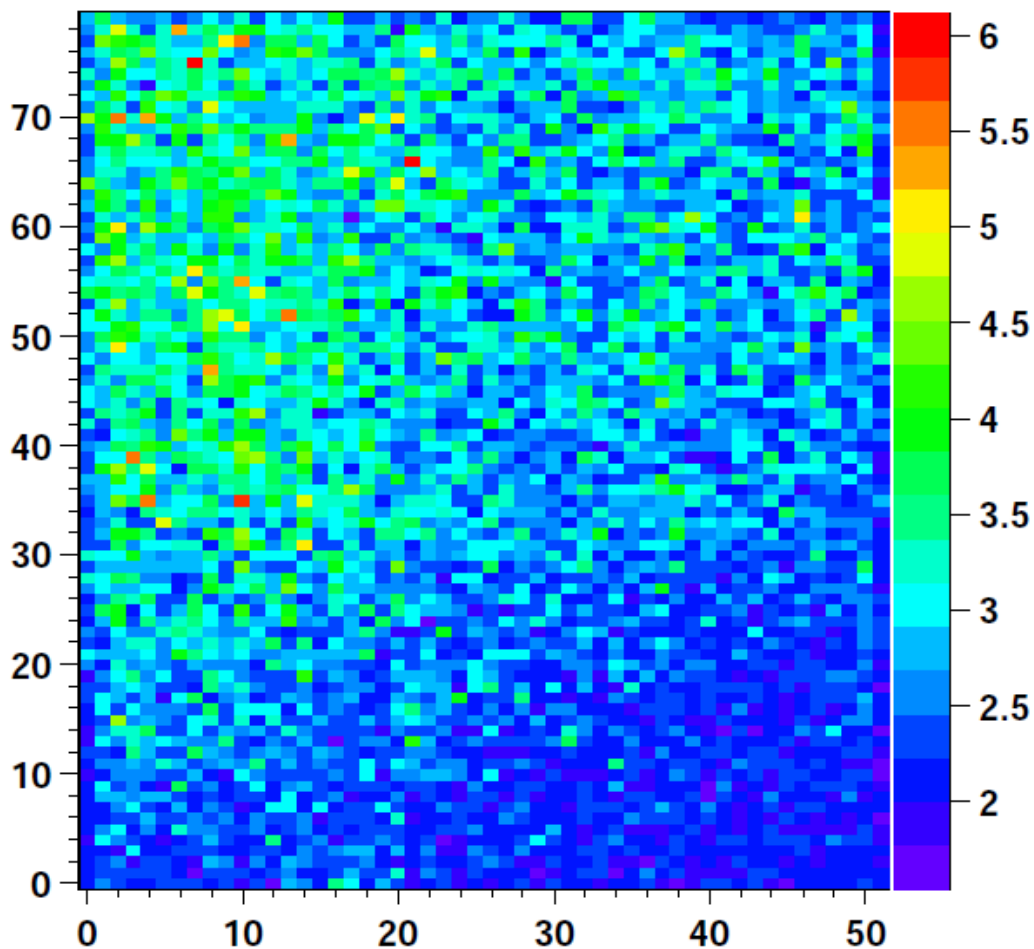
sigma



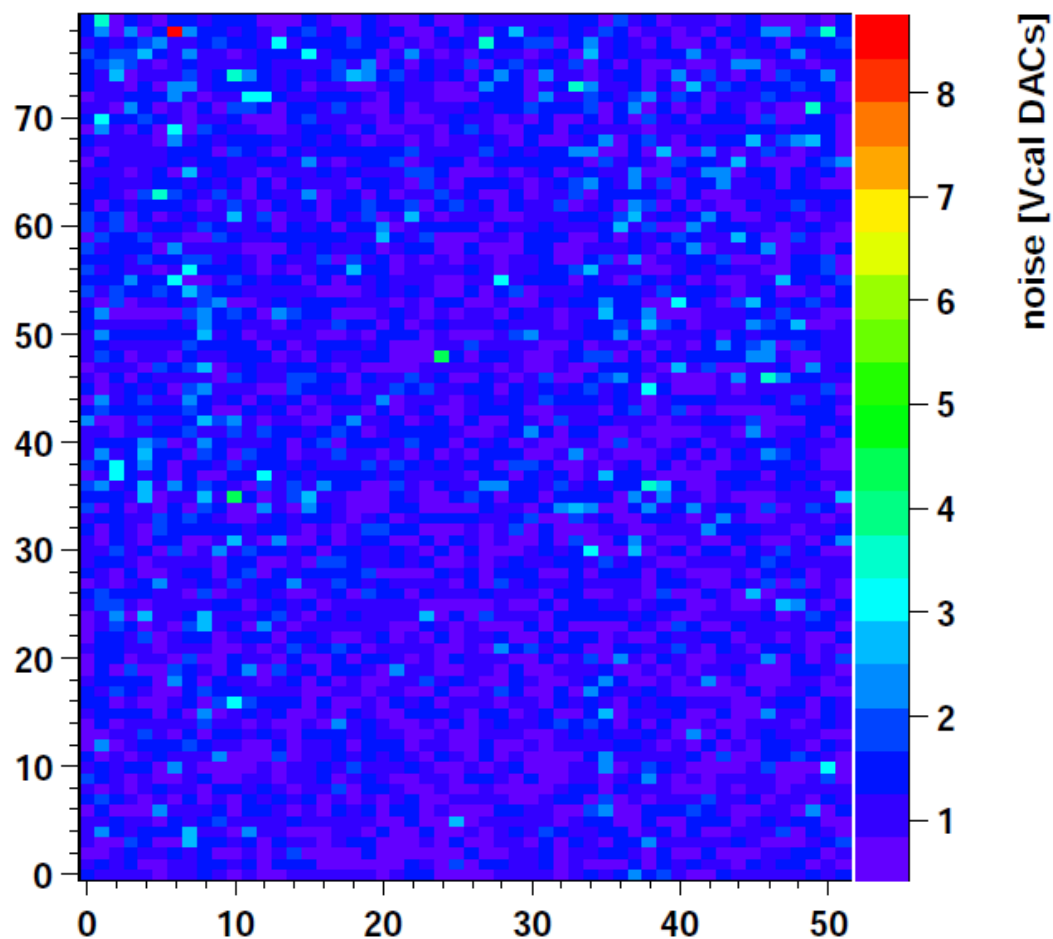
Ia = 25 mA

Noise map, chip204

0 MRad



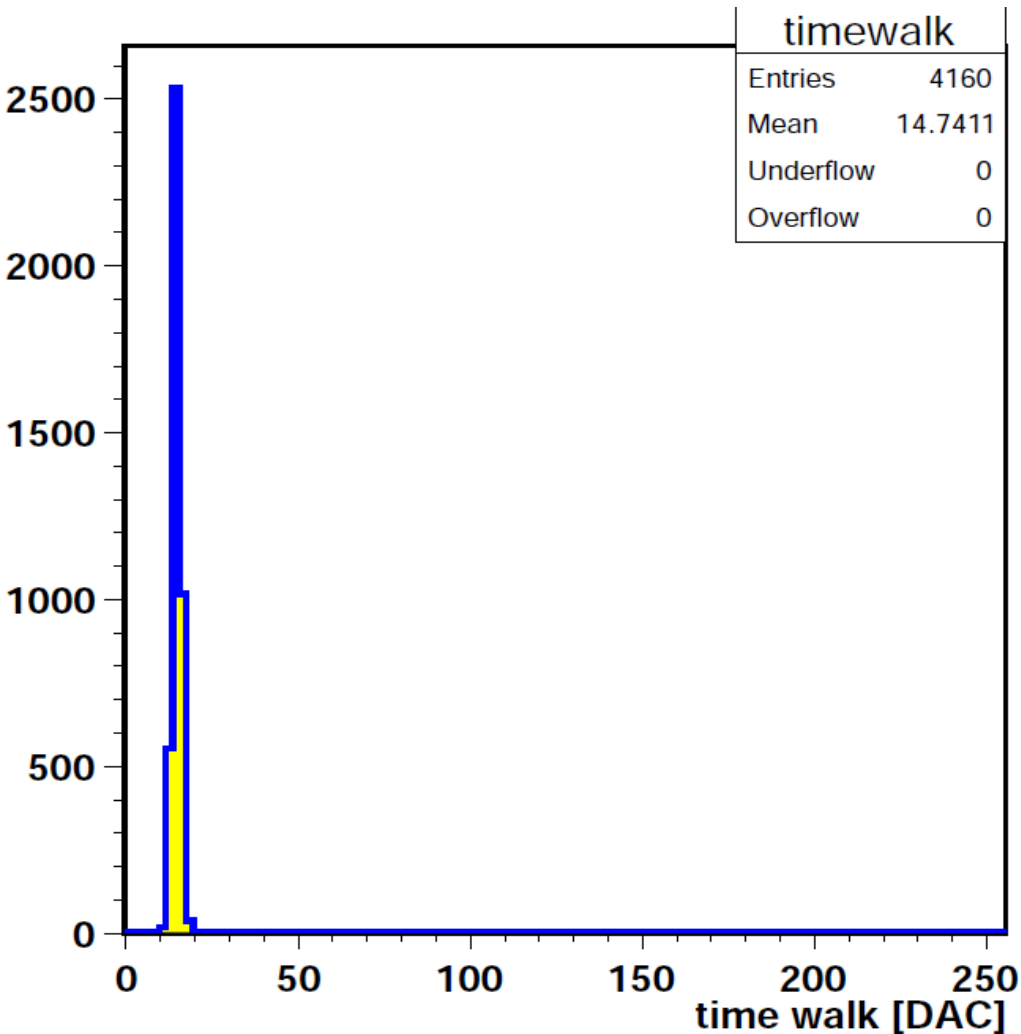
38 MRad



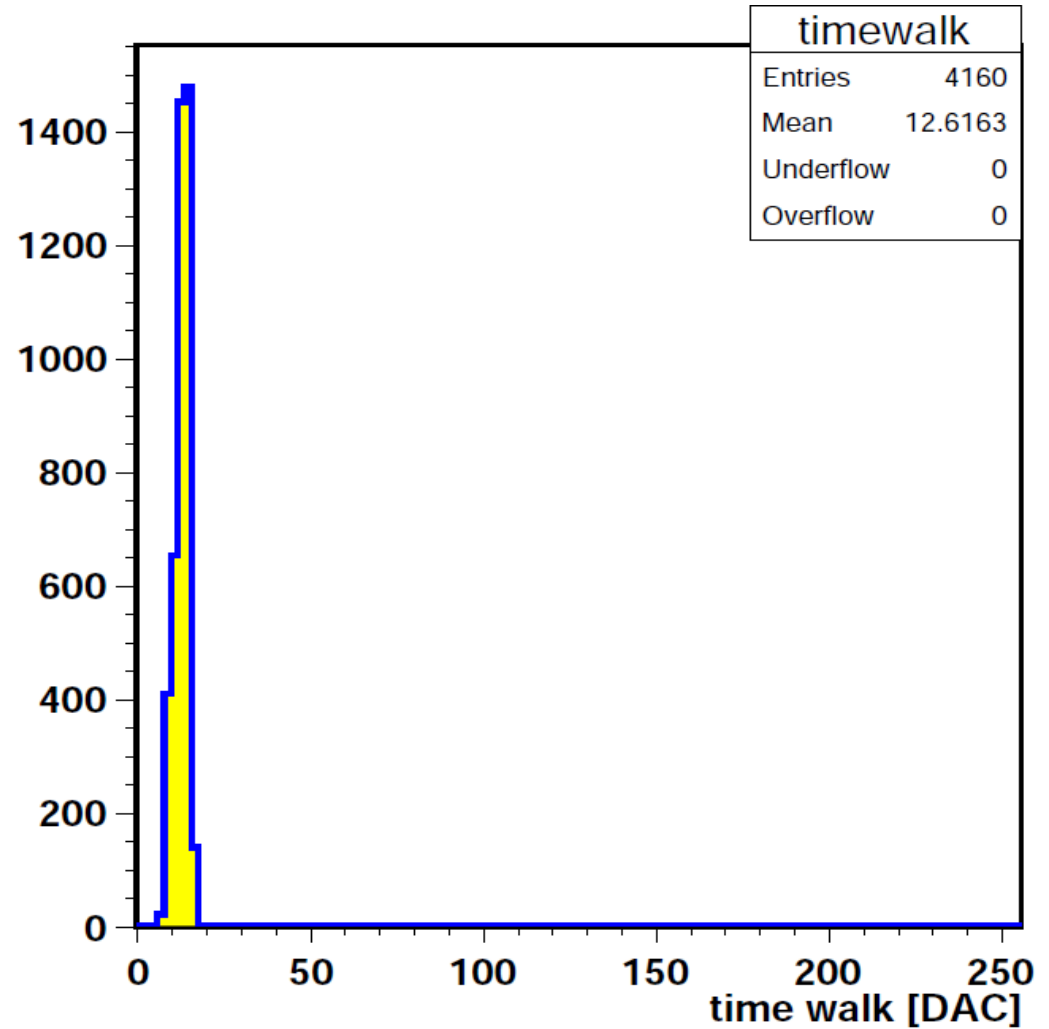
Ia = 25 mA

Timewalk, chip204

0 MRad



38 MRad

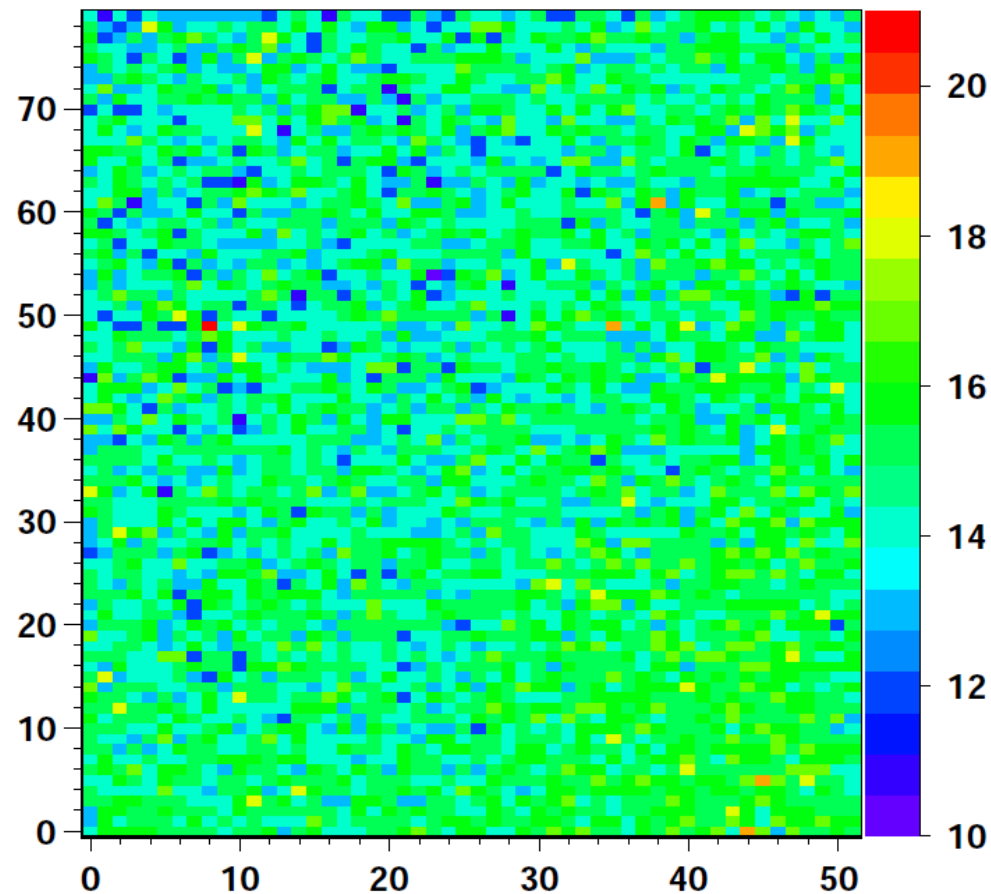


Ia = 25 mA

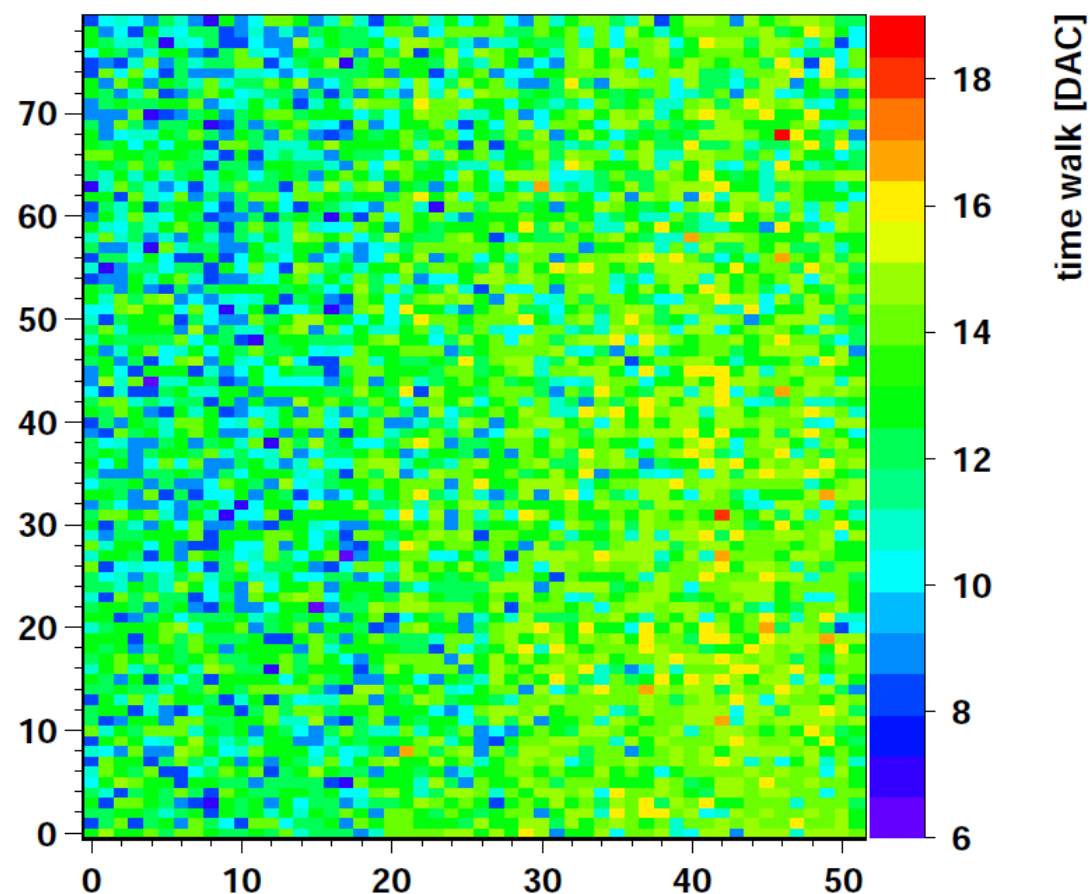
Timewalk less than 0.25 BC

Timewalk map, chip204

0 MRad

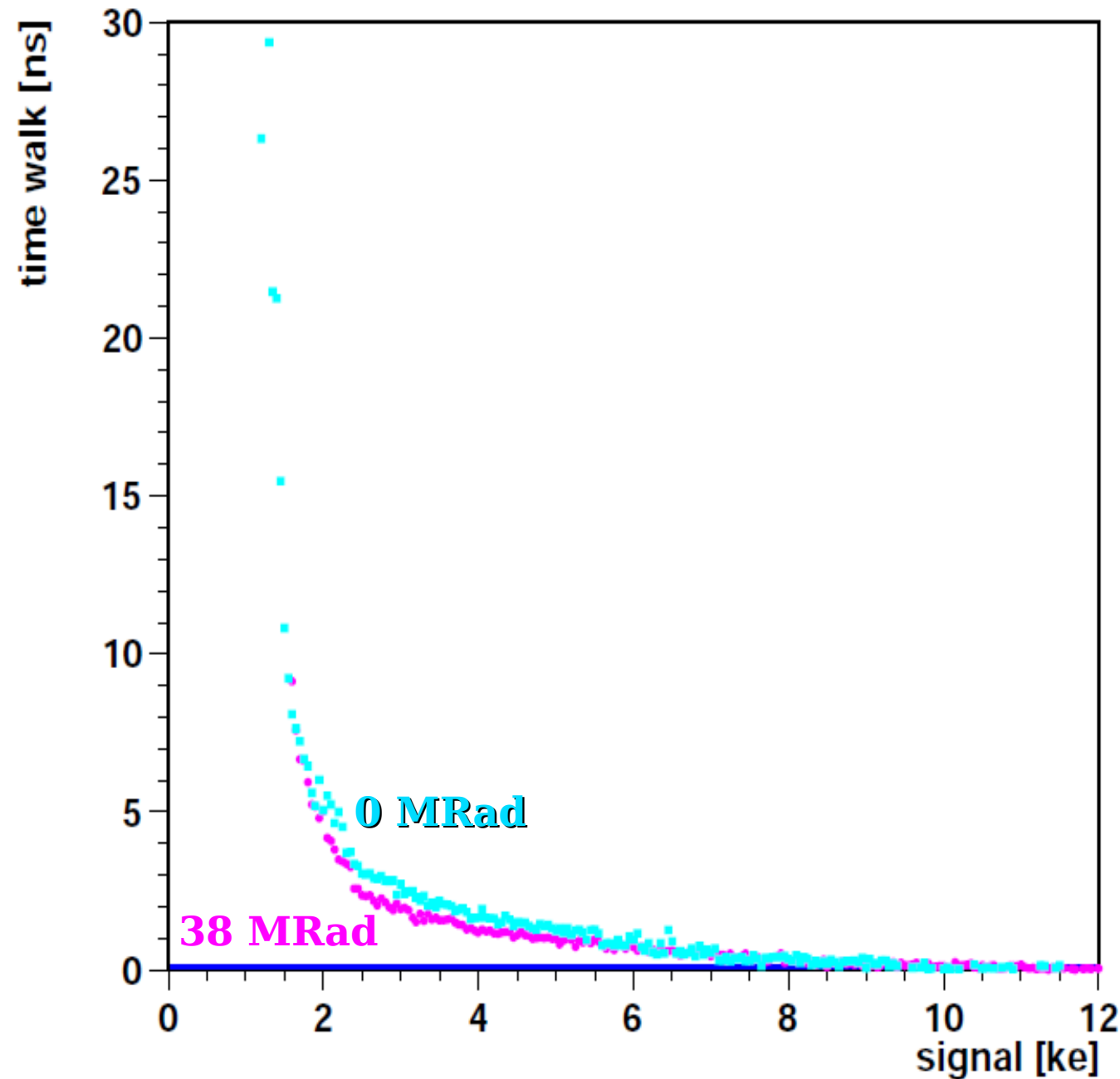


38 MRad



Ia = 25 mA

Compare timewalk

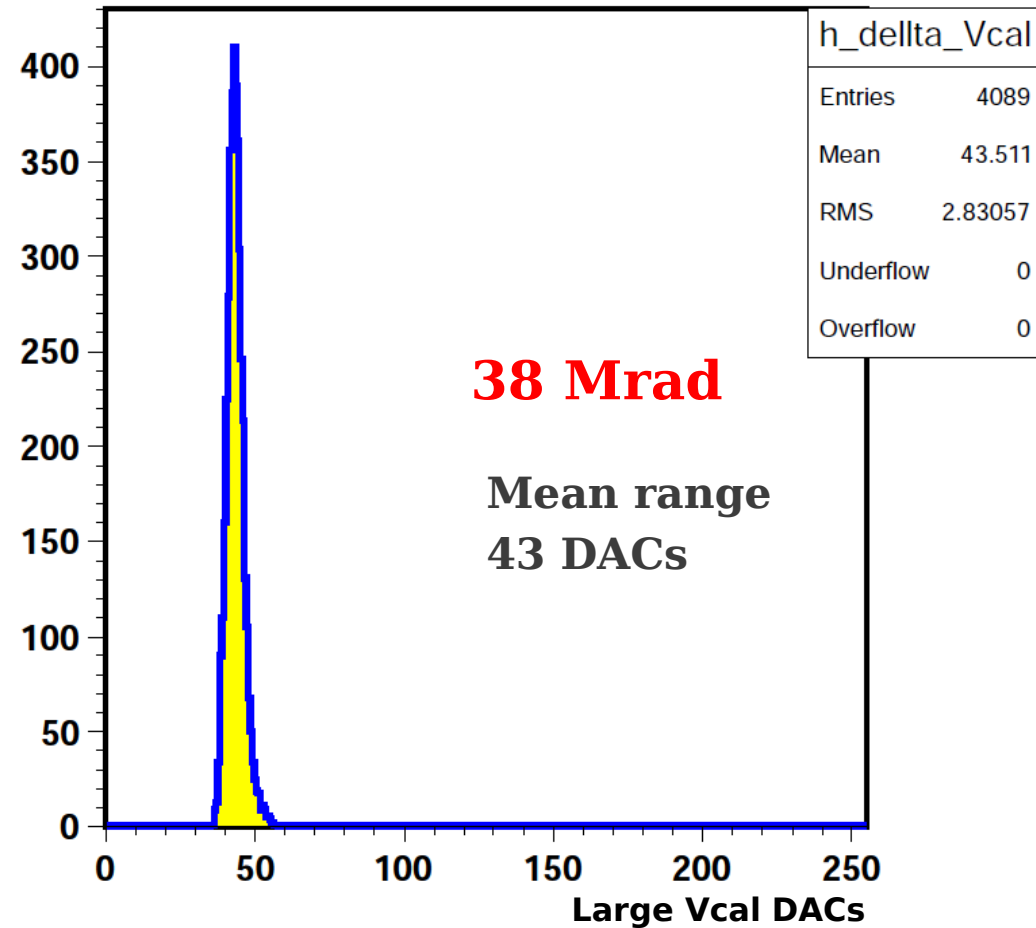
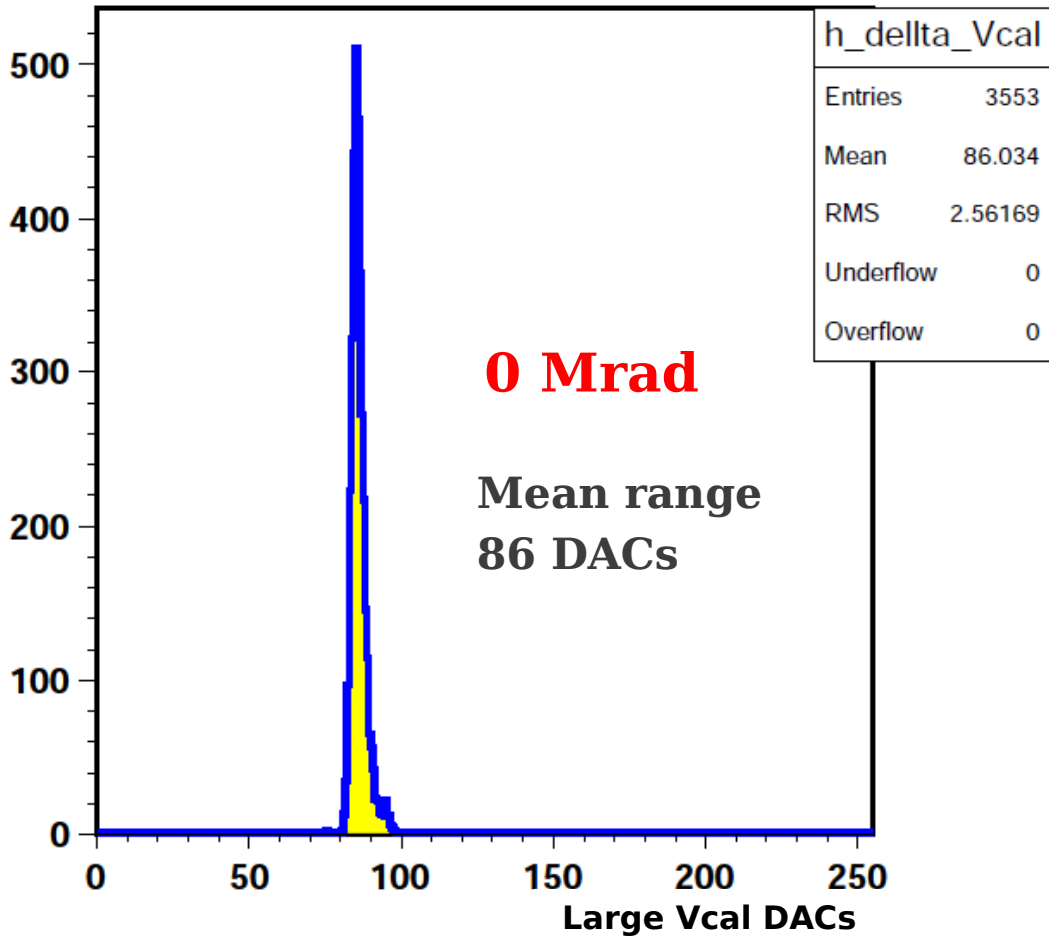


- **psi46dig chip 204**
- **no sensor**
- **38 MRad dose**
- **pixel (22, 22)**
- **trim 30**

- **psi46dig chip 204**
 - **no sensor**
 - **0 MRad dose**
 - **pixel (22, 22)**
 - **trim 30**

**Assume 50e per Vcal
DAC for signal**

10% to 90% range, chip 204



summary

- high dose irradiation of bare 2012 digital ROCs:
 - 38 and 113 MRad at Karlsruhe
 - ~ phase I lifetime dose for layers 2 and 1
- lab tests:
 - chips are operational
 - DAC units may have changed → check with sensors

Back up

Timewalk plots, chip204

0 MRad

50 MRad

