Irradiated ROCs 1

Daniel Pitzl, DESY

Hamburg CMS Pixel Upgrade meeting, 30.11.2012

- LHC dose vs radius
- Analog current vs Vana DAC
- Measured on the test board
- Digital ROCs:
  - unirradiated
  - irradiated

Tracker radiation dose

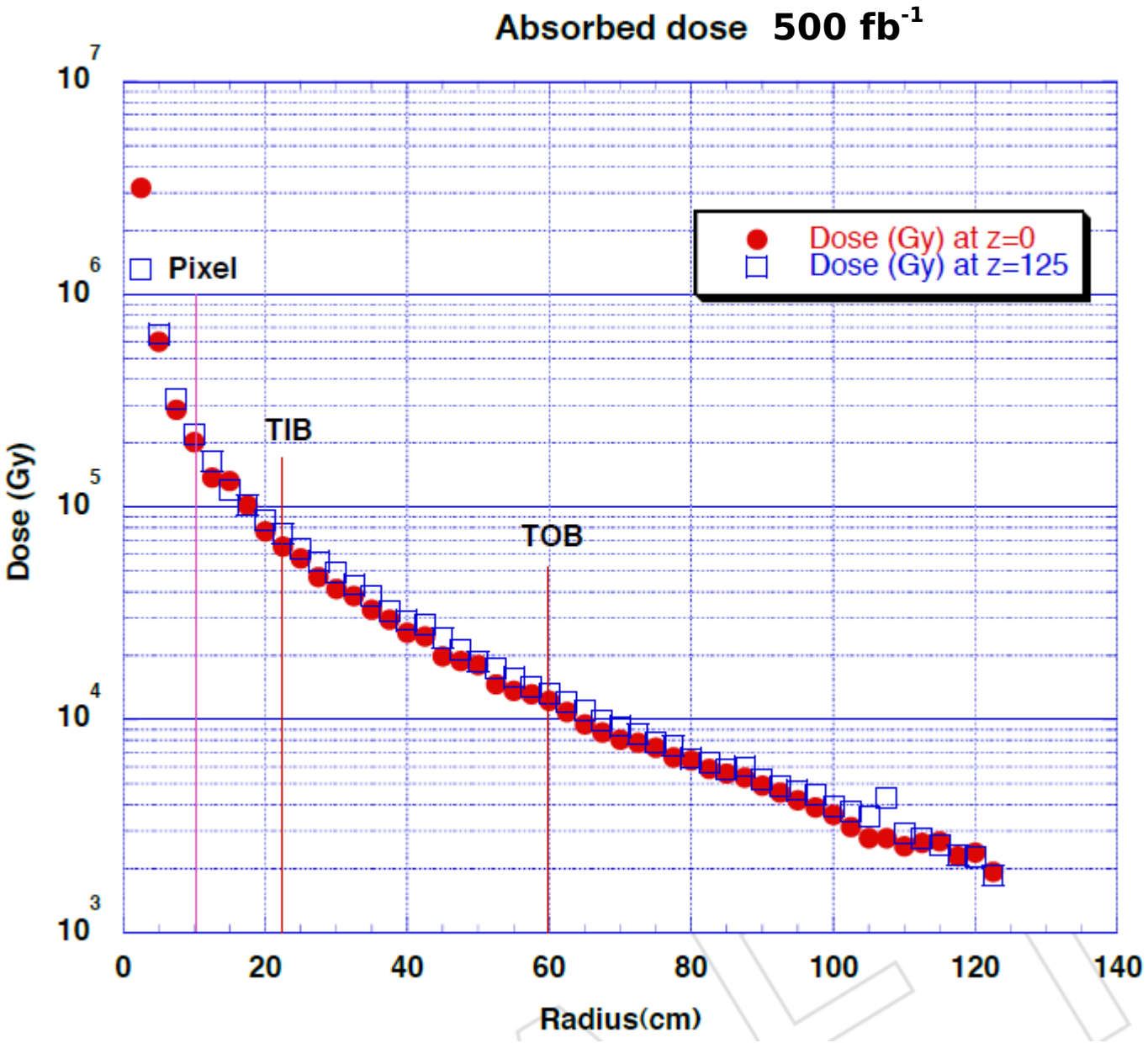
Layer 1: 1 MGy

Layer 2: 400 kGy

Layer 3: 200 kGy

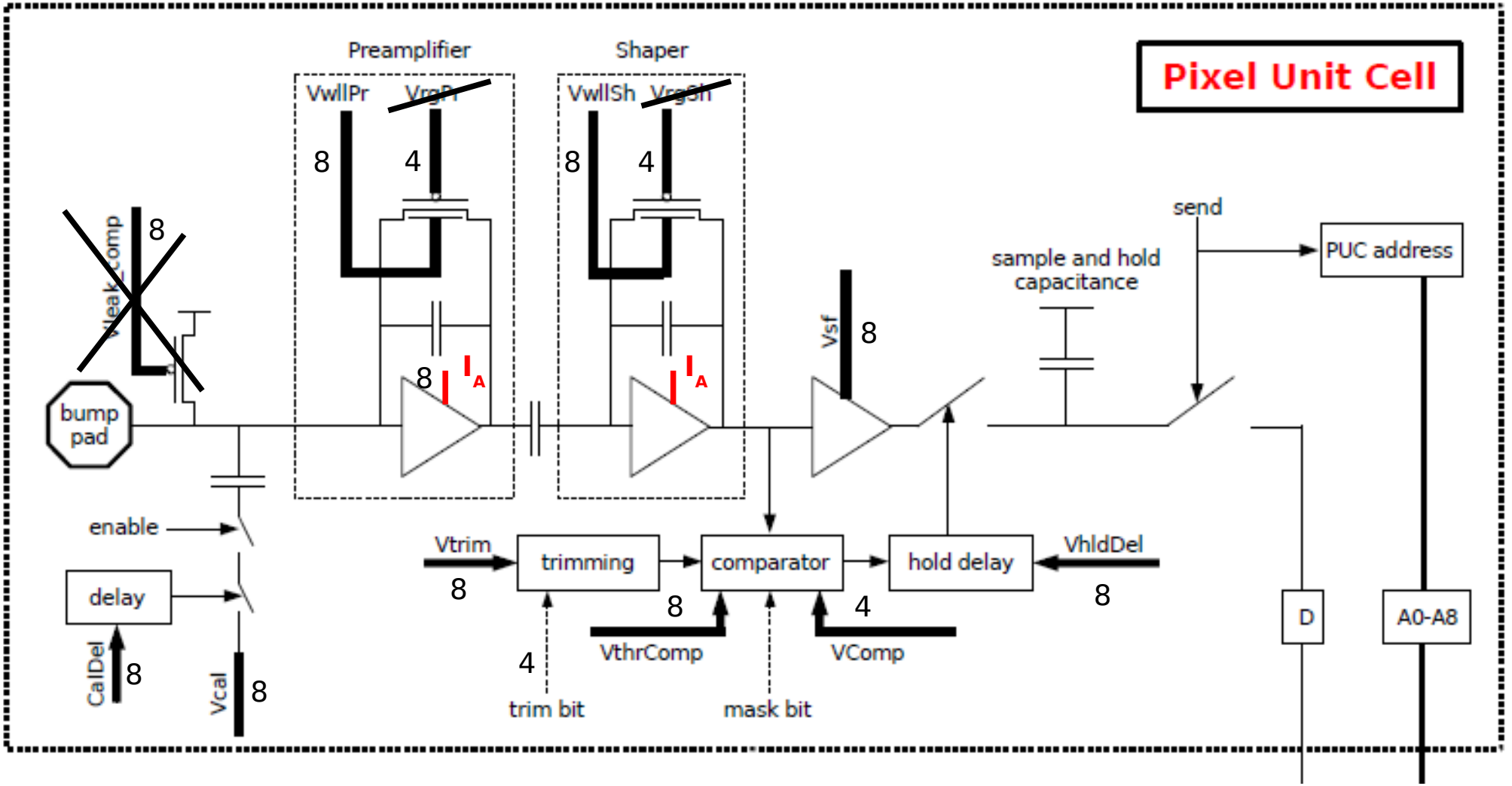
Layer 4: 150 kGy

100 kGy = 10 Mrad

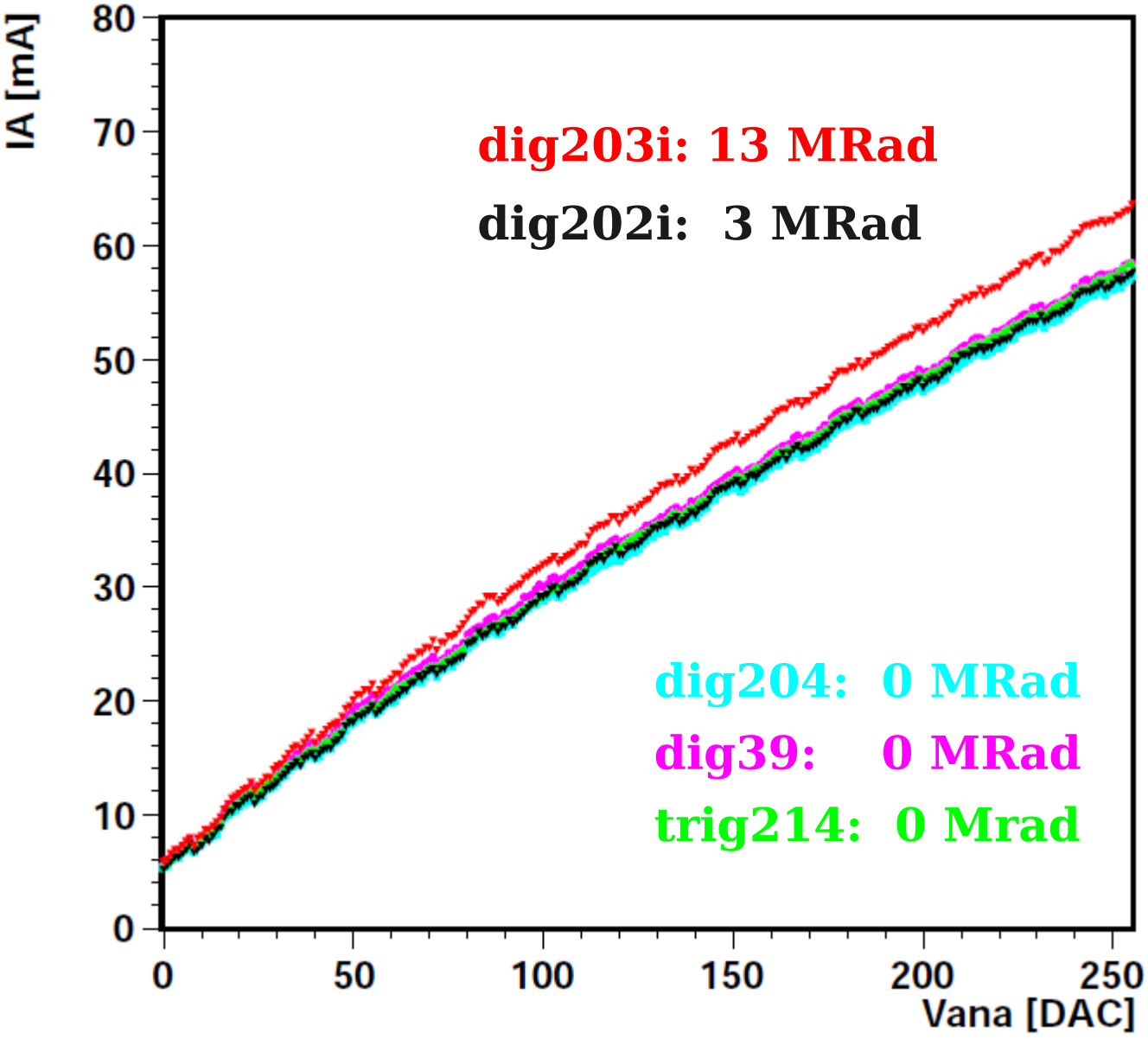


Pixel upgrade TDR 2012

psi46dig pixel unit cell

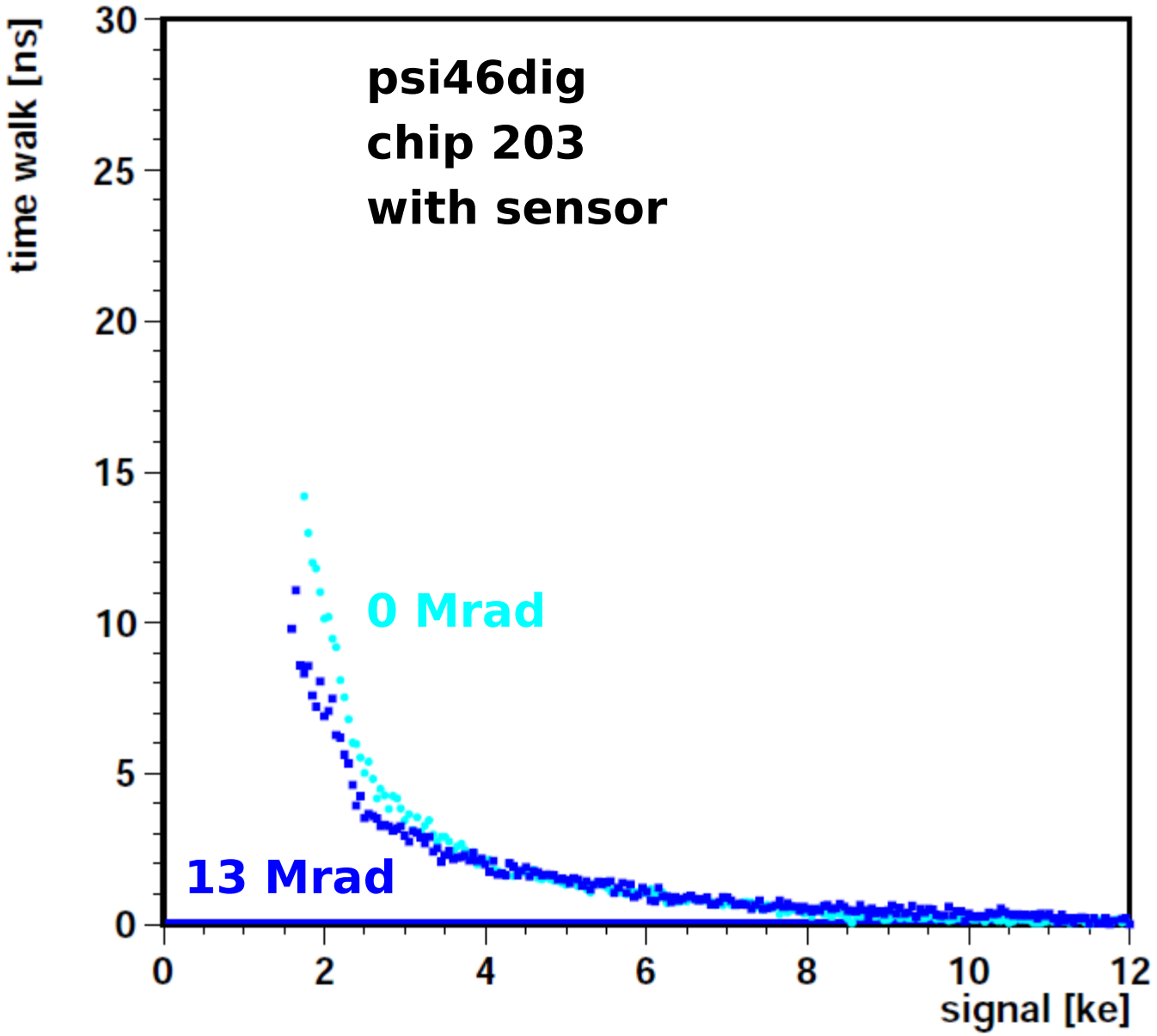


Analog current vs Vana DAC



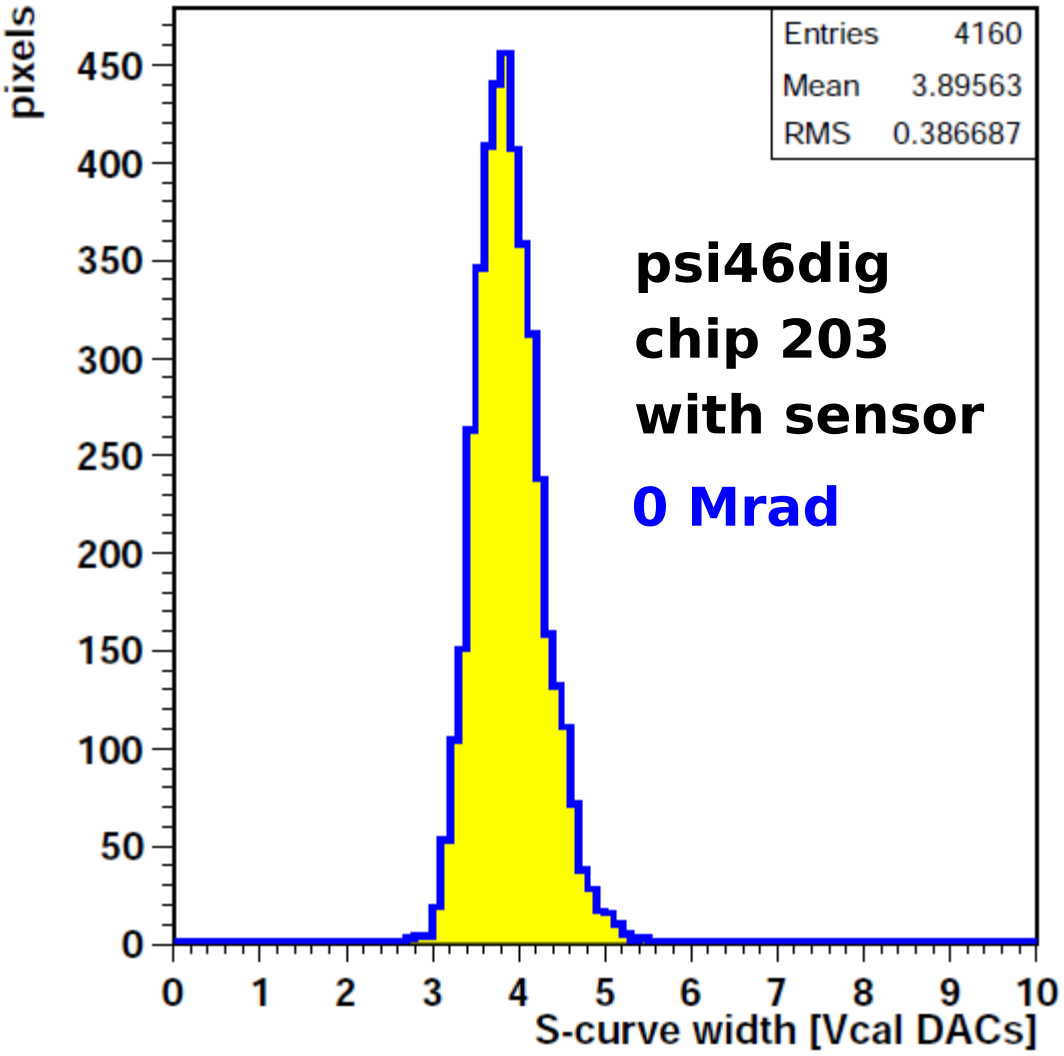
- Test board:
  - `va 1900 mV`
- Vana: 8 bit DAC, scanned in steps of one, with 500 ms delay.
- Current measured on the test board: `GetIA`
- 3 unirradiated ROCs are similar
- no change after 3 MRad.
- 10% higher with 13 MRad.

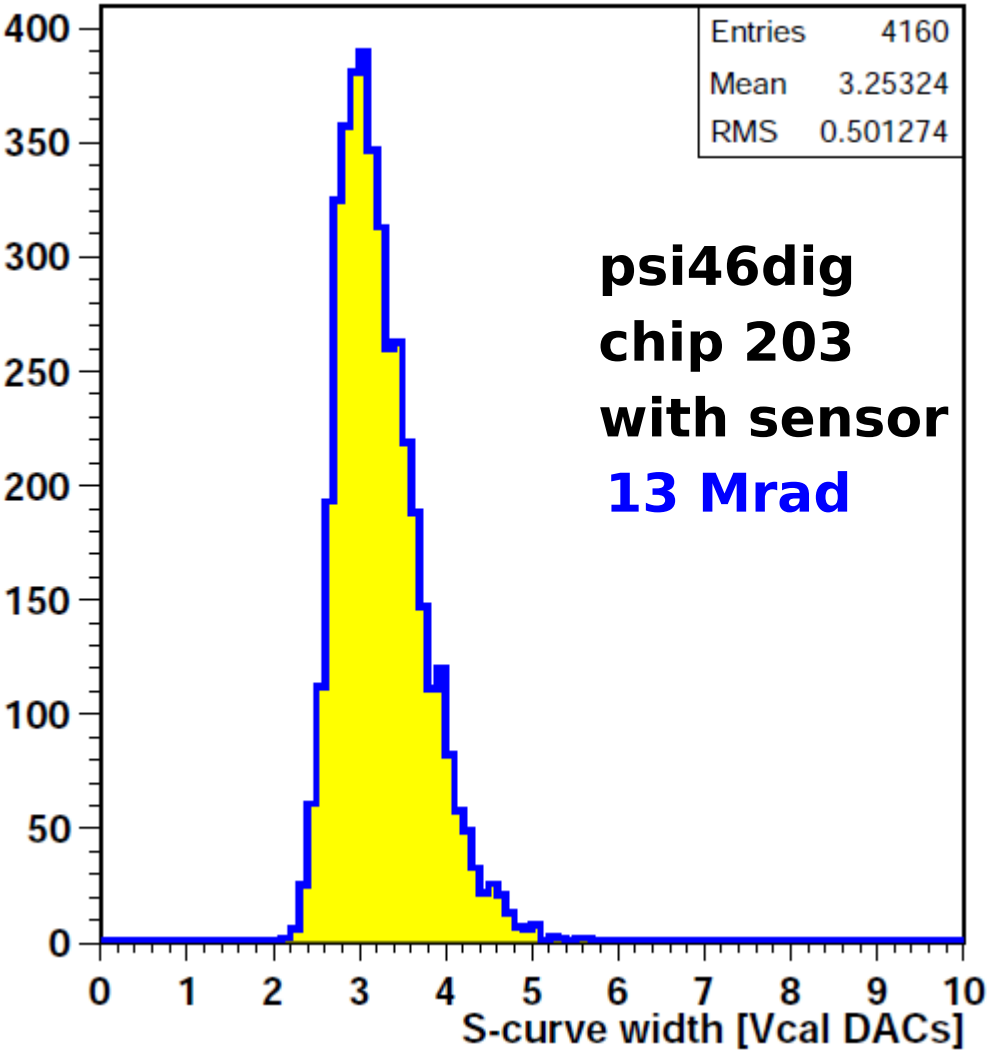
Timewalk



- Chip 203
  - with sensor
  - Ia 35 mA
  - trimmed to 1.5 ke threshold (Vcal 30)
  - pixel 22 22
  - before and after 13 Mrad

Noise

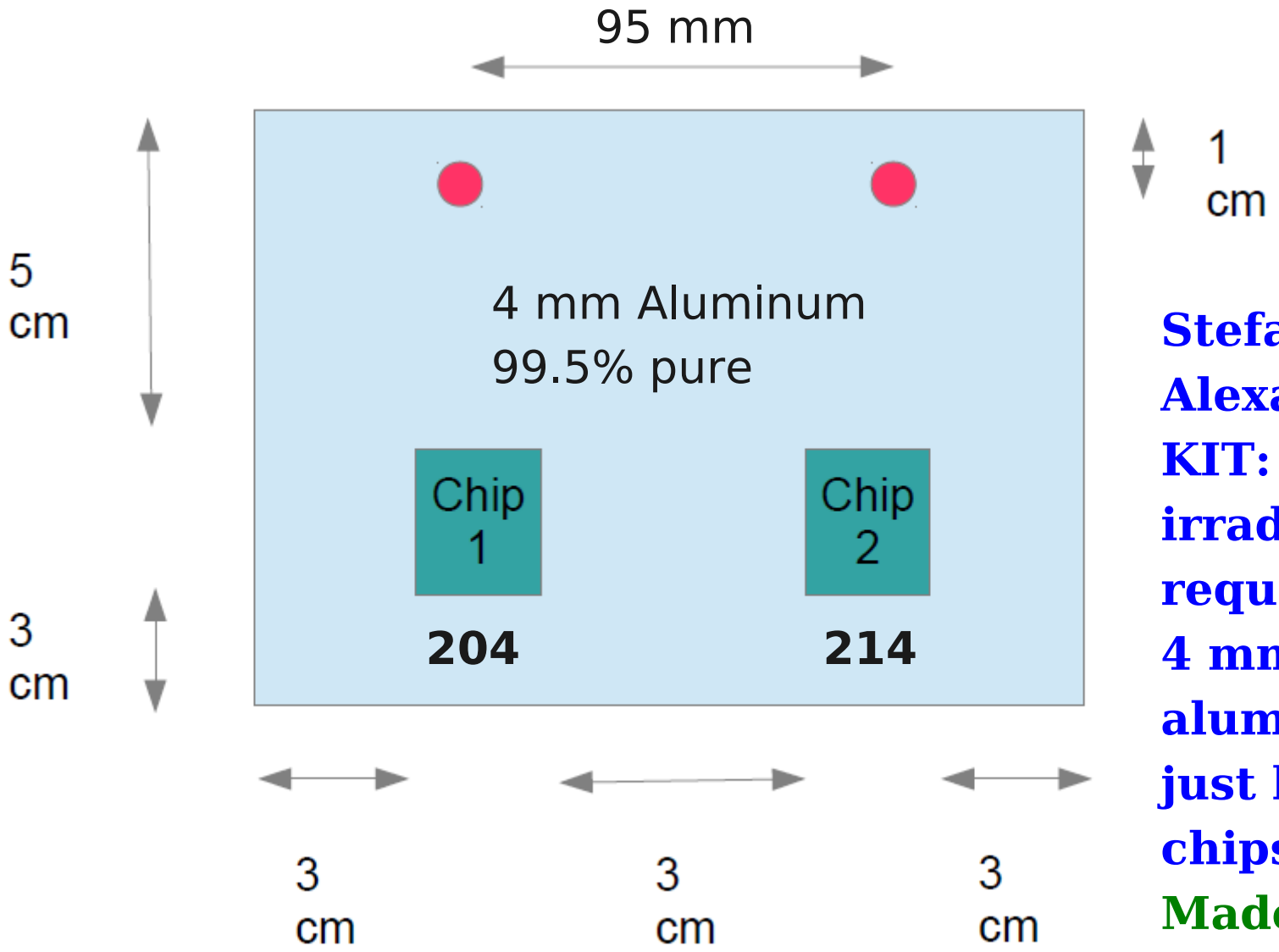

pixels
Entries 4160
Mean 3.89563
RMS 0.386687
psi46dig
chip 203
with sensor
0 Mrad
S-curve width [Vcal DACs]


Entries 4160
Mean 3.25324
RMS 0.501274
psi46dig
chip 203
with sensor
13 Mrad
S-curve width [Vcal DACs]

Chip 203

- with sensor
- Ia 35 mA
- trimmed to 1.5 ke threshold (Vcal 30)
- pixel 22 22
- before and after 13 Mrad

irradiation mask for KIT



Stefan Heindl,
Alexander Dierlamm
KIT:
irradiation mask required:
4 mm high purity aluminum,
just leaving the chips exposed.
Made by
Adam Zuber and
Holger Maser.

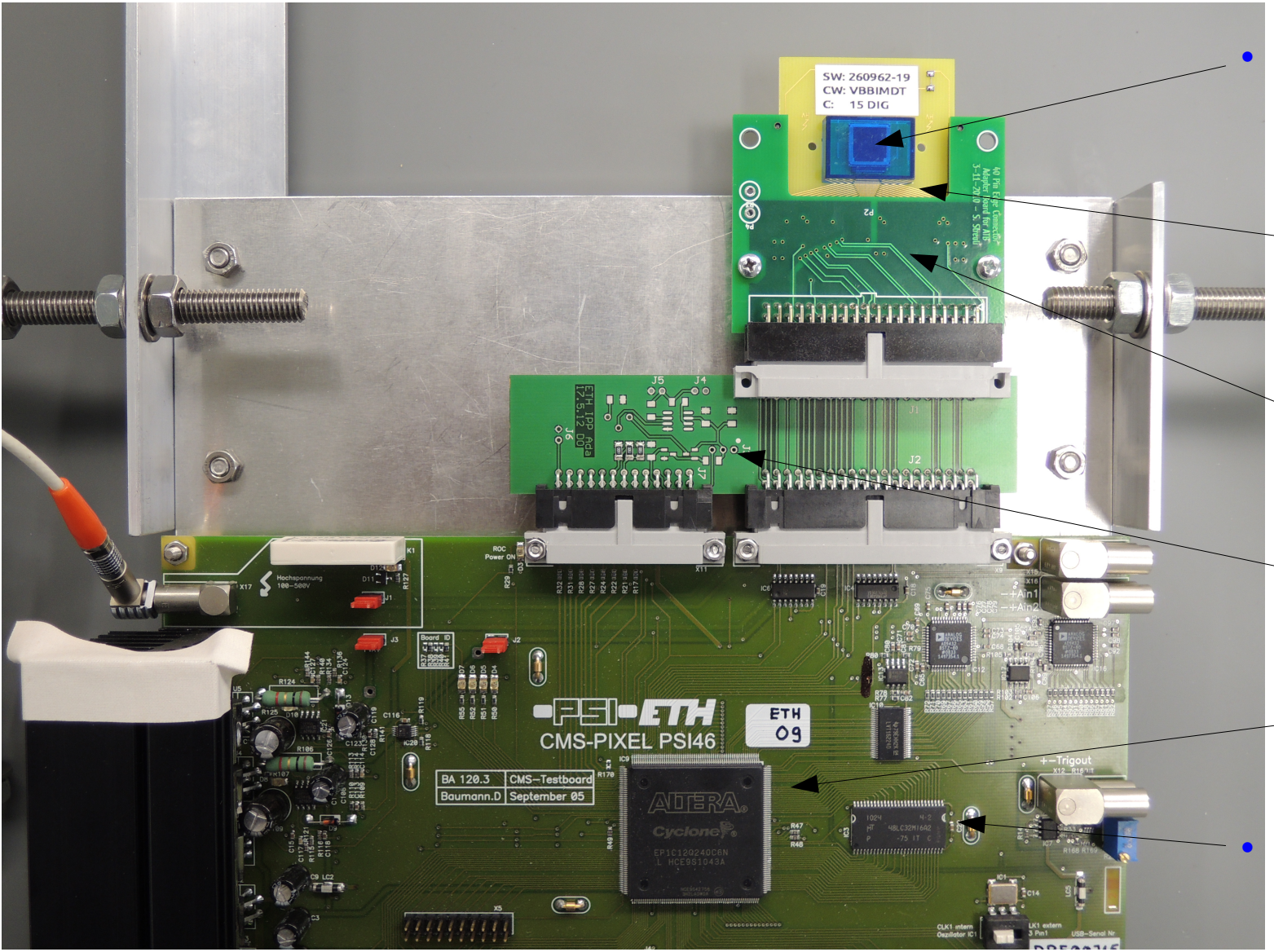
Stefan Heindl, KIT, Sep 2012

Summary

- psi46dig ROCs with sensor irradiated at CERN to 3 and 13 Mrad
  - fully functional
  - 10% analog current increase after 13 Mrad
  - noise, time walk not worse
- Next:
  - transport back to DESY
  - more lab tests
  - beam test in January
  - X-ray test at Uni
- Further irradiation:
  - psi46dig ROCs 204 and 214 without sensors fully characterized
  - send to KIT Zyklotron lab
  - irradiated to 30 and 100 Mrad in Jan '13

Back up

psi46 test board



- Single chip module:
  - Indium bump bonded at PSI
  - Glued and wire bonded to carrier printed circuit board
  - Interface card to psi46 TB with edge connector
  - ETH adapter card for digital 160 MHz differential signal directly into FPGA (LCDS into LVDS)
- 64 MB memory