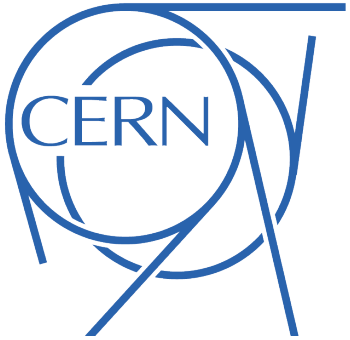
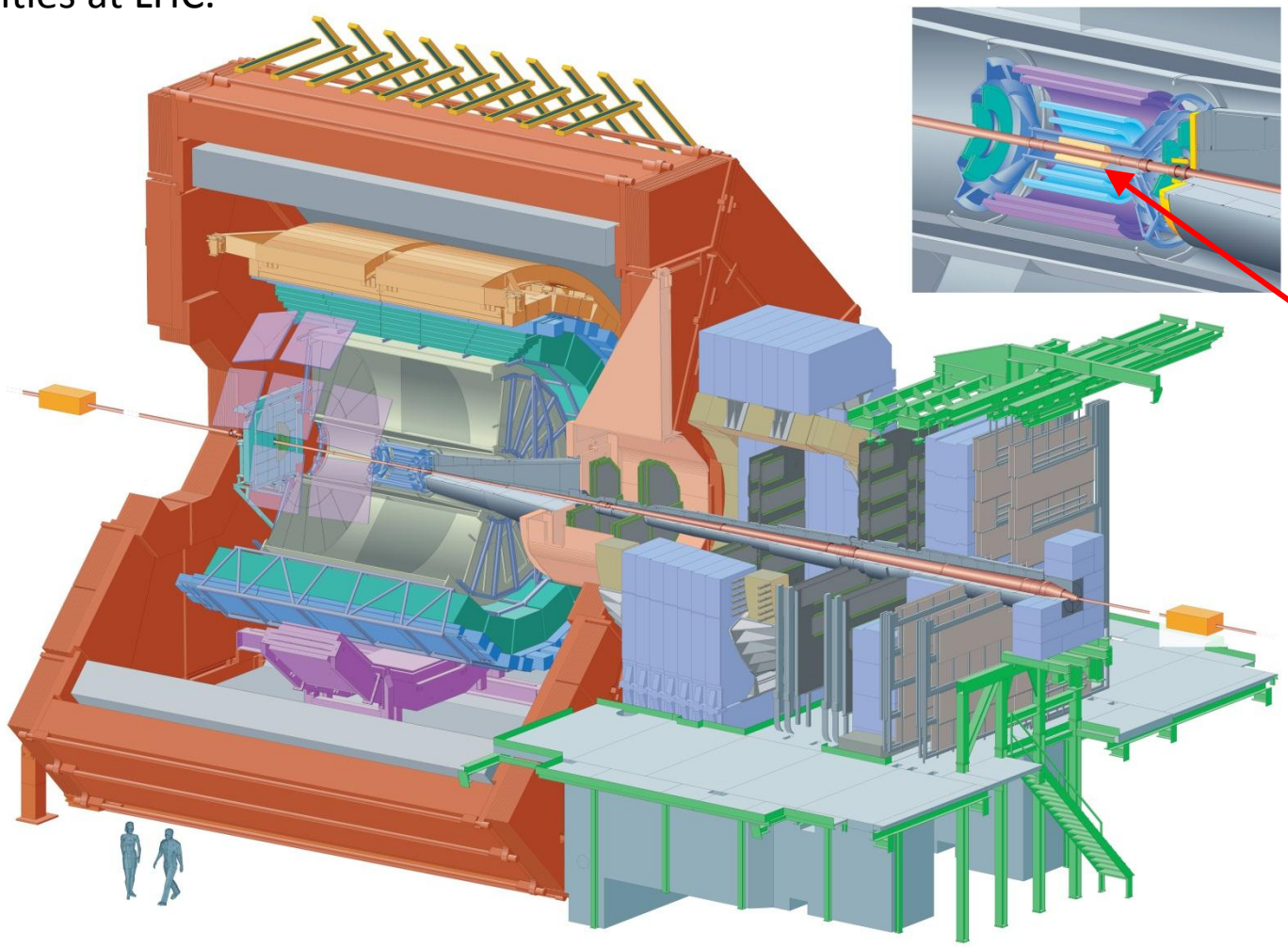
TPAC – One path to the ALICE ITS upgrade

Carl-Johan Haster – Summer student 2011



ALICE and its Inner Tracking System

Optimised for heavy ion collisions to study strongly interacting matter at the at high energy densities at LHC.



The ITS

SPD – Silicon Pixel Detector

Hybrid vs. monolithic pixel sensors

Hybrid pixel

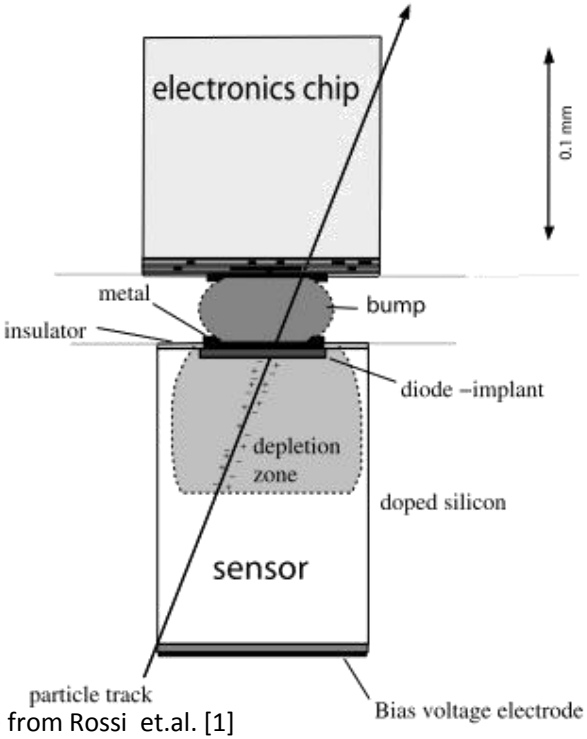


Figure from Rossi et.al. [1]

Currently two layers of SPD (r=3.9 cm and 7.6 cm)

Monolithic pixel

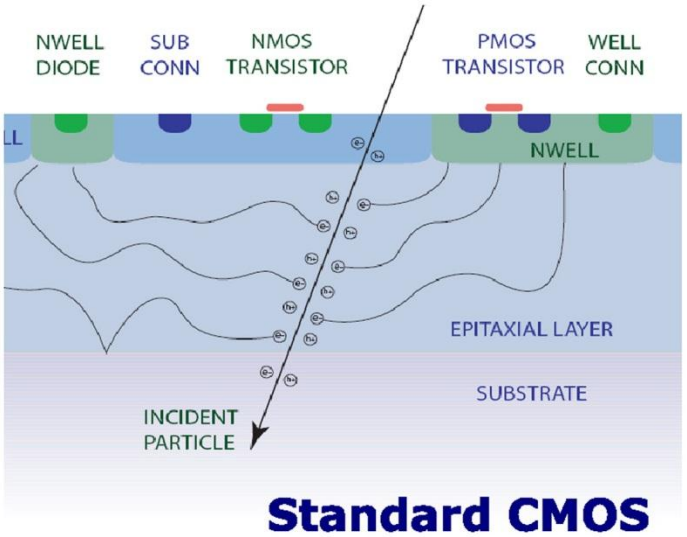


Figure from Stanitzki [2]

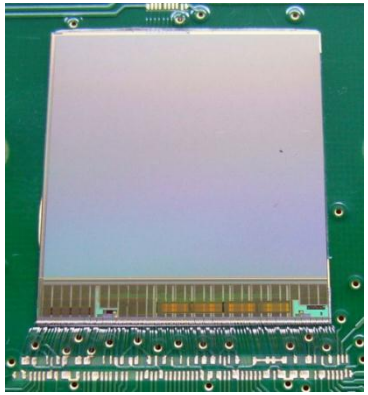
Upgrade has at least three layers of pixel detectors
– starting closer to the beampipe (first layer ~ r=2.2 cm)

Both technologies are being investigated for the upgrade

Different options of monolithic sensors

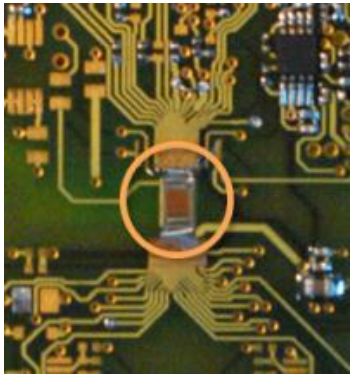
- INMAPS
- MISTRAL
- LePIX

TPAC (SPIDER collaboration) [2]



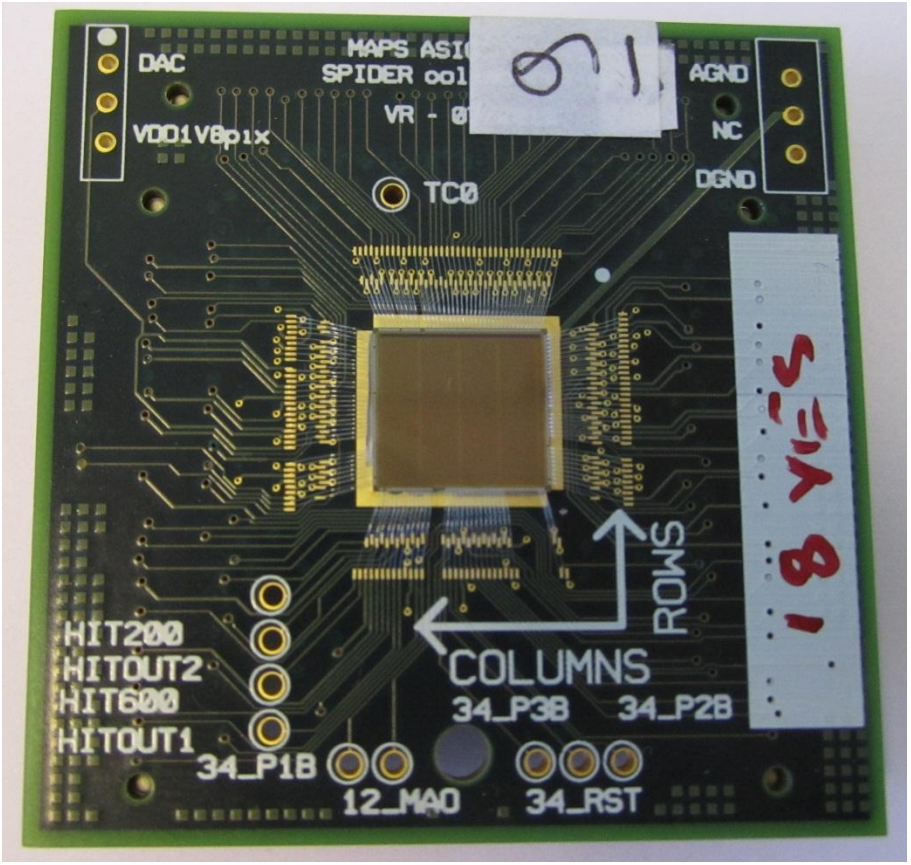
ULTIMATE (STAR) [3]

Picture from Greiner et al. [3]



Picture from FEE meeting in Bergamo [4]

TPAC



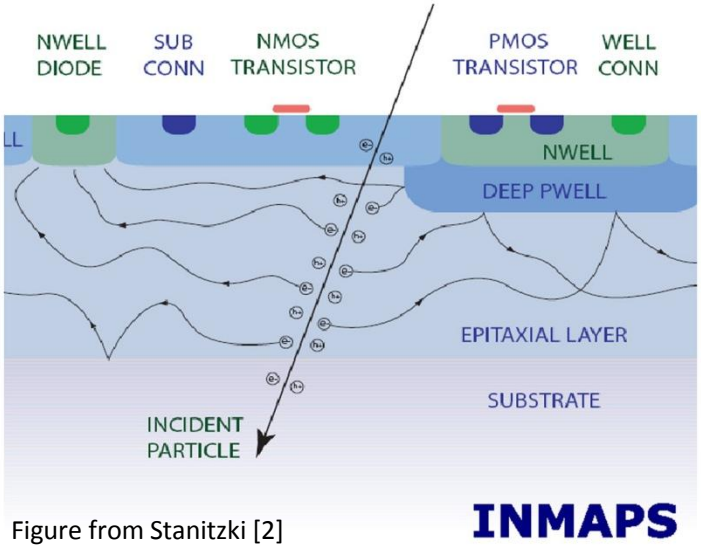


Figure from Stanitzki [2]

Deep p-well shields transistors -> signal registered at diode

Is the INMAPS technology suited as a starting point for the new ITS?

Irradiation tests

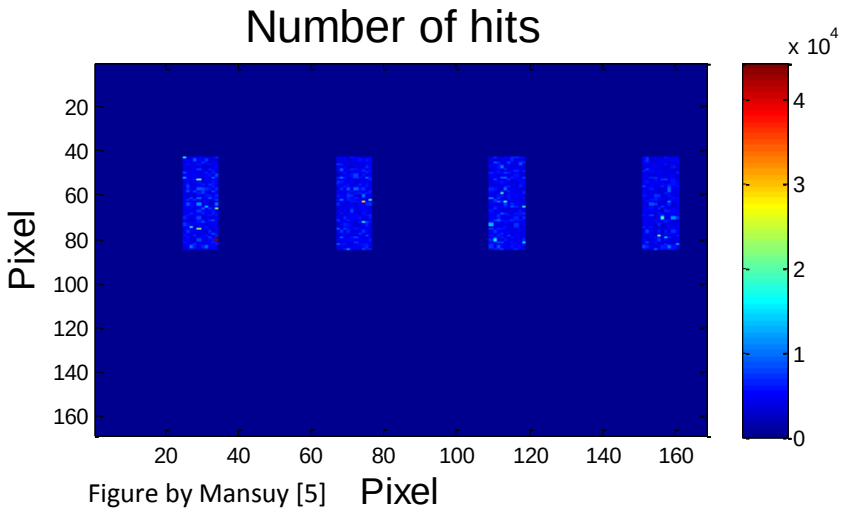
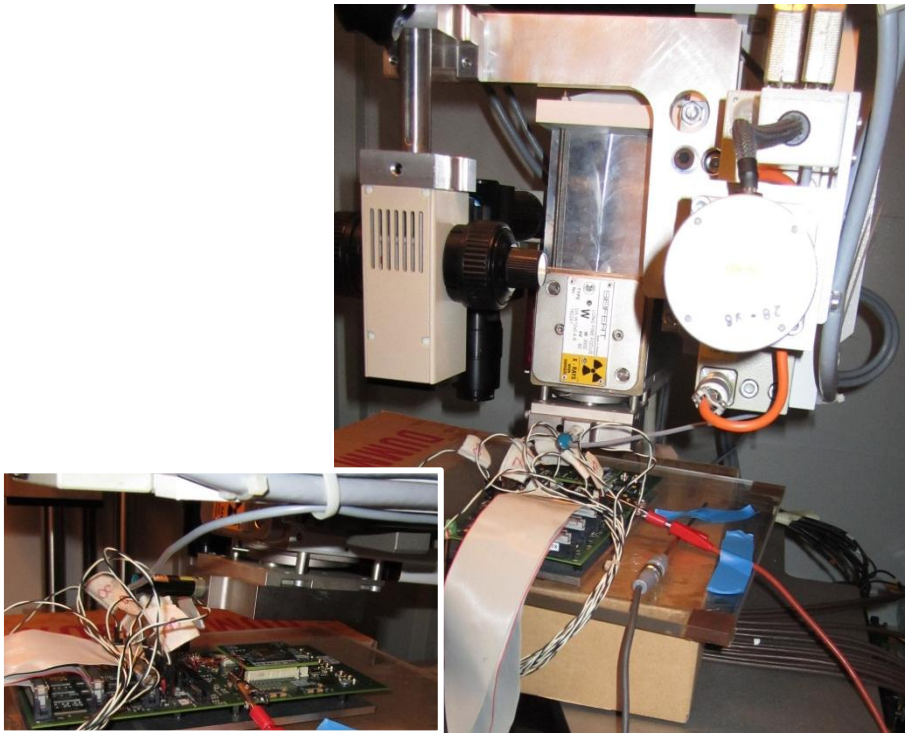
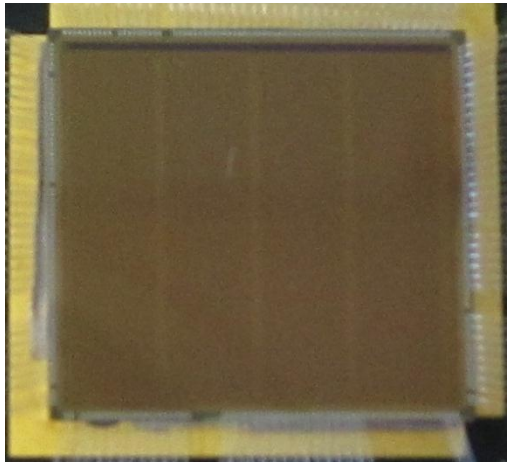


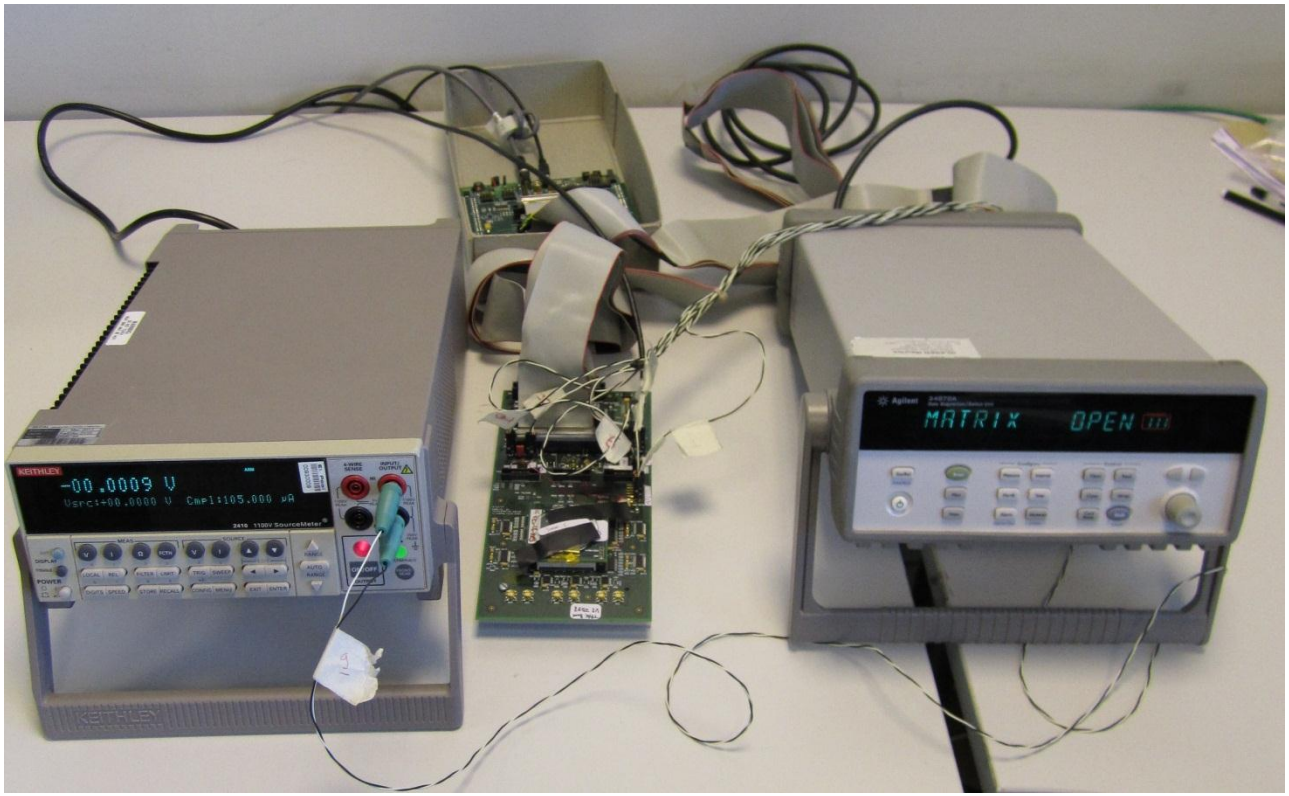
Figure by Mansuy [5]

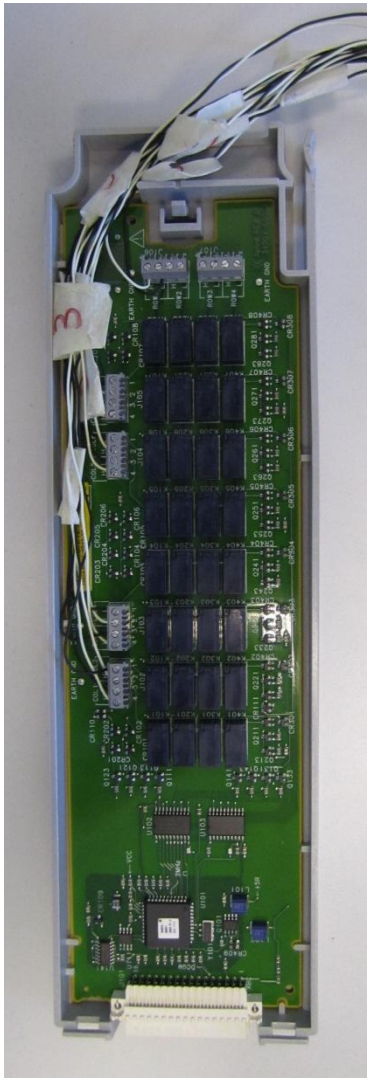




- Tungsten X-ray tube – 10 keV peak energy
- X-ray beam covering the whole sensor
- Dose rates between 3.3-33 krad/min
- Observe noise signals from the pixels
- Monitor 8 current values accessible on the readout card

Current monitoring - hardware

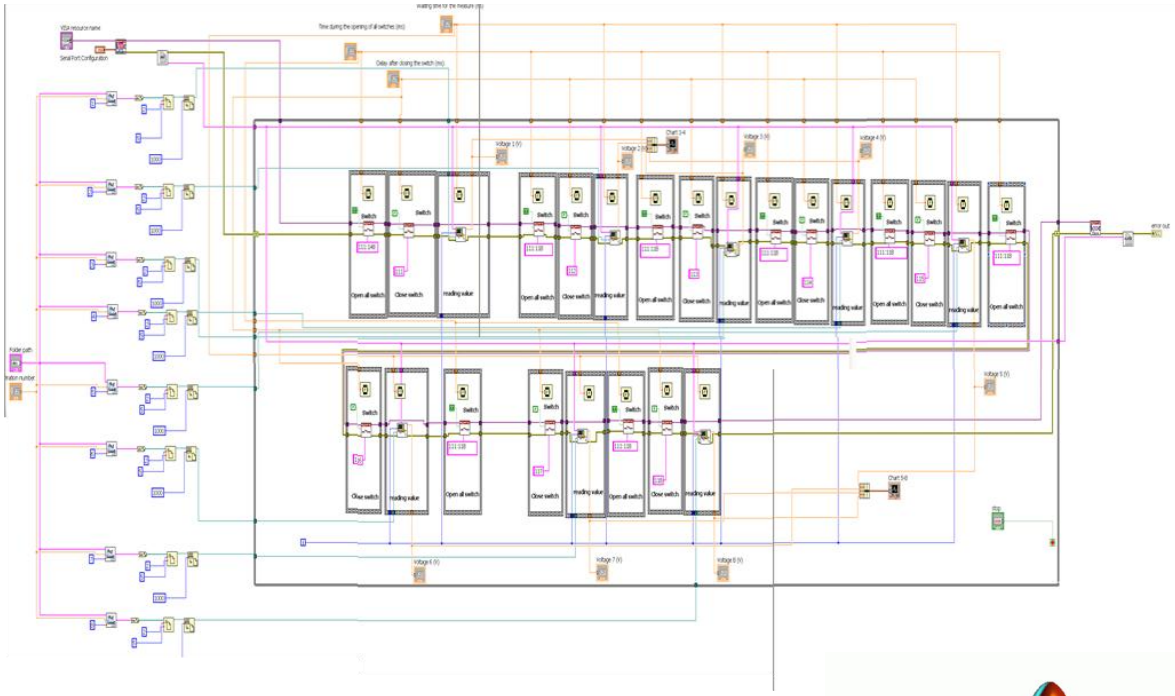


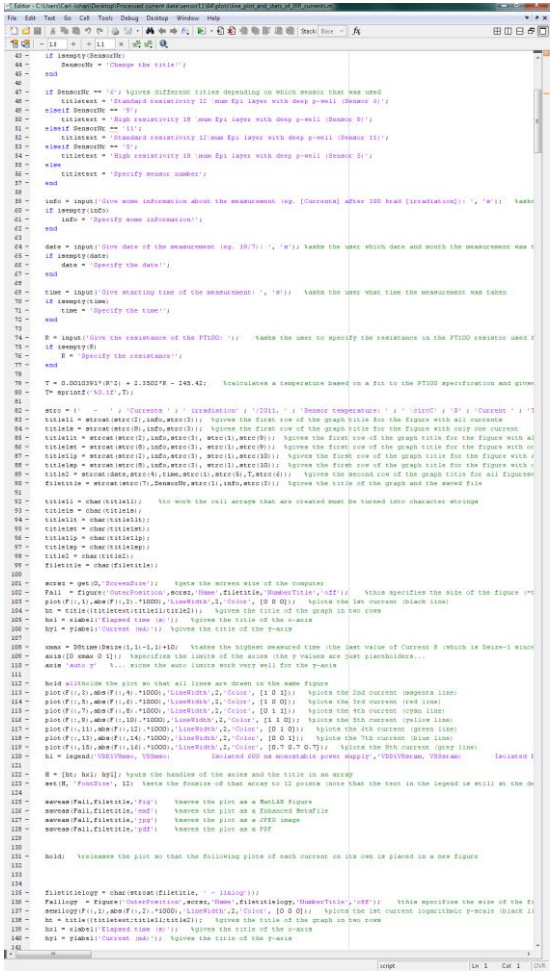


<u>Voltmeter</u>
Keithley 2410

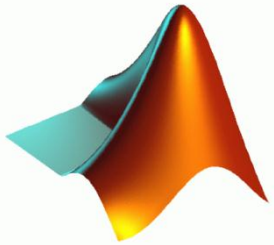
<u>Switch unit</u>
Agilent 34970A with
Agilent 34904A (4x8 Matrix Switch)

Current monitoring - software



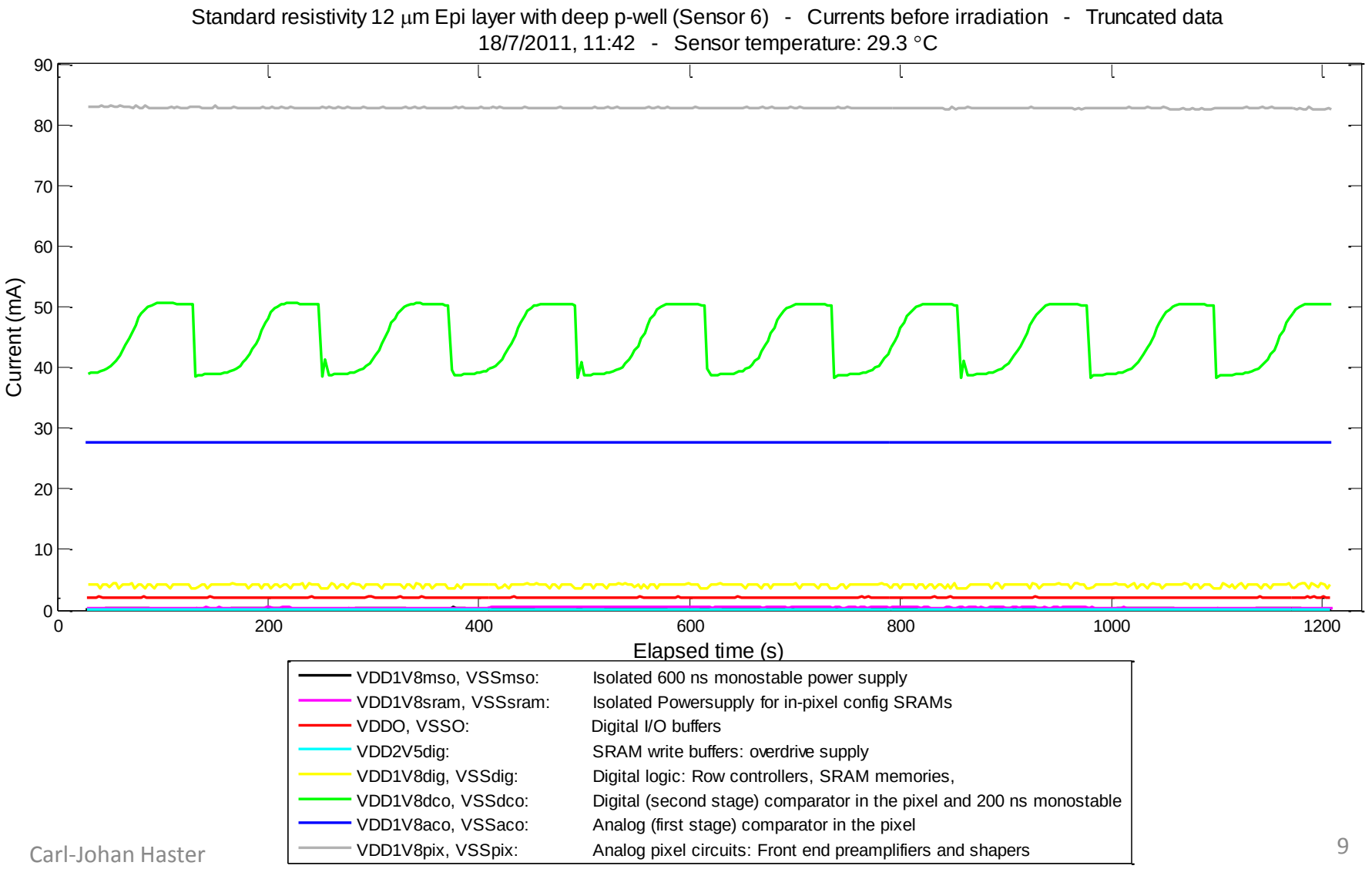


NATIONAL INSTRUMENTS LabVIEW

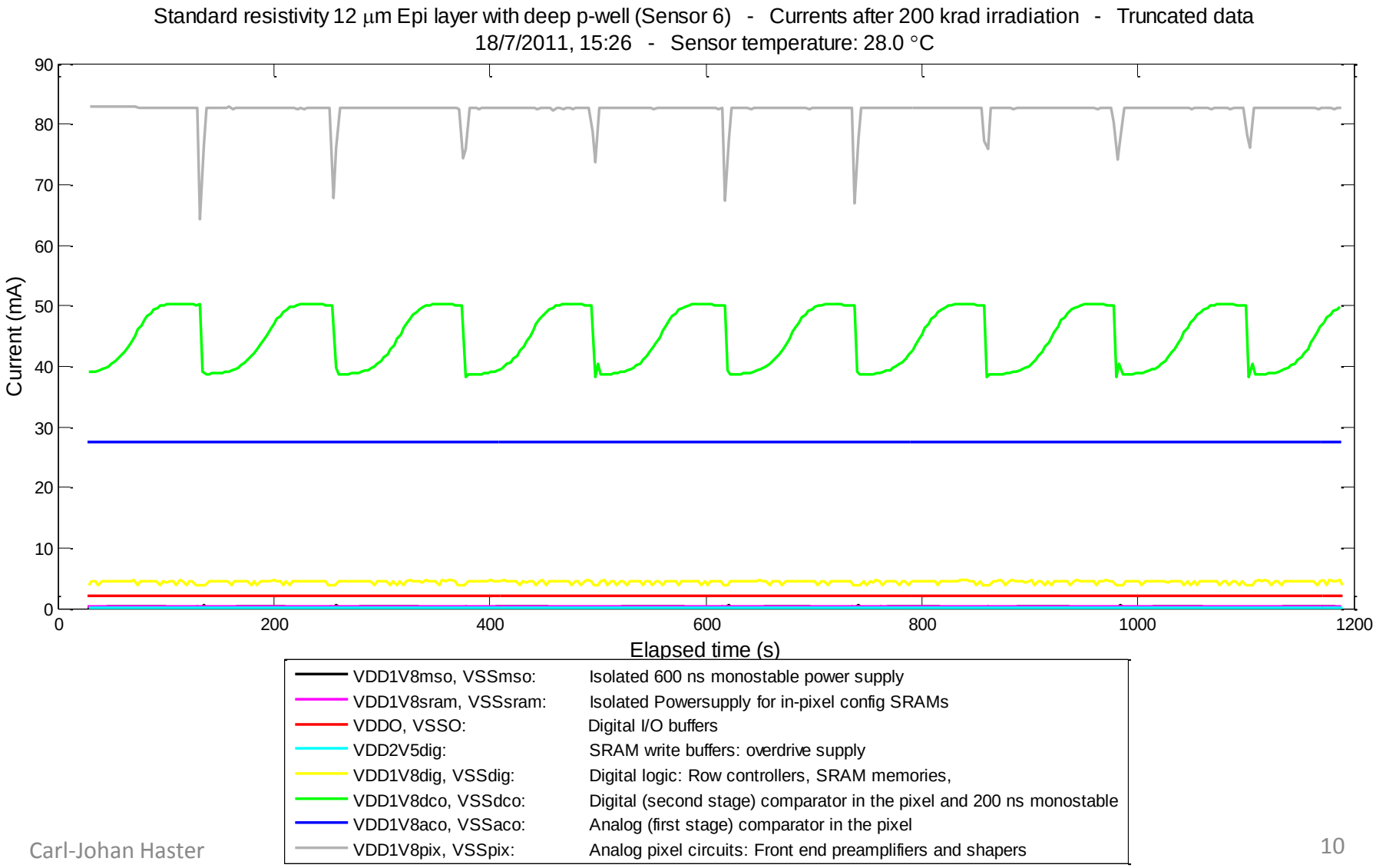


Co-written with Chloe Rolland

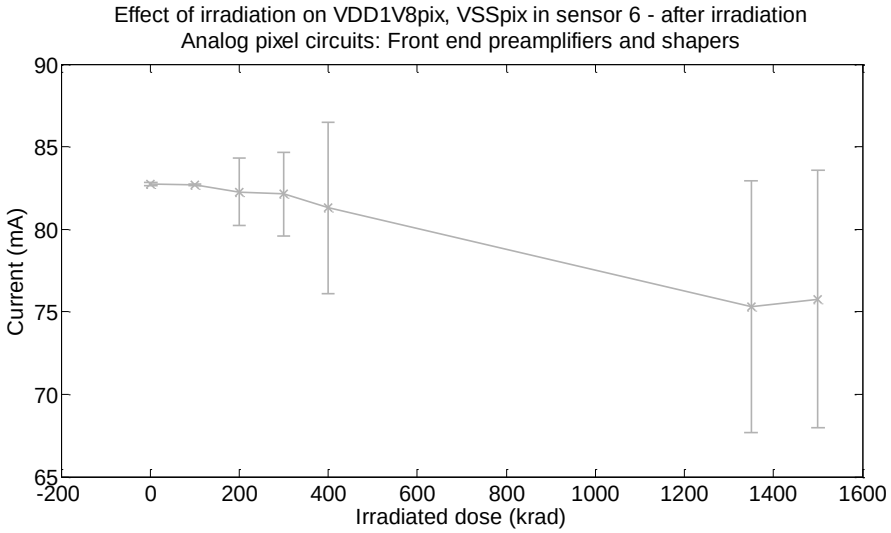
Currents before irradiation

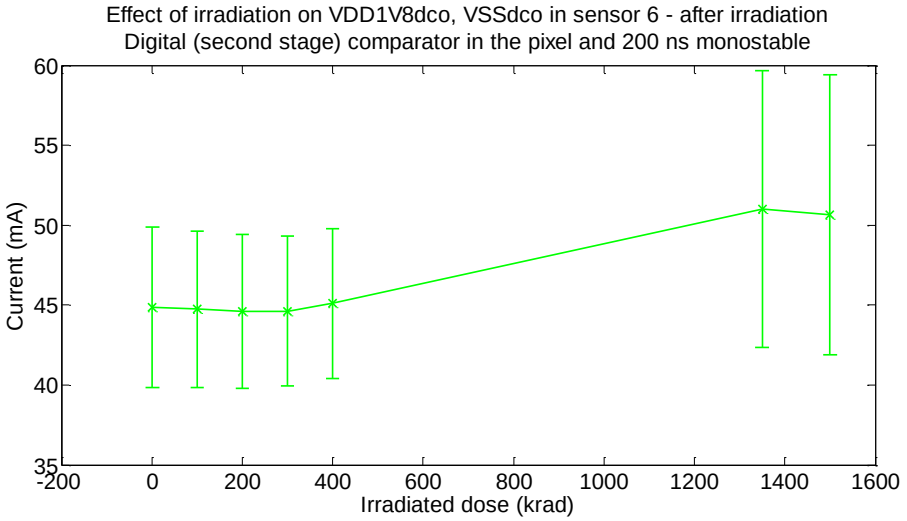


Currents after 200 krad



Effect of irradiation on currents





- Small changes at low doses
- Increase in uncertainties due to spikes
- Effects on loading the sensor configuration observed at very high doses

Conclusions

- Calibrate the on-board power supply for the SRAM to study the calibration loading process
- Need more granular dose steps
- Experiment with varying dose rates
- Investigate annealing behaviour

- Still early in the R&D phase

Picture references

1. Rossi, L., Fischer, P., Rohe, T. & Wermes, N. (2006). *Pixel Detectors: from Fundamentals to Applications*. Berlin: Springer.
2. Stanitzki, M. (2010). Nucl. Instr. and Meth. A doi:10.1016/j.nima.2010.11.166
3. L. Greiner et al., A MAPS based vertex detector for the STAR experiment at RHIC, Nuclear Instruments and Methods Section A, 2010, In Press, 10.1016/j.nima.2010.12.006
4. http://indico.cern.ch/conferenceOtherViews.py?view=standard&confId=122027
5. Mansuy, C. (2011). CERN – PH-AID-DT