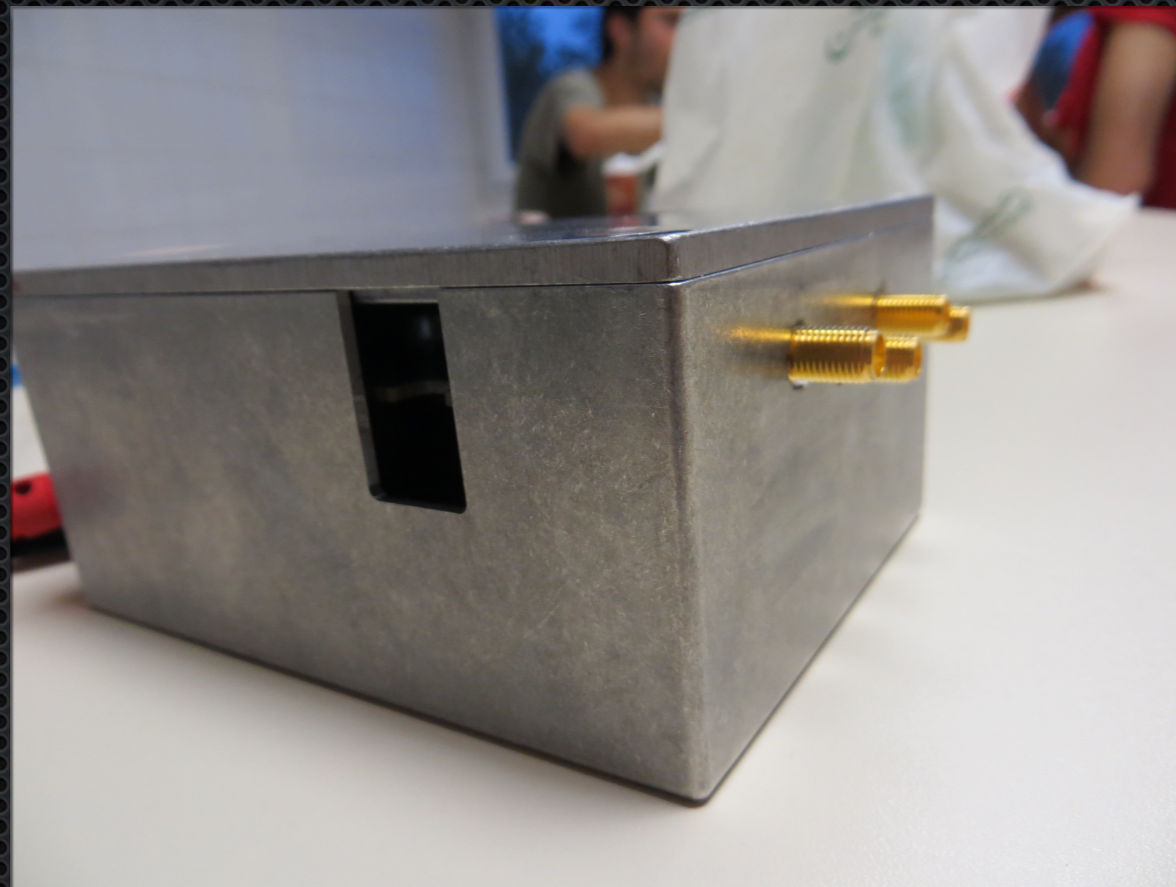


Edge -TCT measurements on irradiated HV - CMOS sensors

A summer student presentation by
Constantin Weisser

I came to CERN and built a
box . . .

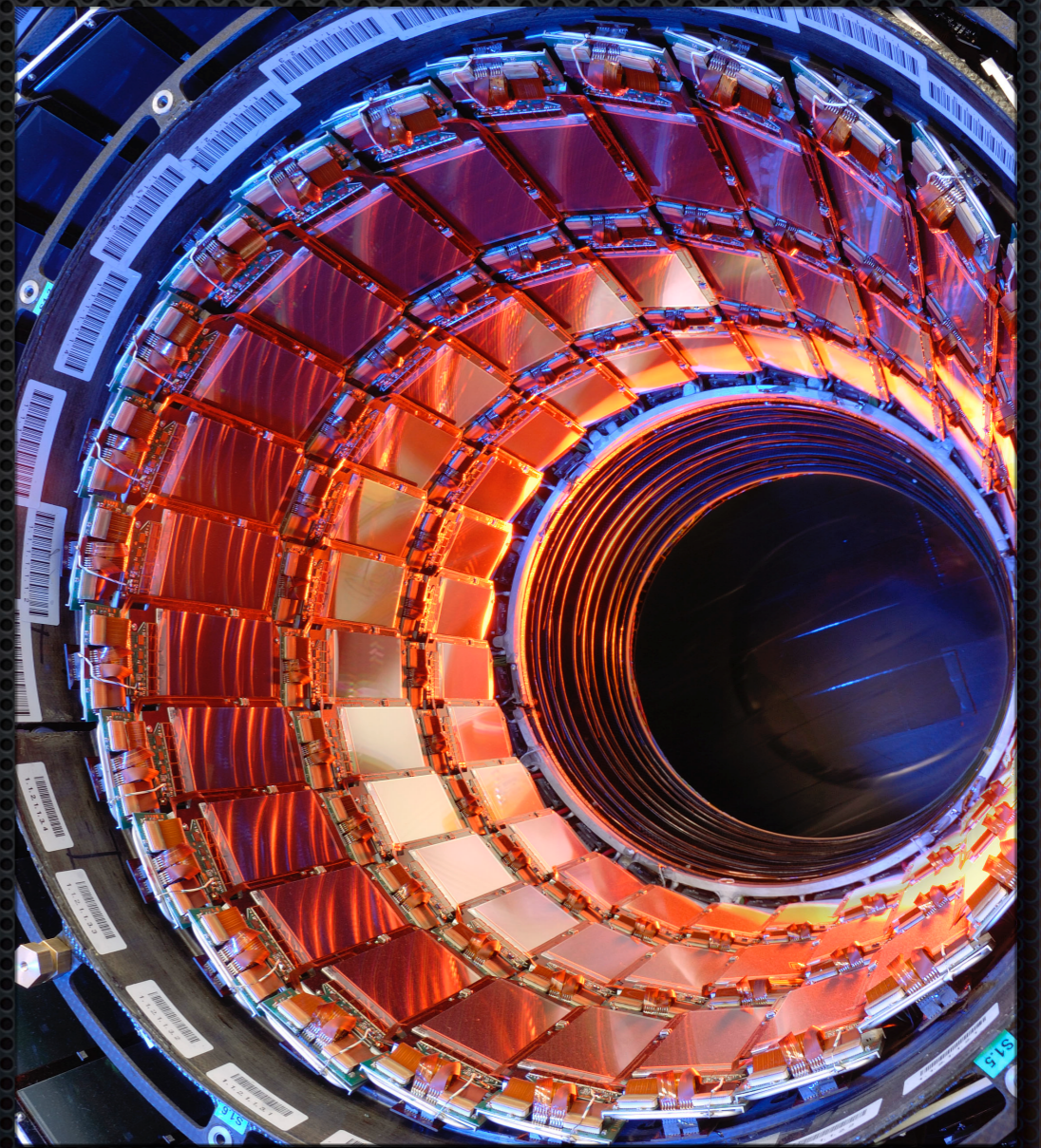


Actually,
I only drilled holes into it.

Background

1. Pixel detectors in LHC are used for Particle Reconstruction
2. With the new upgrades a higher granularity of sensors is needed and particles will exert 10 times more fluence
3. Detectors are not perfect and radiation can induce defects in the crystal lattice

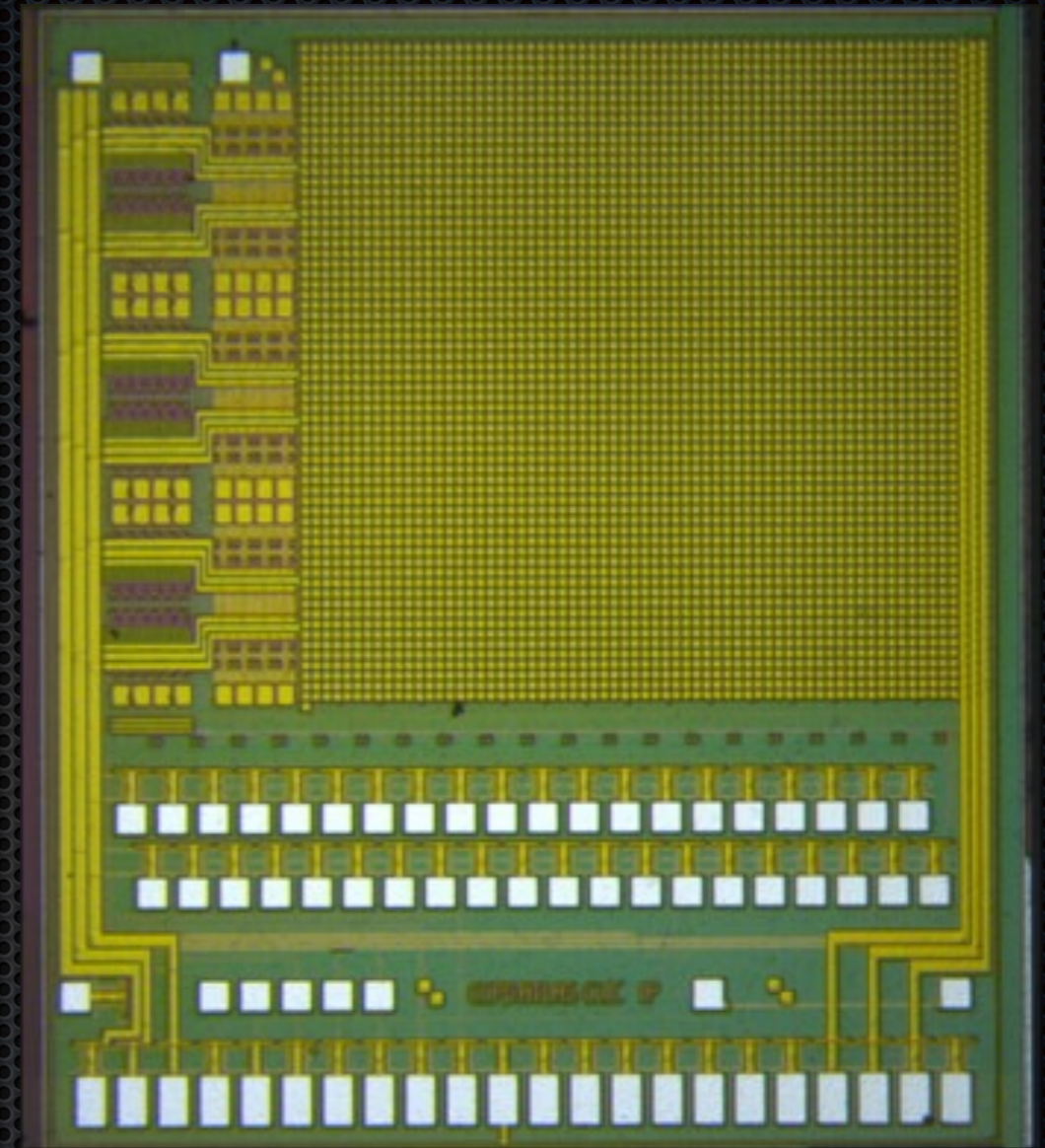
⇒ We need **cost efficient and radiation hard detectors!**



source: <http://wreel.info/images/photos/d072403e5ec23ff7bf9eaf888011b37c1bbe728f.jpg>

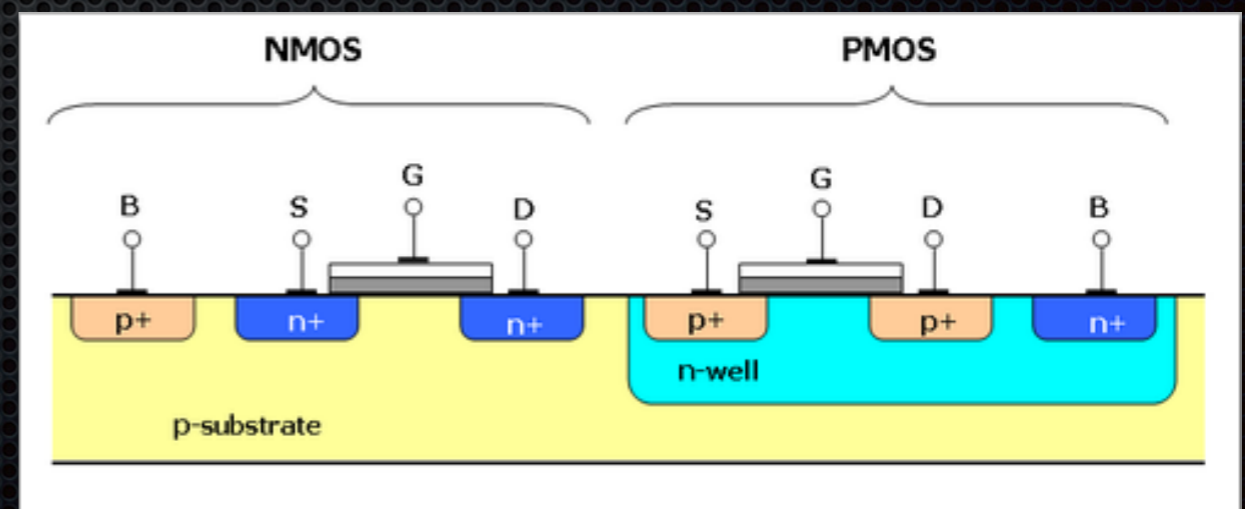
HV-CMOS

1. Used by automotive industry
2. Cheap
3. Multiple suppliers possible



HV-CMOS chip version 3

BUT,
we need to test them

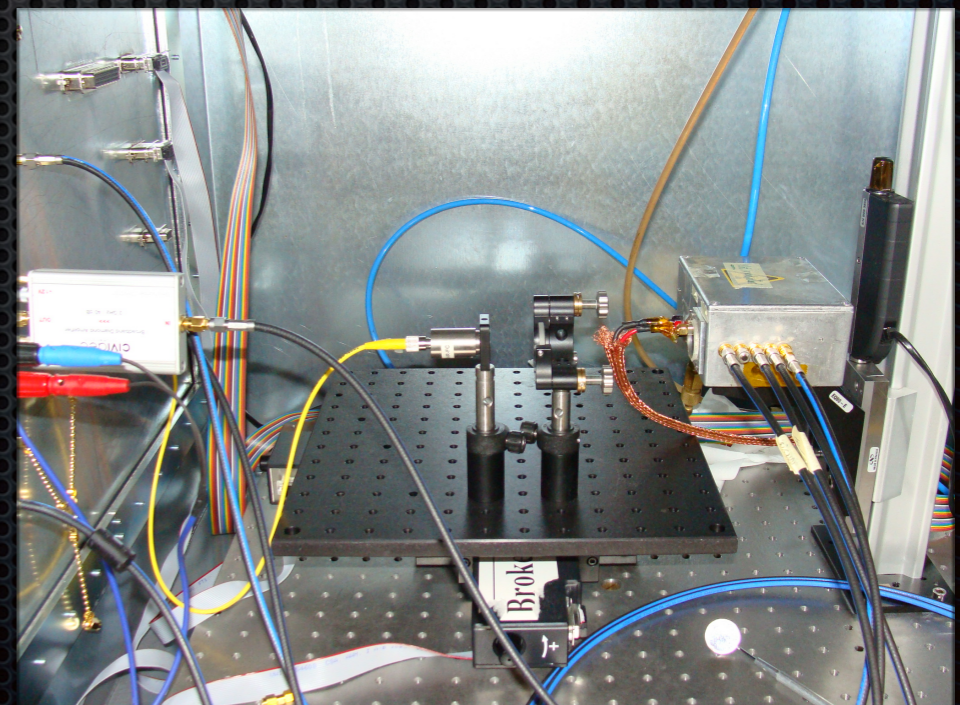
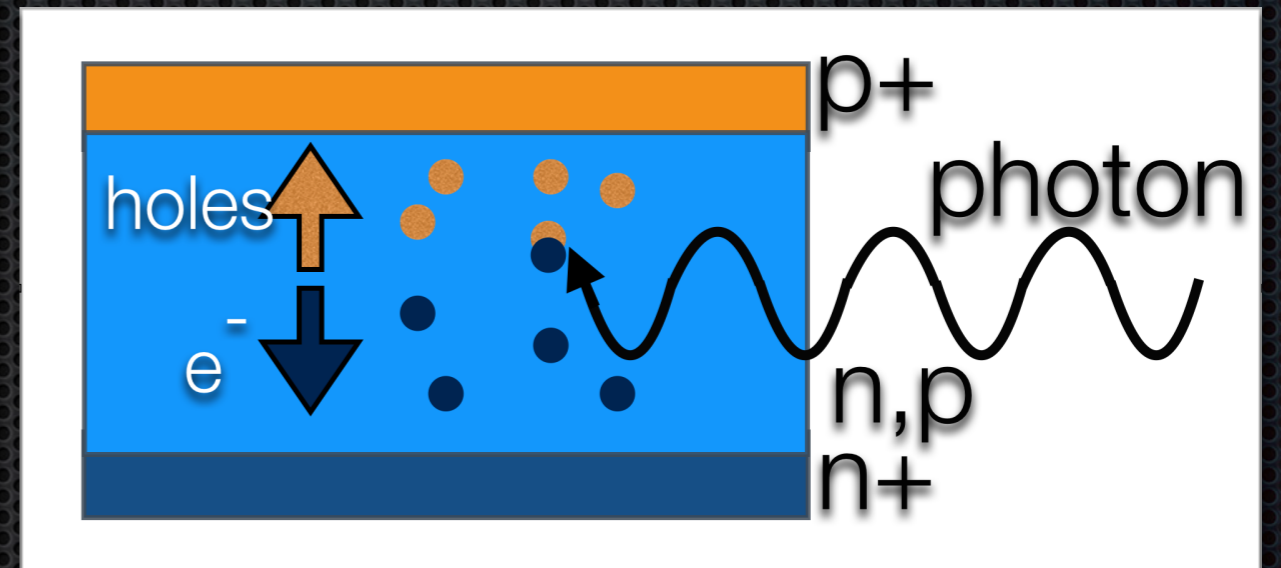


HV-CMOS and Readout

- ✦ HV-CMOS chips can be used as pixel or strip detectors
- ✦ Active elements provide amplification directly on chip
- ✦ Therefore, no separate readout chip is needed in the (distant) future, which reduces the thickness of “dead material”, that doesn’t record a signal
- ✦ No bump-bonding needed

Edge - TCT technique

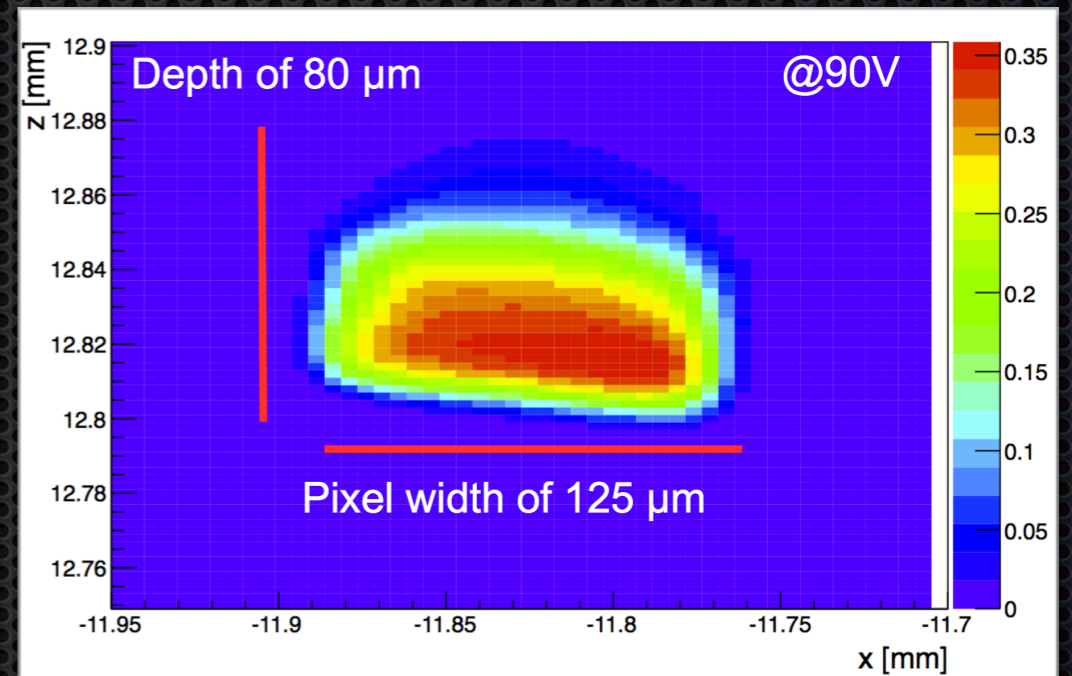
- Laser light is shone onto the sensor from the side
- Electron - Hole pairs are created in the depletion region
- These drift to the top or bottom due to the electric field in the bulk
- This signal is recorded



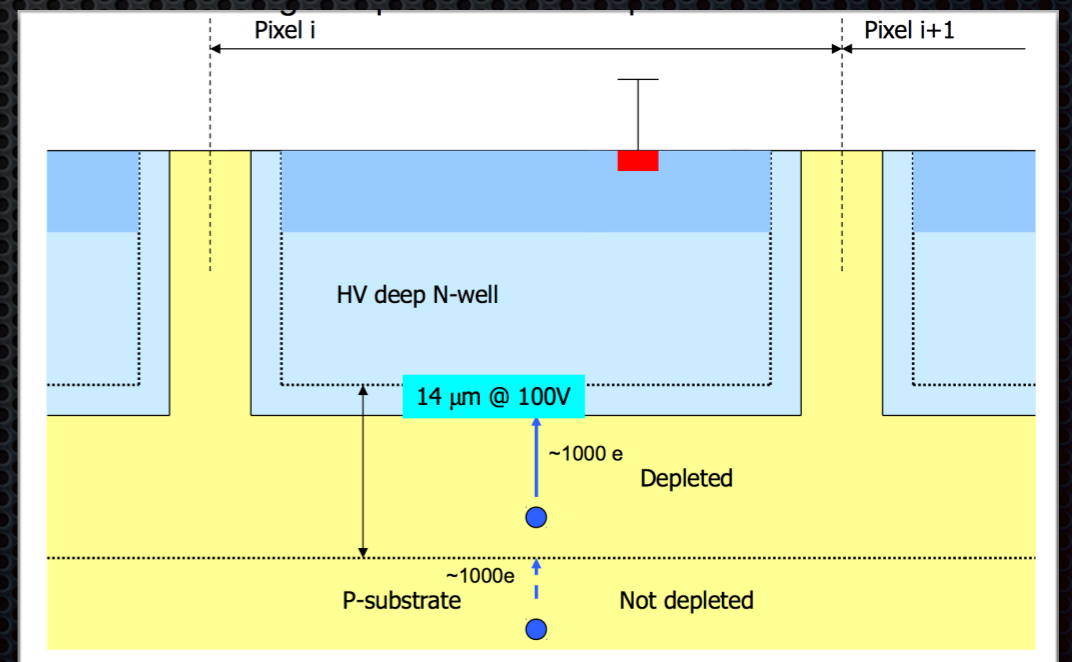
Edge - TCT continued

Monitoring the current pulses over time (transients) can give information about

- drift velocity profile
- trapping times
- charge collection efficiency
- depletion voltage



Maria Brunetti



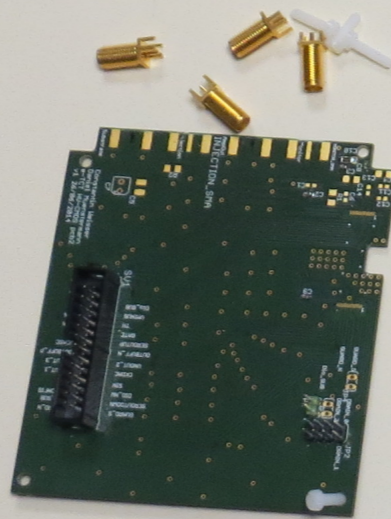
Gregor Kramberger

Integration of the chip into the edge - TCT setup

Lid

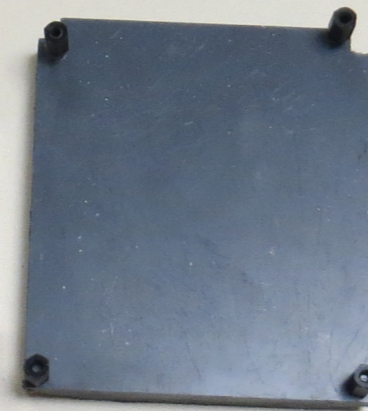
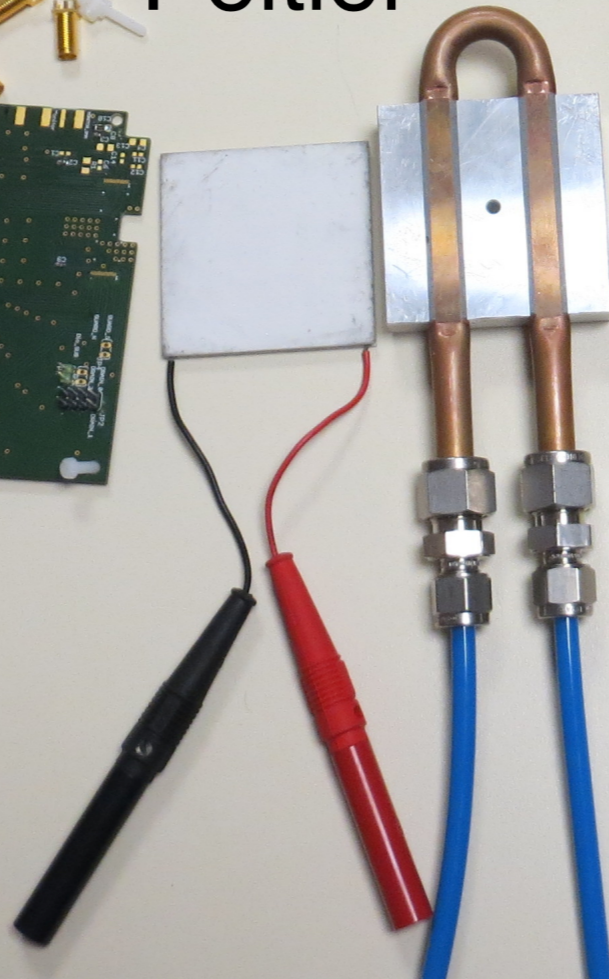


PCB

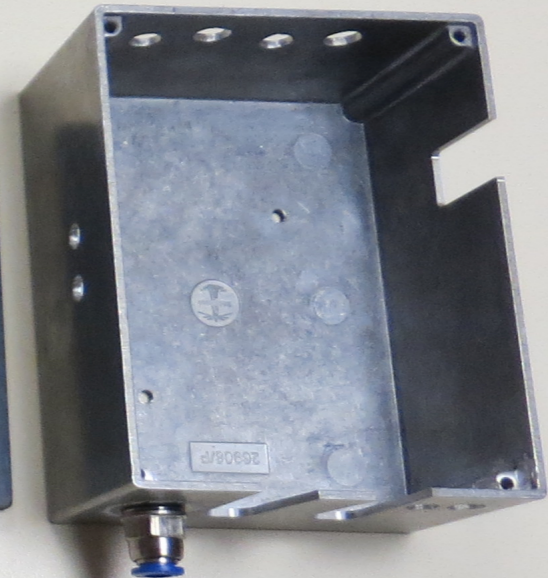


Cooling Block

Peltier

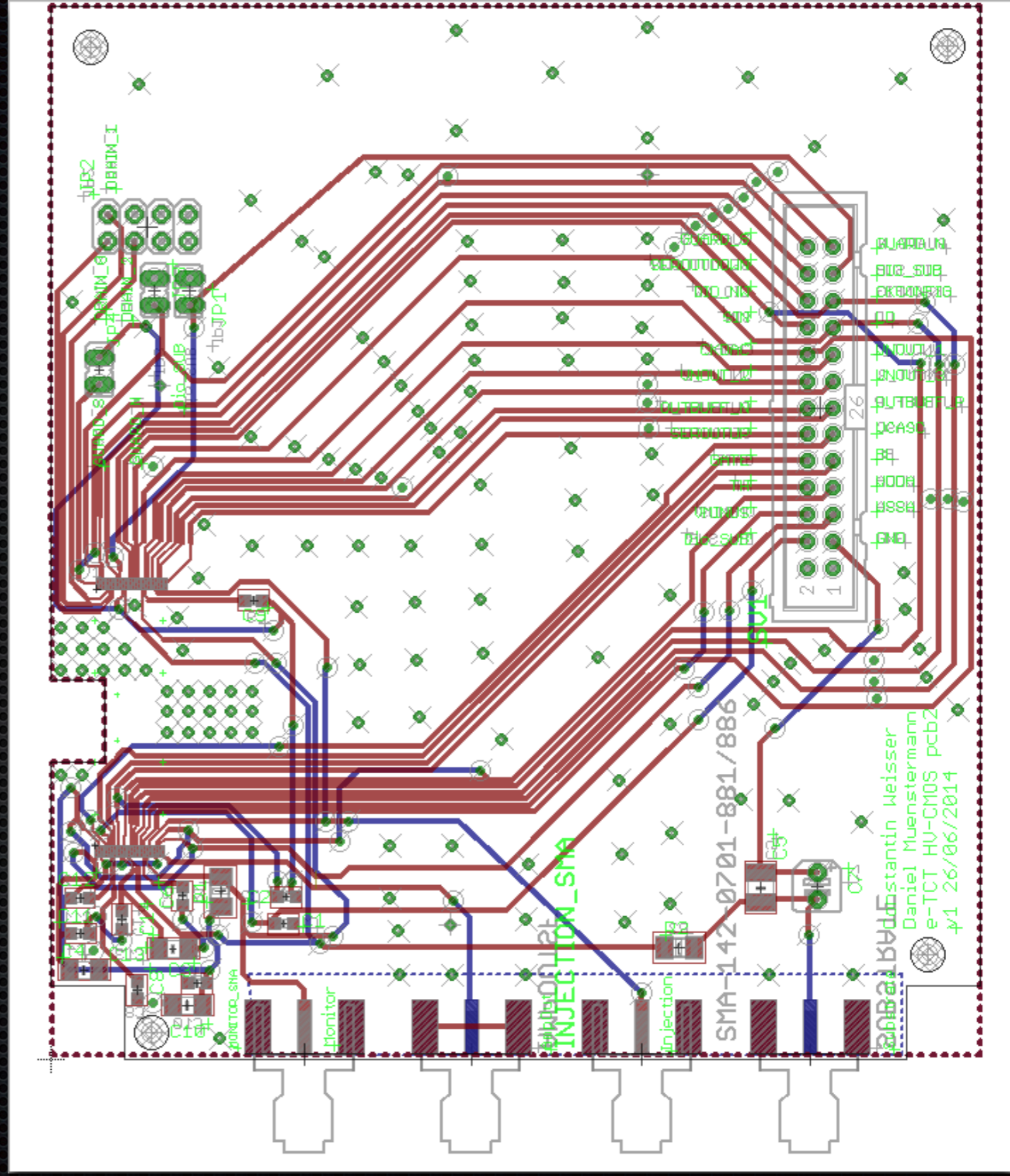


Plastic Plates



Box

PCB



How is this different

- ✦ Investigation into HV - CMOS sensors for particle physics is relatively recent
- ✦ Previous HV - CMOS chips have been completely characterised, but this third version of the chip hasn't
- ✦ The thickness of the charge collection layer has not been measured accurately

Outlook

- ✦ The box needs to be integrated into the edge - TCT setup
- ✦ The charge collection layer thickness will be measured
- ✦ The efficiency of sensors at different degrees of radiation will be recorded
- ✦ Tests will be performed, whether temperature treatments will increase the collected charge

If favourable results are found this “would open a completely new production method for cost-efficient, large-scale, ultra-fine-pitch pixel and strip detectors.”

Daniel Muenstermann

Acknowledgements

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