Karlsruhe Institute of Technology

► HV-CMOS

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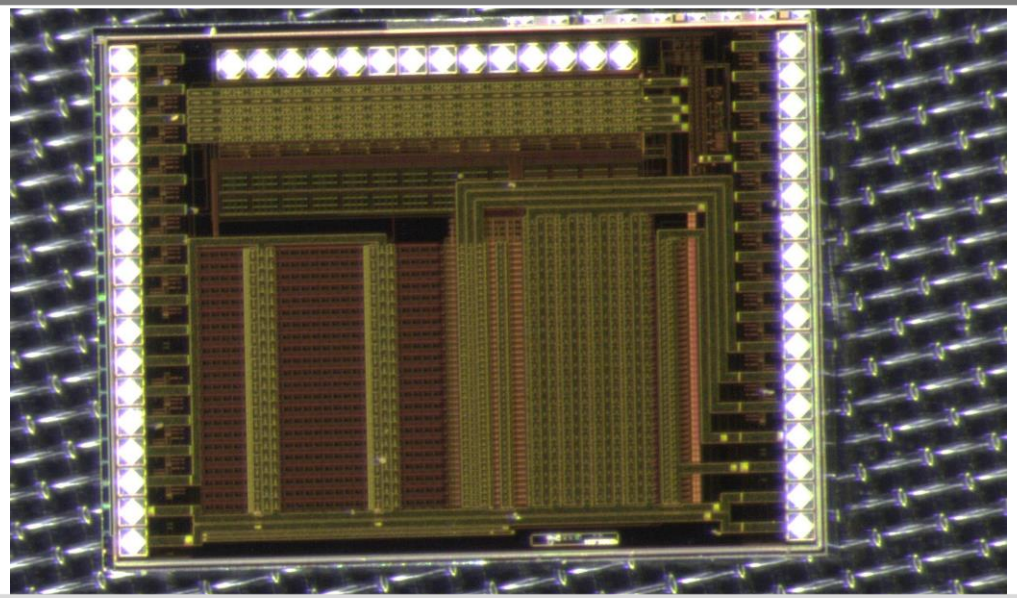
Robert Eber, Felix Ehrler, Ivan Peric, Sebastian Racs

Institut für Experimentelle Kernphysik (EKP), Institut für Prozessdatenverarbeitung und Elektronik (IPE)



HVStripV1 – Status

- 1st irradiation campaign completed
  - Stepwise irradiation with X-rays to 600kGy
  - Measurements
    - MOSFETs characteristics
    - Noise, Gain

- 1 chip irradiated to 2e15n_{eq}/cm^2 (parasitic use of 23MeV proton beam)
  - Waiting to get the chip back

- Irradiation to 1e15n_{eq}/cm^2 queued

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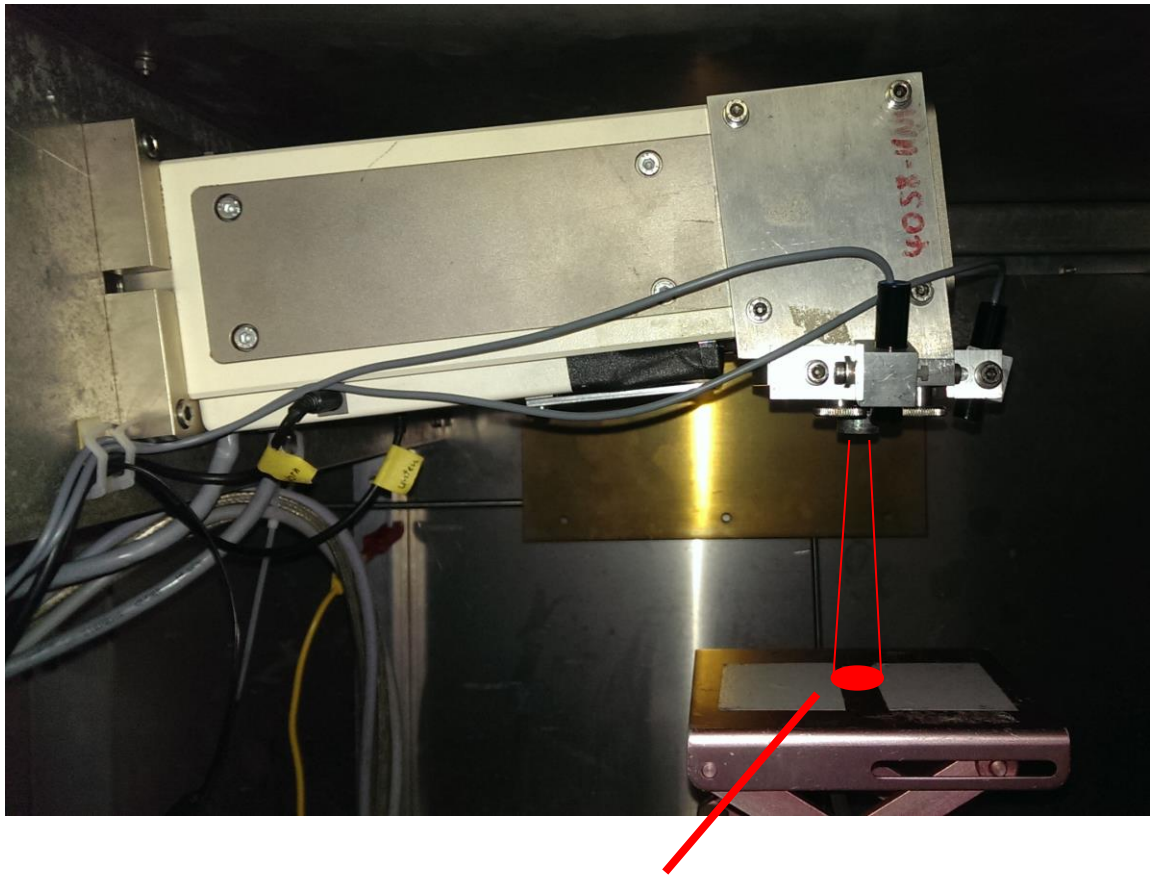
EKP X-ray tube



Small irradiation spot

- EKP X-ray tube
- Maximum energy: 60keV
- Variable tube current: 2mA – 30mA
  - Fast irradiation ~15kGy/h

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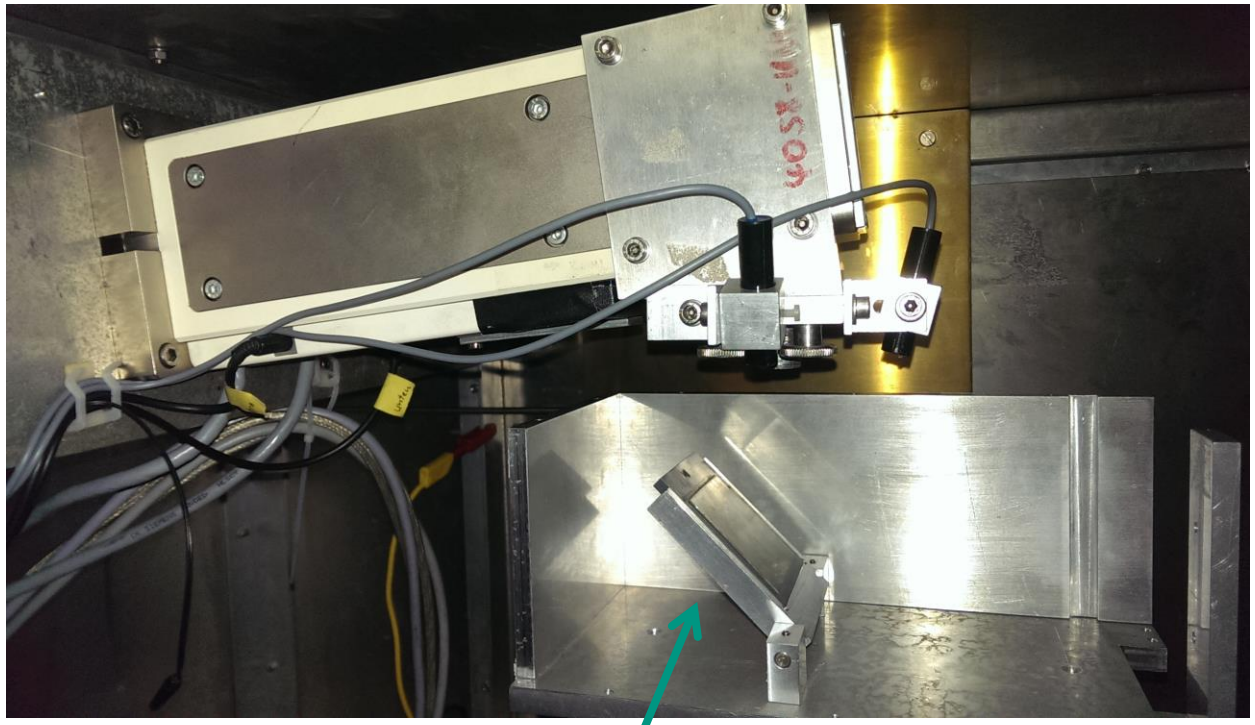
EKP X-ray tube



Target holder for exchangeable targets

- EKP X-ray tube
- Maximum energy: 60keV
- Variable tube current: 2mA – 30mA
  - Fast irradiation ~10kGy/h
  - Acceptable rate for spectra measurements
- Different targets available
  - Fe, Cu, Zn, Mo, Ag, In, Sn

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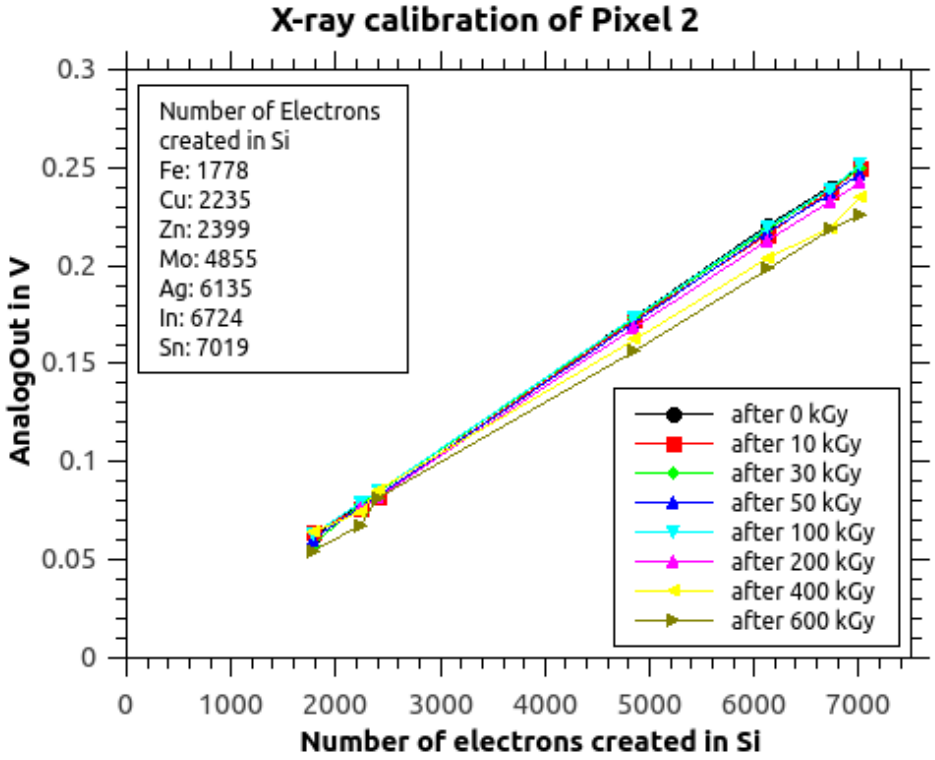
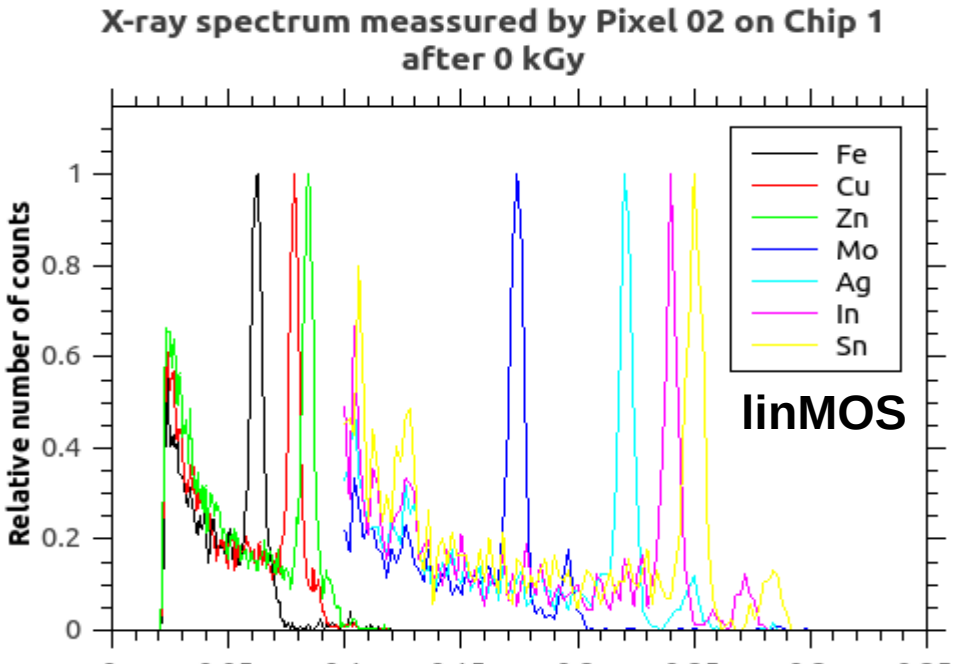
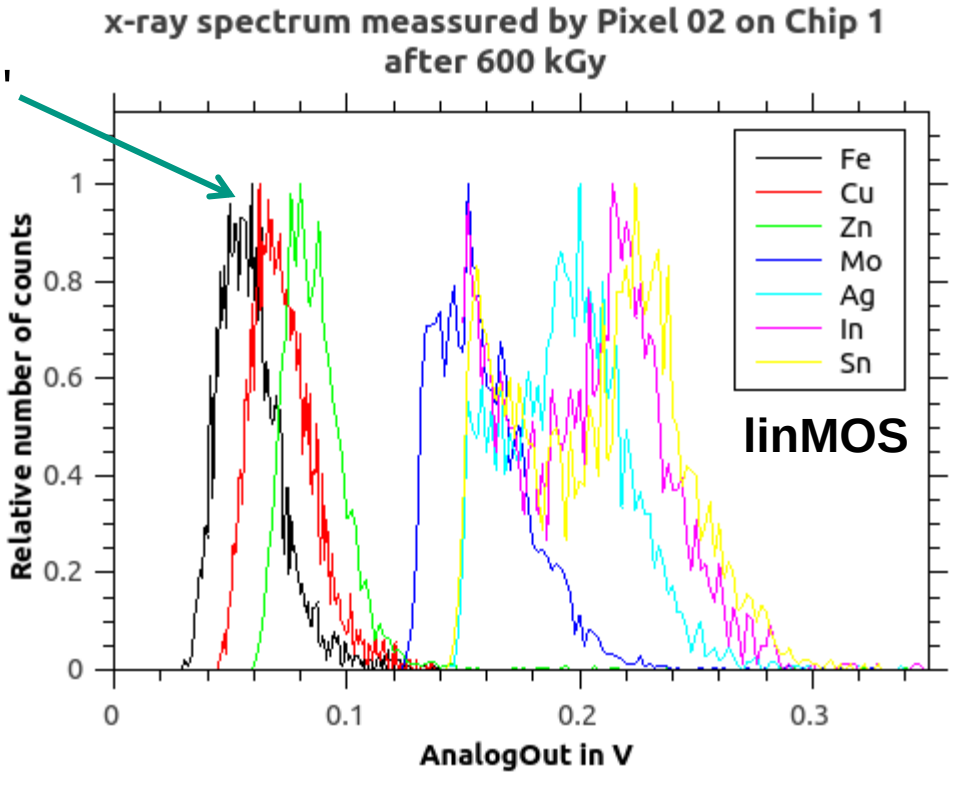
Spectra measurements

- Analog calibration of pixel (linear NMOS)
- Increase in noise
- Decreased gain after high dose
- Small effect, but visible at Dose > 200kGy



"Signal trigger"





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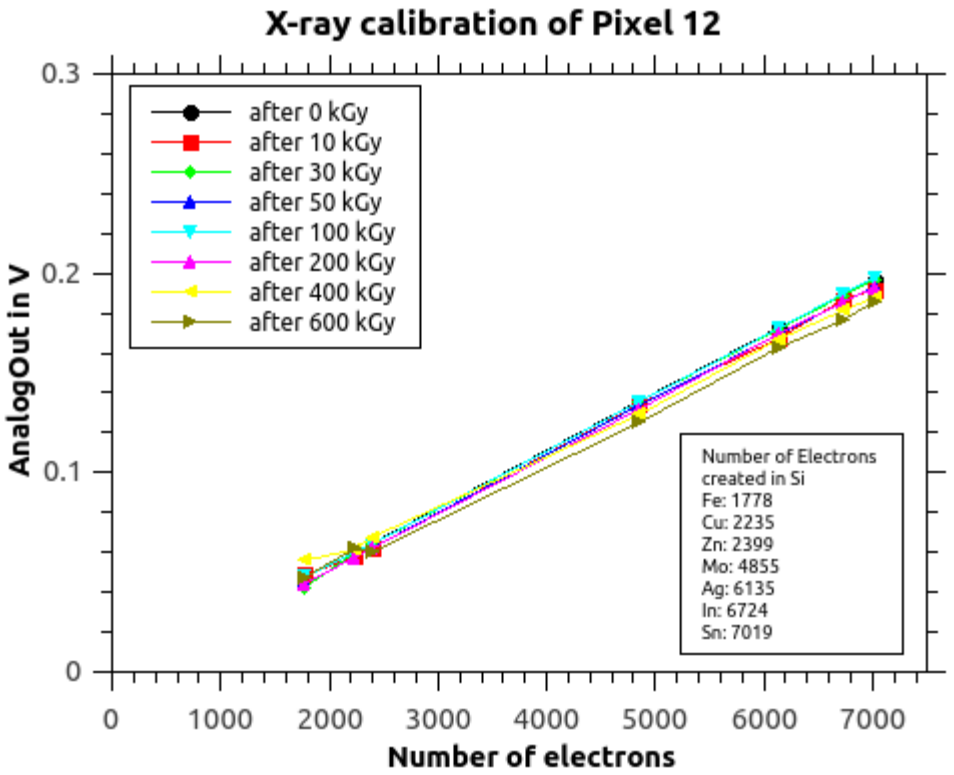
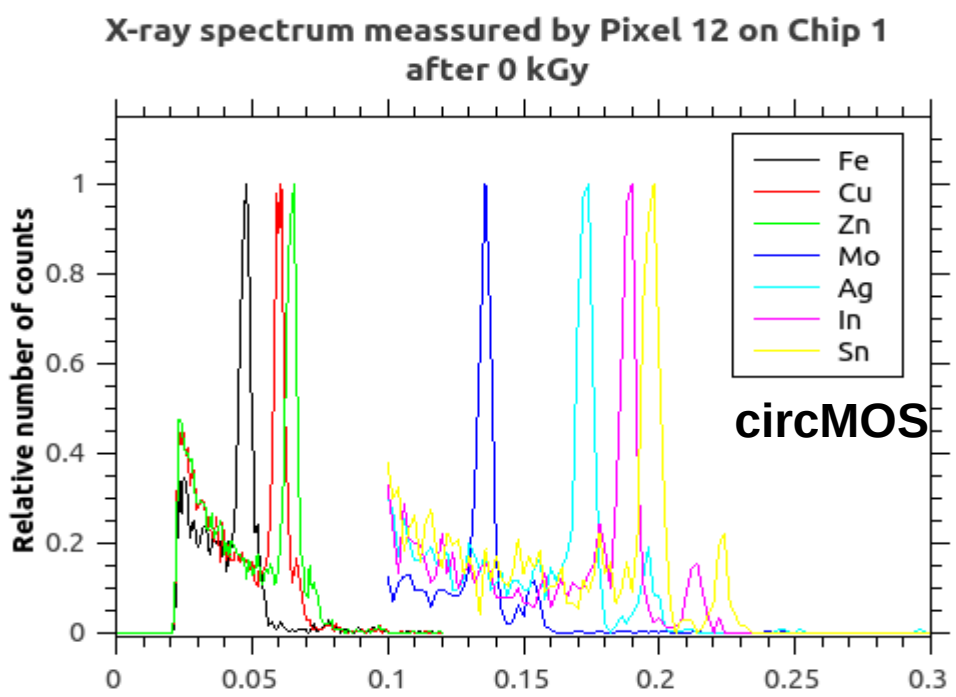
Spectra measurements

- Circular NMOS
- Also increase in noise
- Small effect even after irradation





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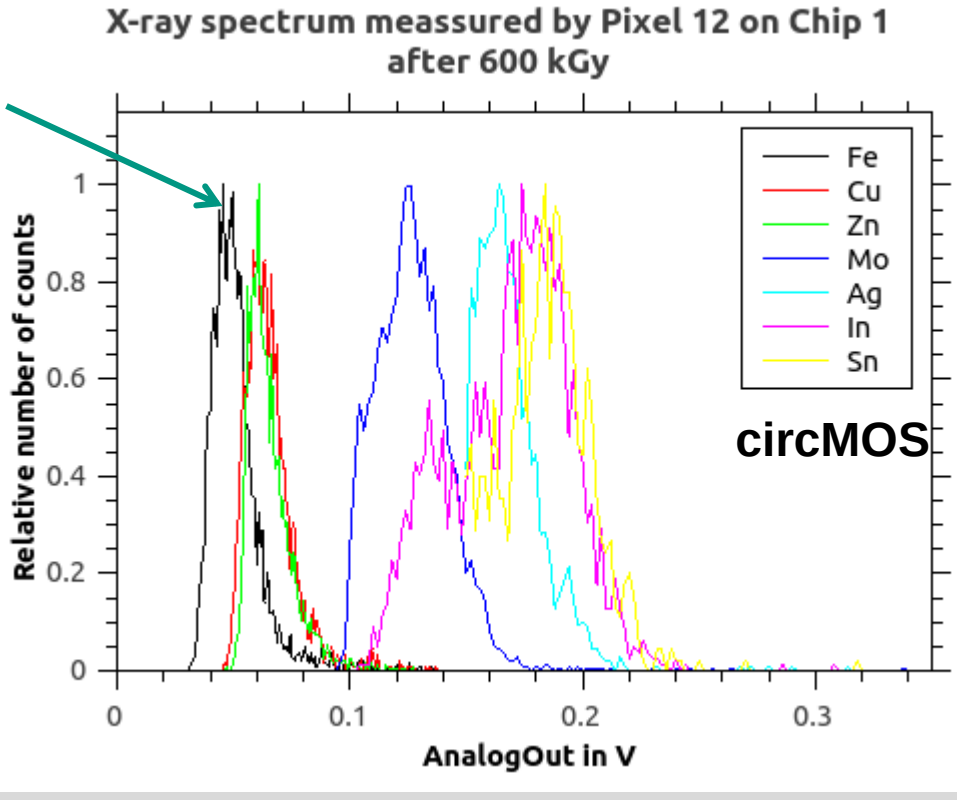

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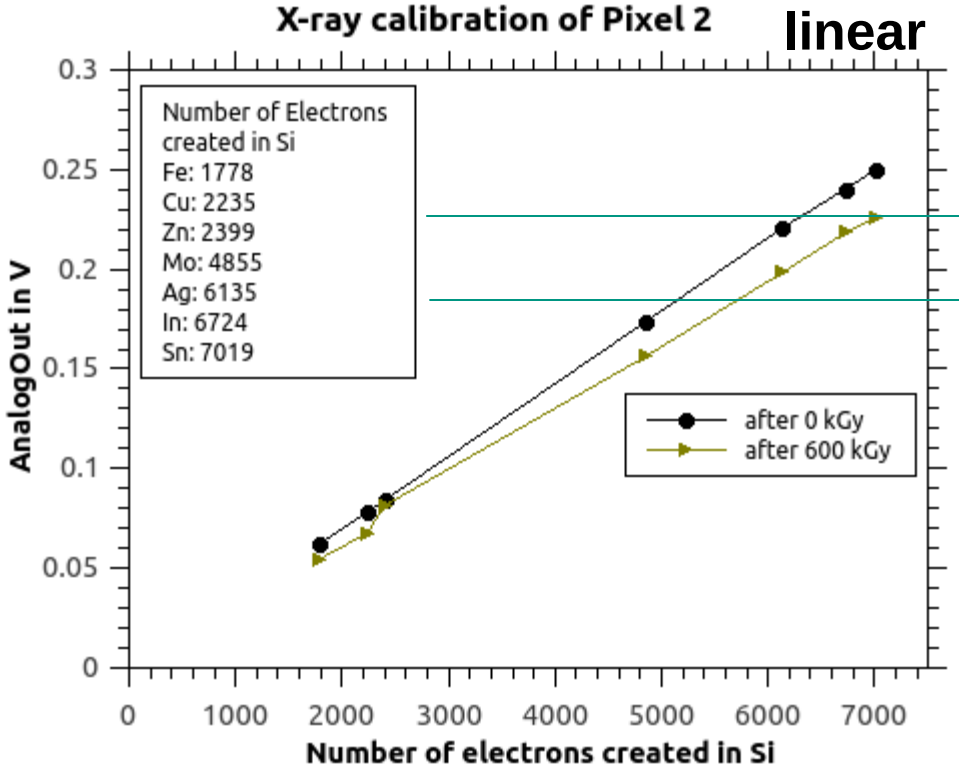
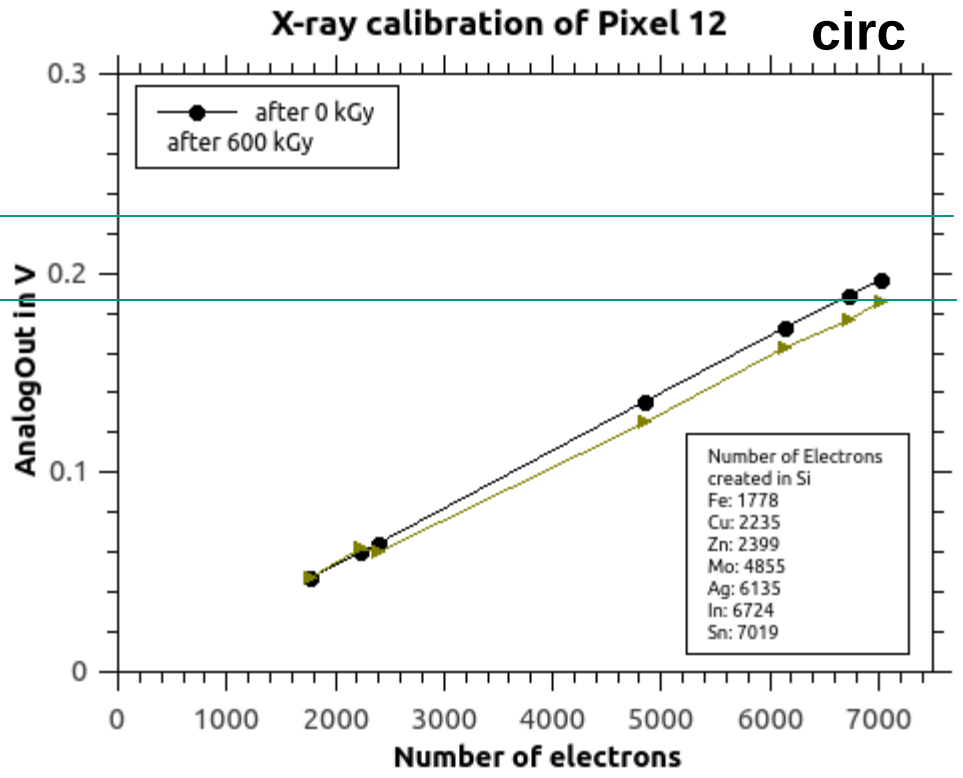
Linear NMOS and circular NMOS

- Smaller analog output of the pixels with enclosed transistors
- Less effect after large dose
- Linear NMOS still working (can handle small signals?)





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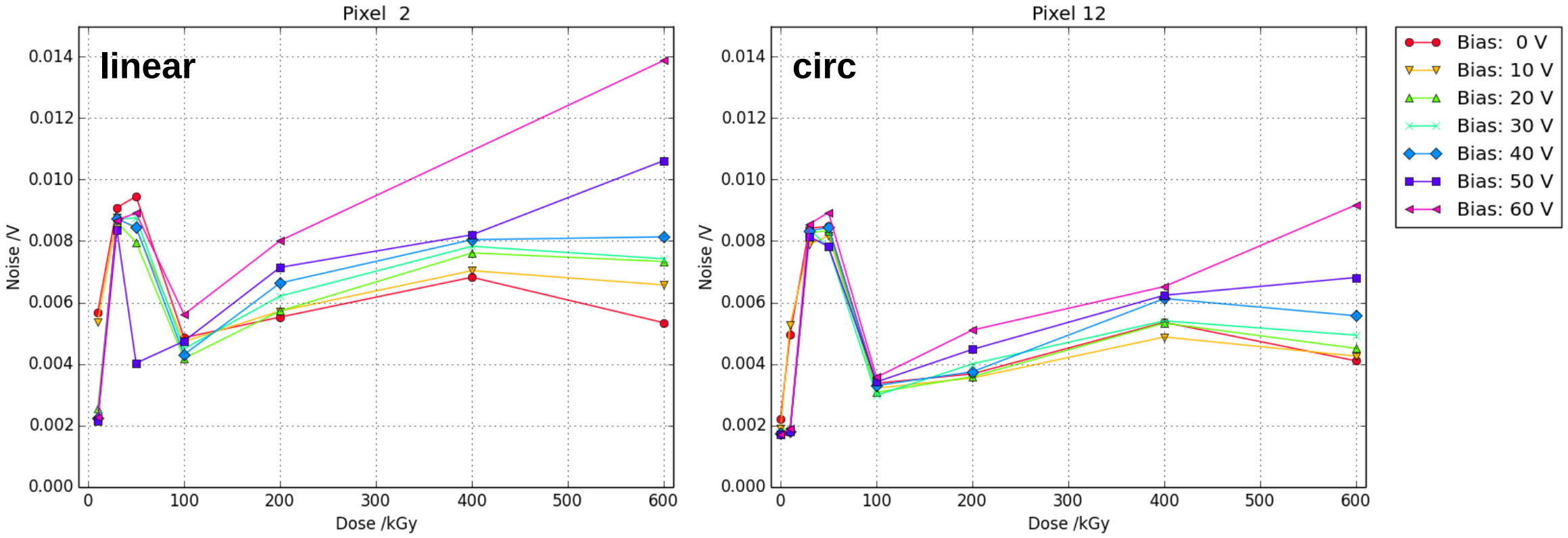
Noise of Pixels vs. Dose



- Noise of pixels increases with dose at envisaged bias voltage

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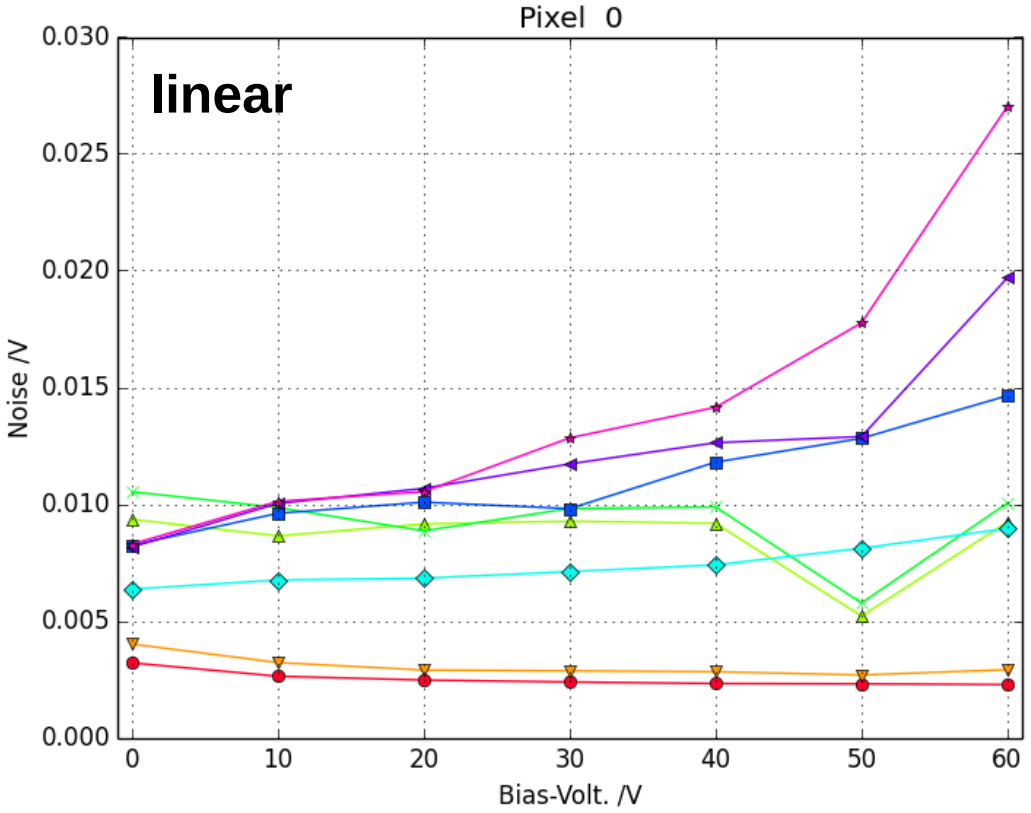
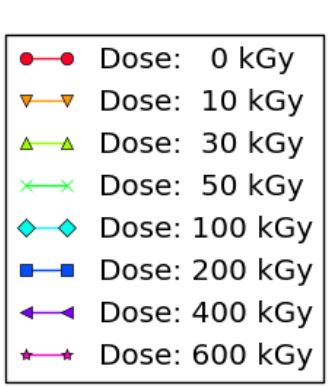
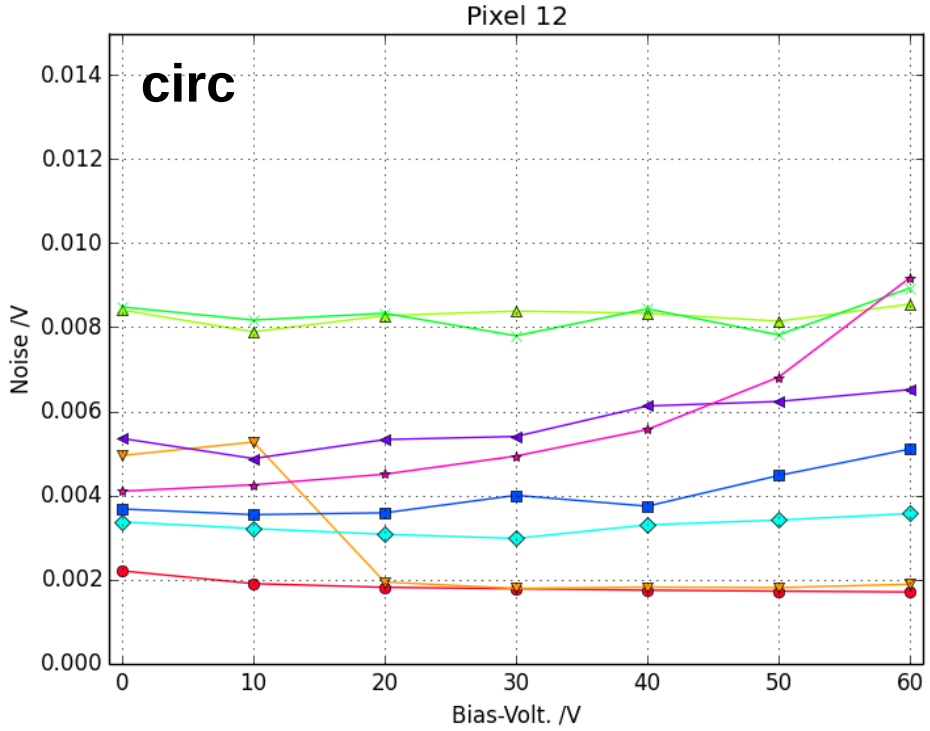
Noise of Pixels vs. Bias voltage





- Noise decreases with voltage before irradiation
- Increase in noise after irradation



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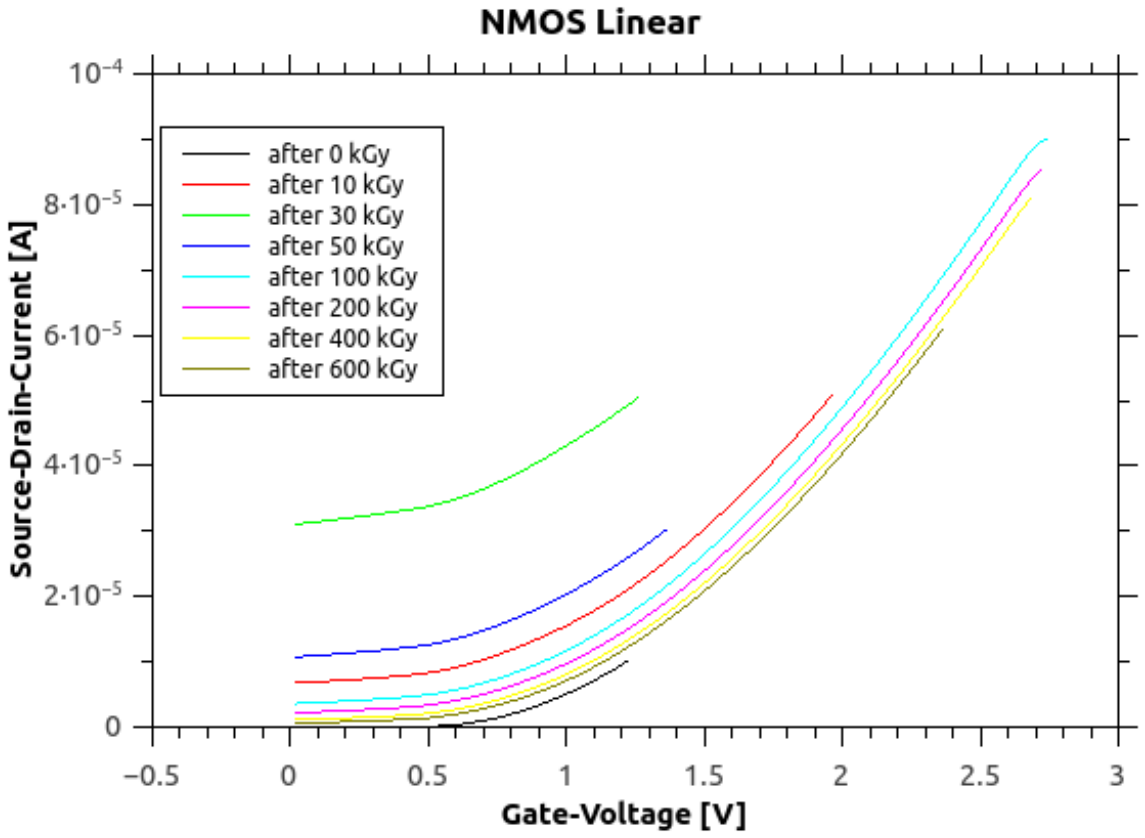
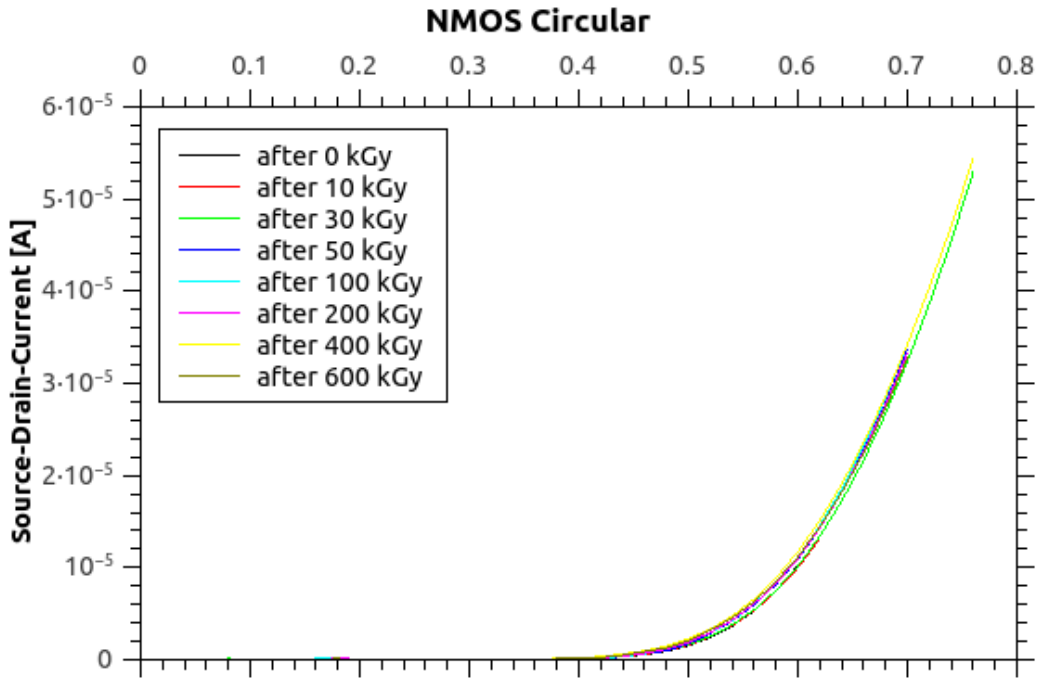
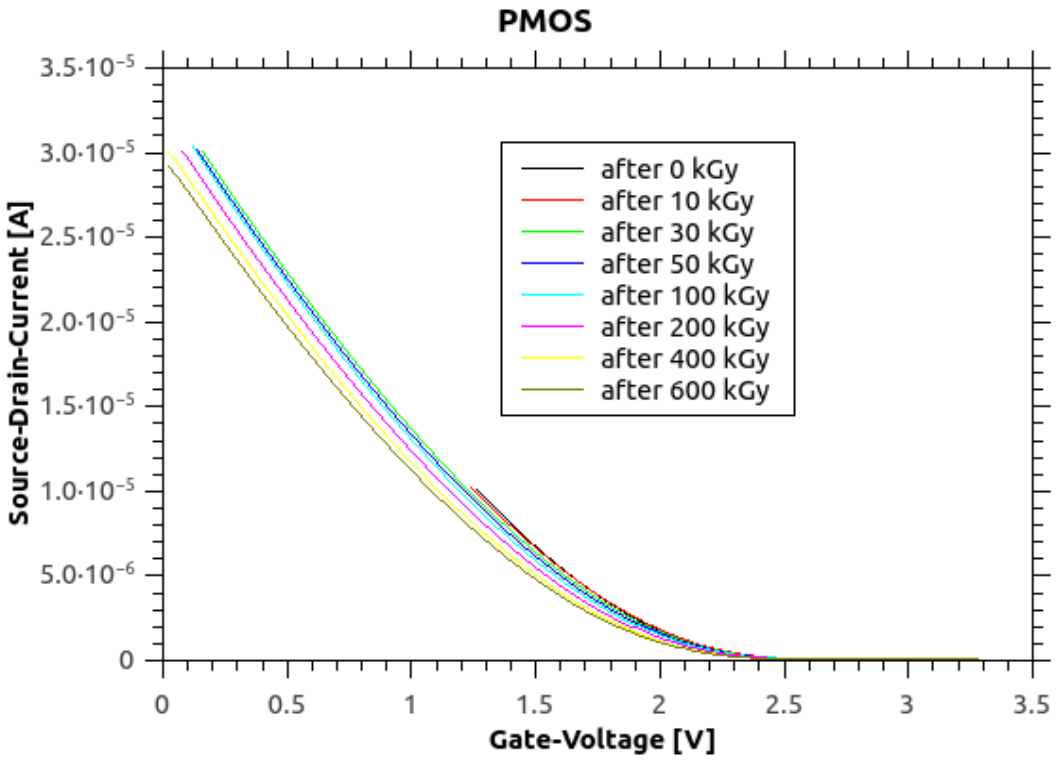
Institut für Experimentelle Kernphysik, KIT

MOS Behaviour after Irradation

- Irradiation effects mostly visible for linear NMOS (expected)







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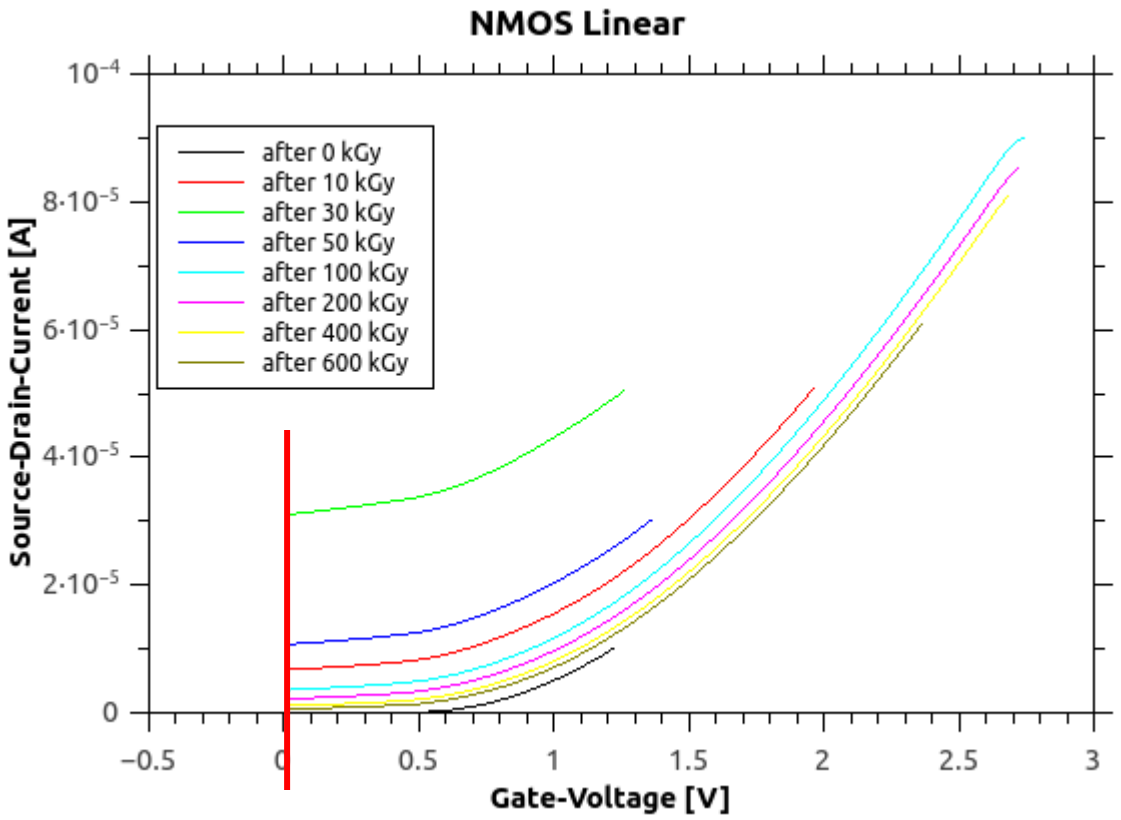
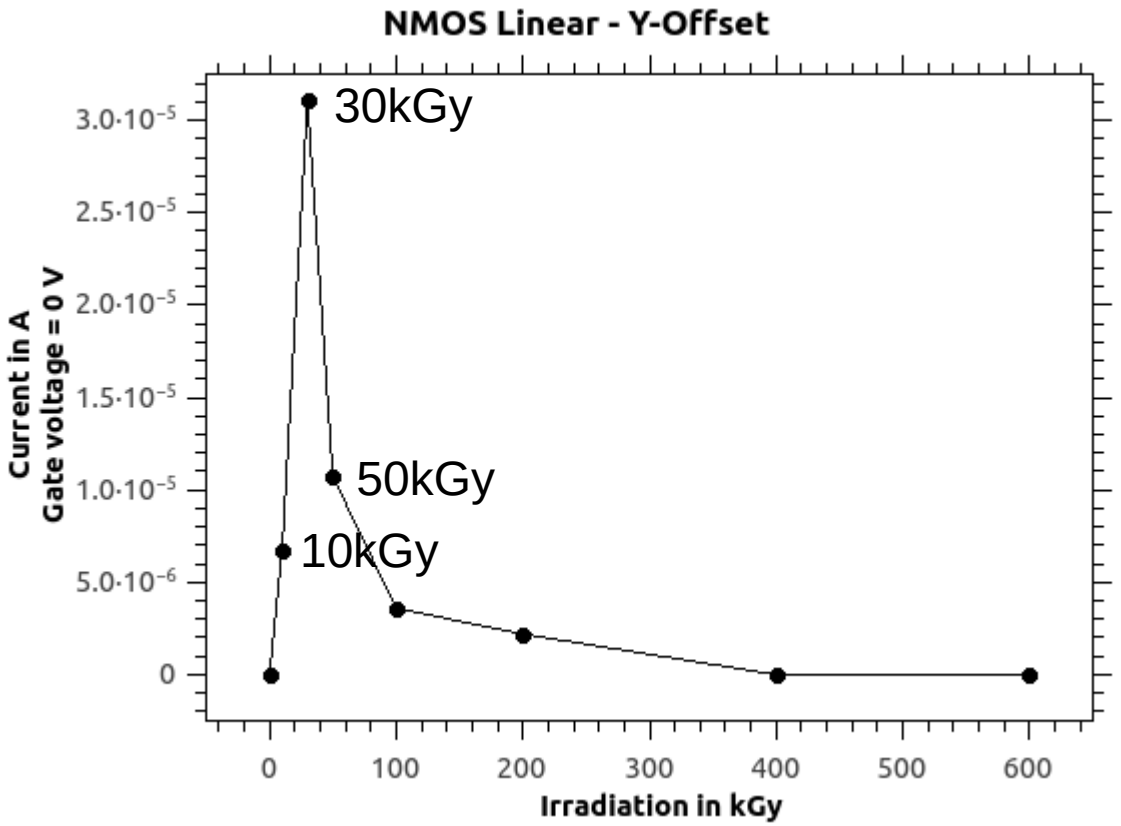
Institut für Experimentelle Kernphysik, KIT

Linear NMOS





Offset

- Large offset after initial steps at 10kGy, 30kGy, 50kGy
- Decreasing after > 100kGy
  - Activation of interface traps?

Robert Eber
Institut für Experimentelle Kernphysik, KIT

Summary

- Irradiation completed successfully up to 600kGy
- **HVStripV1 still working!**
  - **Success for 0.35µm technology**
- Evaluate the use of linear NMOS transistors
  - Increased leakage current, noise…
- Current studies:
  - Annealing of this chip
  - Prove timewalk compensated comparator
- Plans:
  - Investigate chip after proton irradiation
  - Annealing at different doses

Robert Eber
Institut für Experimentelle Kernphysik, KIT