Bias on/off proton irradiation results of MCz-Si and Fz-Si pad detectors

S. Väyrynen[1)], J. Härkönen[2)], H. Tikkanen[1)], I. Kassamakov[3)], E. Tuovinen[1)], J. Räisänen[1)] and E. Tuominen[1)]

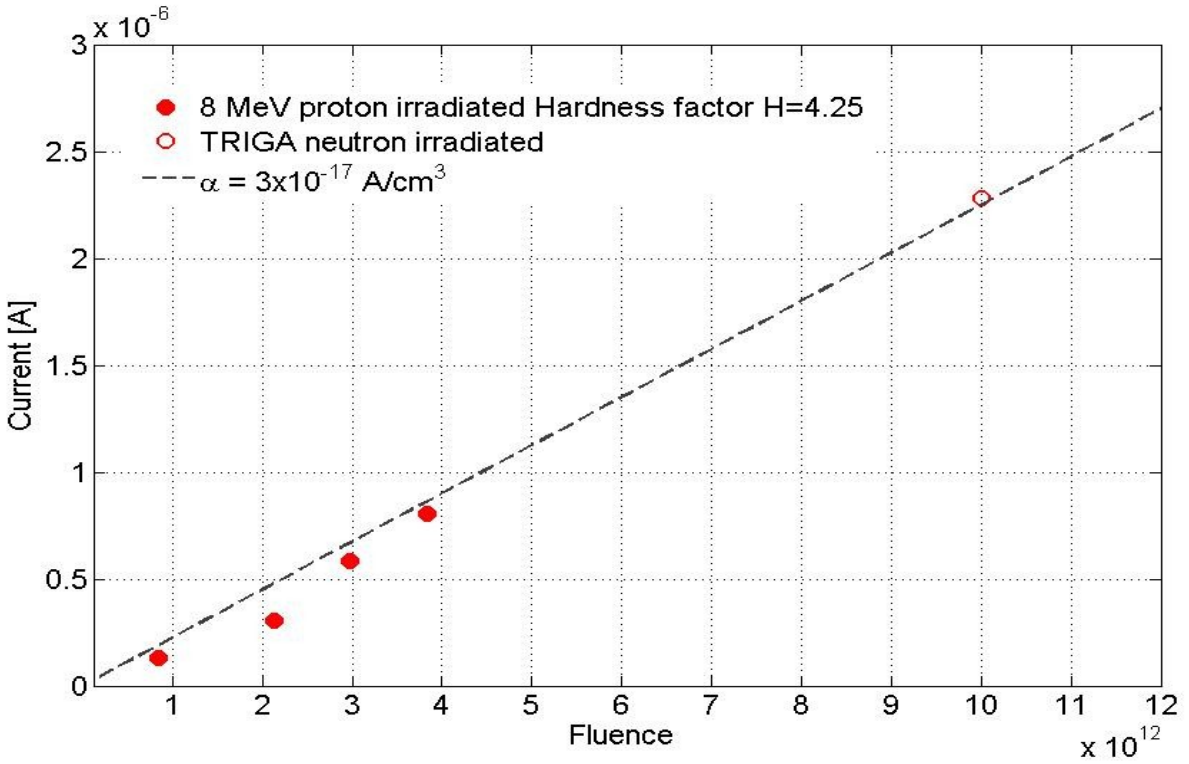
[1)] *Accelerator Laboratory, University of Helsinki, Finland*
[2)] *Helsinki Institute of Physics, Finland*
[3)] *Micronova, Helsinki University of Technology, Finland*

Outline

- Motivation
  - Does the presence of the electric field influence on the defect formation during the irradiation / running experiment ?
  - Pioneering work done Josef Stefan Institute, Ljubljana.
  - JSI results suggest that there is an *effect*.
  - This far experiments only with neutrons
- Experimental setup and measurements
  - 9 MeV proton beam at Accelerator Laboratory of University of Helsinki
  - MCz-Si and Fz-Si diodes (RD50 design)
- Results
- Summary

Proton beam

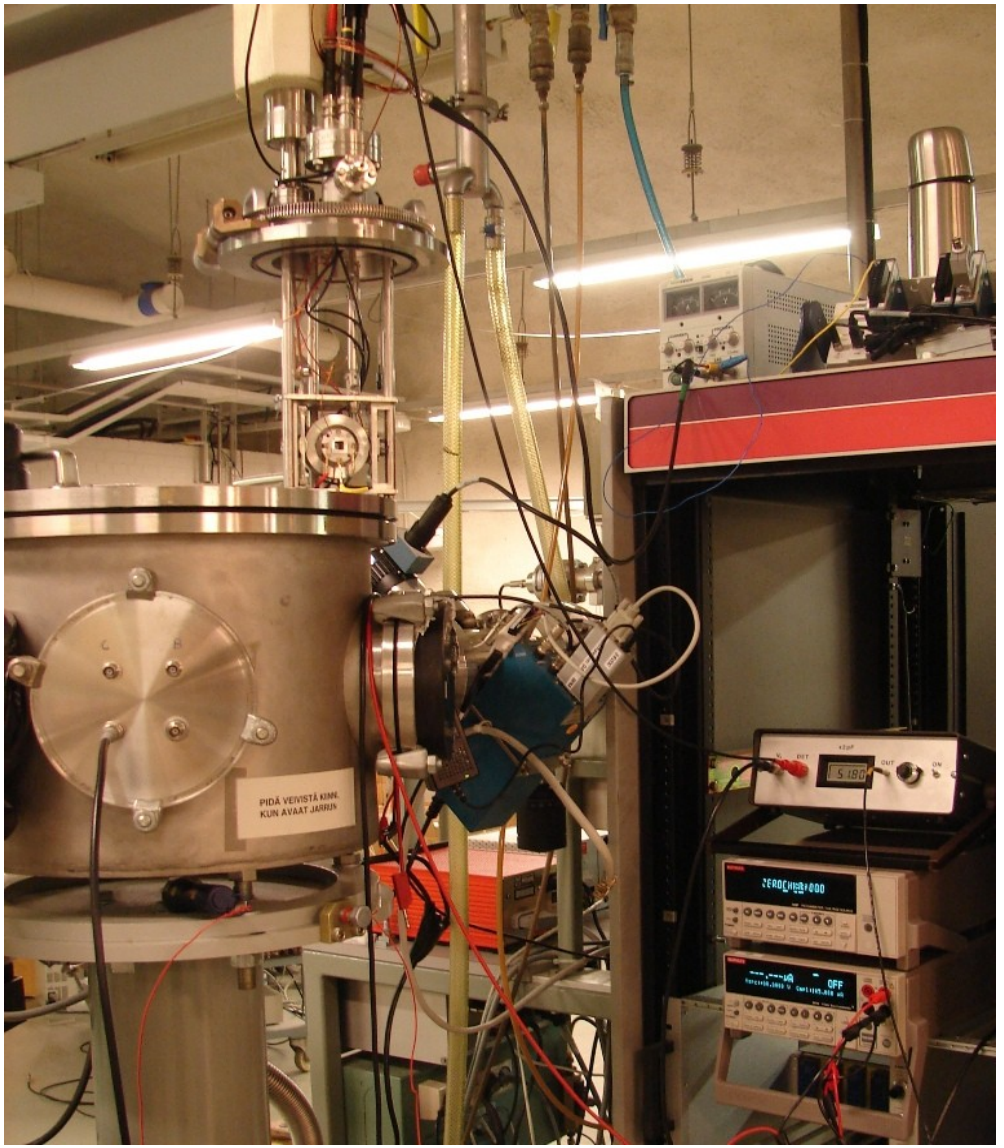
- 8 MeV DC proton beam from Van der Graaf accelerator
- Beam current “as low as possible”, i.e. 0.5-0.7 nA
- Irradiation temperature -50^{0}C
- Fluencies up to 1.2x10^{12} p/cm^2
- Hardness factor ~4.25



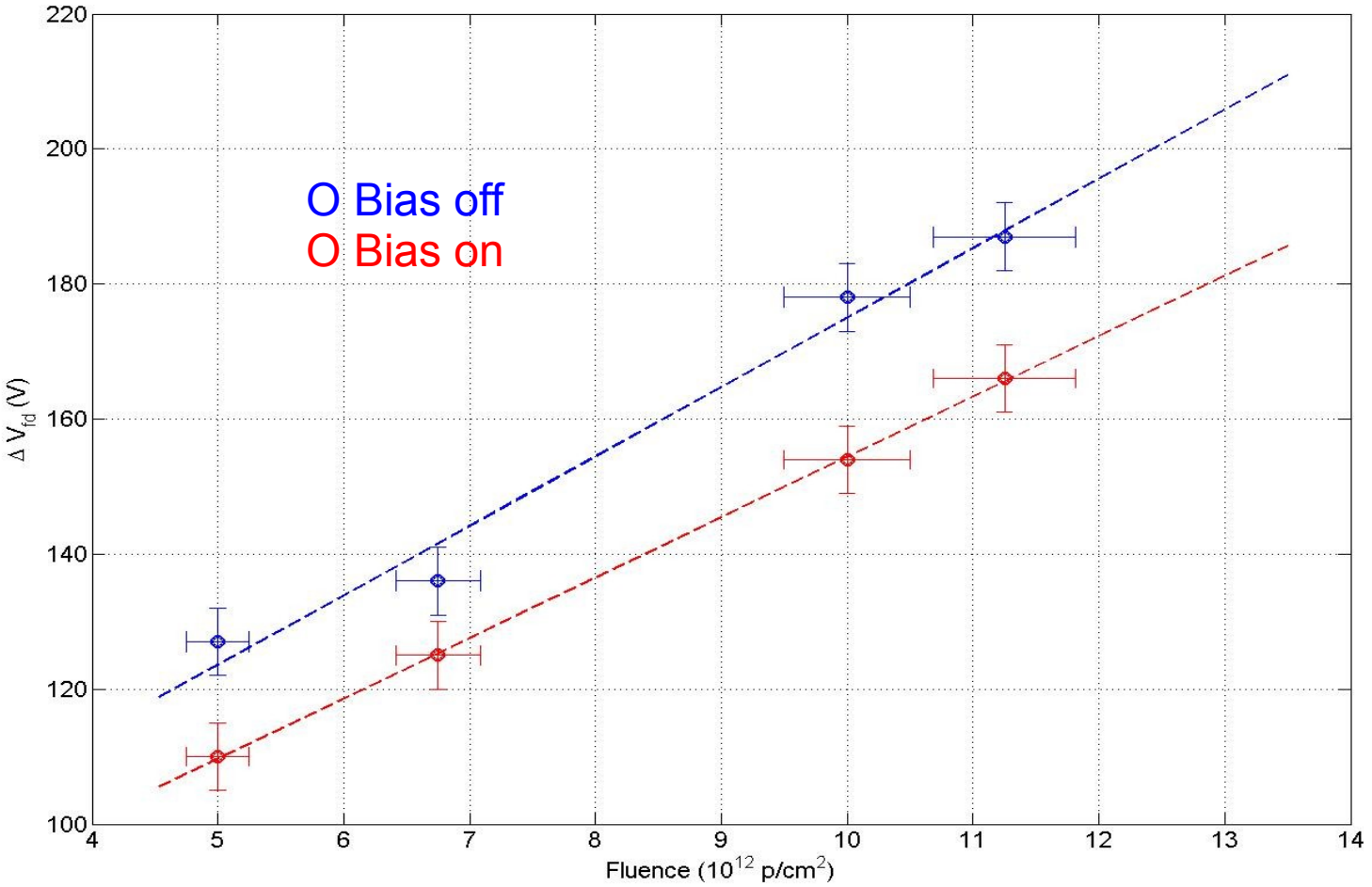
- Bias 400V for MCz-Si
- Bias 100V for Fz-Si
- Samples wire bonded and taped on PCB support
- Hybrid placed on cold finger

Measurements

- CV & IV after 26-47 days after irradiation
- Remarkable instability just after irradiation
- Samples stored at -20^{0}C
- Fz-Si
  - Thickness ~ 285μm
  - SCSI fluence <1x10^{13} cm^{-2}
- MCz-Si
  - Thickness ~300μm
  - SCSI fluence > 1x10^{14} cm^{-2}

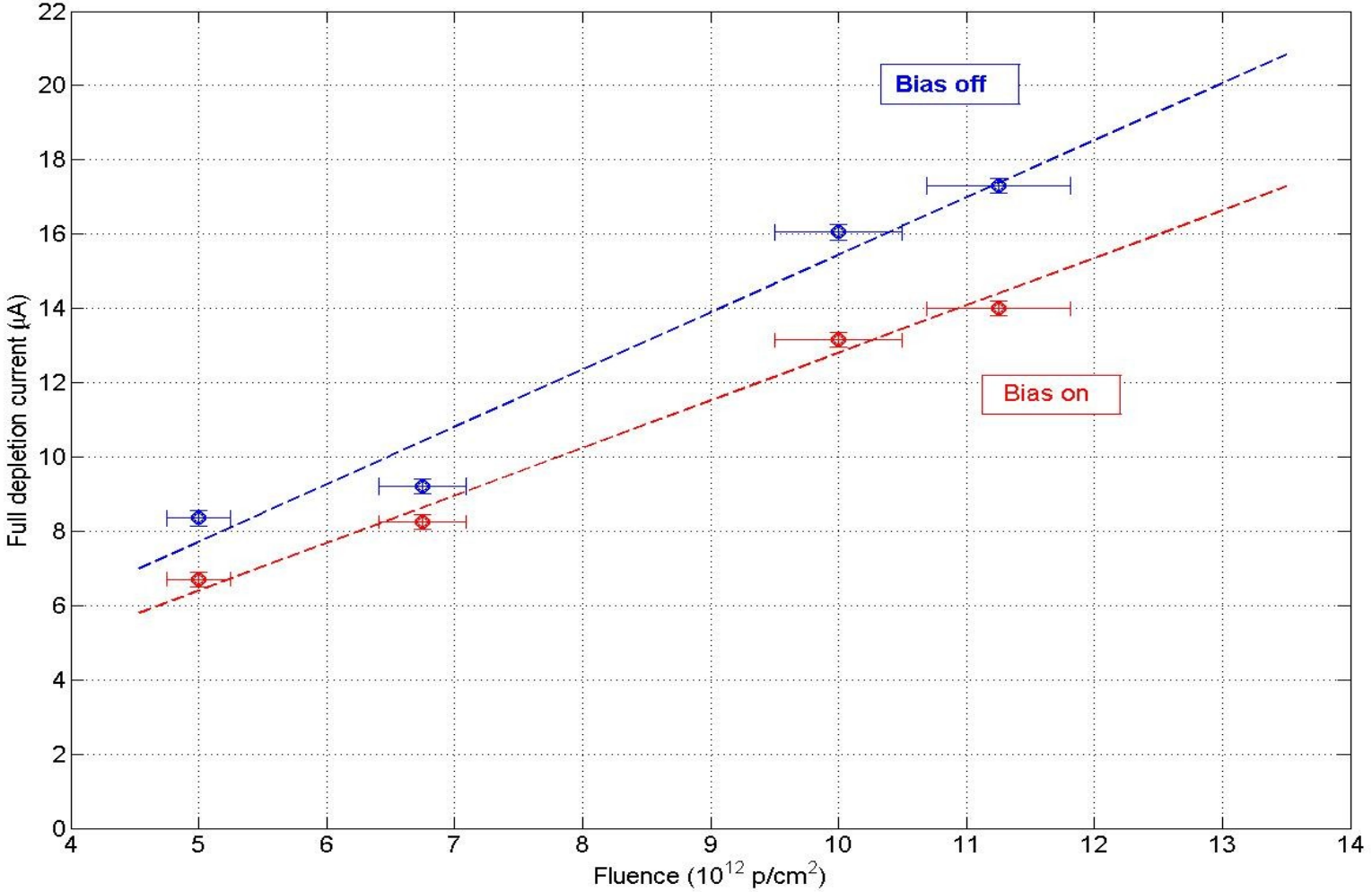


Results MCz-Si - V_{fd}



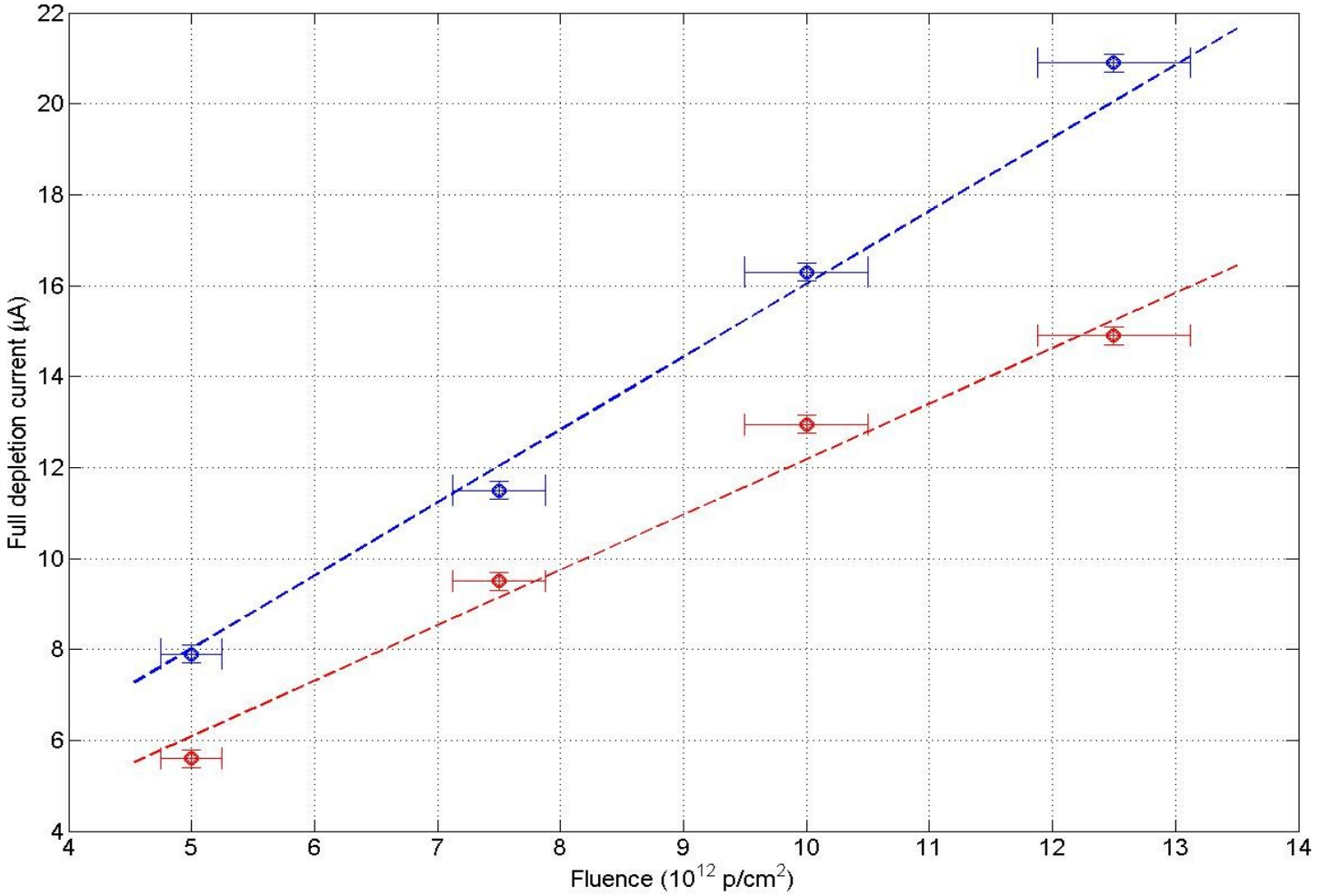
Slope “bias on” ≈ 81% slope “bias off”

Results MCz-Si -I_{leak}



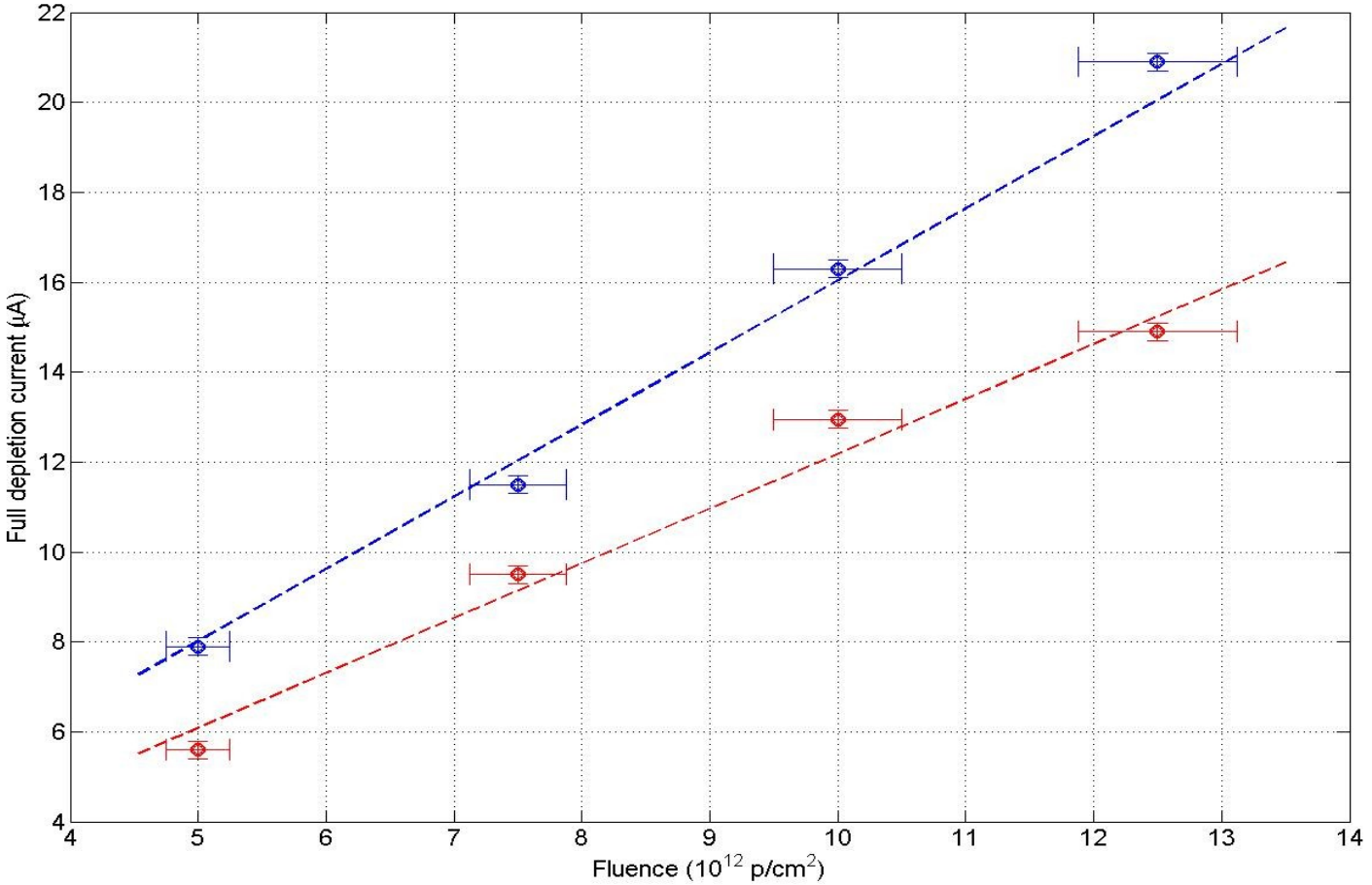
Slope “bias on” ~ 87% slope “bias off”

Results Fz-Si -V_{fd}



Slope “bias on” ~ 81% slope “bias off”

Results Fz-Si -Ileak



Slope “bias on” ~ 76% slope “bias off”

Summary

- “Bias on” decreases the introduction of negative space charge for MCz-Si and Fz-Si detectors, both.
- This is observed at 4 different fluencies up to 5×10^{13} n_{eq}/cm^2