9th RD50 Workshop PDC discussion

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24 GeV proton irradiated samples

	MCz-n Cz-n	MCz-p	Epi-n	STFZ-n STFZ-p	DOFZ-n DOFZ-p
β_{eq} [10^{-3}cm^{-1}]	-4.2 to -6.5 [1,2,7] -5.4 [3]	|3| to |7.5| [1,4] ** ???	-3 to -10 [6] ****	24 [5] 4[7]	6-7 [5] 4[7]
g_Y [10^{-2}cm^{-1}]	3.8 [2] * 4 [3]	>3 [1,4]***	2.9 [6] (first component)	4.8	2.3*
τ_{ra}	~80 min@80C (1st component)	>100 min@80C	~120min@80C	~50 min@80C	~200min@80C

Yellow: Negative space charge

Red: Positive space charge

[1] N. Manna, 8th RD50 workshop
[2] A.G. Bates and M. Moll, *Nucl. Instr. and Meth. A555* (2005) 113.
[3] E. Fretwurst, 3rd RD50 workshop
[4] H. HödelMoser, RESMDD06
[5] Rose RD48 status report
[6] G.Lindström, NIMA ()
[7] G. Pellegrini et al., NIM A552 (2005) 27.
[8] N. Manna, 7th RD50 workshop
[9] Lozano et al, NIMA A 552 (2005) 27–33.
[10] V Cindro, 8th RD50 Workshop

*saturation at Φ_{eq}>5·10^{14} cm^{-2}
** not clear what "type"
***annealing not fully completed
**** depends on thickness

Neutron irradiated samples

MCz-p,n ; DOFZ-n ; STFZ-n type:

- $\beta_{eq} \sim g_c \sim 20 \cdot 10^{-3}$ cm^{-1} [5,8,10]
- $g_Y = 4 \cdot 10^{-2}$ cm^{-1}
- $\tau_{ra} = \sim 80$ min@80C

Epi-Si:

- ρ>150 Ωcm (75 and 150 μm samples)
  - $g_c \sim 5 \cdot 10^{-3}$ cm^{-1} [8,11]
- ρ=50 Ωcm (75 and 150 μm samples)
  - $g_c \sim -5 \cdot 10^{-3}$ cm^{-1} [8,11]

[1] N. Manna, 8th RD50 workshop
[2] A.G. Bates and M. Moll, *Nucl. Instr. and Meth. A555* (2005) 113.
[3] E. Fretwurst, 3rd RD50 workshop
[4] H. HödelMoser, RESMDD06
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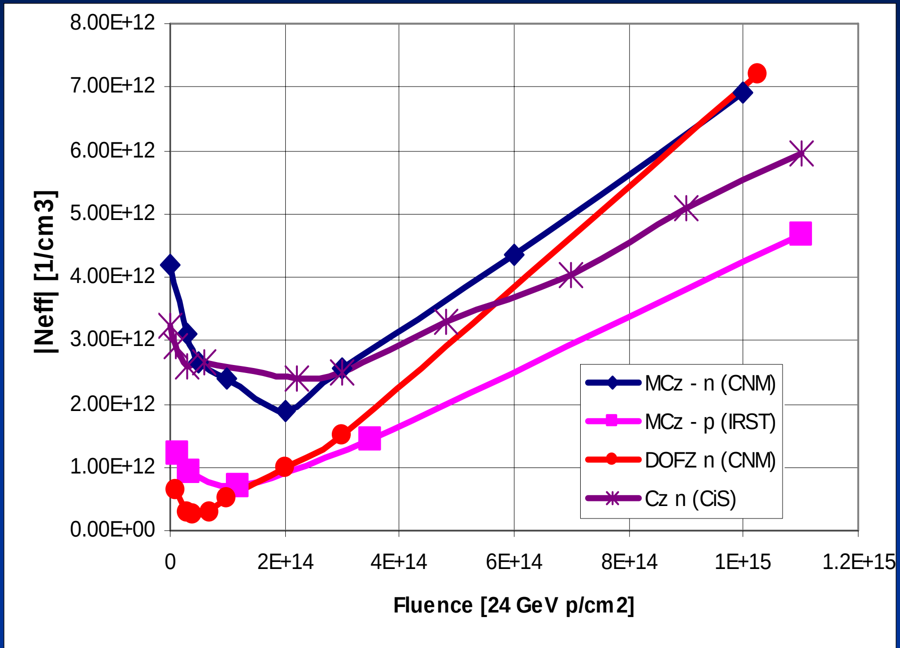
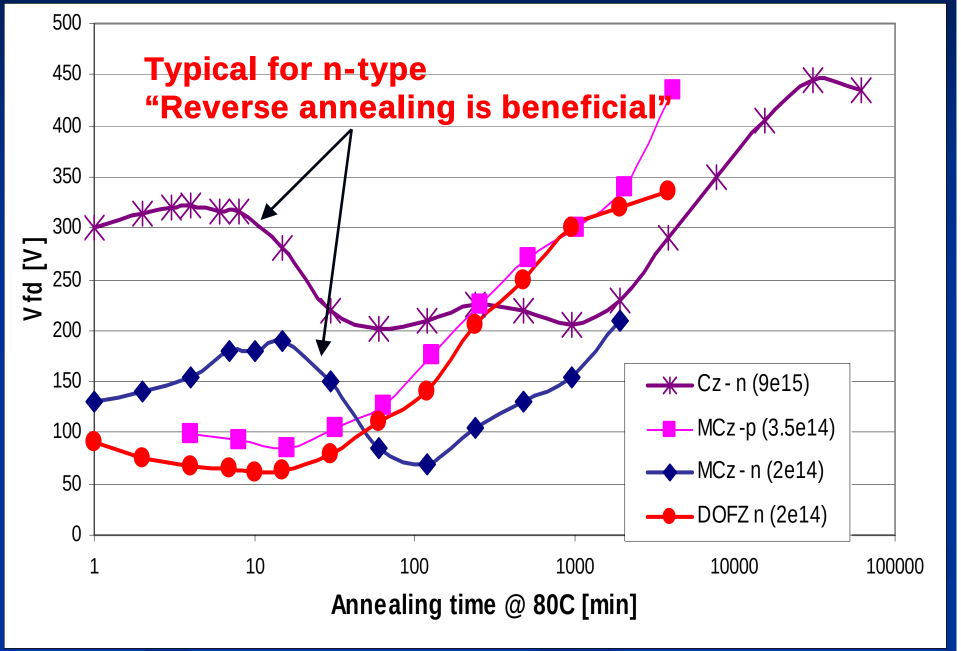
[8] N. Manna, 7th RD50 workshop
[9] Lozano et al, NIMA A 552 (2005) 27–33.
[10] V Cindro, 8th RD50 Workshop
[11] G. Kramberger, 8th RD50 Workshop

26 MeV proton irradiated samples

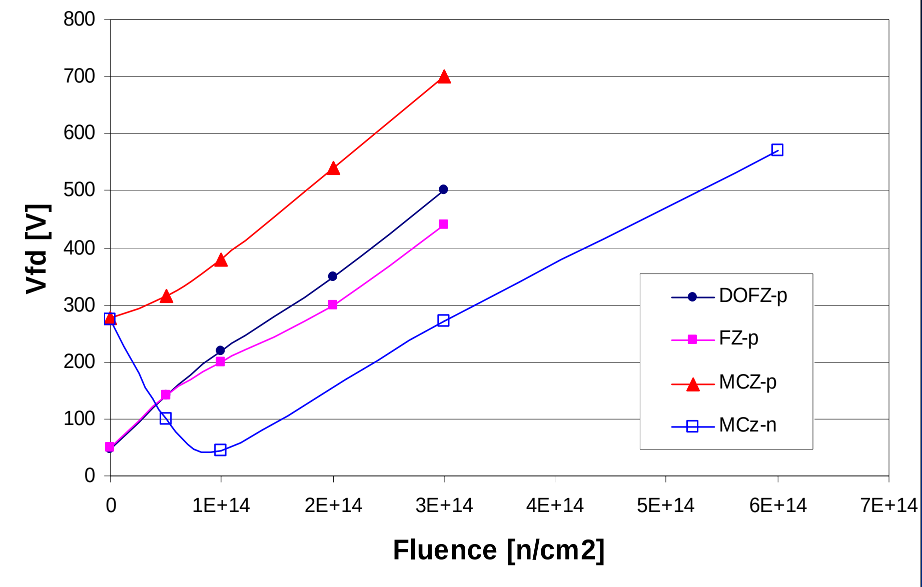
Type inversion is observed for all materials (SMART, HH)!
How does that fit to our picture?

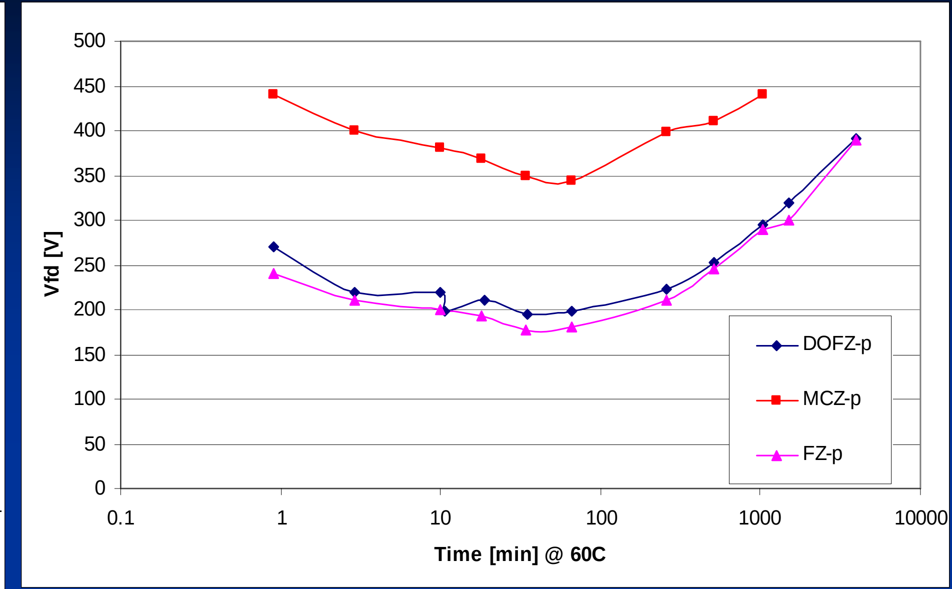
24 GeV proton irradiated samples

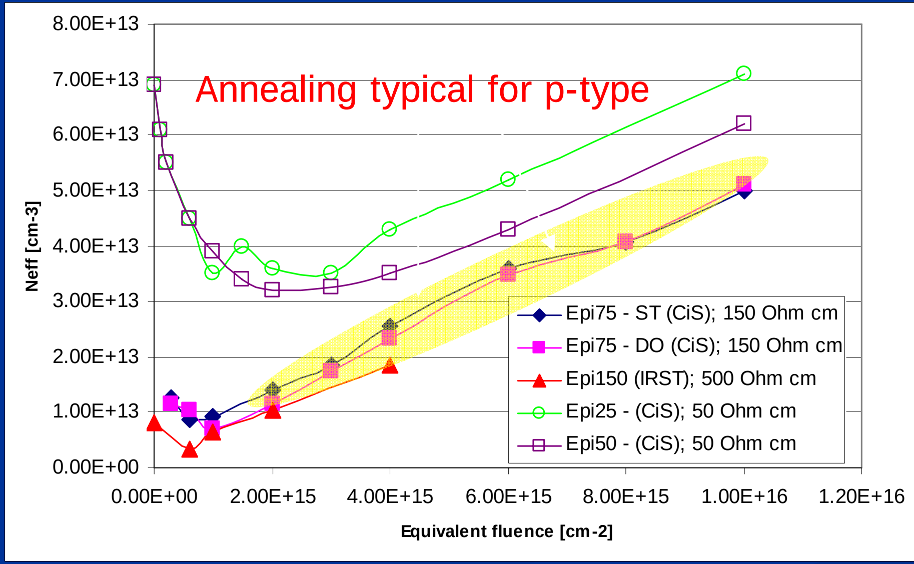




Neutron irradiated samples





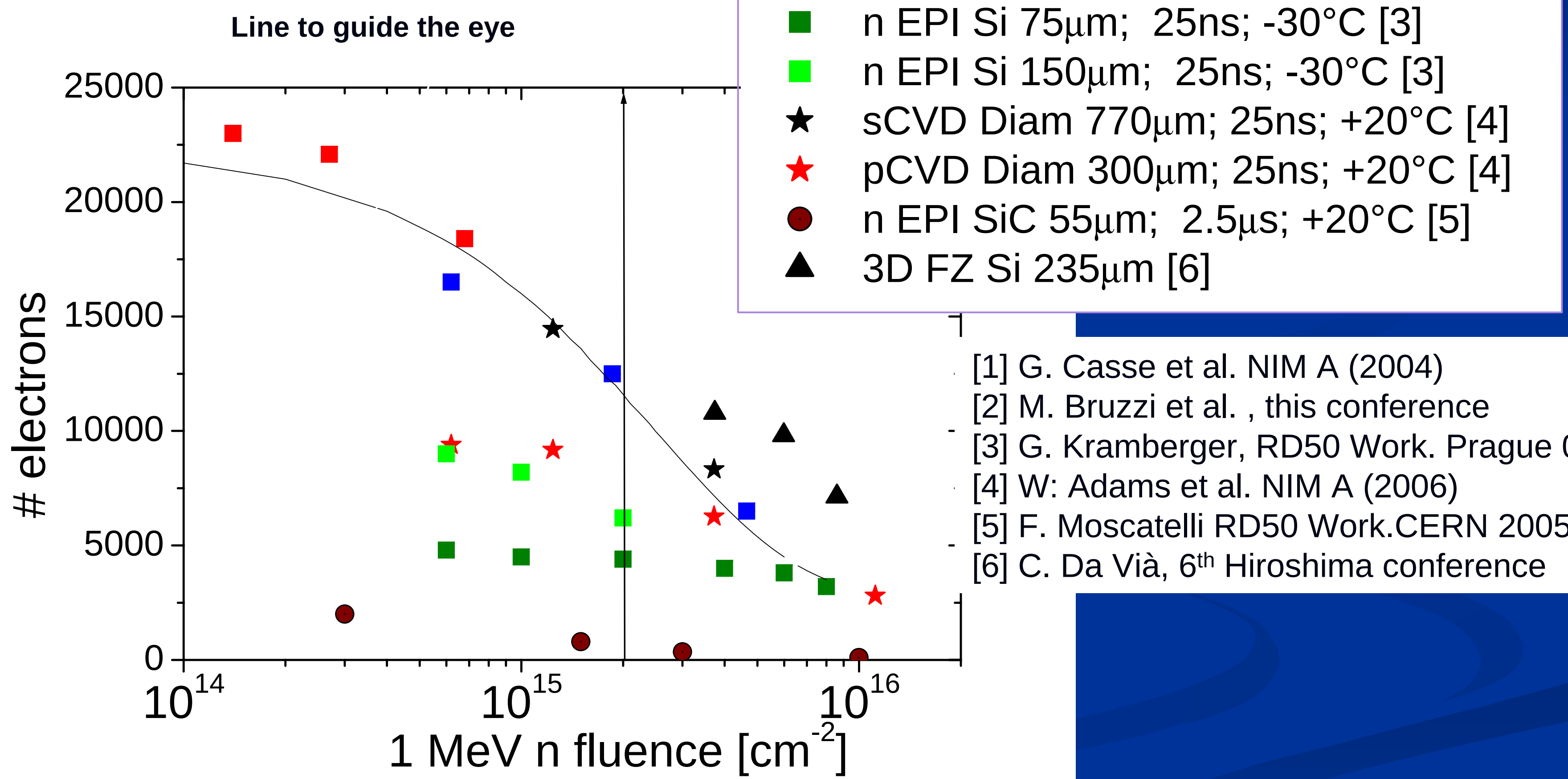


Why MCz-p is different from MCz-n and why Epi-n 50Ωcm don't undergo SCSI after neutron irradiations?

Hypotesis: Fermi level effect due to shallow dopants in p-type (no acceptor removal):The same defects are present as expected from n-type what is different is their occupation – they don't show!

A possible solution is high resistivity p type material (Epi-p, MCz-p). Maybe the concentration of shallow dopants will be low enough to observe the same behavior as for MCz-n – effective donor generation!

CCE comparisson



[1] G. Casse et al. NIM A (2004)
[2] M. Bruzzi et al. , this conference
[3] G. Kramberger, RD50 Work. Prague 06
[4] W: Adams et al. NIM A (2006)
[5] F. Moscatelli RD50 Work.CERN 2005
[6] C. Da Vià, 6th Hiroshima conference

Probing of material type

- Probing material type
  - TCT
  - Annealing curve shape
  - Neutrons introduce negative space charge, so adding them to
    - p-type material -> V_{fd} increases
    - n-type material -> V_{fd} decreases

We also need to do some mixed irradiations to check for any surprises and simulate SLHC detector!
(are there any fully annealed MCz-p type that you can miss?)

To do

- Mixed irradiations
- Isochronal annealing (60,80,100,120,140 ^{o}C...) measurement of trapping !
- Conversion list pad detector -> different segmented devices (shaping times of amplifiers)
- Bistability with ^{90}Sr
- Non-uniformity of MCz before irradiations
- Revision of CV measurements (freq., T) for high fluences