TCT-Measurements of mixed irradiated Magentic Czochralski Diodes in the SLHC-Scenario

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Overview

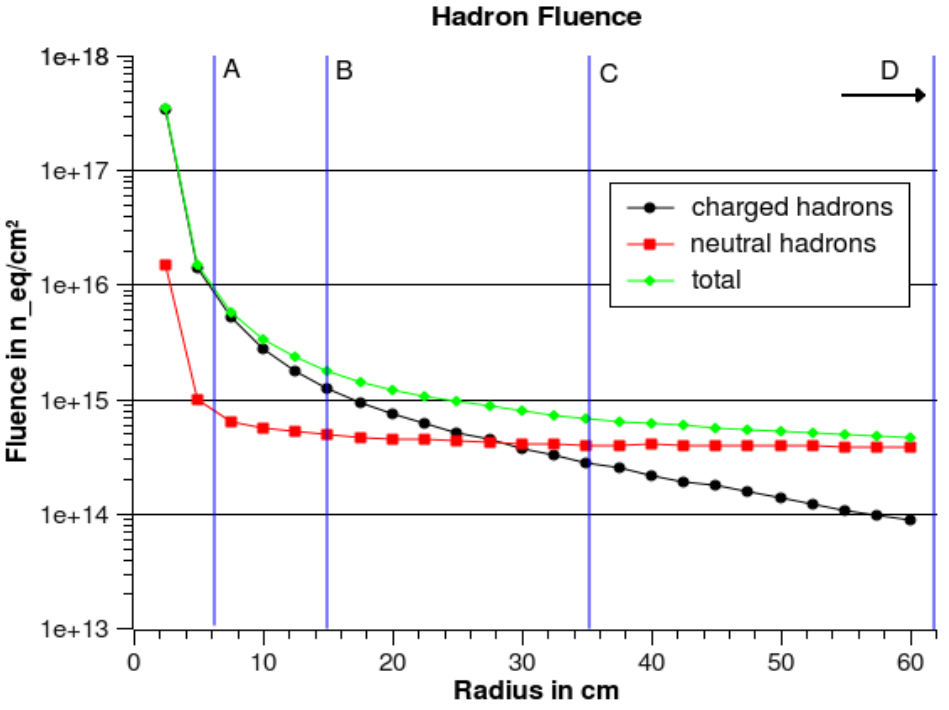
- Irradiation scenario
- TCT project at Karlsruhe
- Depletion voltage behaviour
- First measurements

Irradiation Scenario

Set of diodes

	MCz p-type	MCz n-type	F(n) (n_eq/cm²)	F(p) (n_eq/cm²)	**Radius Tracker**	Position
A	082-1, 083-36	n01, n02	8,80E+014	1,04E+016	**6cm**	Pixel
B	082-6, 083-37	n03, n04	4,80E+014	1,25E+015	**15cm**	inner Tracker / Pixel
C	082-11, 083-39	n05, n07	3,90E+014	2,90E+014	**35cm**	inner Tracker
D	082-15, 083-21	n15, n16	3,40E+014	7,00E+013	**70cm**	outer Tracker
	082-12, 083-55	n11, n14	3,50E+014	0	**-**	-

- MCz-Diodes:
  - N-type from HIP
  - P-type from Micron
- N-type: 2 for each fluence to compare
- P-type: p-stop and p-spray



Irradiation Scenario

Set of mini strip sensors

	MCz n-type	MCz p-type	FZ n-type	FZ p-type	**Radius Tracker**
A	MCz08-03-1	2553-13-3-3	FZ08-02-1	2328-5-1	**6cm**
B	MCz08-03-2	2553-13-3-4	FZ08-02-2	2328-5-2	**15cm**
C	MCz08-04-4	2553-14-2-1	FZ08-02-3	2328-5-3	**35cm**
D	MCz08-02-11	2553-13-4-2	FZ08-02-5	2328-5-5	**70cm**
	MCz08-04-5	2553-13-4-1	FZ08-02-4	2328-5-4	**?**

- Irradiation done:
  - First neutron irradiation at Louvain-La-Neuve Cyclotron
  - Then proton irradiation at Karlsruhe Cyclotron

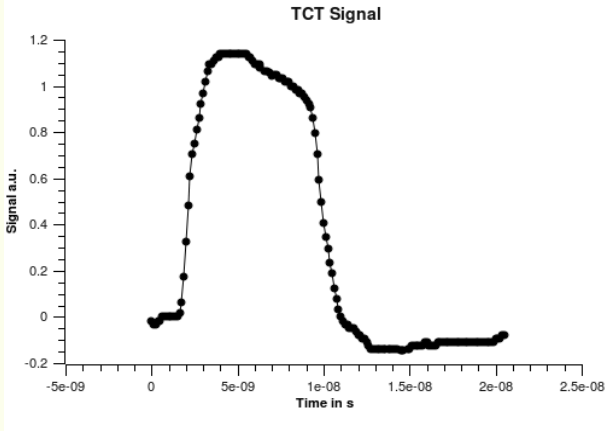
- IV and CV curves taken before and after each irradiation step

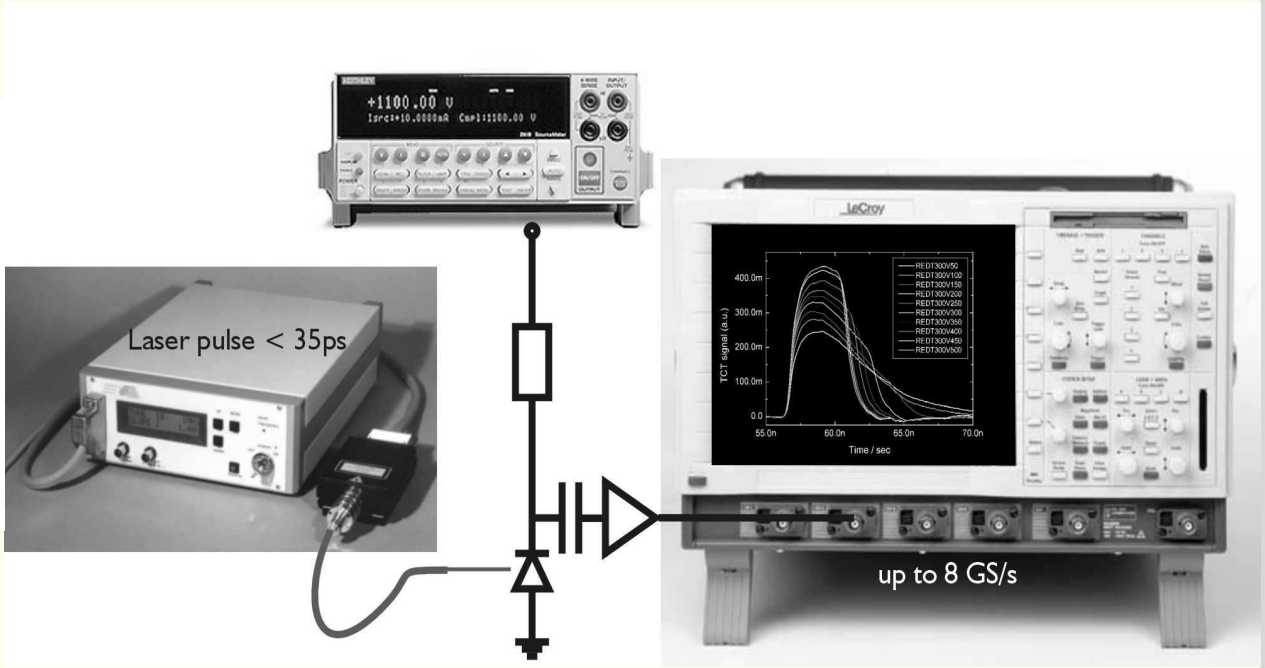
TCT project at Karlsruhe

- TCT measurements with red and infrared Laser
- Illumination from both sides, look at both charge carrier types
- Analysis of charge collection efficiency and effective trapping times
- TSC studies with diodes in Hamburg

- Readout with Alibava system in preparation
- First commissioning

TCT measurements



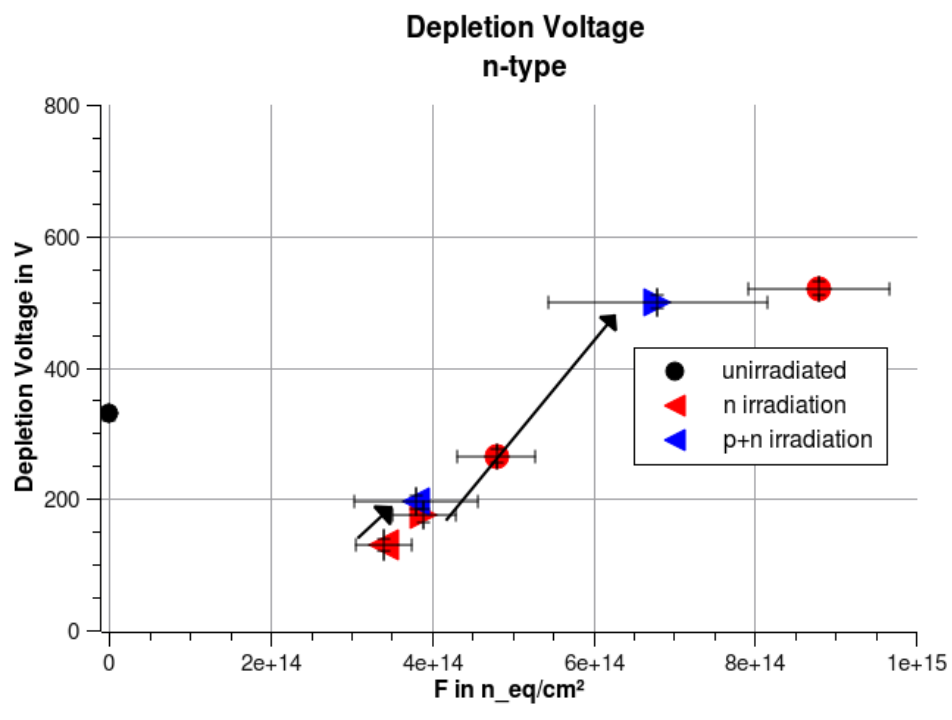


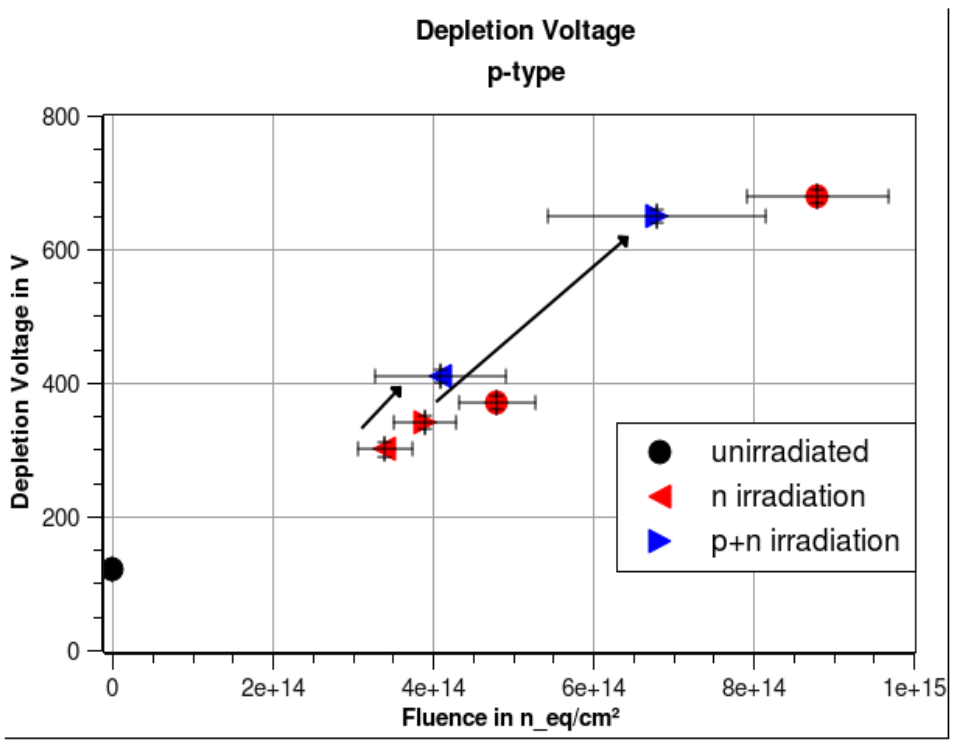
Focus now on:

- TCT measurements with a red picosecond laser
- Temperature cooling from -40°C to 0°C
  (interesting range for cooling but can go down further)
- Lower irradiated diodes (R=70cm, R=35cm)

Depletion voltage after irradiation

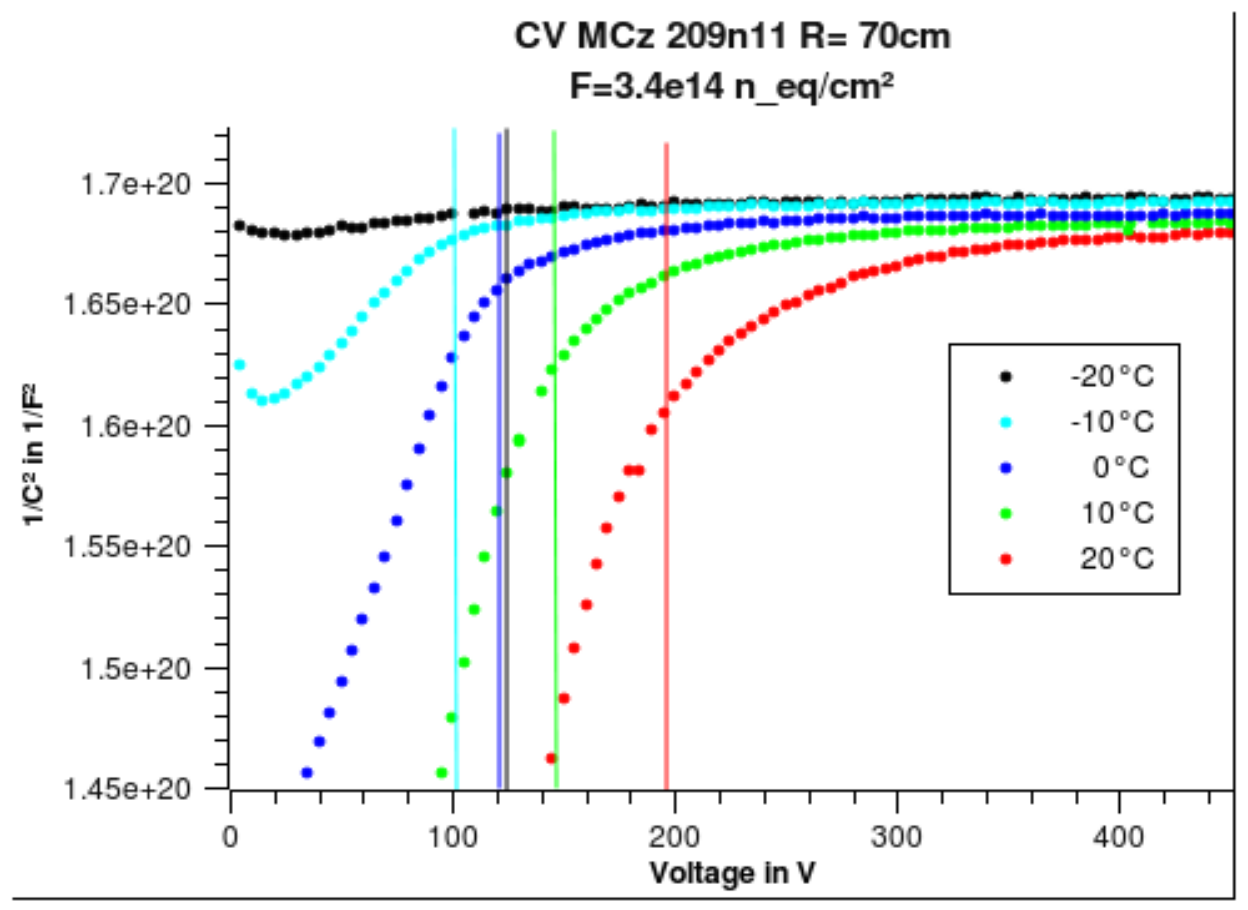
Diodes





- Depletion voltage from CV curves
  ν = 1kHz, T= -20°C
- Maximum annealing time 24h at room temperature
- No further annealing done

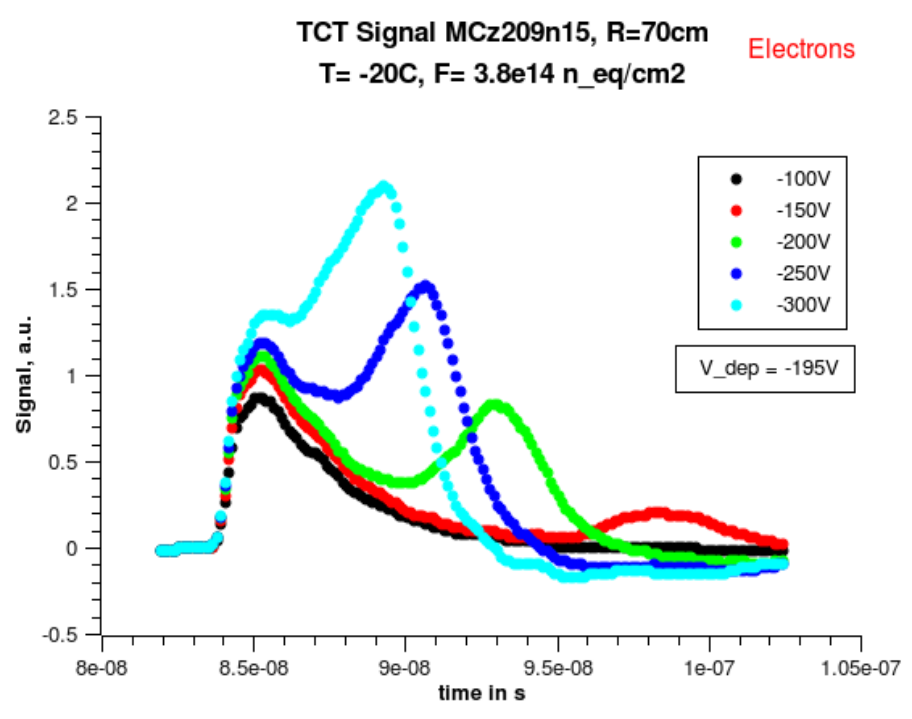
Depletion voltage with different temperatures

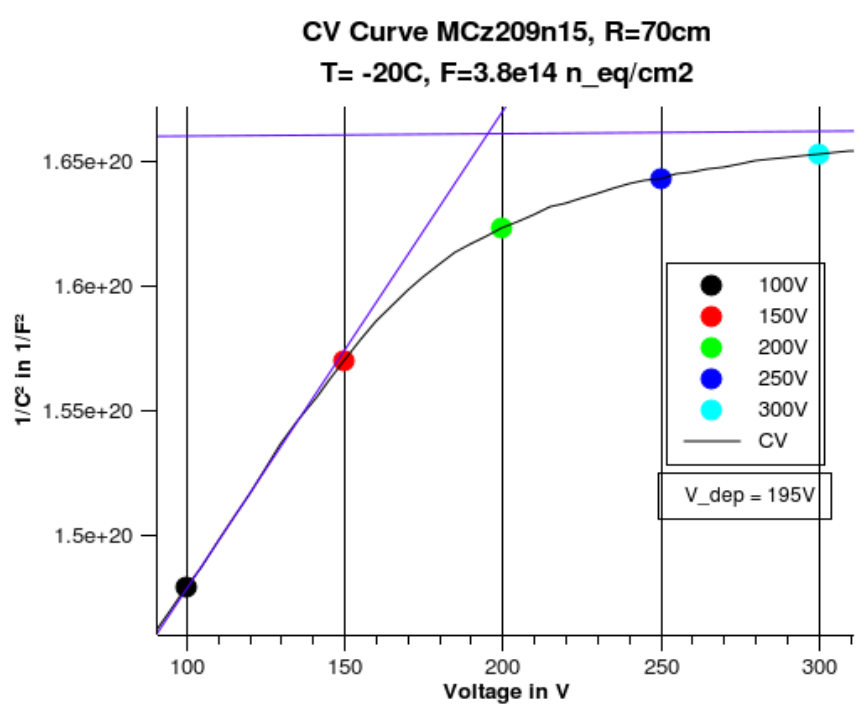


$\nu = 10\text{kHz}$

- Depletion voltage depends on temperature
- Need model for CV measurements

Depletion Voltage TCT - CV





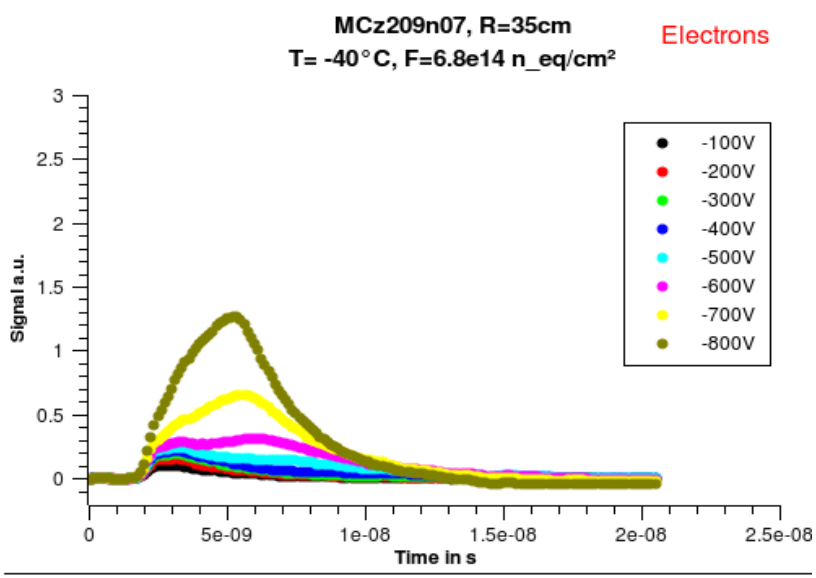
v=1 kHz

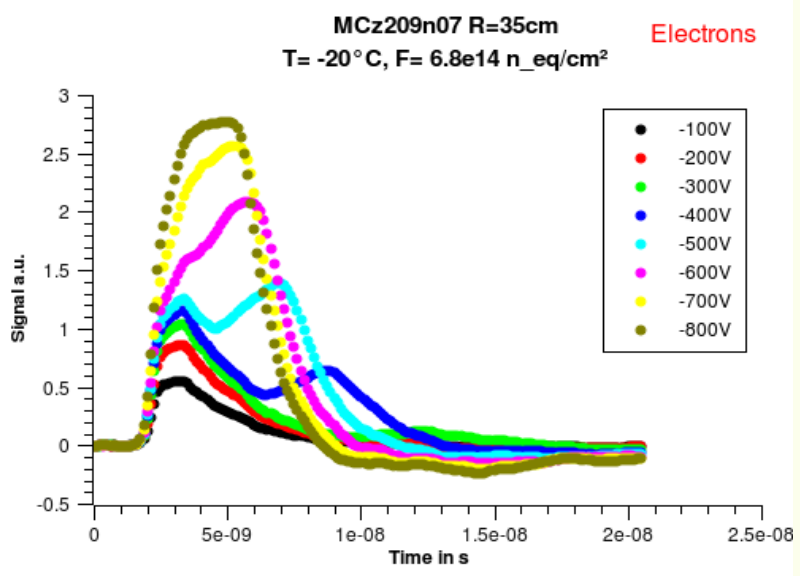
- Peak of double junction shows earlier than depletion voltage of CV-Curve
- Depletion voltage depends on frequency

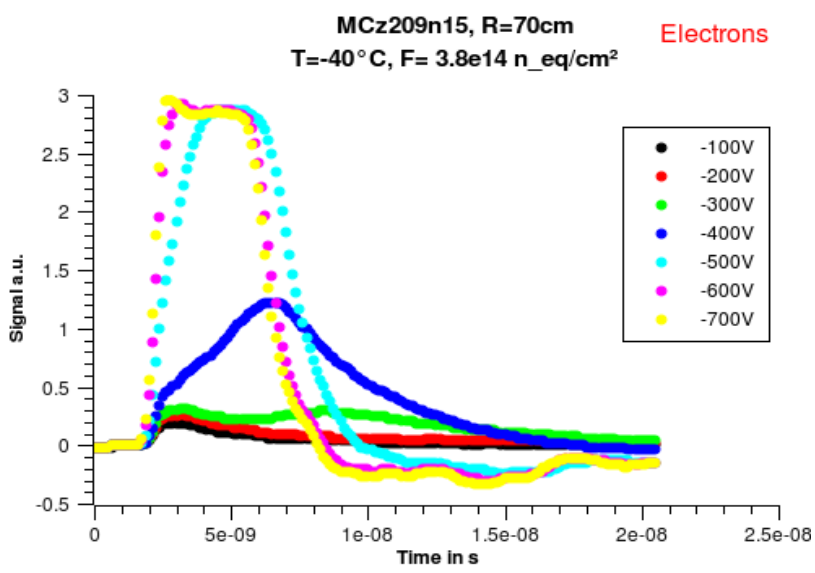
Comparison Fluence - Temperature

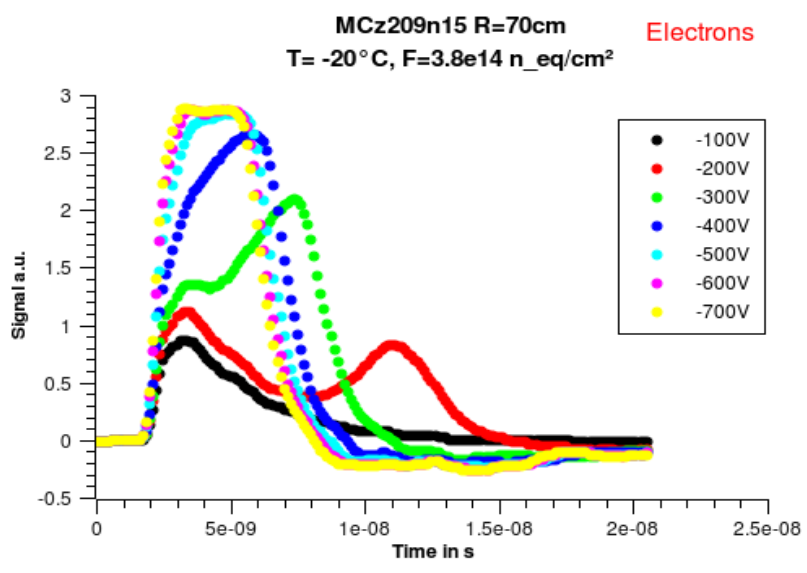
Temperature

FLUENCE

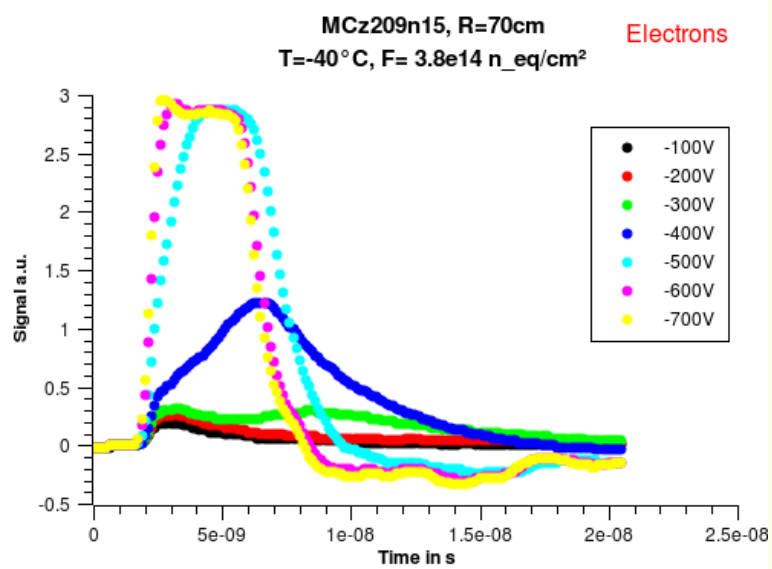


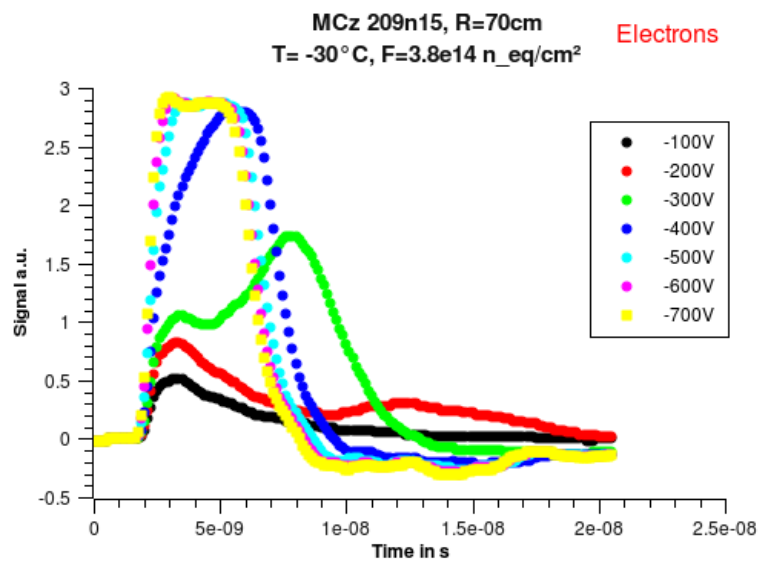


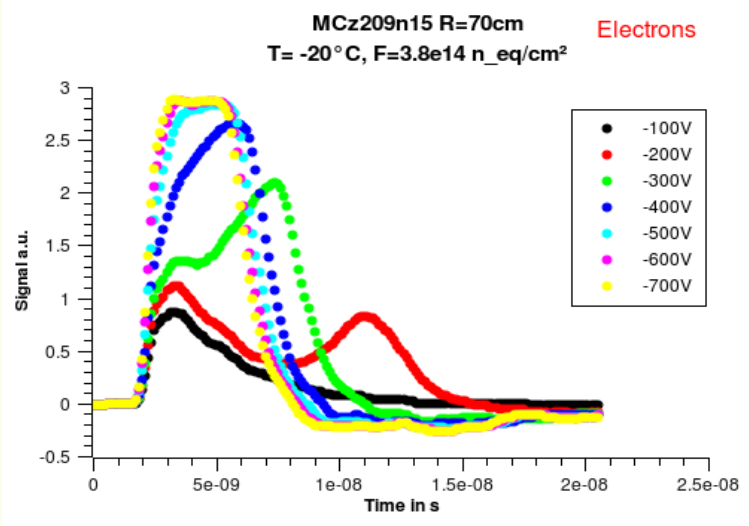


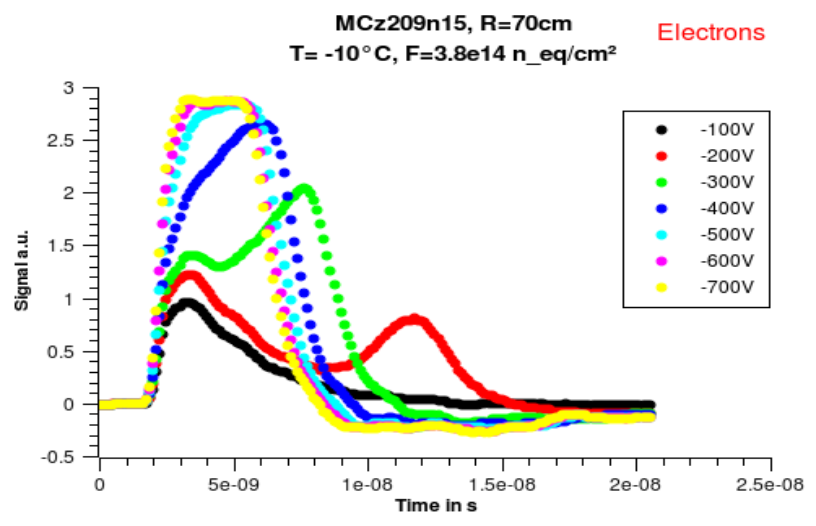


R=70cm increasing temperature









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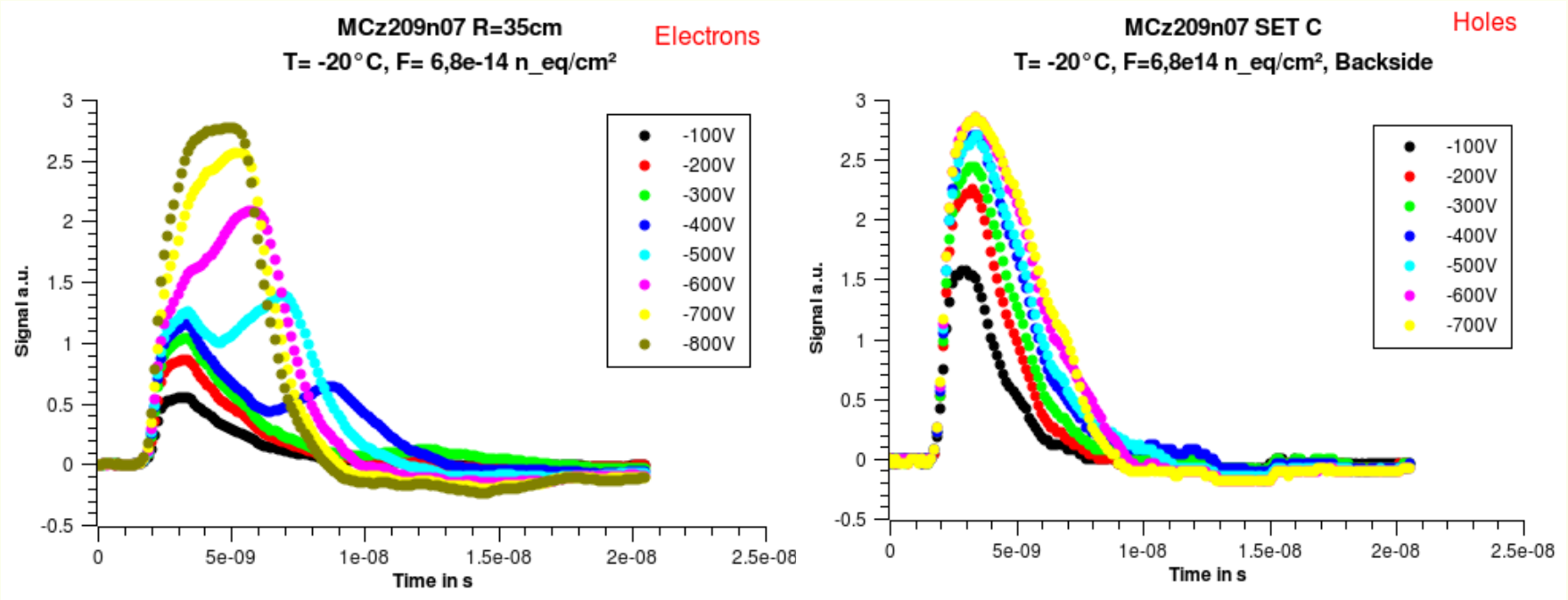
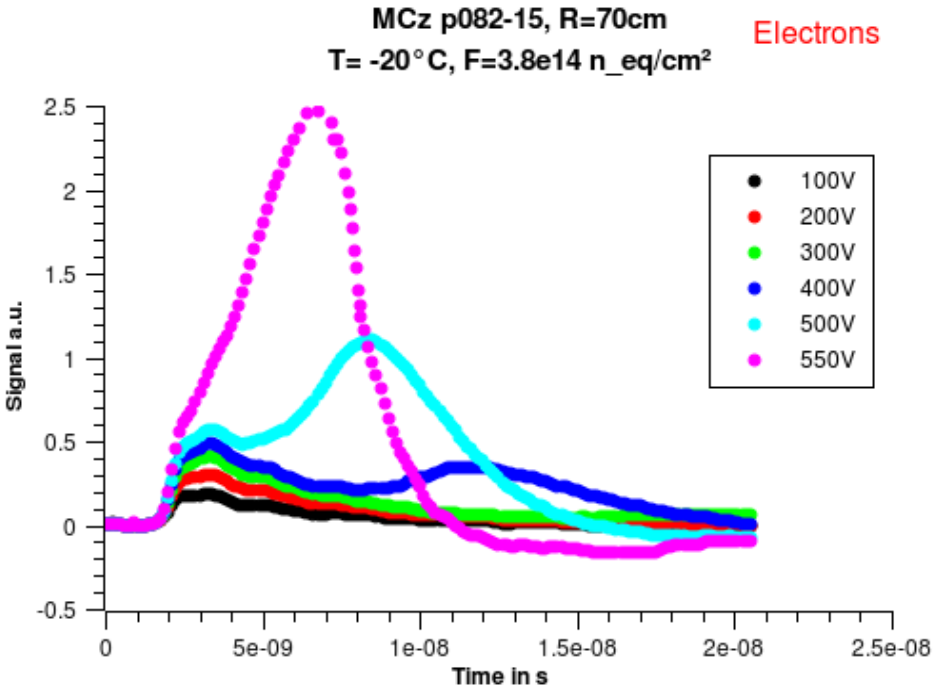
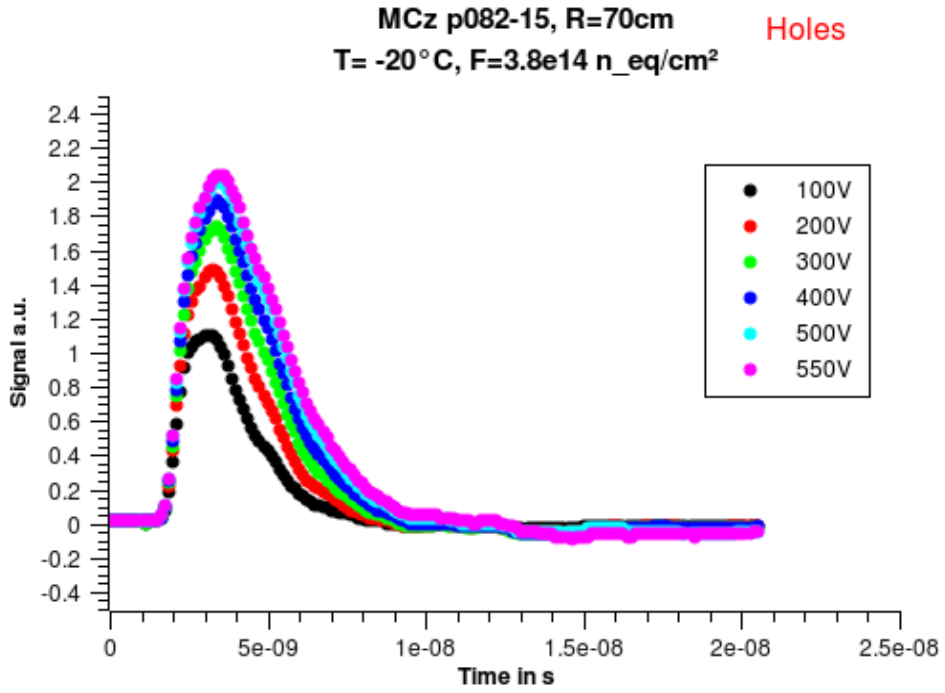
Comparison Charge Carrier Type



- N-type diode
- Illumination possible from both sides
- Good for modelling the electric field in diode

Comparison Charge Carrier Type





- P-type diode

Summary & Outlook

- Mixed irradiation complete
- Started first measurements
- Compare results with existing models
- Complete set of measurements
- Repeat for several annealing steps

- Any suggestions for further measurements?

Thank You
for
your attention!