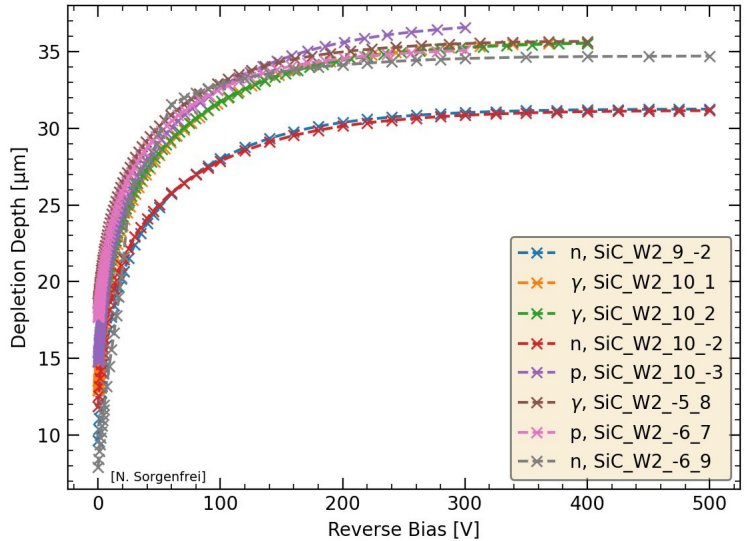
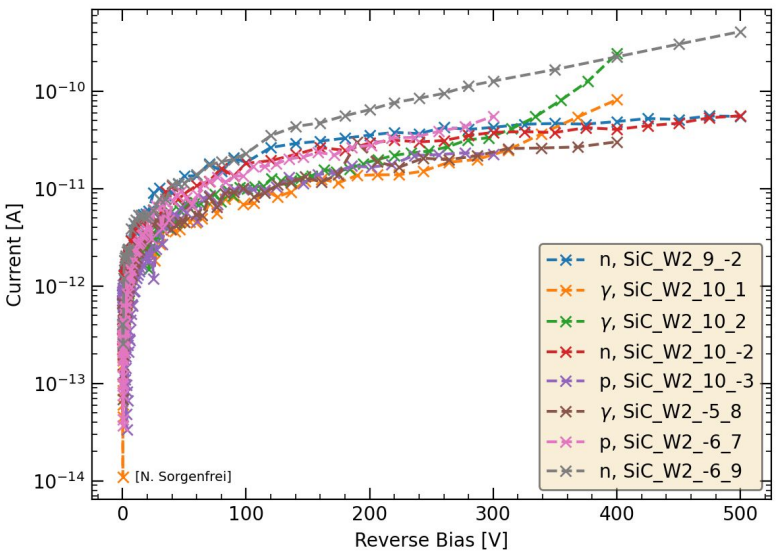
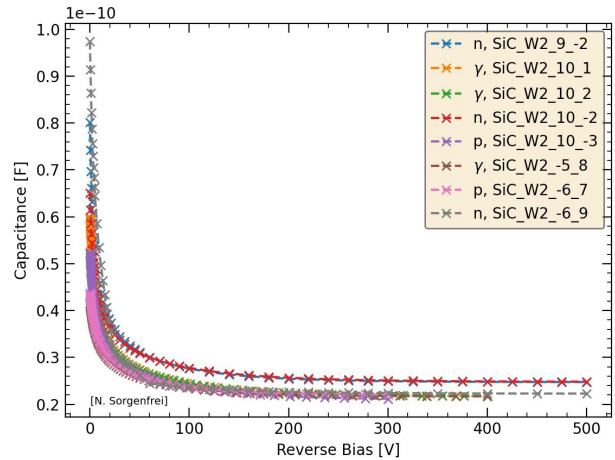
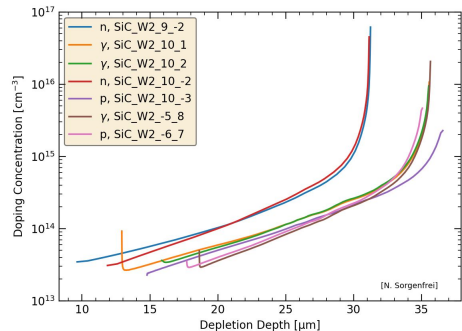
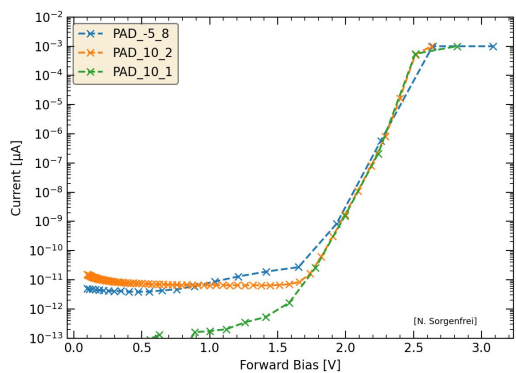


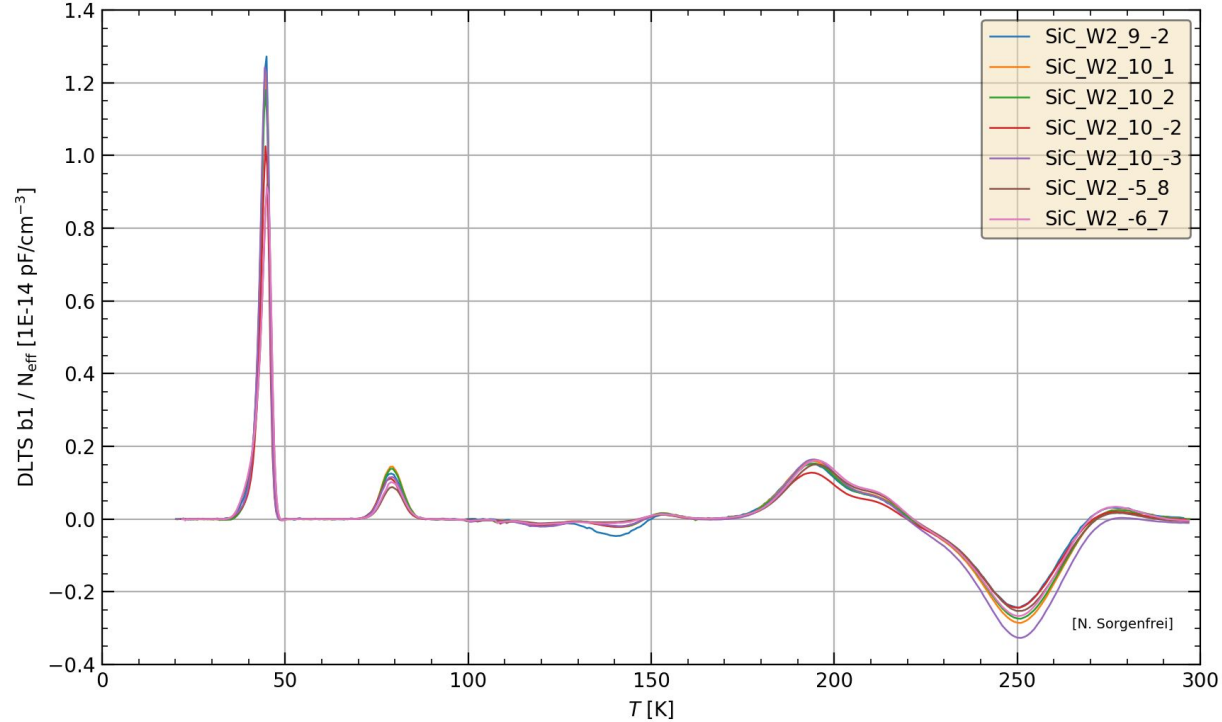
RD50 Common Project 4H-SiC PAD Diodes: Irradiation campaign

Name [CNM W2 Run 17047]	Irradiation Type	Fluence [n_{eq}/cm^2] / Dose	Facility	Status	Measured unirrad	Measured irrad
PAD_9_-2	n	1E11	JSI	@JSI (28.10.24)		
PAD_10_-2		1E12				
PAD_-6_9		1E13				
PAD_-6_7	p	1.61E11	PS IRRAD	@PS IRRAD (28.10.24), irradiated, glued and wire bonded. IV & CV after irrad not meas. yet, DLTS ongoing		
PAD_10_-3		1.61E12				ongoing
PAD_-5_8	γ	0.2MGy	??	measured DLTS unirrad. sampels given to Nicola Pacifico (30.11.24)		
PAD_10_1		1MGy				
PAD_10_2		1MGy				
PAD_-3_10	unirrad	-	-	Remains unirradiated for high temperature cryostat		-

Unirradiated IV CV measurements

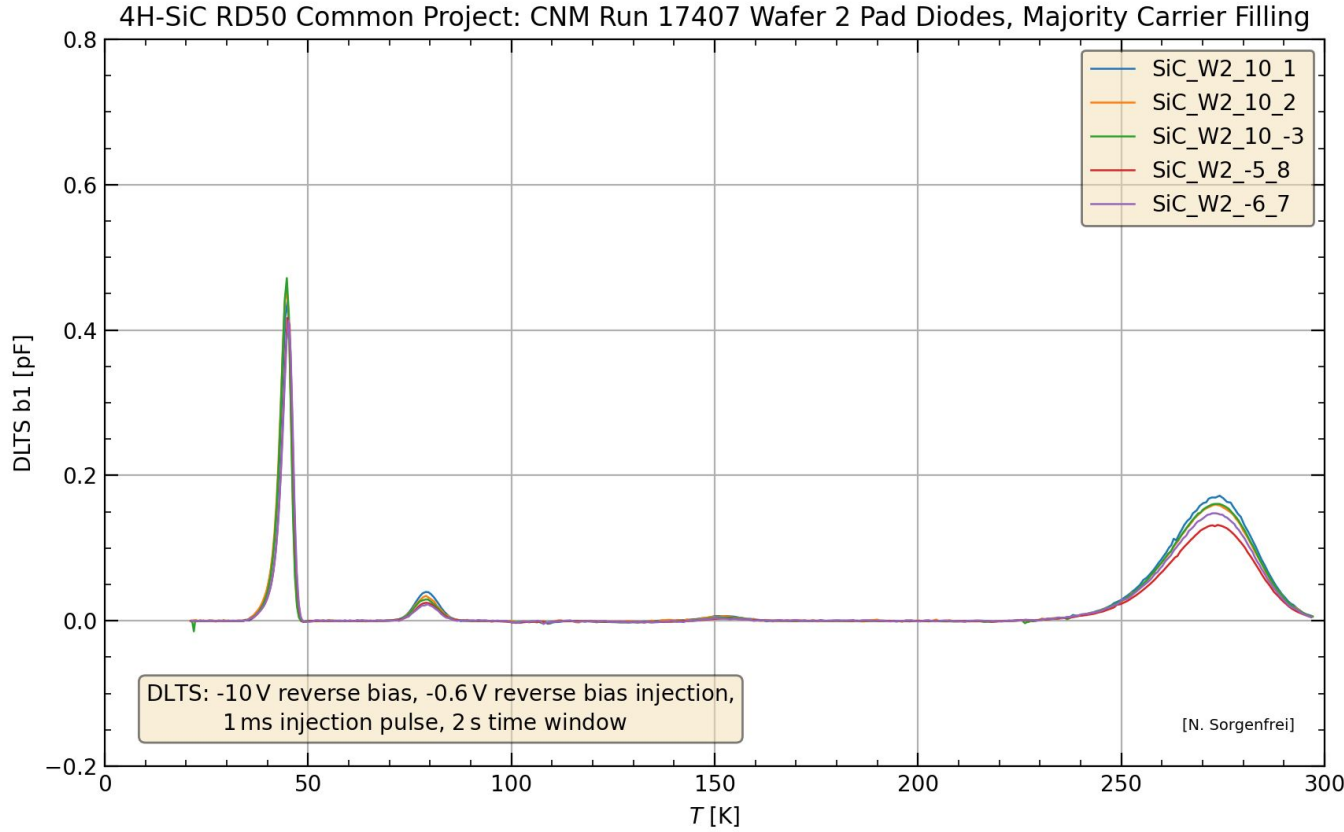


Unirradiated DLTS Measurements normalized to N_{eff}

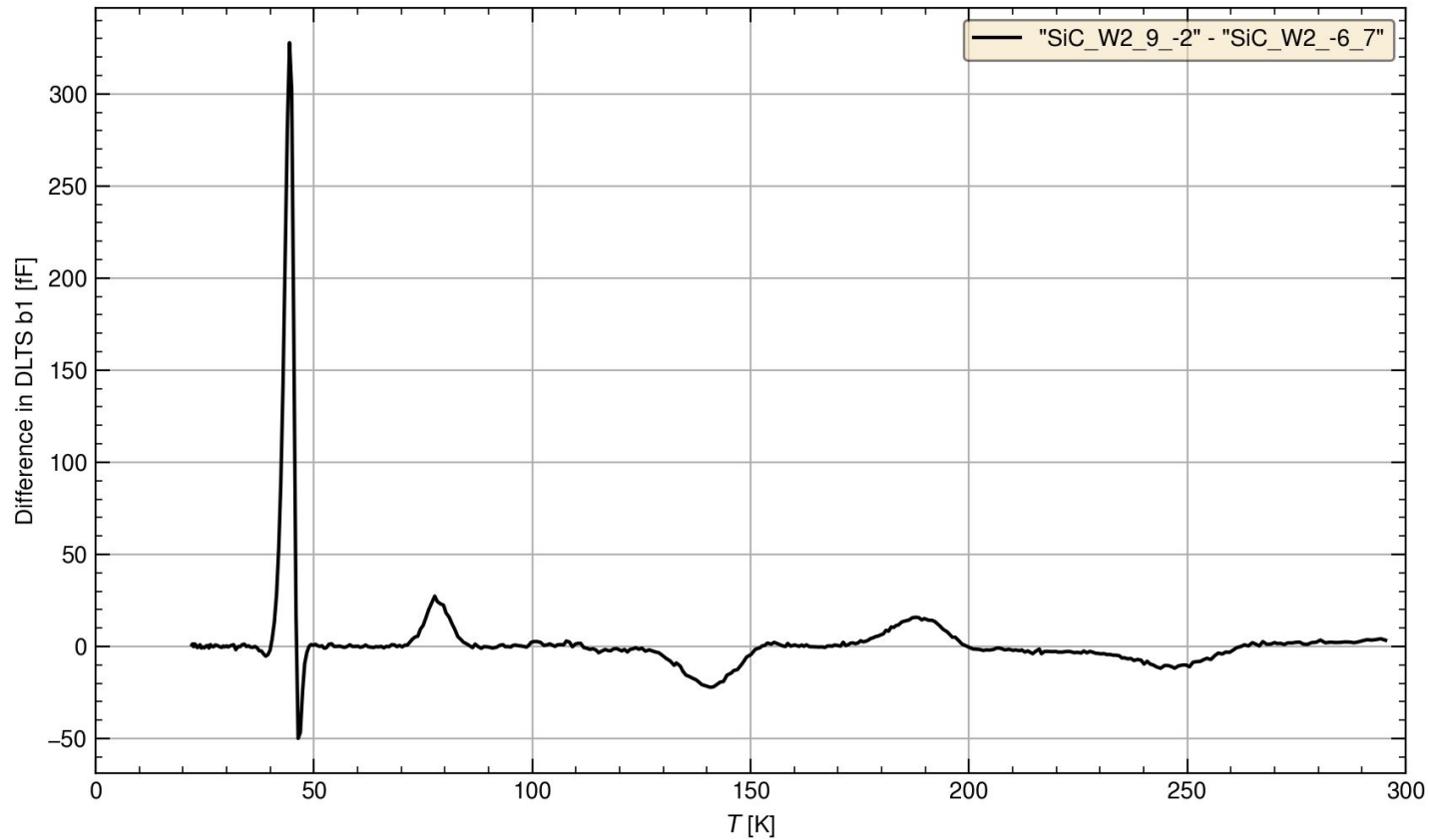


- No strong change observed
- Concentrations remain constant

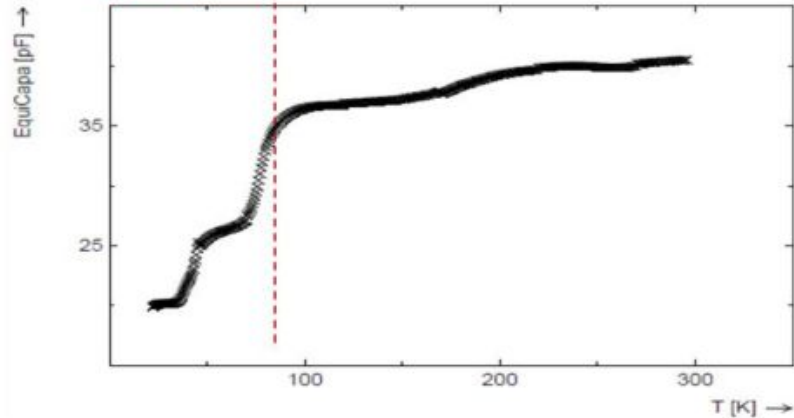
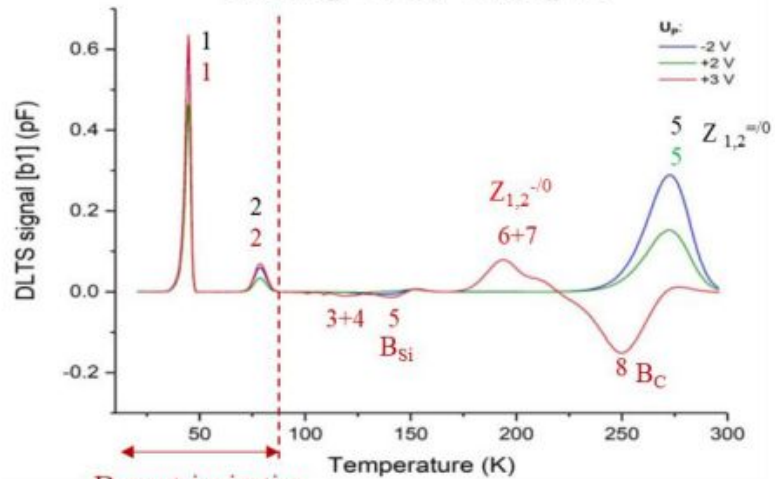
Unirradiated DLTS measurements



Comparing the two extreme diodes



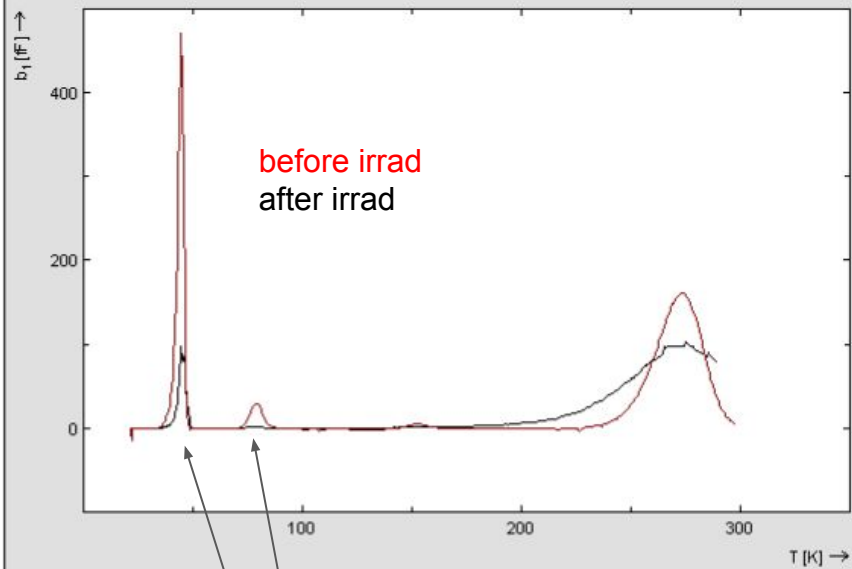
DLTS: $U_R = -10V$, $t_p = 1$ ms, $T_w = 2$ s



After Proton Irradiation: PAD_10_-3, 1.61 E+12 p/cm²

Name	Tw [s]	tP [s]	UR[V]	UP[V]
R-10V_UP-0.6V_1ms.T3A	2.0E+00	1.0E-03	-10.0	-0.6
@DLTS_-10-06V_1ms.T3A	2.0E+00	1.0E-03	-10.0	-0.6

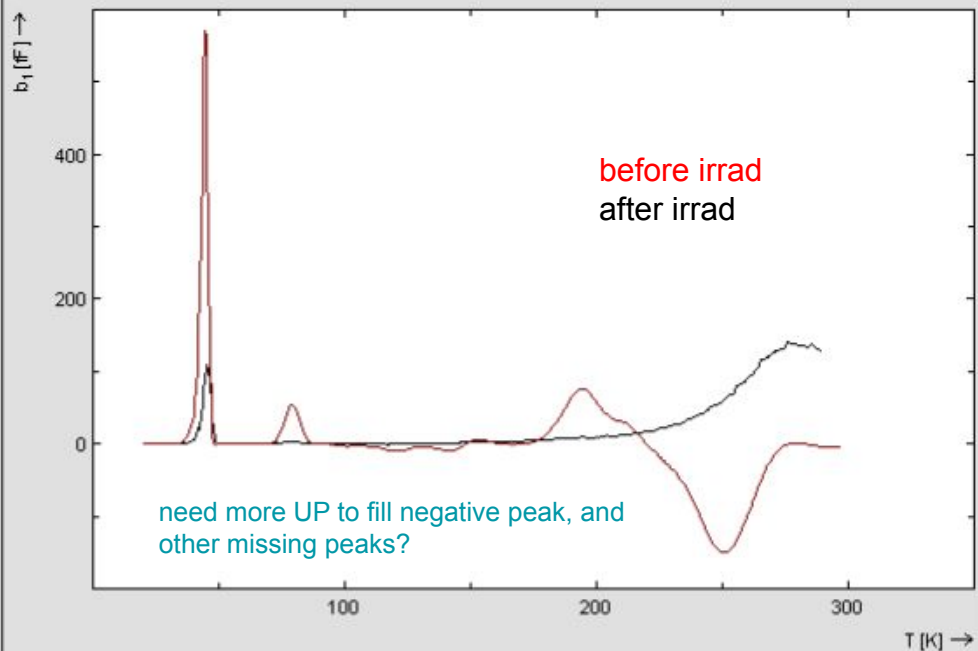
majority injection, UP=-0.6V



(assumed) nitrogen defects decrease concentration → donor removal?

Name	Tw [s]	tP [s]	UR[V]	UP[V]
_UR-10V_UP+3V_1ms.T3A	2.0E+00	1.0E-03	-10.0	3.0
3@DLTS_-10+3V_1ms.T3A	2.0E+00	1.0E-03	-10.0	3.0

majority & minority injection, UP=+3V

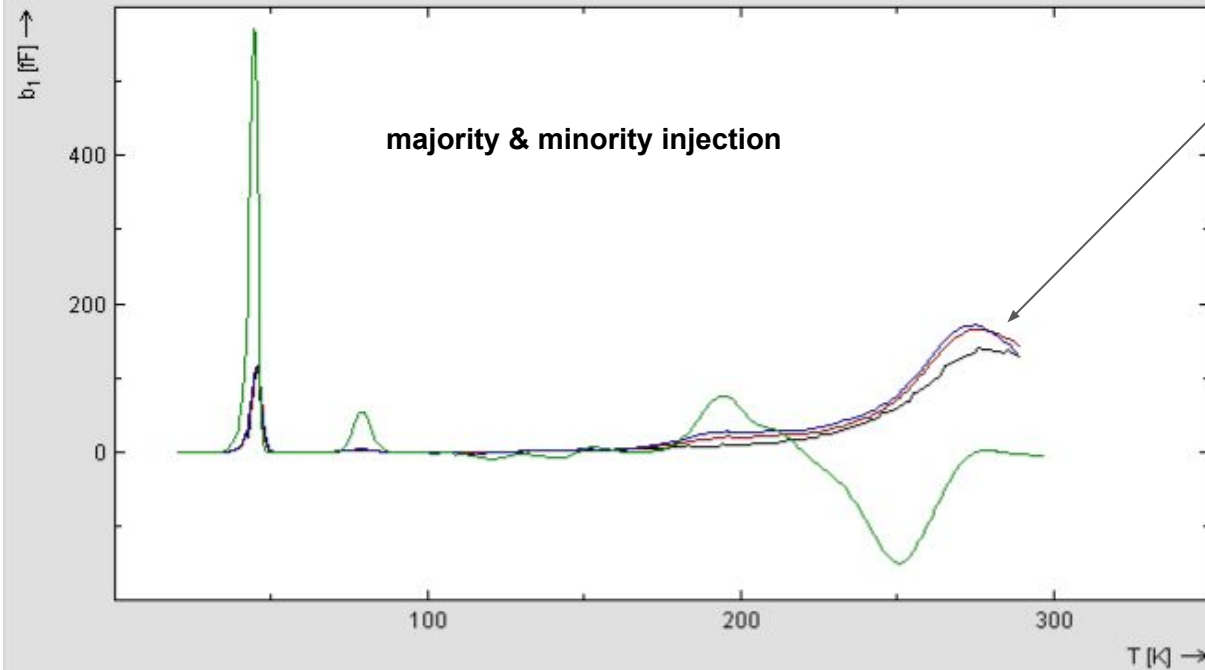


After Proton Irradiation: PAD_10_-3, 1.61 E+12 p/cm2

Name	Tw [s]	τ_P [s]	UR[V]	UP[V]
_UR-10V_UP+3V_1ms.T3A	2.0E+00	1.0E-03	-10.0	3.0
_UR-10V_UP+4V_1ms.T3A	2.0E+00	1.0E-03	-10.0	4.0
_UR-10V_UP+5V_1ms.T3A	2.0E+00	1.0E-03	-10.0	5.0
3@DLTS_-10+3V_1ms.T3A	2.0E+00	1.0E-03	-10.0	3.0

after irradiation

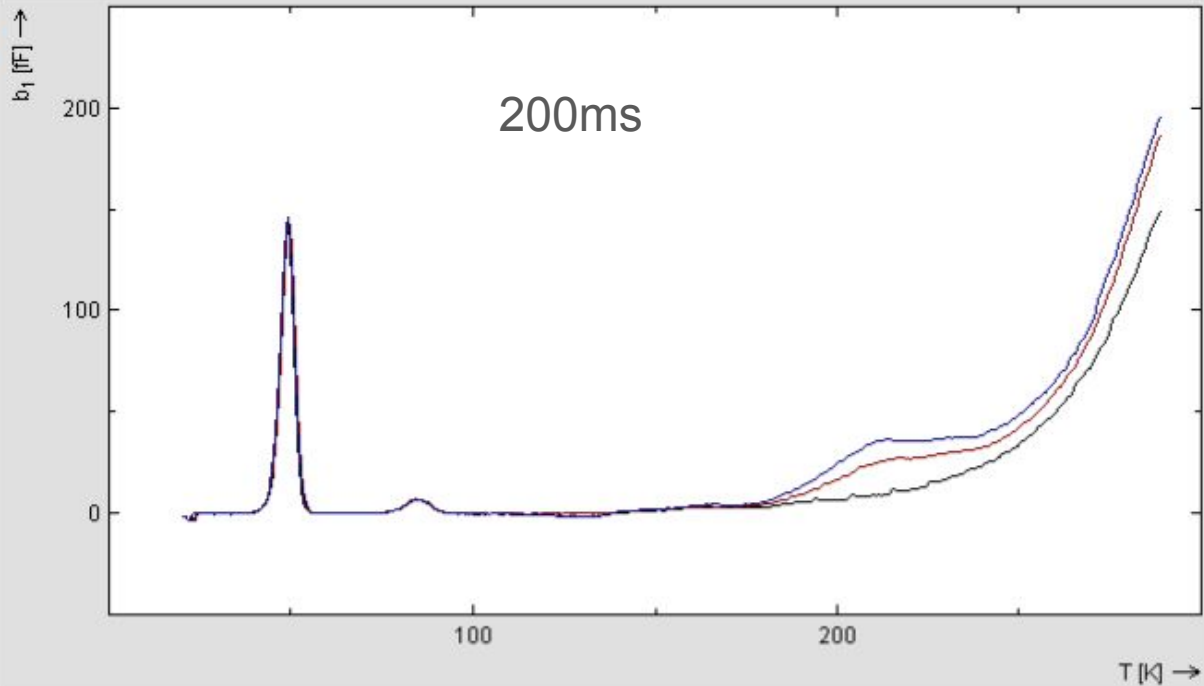
before irradiation



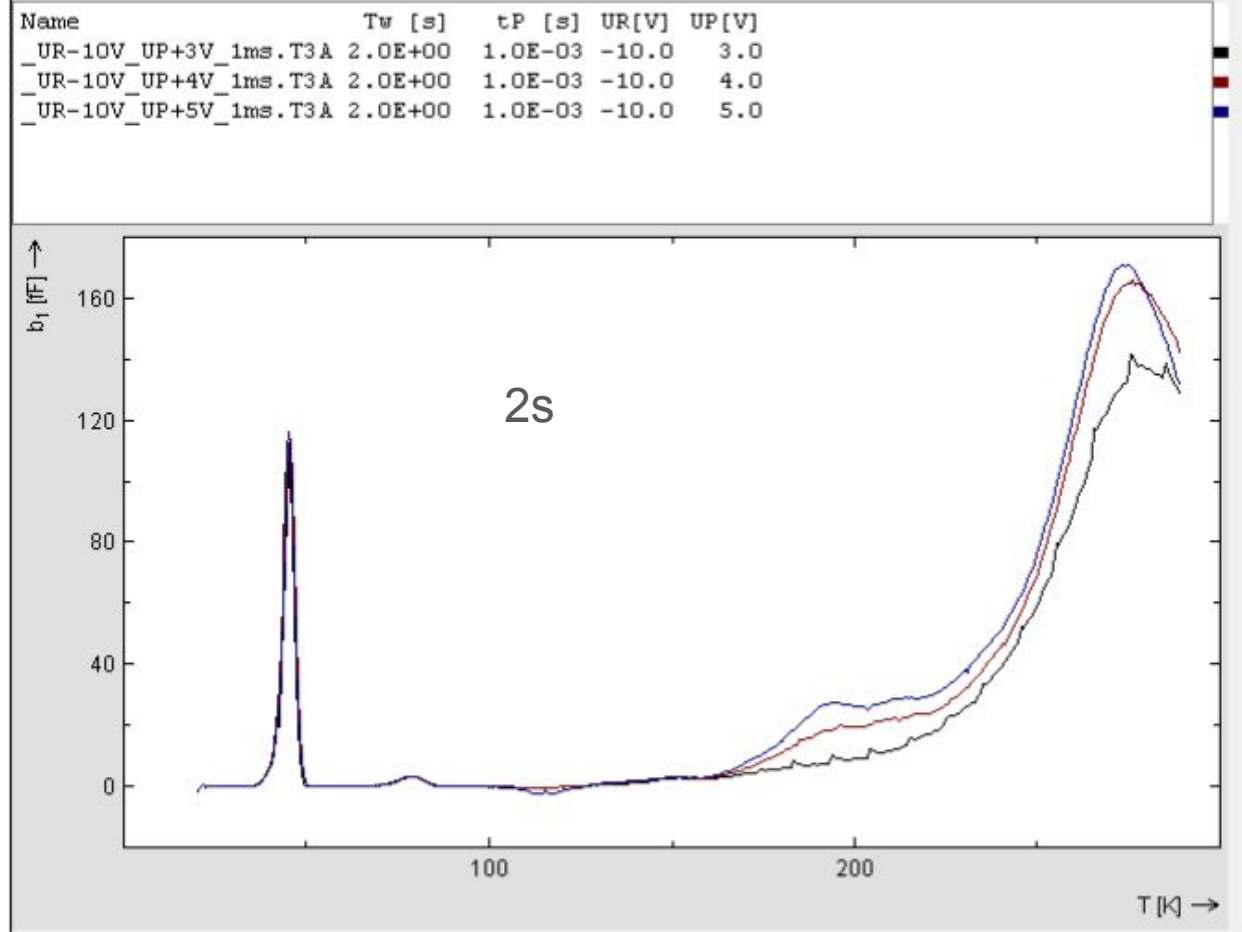
Z1/2 overshadows negative peak

After Proton Irradiation: PAD_10_-3, 1.61 E+12 p/cm2

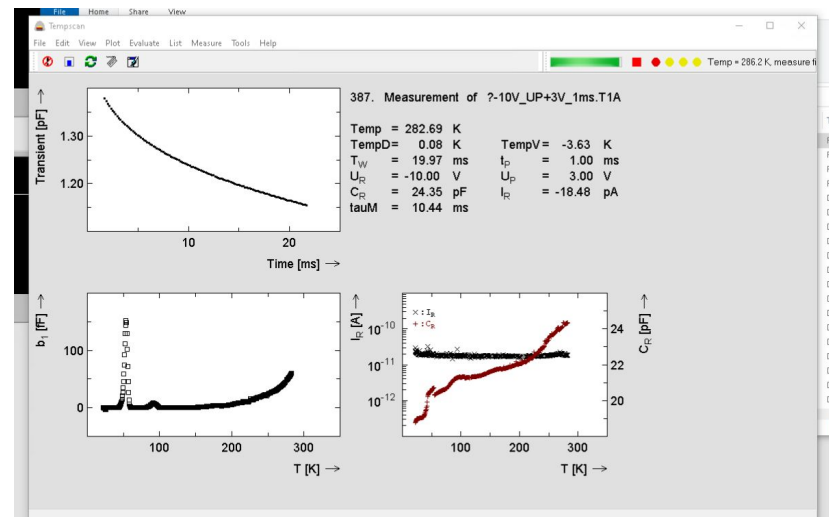
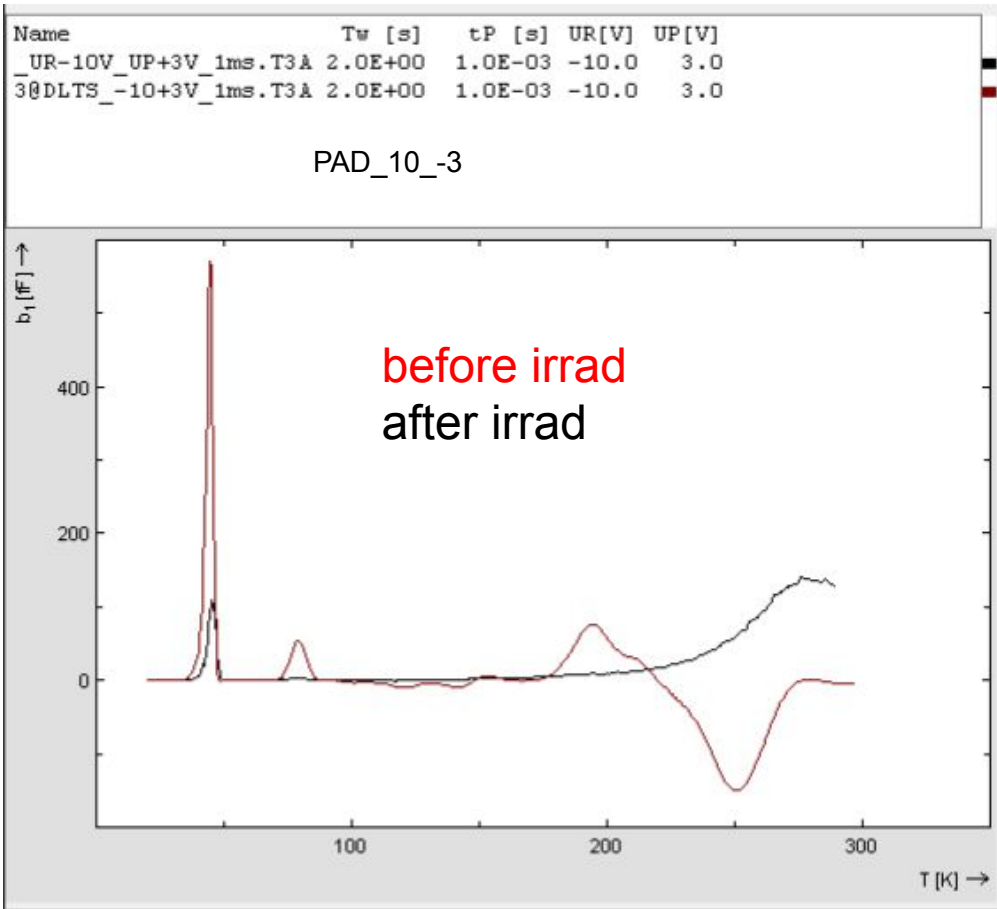
Name	Tw [s]	tP [s]	UR[V]	UP[V]
_UR-10V_UP+3V_1ms.T2A	2.0E-01	1.0E-03	-10.0	3.0
_UR-10V_UP+4V_1ms.T2A	2.0E-01	1.0E-03	-10.0	4.0
_UR-10V_UP+5V_1ms.T2A	2.0E-01	1.0E-03	-10.0	5.0



After Proton Irradiation: PAD_10_-3, 1.61 E+12 p/cm2

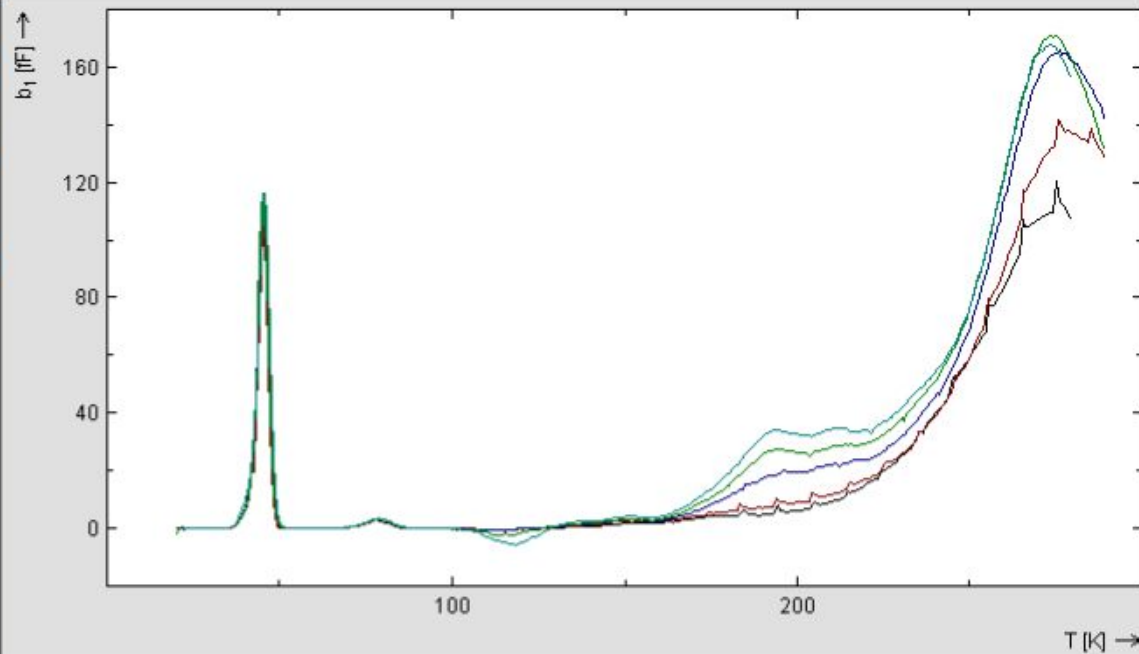


After Proton Irradiation: PAD_10_-3, 1.61 E+12 p/cm²

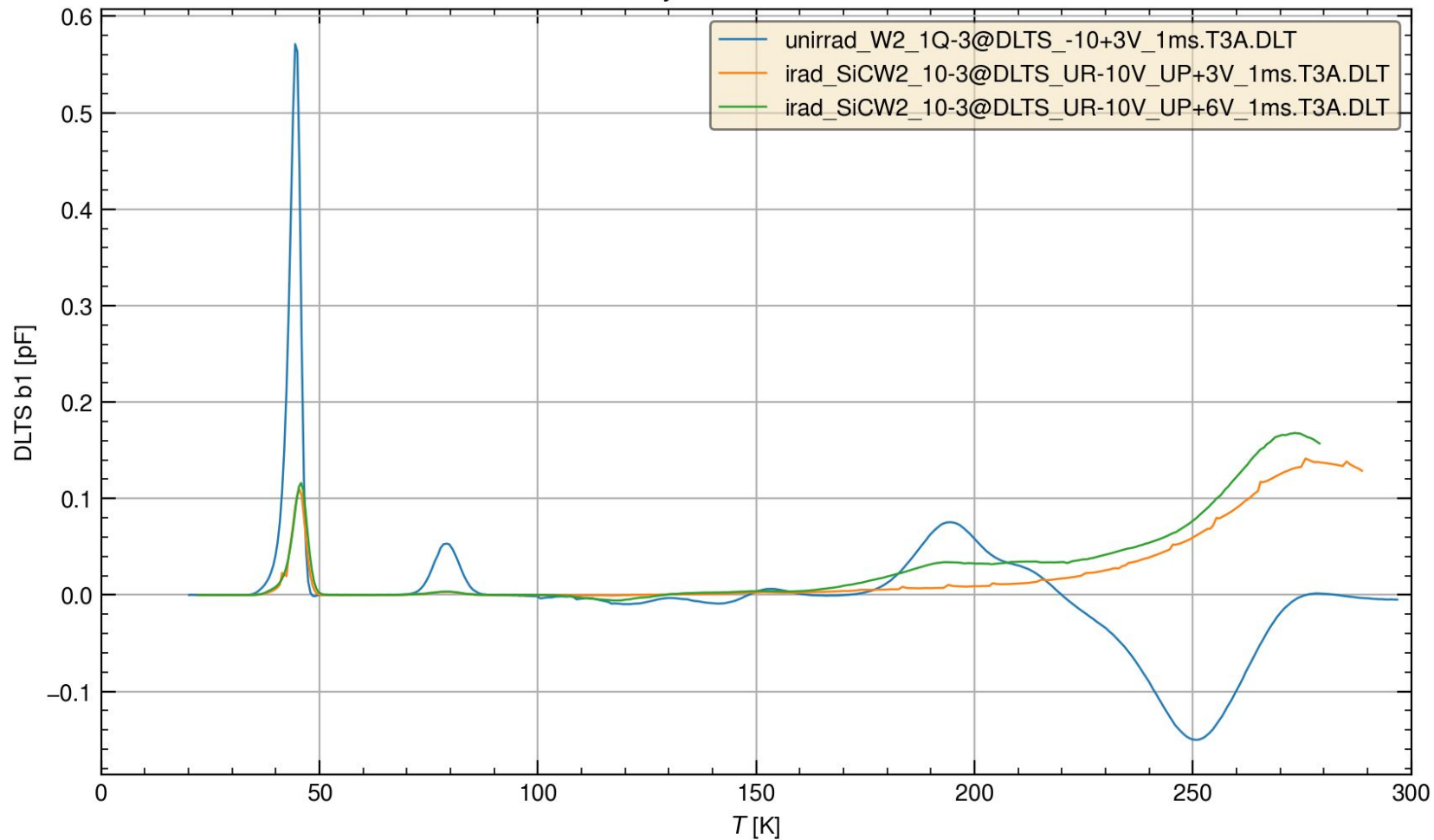


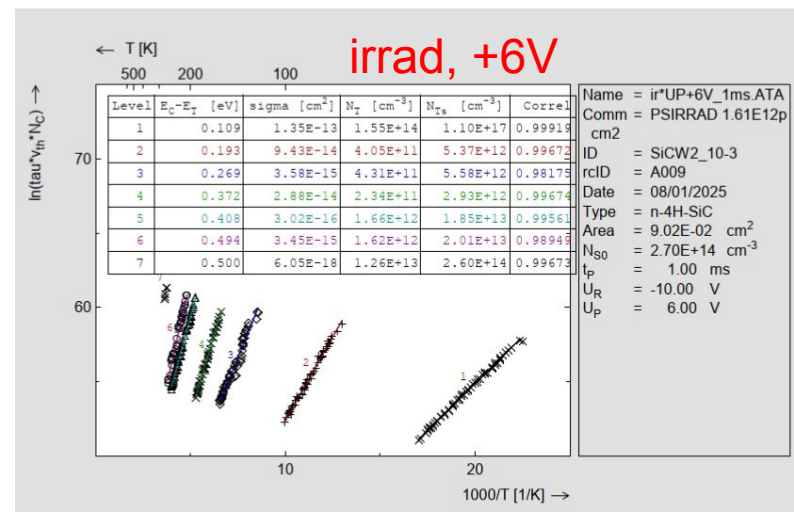
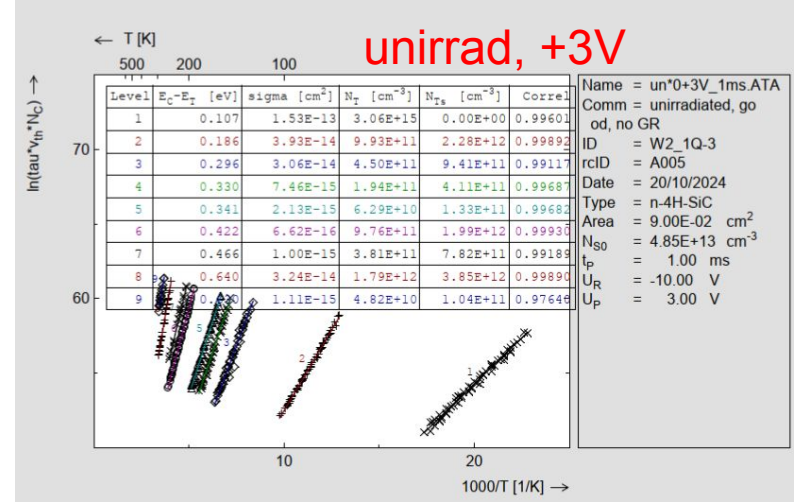
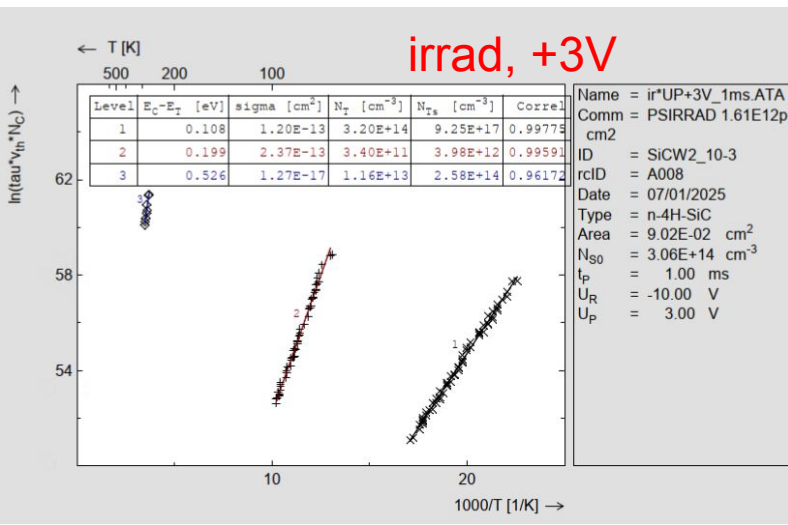
After Proton Irradiation: PAD_10_-3, 1.61 E+12 p/cm²

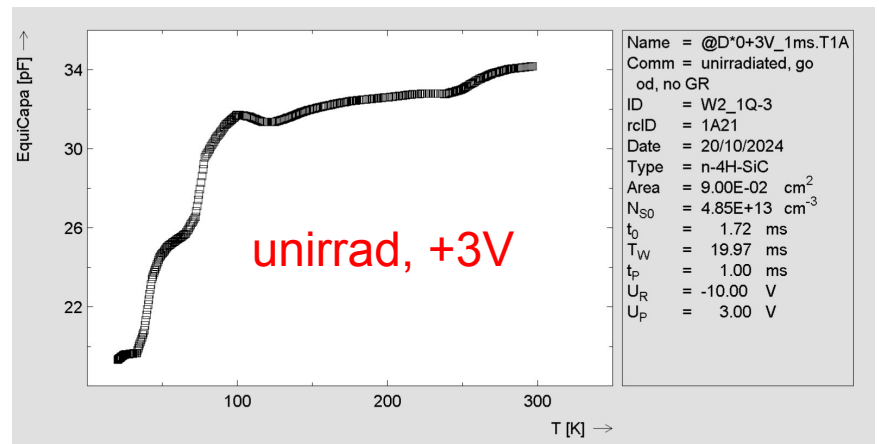
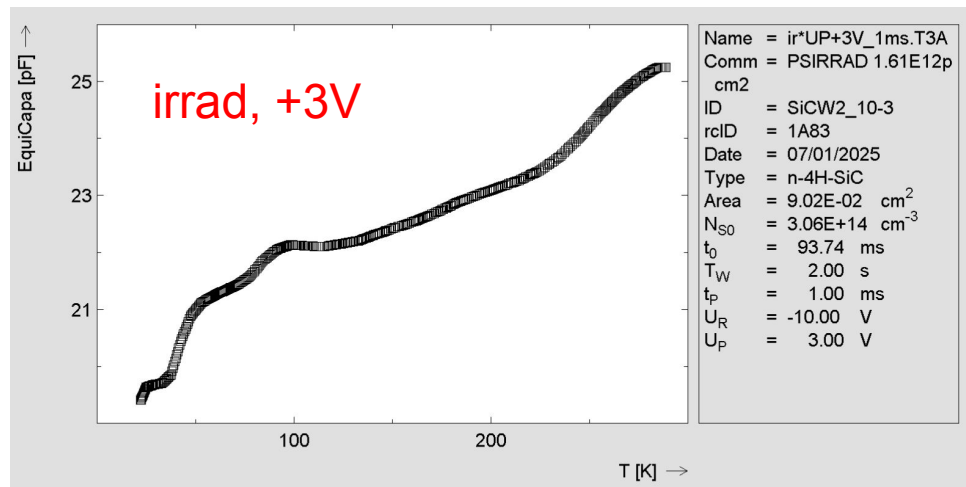
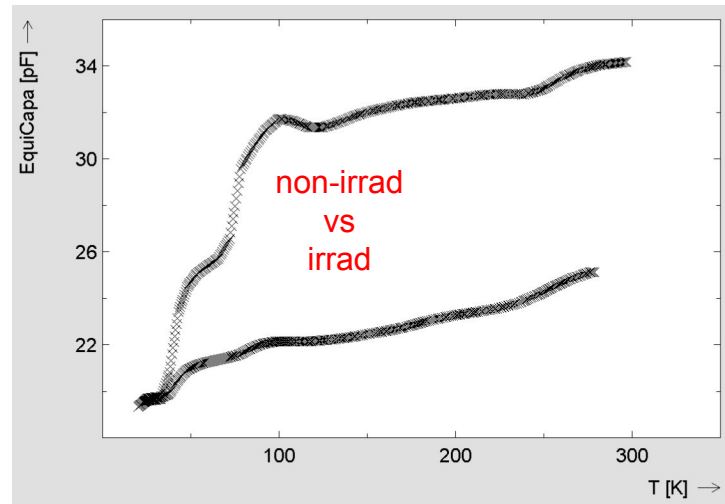
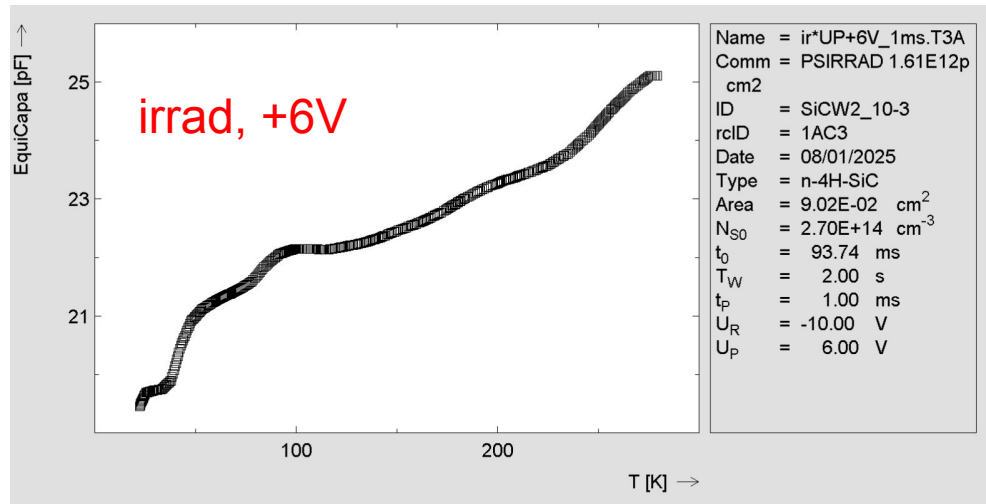
Name	Tw [s]	tP [s]	UR[V]	UP[V]
_UR-10V_UP+2V_1ms.T3A	2.0E+00	1.0E-03	-10.0	2.0
_UR-10V_UP+3V_1ms.T3A	2.0E+00	1.0E-03	-10.0	3.0
_UR-10V_UP+4V_1ms.T3A	2.0E+00	1.0E-03	-10.0	4.0
_UR-10V_UP+5V_1ms.T3A	2.0E+00	1.0E-03	-10.0	5.0
_UR-10V_UP+6V_1ms.T3A	2.0E+00	1.0E-03	-10.0	6.0



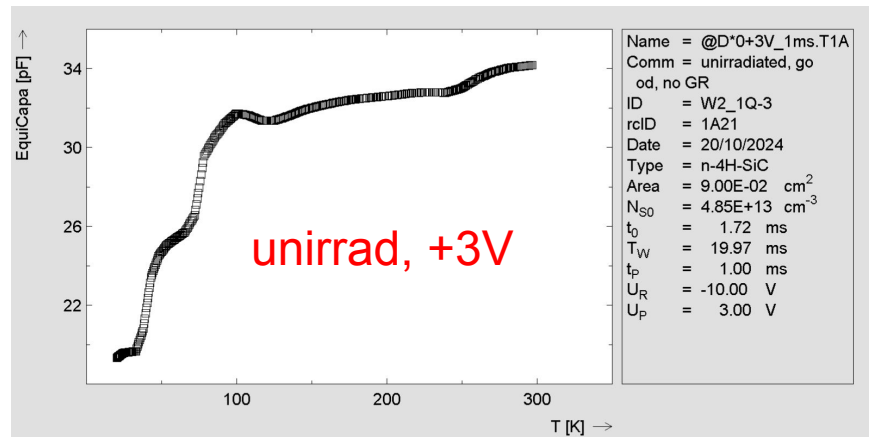
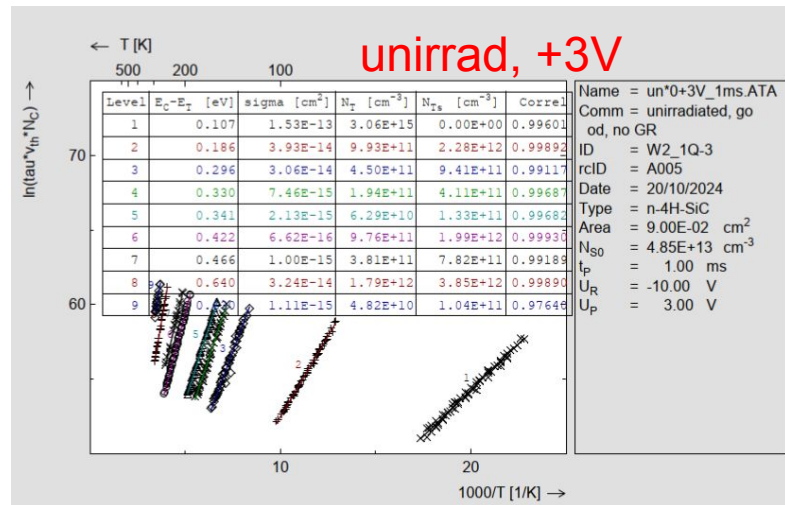
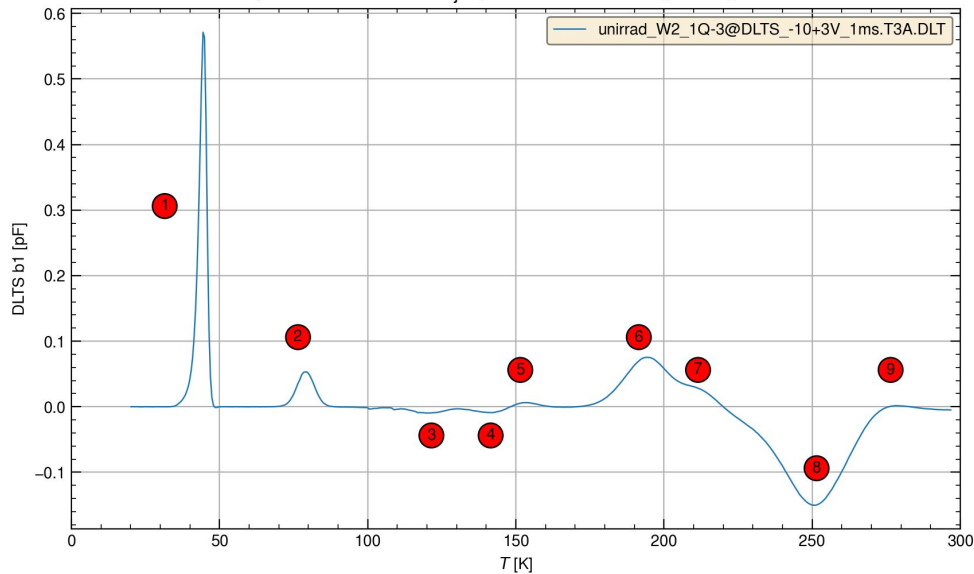
4H-SiC RD50 Common Project: CNM Run 17407 Wafer 2 Pad Diodes

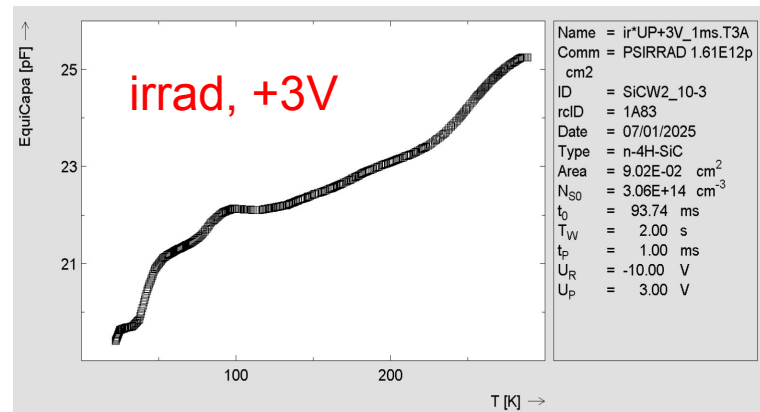
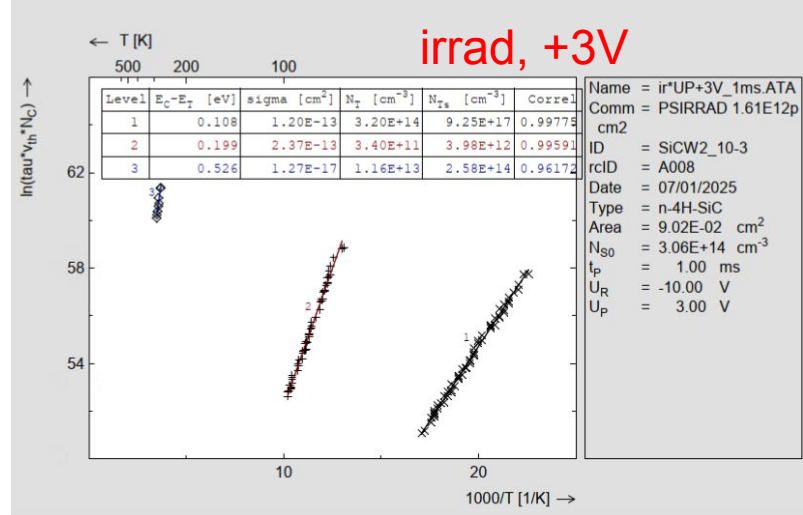
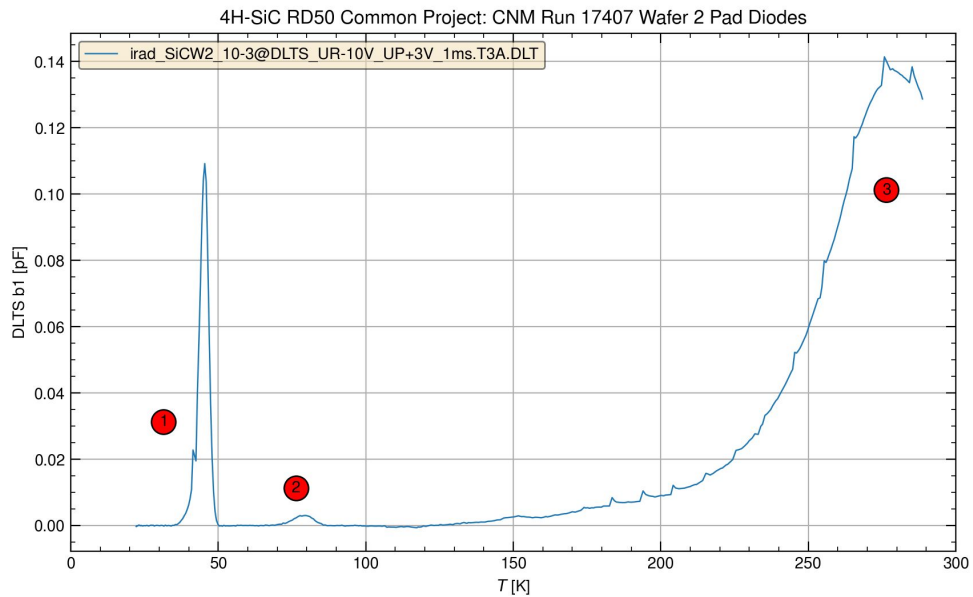


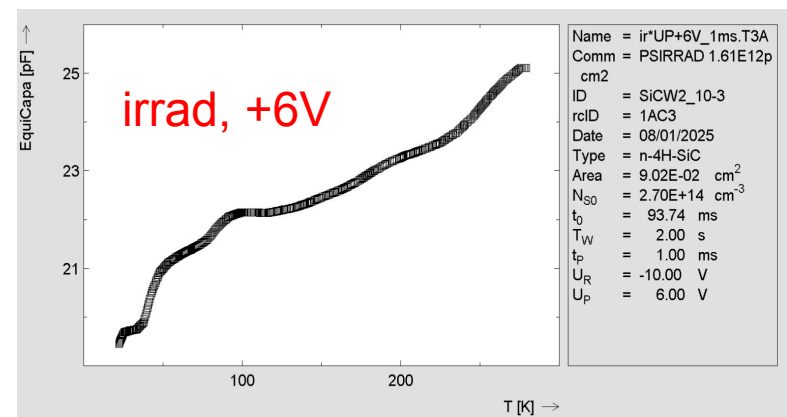
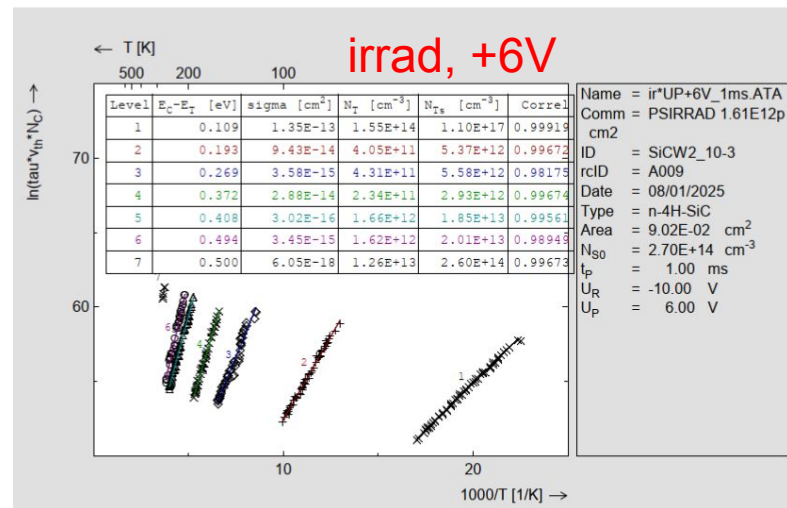
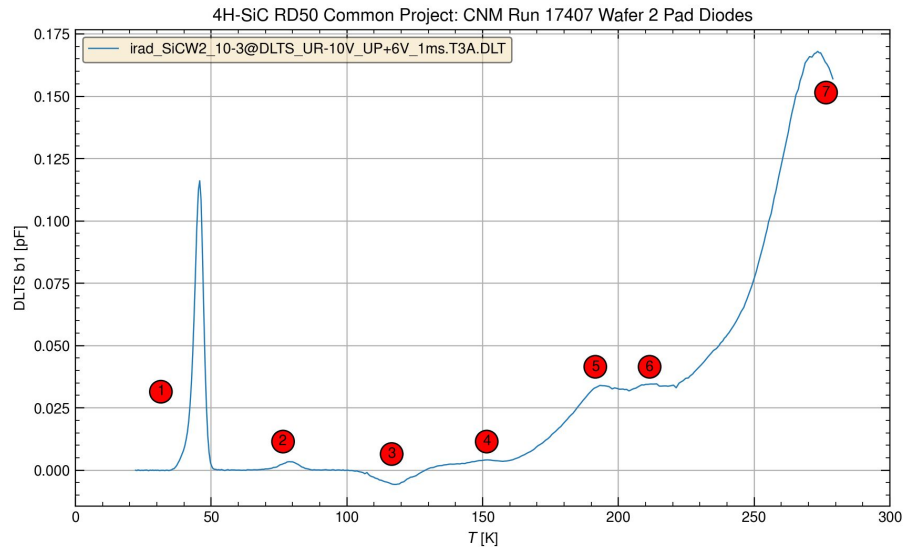




4H-SiC RD50 Common Project: CNM Run 17407 Wafer 2 Pad Diodes



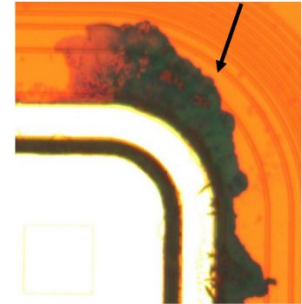
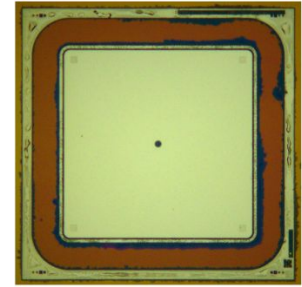




RD50 Common Project 4H-SiC LGADs, Planar Pad Diode Run & Status of Irradiation Campaign at CERN

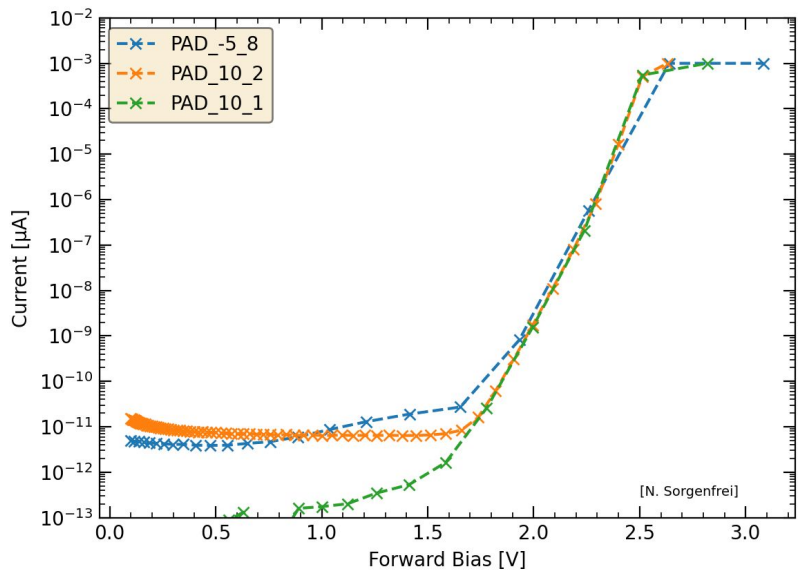
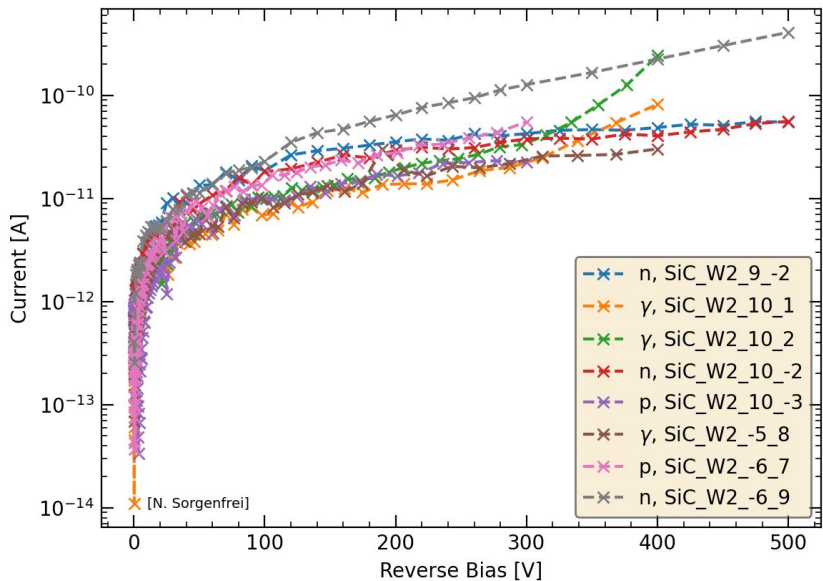
- CNM Run 17047 W2
- n-type epitaxial 4H-SiC pad diodes
- 50 μm EPI layer
- 3x3mm² area
- Outflow of Aluminium during processing
→ Broken guard ring structure
- More details in [talk by Andreas Gsponer at 1st DRD3](#)

- Irradiation campaign by SSD group at CERN
 - Irradiate with Protons, Neutrons and Gammas
 - Compare damage of different particle types
- Status of this project
 - Measured all diodes unirradiated (due to differences in processing)
 - Diodes send out to facilities
 - Awaiting their return



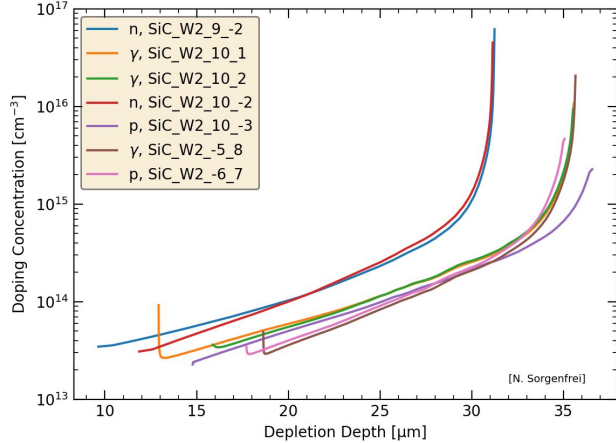
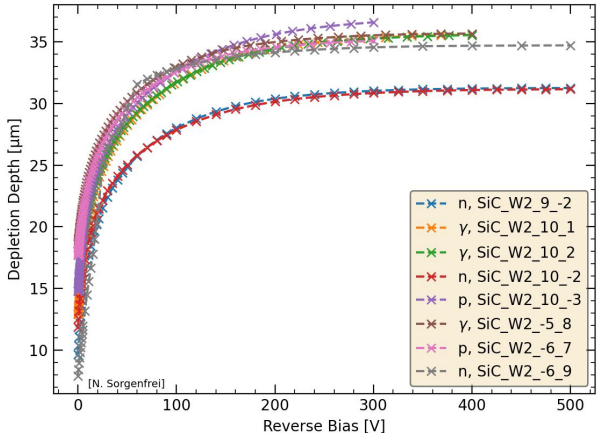
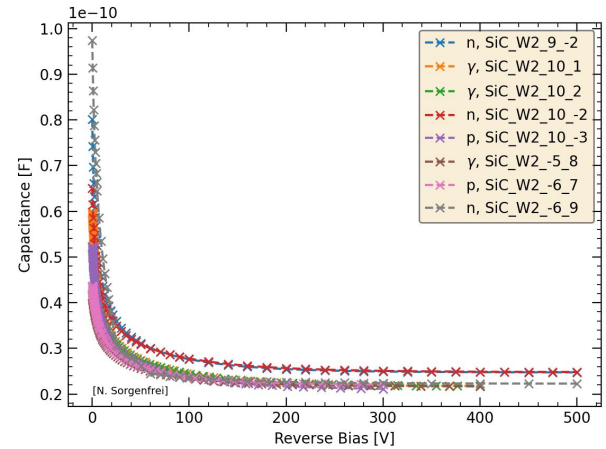
All results shown in the following are from diodes from the same wafer!

IV Measurements of Unirradiated Diodes



- Overall similar behaviour for both reverse and forward bias
- Only slight variations observed

CV Measurements of Unirradiated Diodes



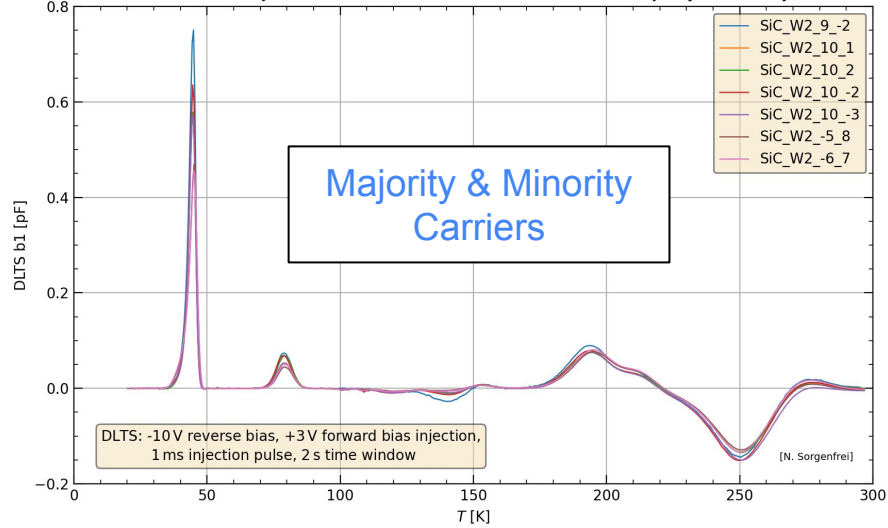
Differences observed in:

- Depletion depth
- Doping concentration profile
- Effective doping concentration
- Due to broken guard ring structure, large uncertainty on active area
→ Extracted values for doping are of indicative nature

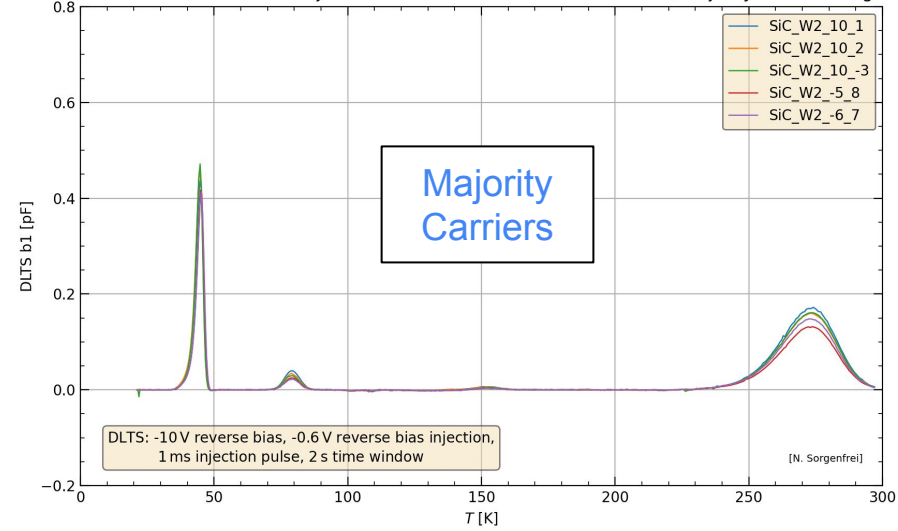
Name	PAD_9_-2	PAD_10_1	PAD_10_2	PAD_10_-2	PAD_10_-3	PAD_-5_8	PAD_-6_7	PAD_-6_9
$N_{eff} [1E13 1/cm^3]$	5.9	4.7	4.9	6.2	4.6	5.1	5.0	6.6

DLTS Measurements of Unirradiated Diodes

4H-SiC RD50 Common Project: CNM Run 17407 Wafer 2 Pad Diodes, Majority & Minority Carrier Filling

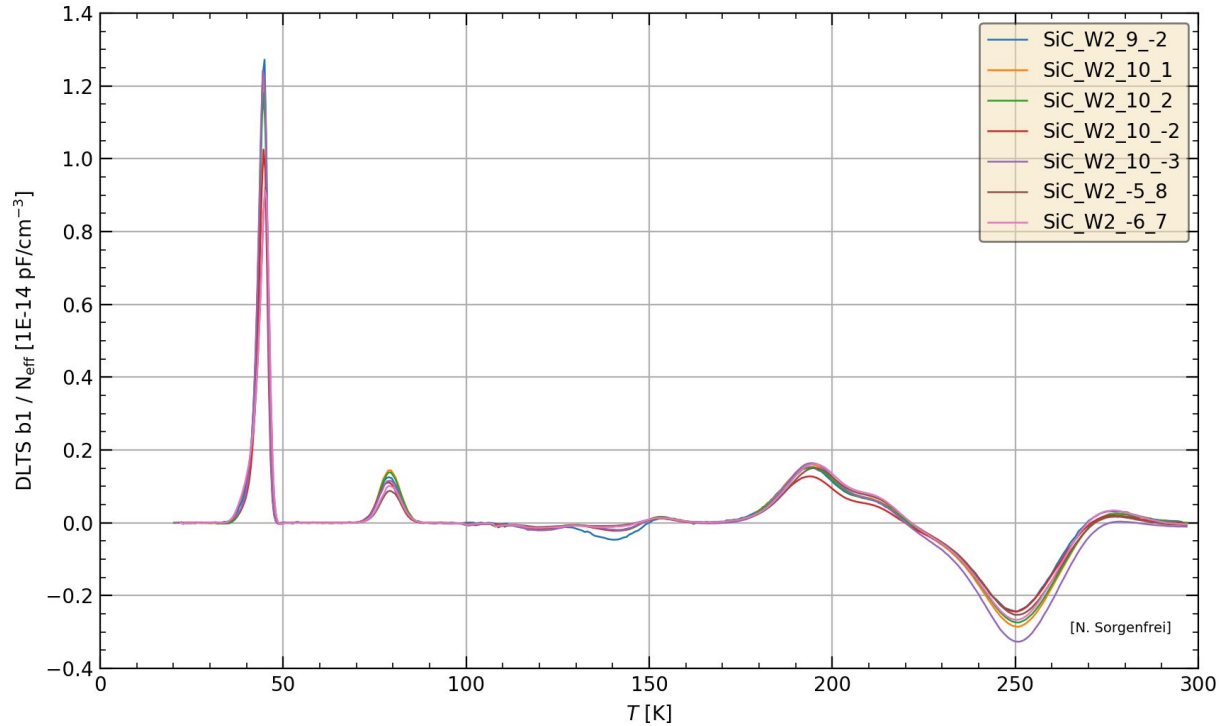


4H-SiC RD50 Common Project: CNM Run 17407 Wafer 2 Pad Diodes, Majority Carrier Filling



- Overall similar behaviour
- Same kind of defects observed in all samples
- Slight variations observed in defect concentration
→ Related to different effective doping concentrations?

DLTS Measurements of Unirradiated Diodes



- All sensors are from the same wafer
- DLTS signals normalised to effective doping concentration extracted from CV measurements
- No strong differences between sensors observed
- Analysis of defect parameters on-going