

Polarization Effects in sCVD Charge Collection

Sergej Schuwalow
DESY Zeuthen

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Experimental Observations

Polarization Model

CCD vs time dependence

Dependence of CCD on the acquired dose

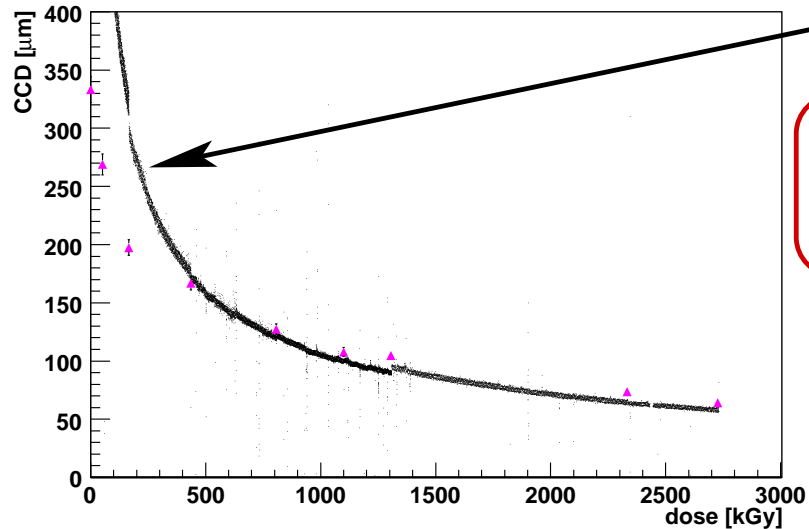
Depolarisation (Model Prediction)

Summary

Sergej Schuwalow
DESY Zeuthen

Experimental Data

CCD (from I_{sens}) vs dose



Sensor current vs dose measurements

Trapping/ detrapping? mechanism???
Recombination?

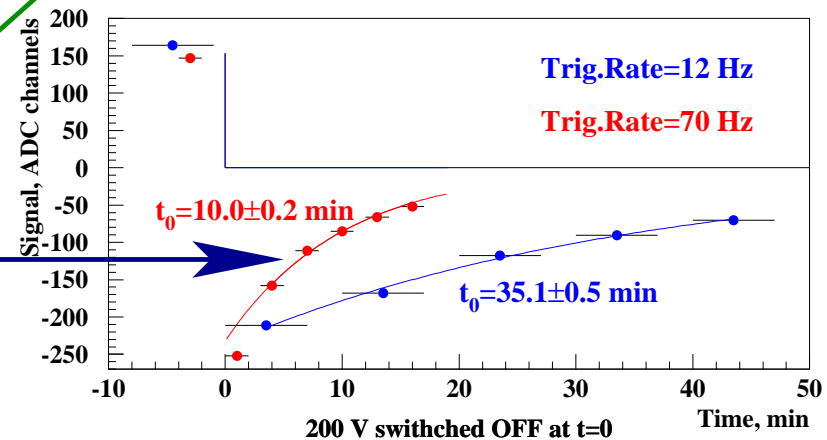
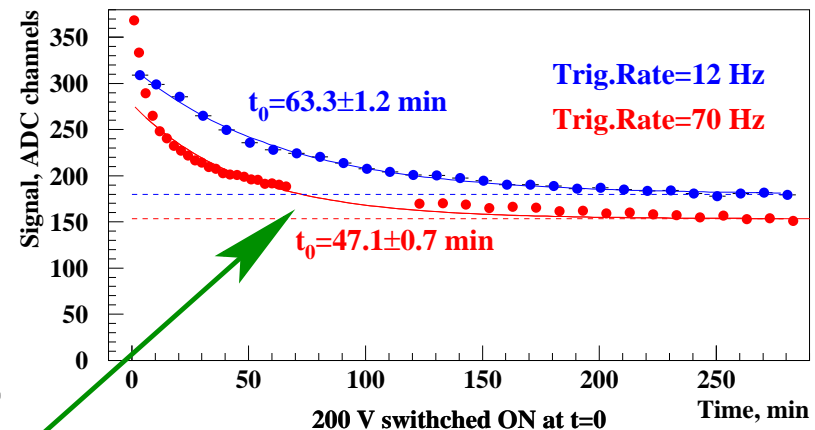
sCVD detector after 2.7 MGy;
Measurements with ^{90}Sr -source

Time and Rate dependent signal

After switching HV off the signal of opposite polarity is observed

Dynamical Polarization

So14-04 Diamond Sample



Polarization Model

Radiation damage – uniformly produced traps

MIP signal – uniformly produced e–h pairs

+Electric field → NONUNIFORM space charge

Change of the electric field

e–h Recombination if the field is low

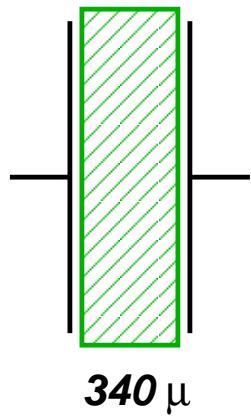
Release of trapped charges (decay time)

Change of the space charge distribution

Steady state POLARIZATION

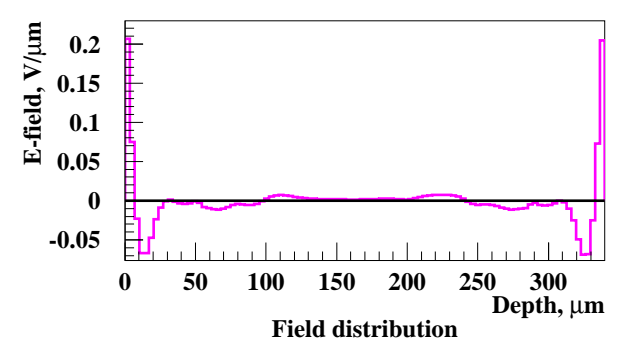
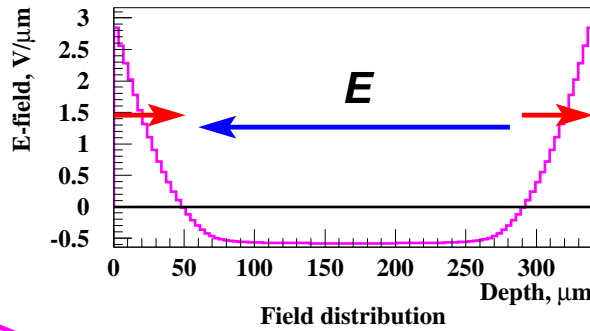
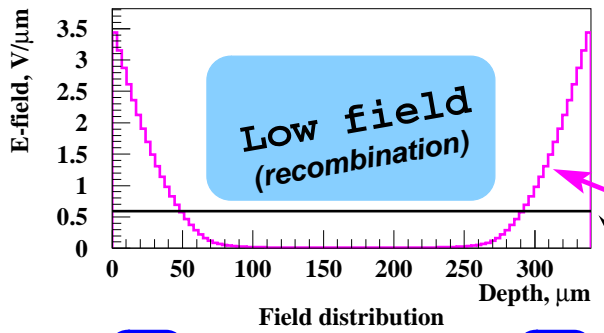
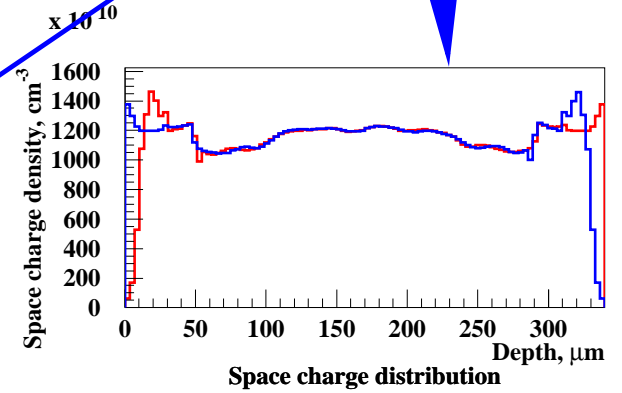
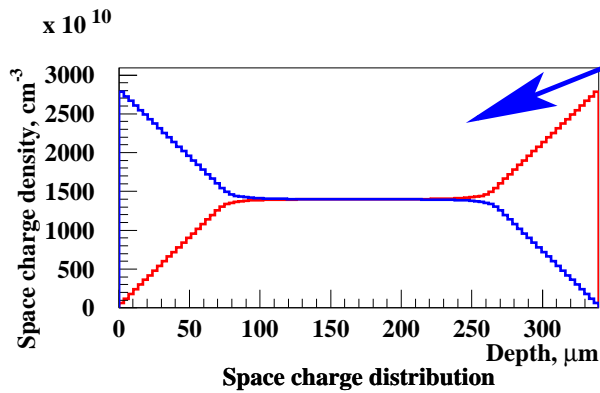
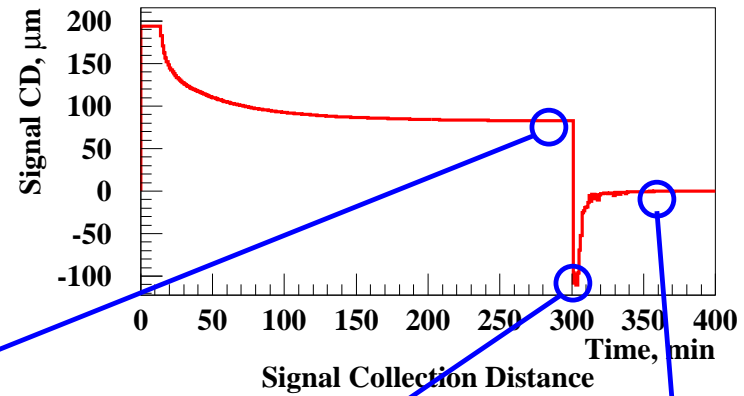
Dependent on trap density, applied voltage and signal rate

Polarization Model: CCD vs time



$HV = 200\text{ V}$
Applied at $t = 0$;
switched OFF at $t=300$

So14_04 sample model



Steady state field

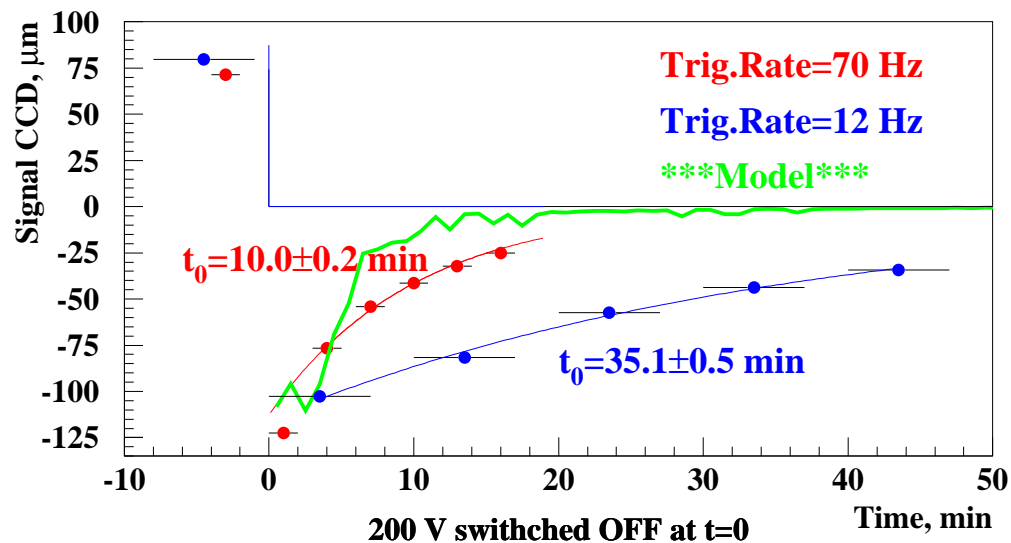
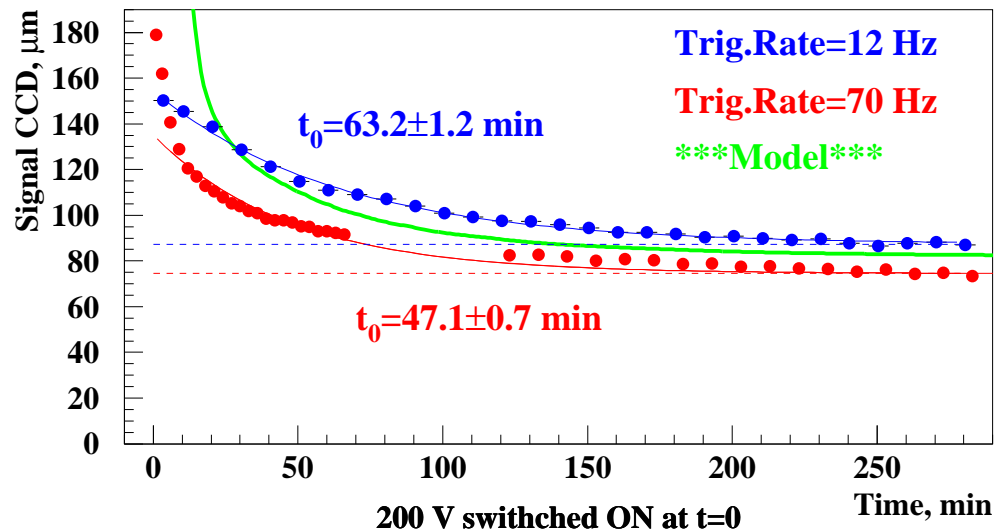
Initial field

Effective Charge Collection Regions

Polarization Model: CCD vs time

Comparison with the data

So14-04 Diamond Sample



*Model reproduces
CCD time dependence*

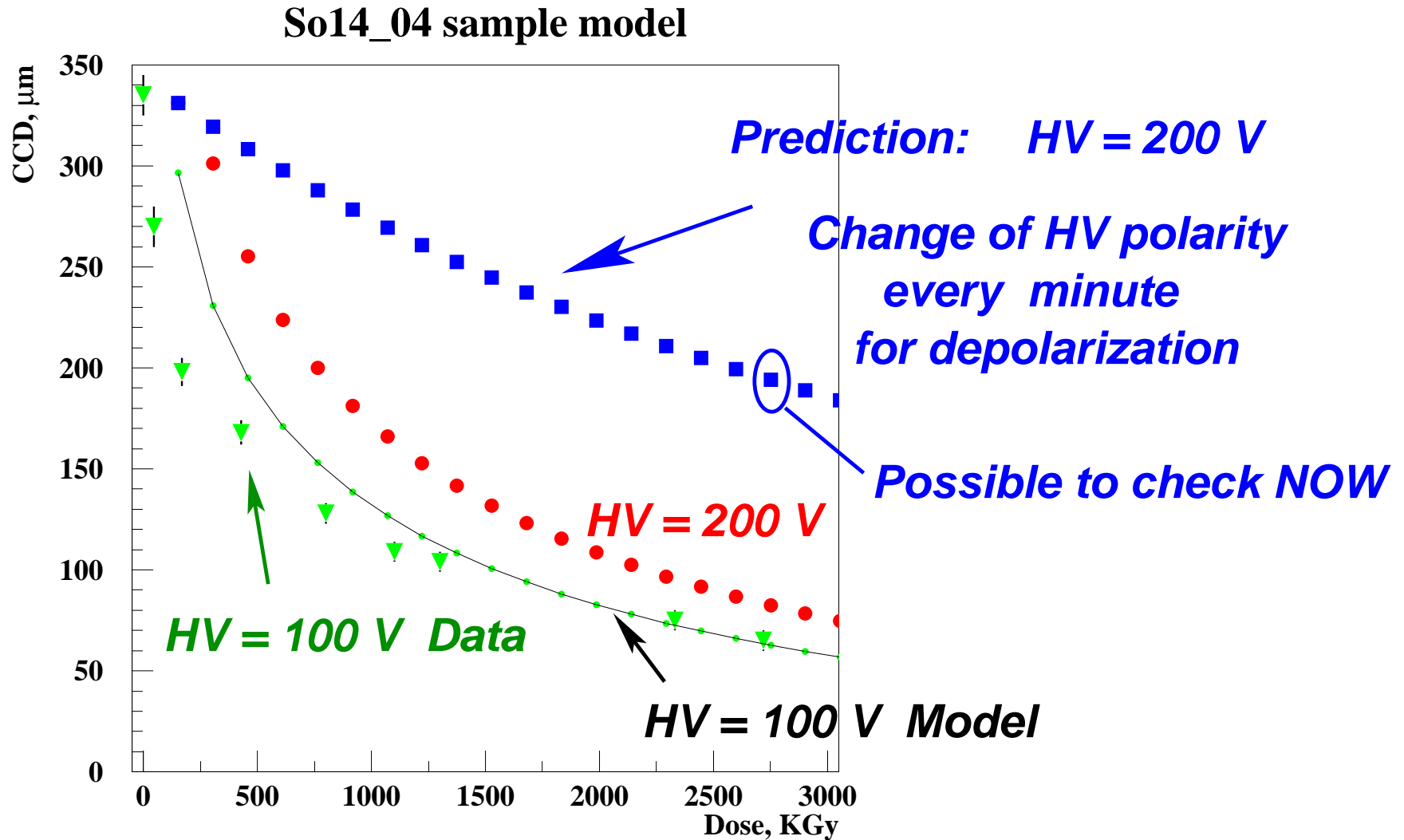
At the moment:

*Too strong rate
dependence*

*Too fast
relaxation
after HV=0*

Polarization Model: CCD vs dose

(Assuming linear dependence of trap density vs dose)



Summary

Clear evidence for the polarization effects in the sCVD charge collection process is experimentally observed

A Polarization Model for the description of this effect has been developed

It was shown that polarization plays a significant role in the observed decrease of the signal from radiation damaged diamond detectors

Plans:

Calculate pair production rate for the ^{90}Sr –source setup

Check the depolarization method (prediction)

Try to apply the Model to other materials (pCVD, Si, GaAs)