Test beam results

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Overview

- Goals
- Place, facility
- Setups
- Results
  - Diamonds
  - Sapphires
- Summary

Goals

1. Observe signals directly (without amplifier&shaper) from different kinds of sensors under different conditions:

- scCVD diamonds of usual thickness (320 µm)
- thin scCVD diamond (100 µm)
- single crystal sapphires

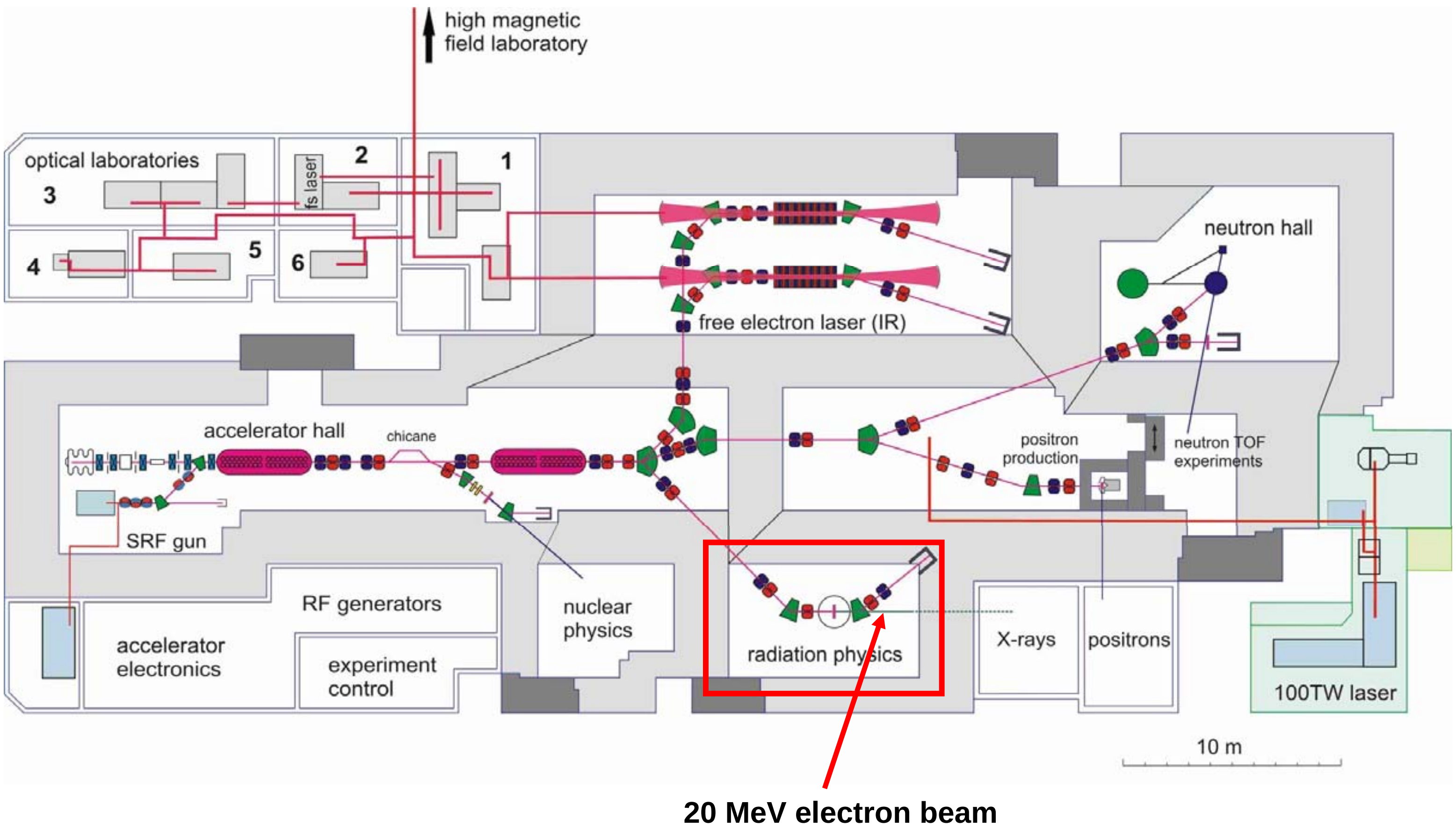
- fresh sensors
- irradiated sensors

2. Estimate charge carrier mobilities for sapphire

3. Irradiation hardness studies of a thin scCVD and a monocrystalline HTHP diamonds

Place, facility

ELBE facility (FZD Rossendorf)

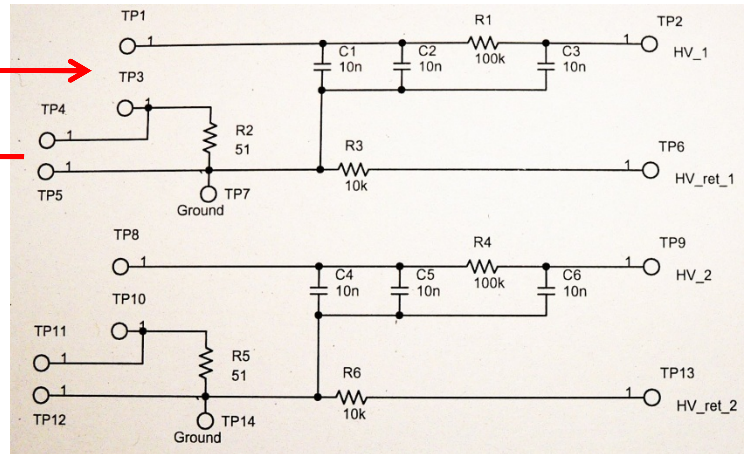


Setups

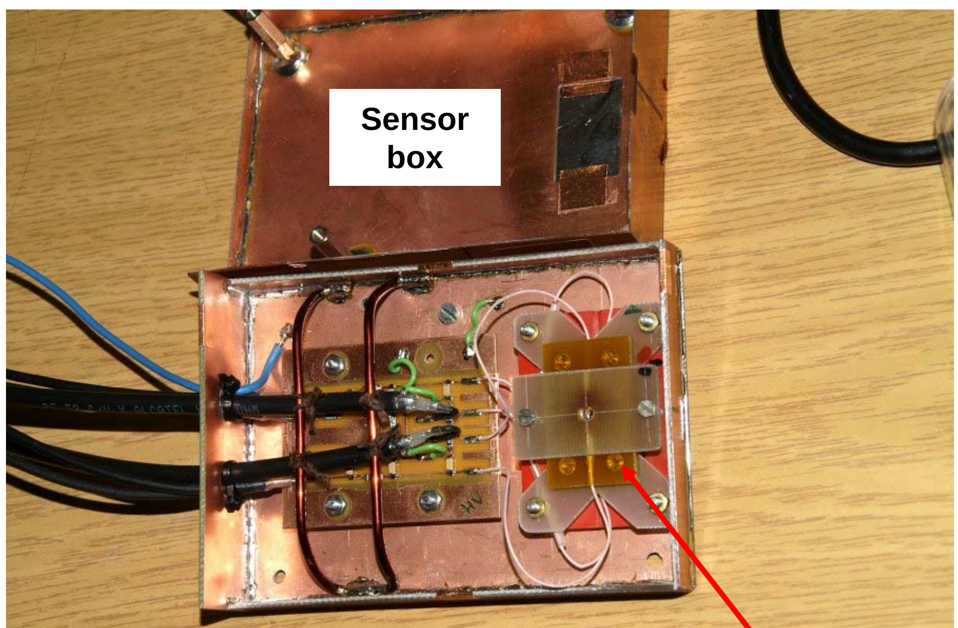
Beam setup

Sensor

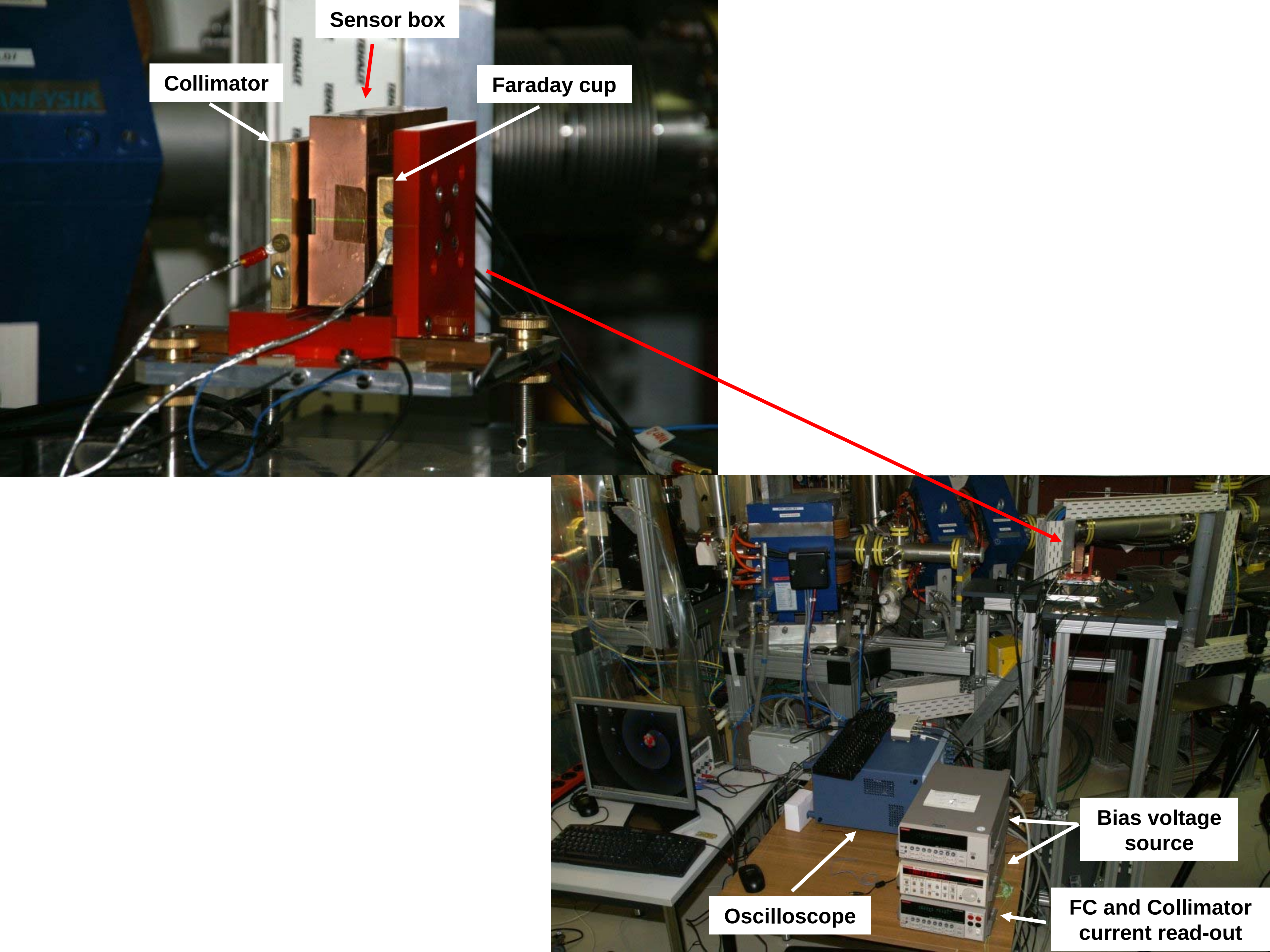
Signal



Bias voltage feed and signal read-out



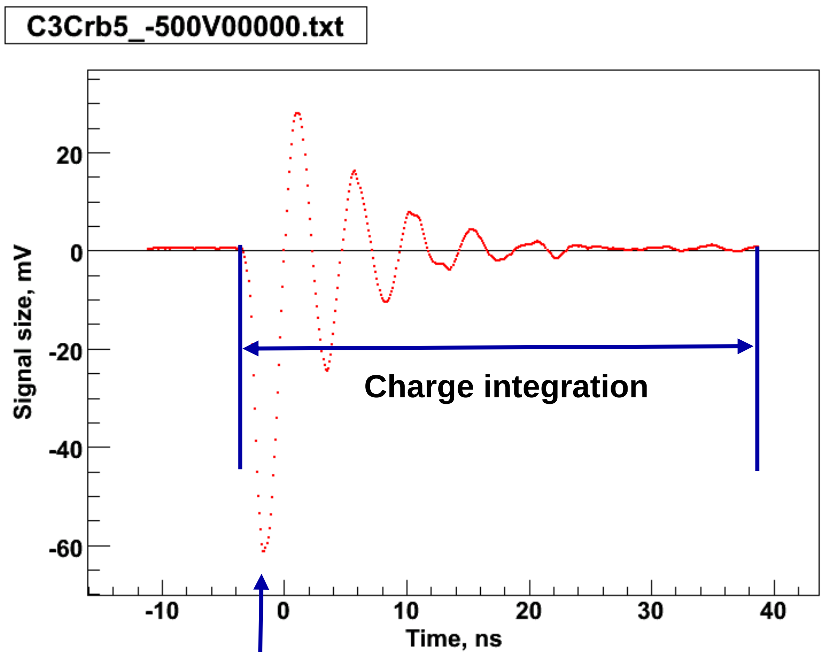
Sensors


Sensor box
Collimator
Faraday cup
Bias voltage source
Oscilloscope
FC and Collimator current read-out

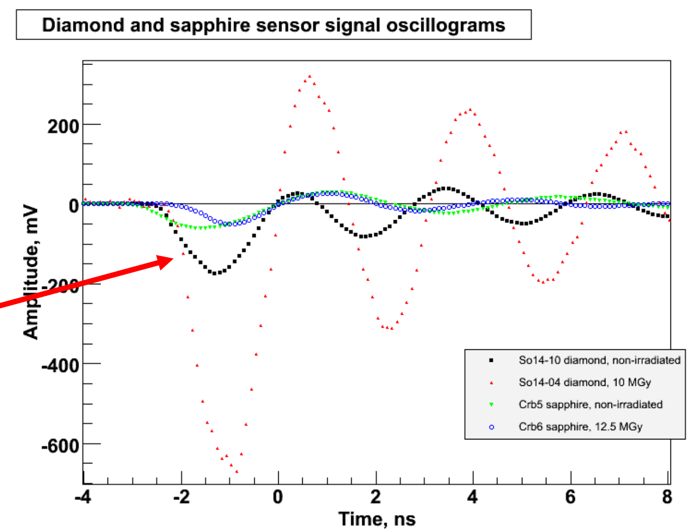
CCD setup

CCD measurements as a function of absorbed dose for the thin scCVD diamond

Results



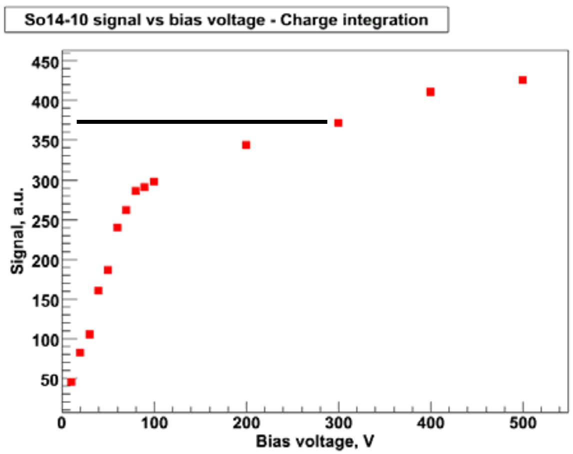
Direct conversion

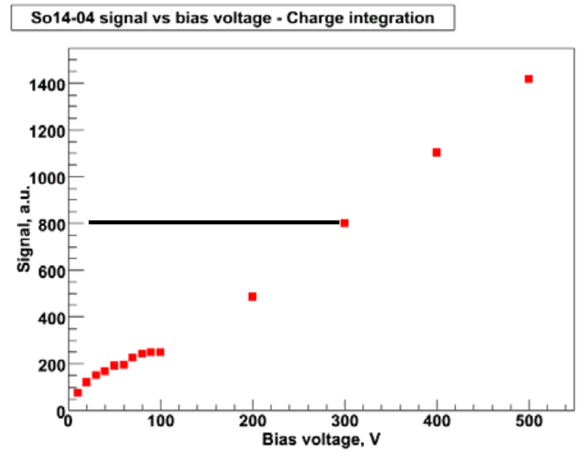


Different signal widths for different sensors

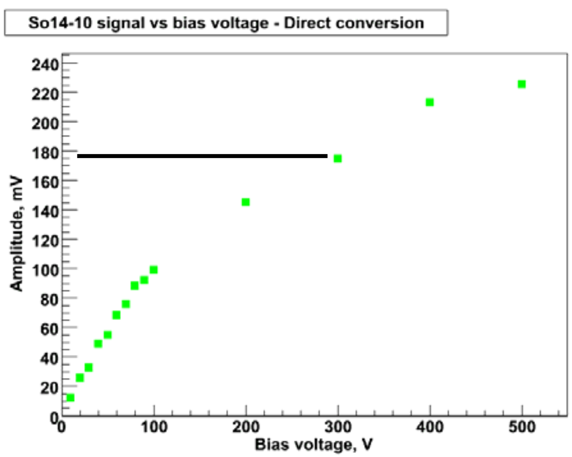
Diamonds

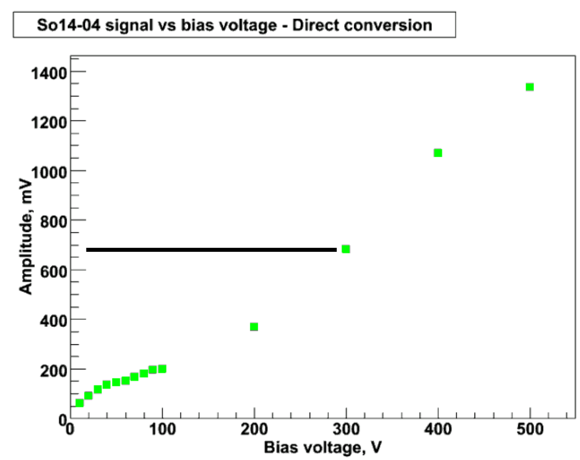
Signal vs bias voltage, scCVD diamonds 320 µm





1 V/µm level

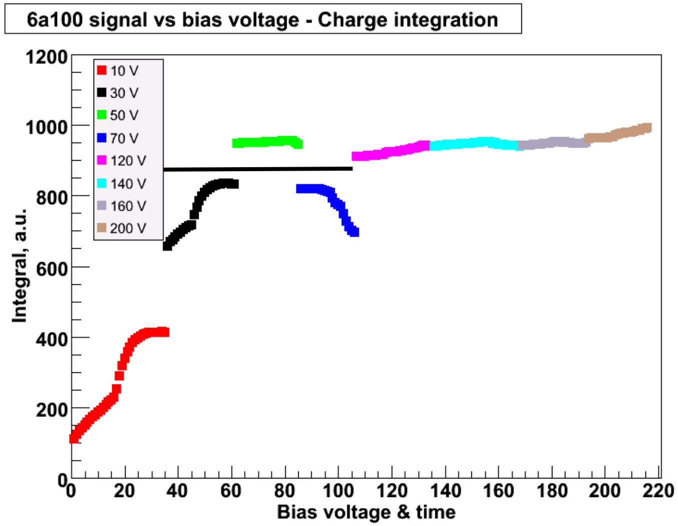


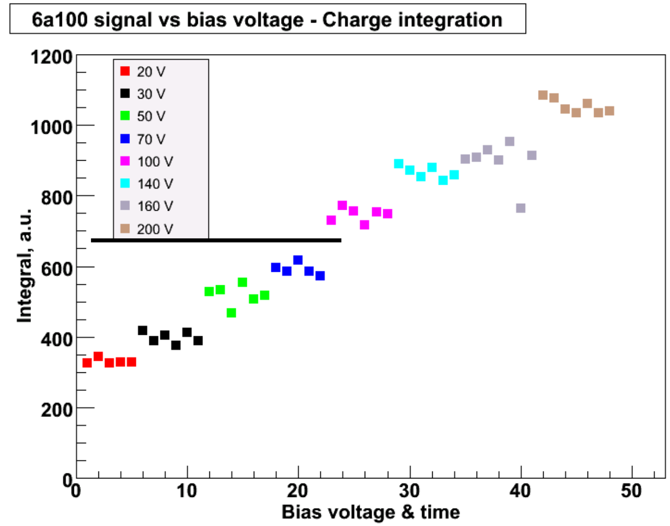


Fresh diamond

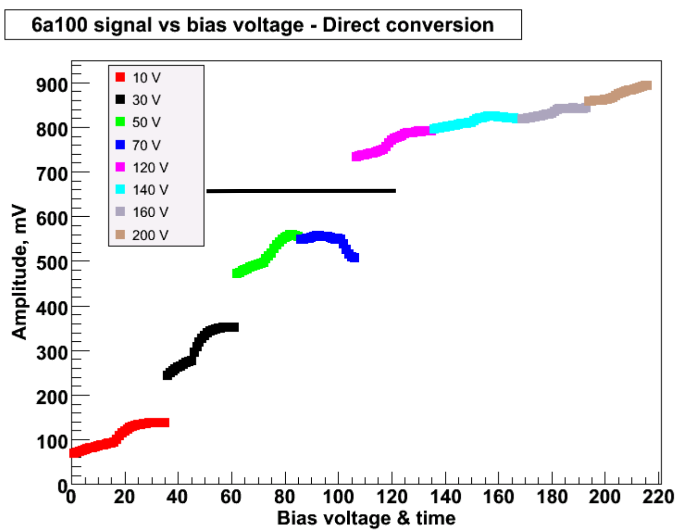
Diamond irradiated to 10 MGy

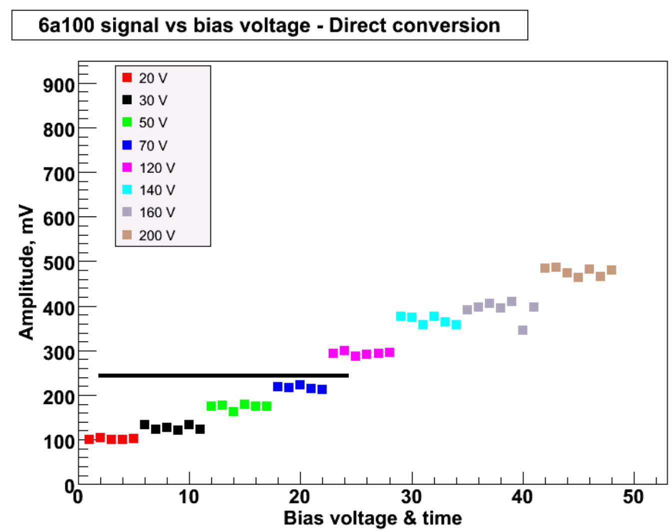
Signal vs bias voltage, scCVD diamond 100 µm





1 V/µm level



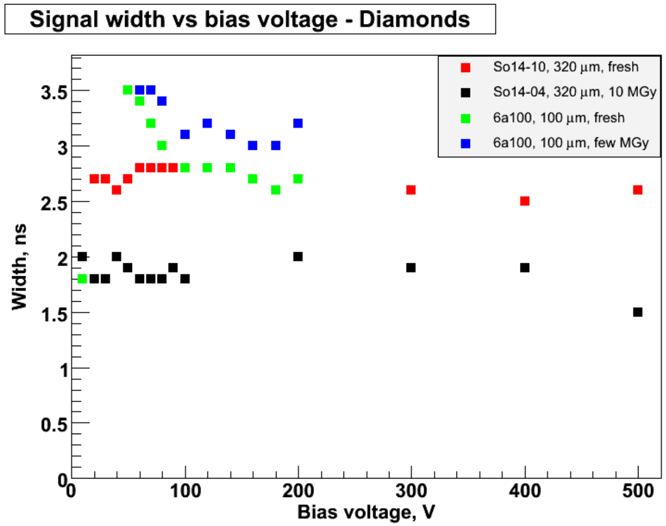


Fresh diamond

Diamond after irradiation to few MGy

Signal drops ~1.2 times for integral and ~ 2.7 times for amplitude after few MGy

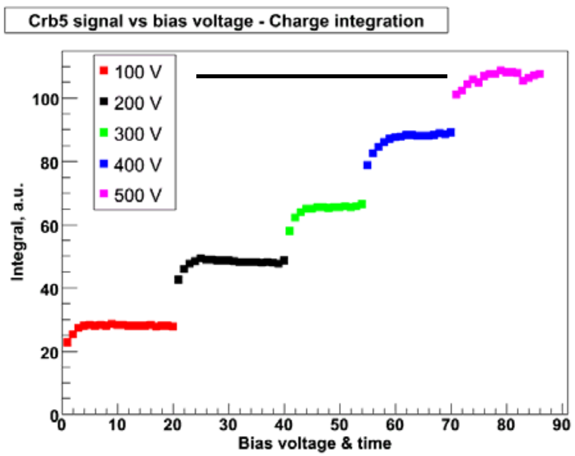
Signal width vs bias voltage, scCVD diamonds

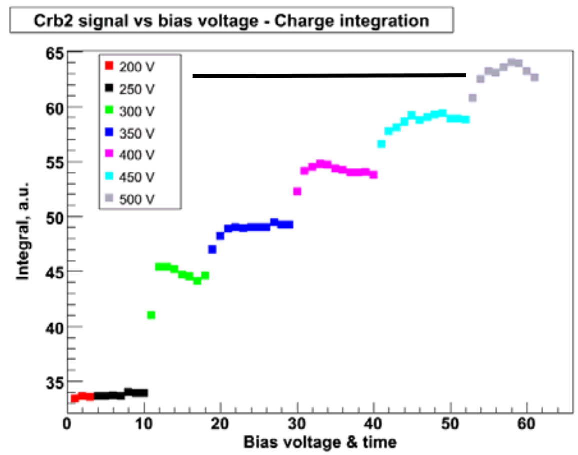


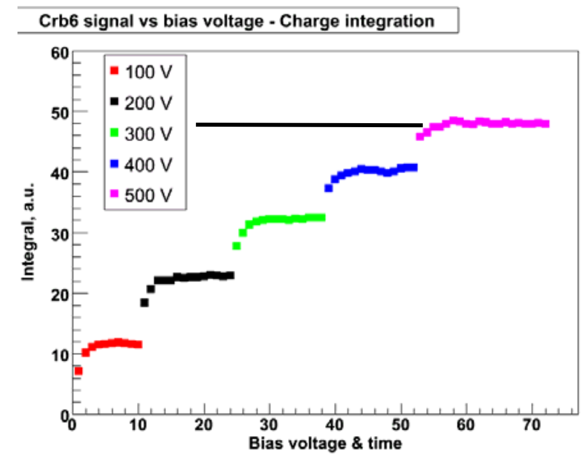
Signal width for the irradiated 320 μm diamond is smaller than for the non-irradiated one
Other way around for the 100 μm diamond

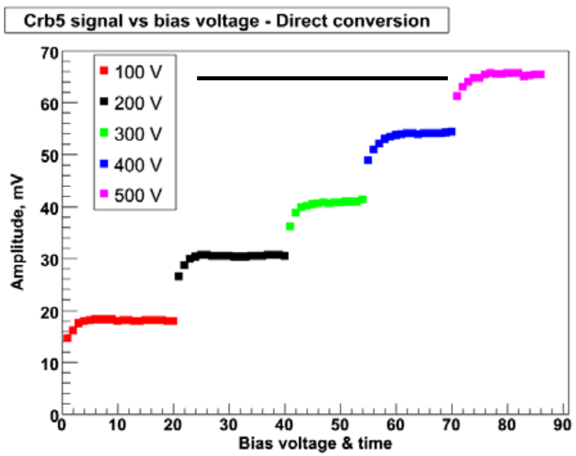
Sapphires

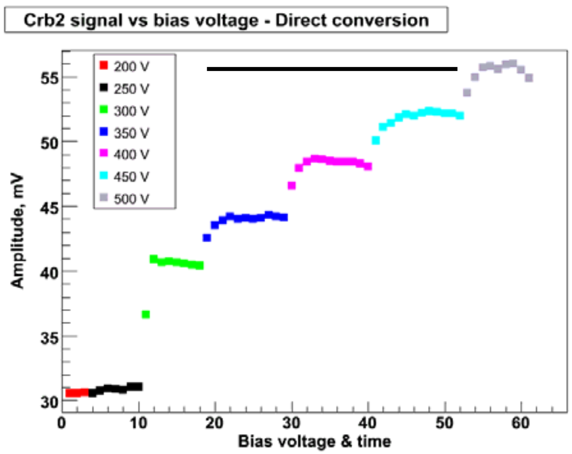
Signal vs bias voltage, sapphires 500 µm

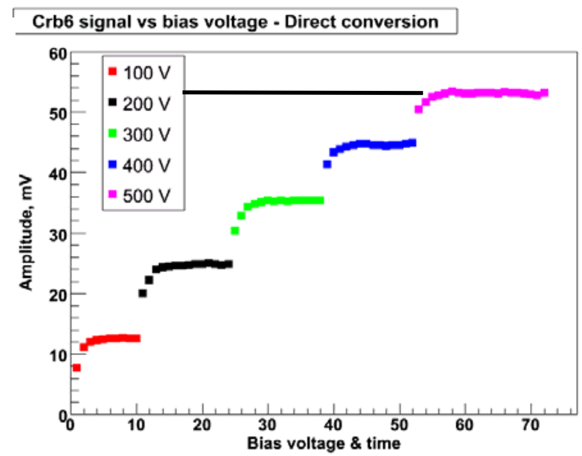










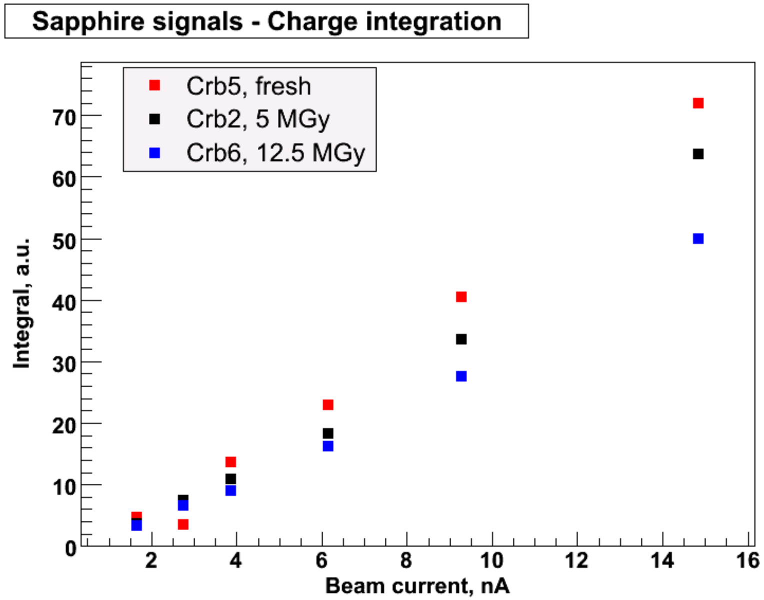


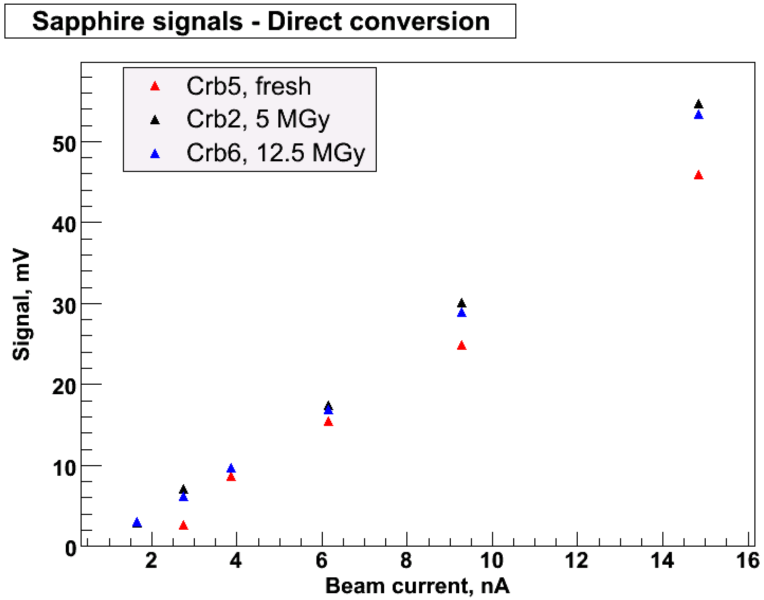
Fresh sapphire | **Sapphire irradiated to 5 MGy** | **Sapphire irradiated to 12.5 MGy**

Signal drops ~2.4 times for integral and ~ 1.2 times for amplitude after 12.5 MGy

Signal vs beam current, sapphires 500 µm

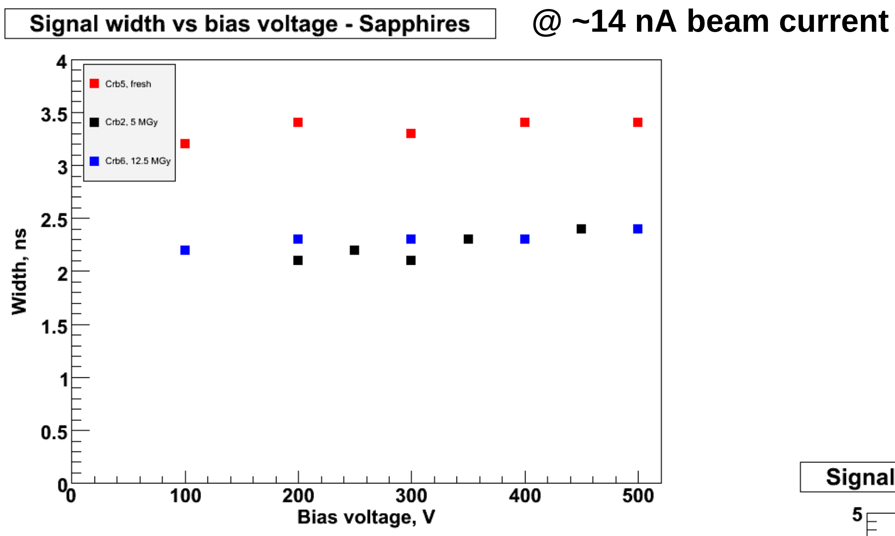
Bias voltage 500 V

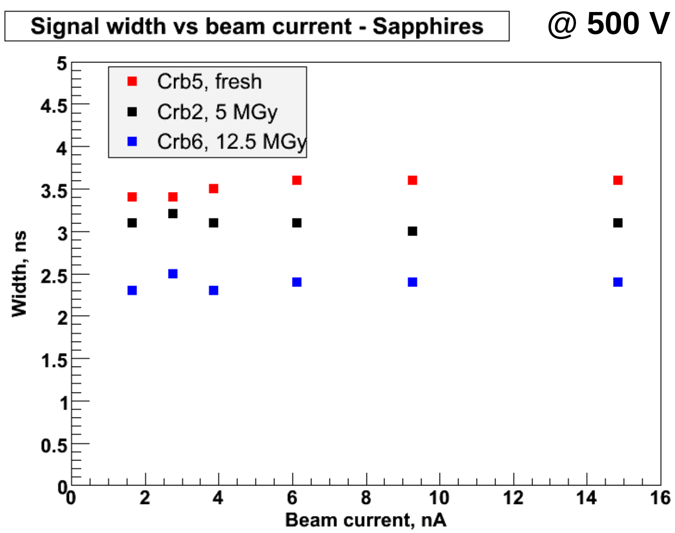




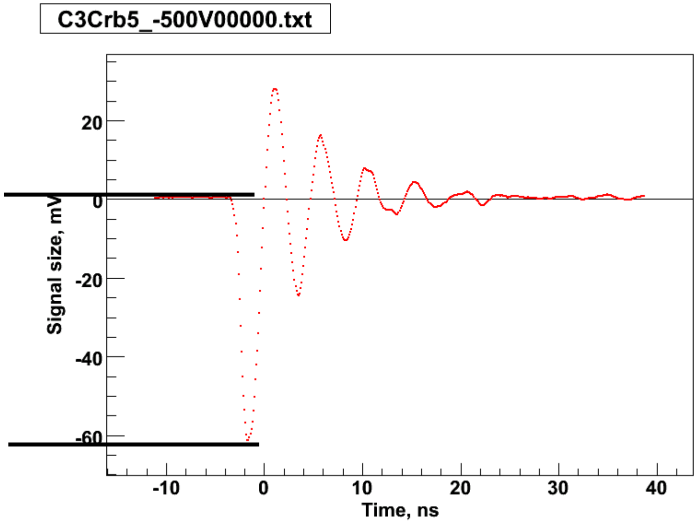
Maximal amplitude is for the sensor irradiated to 5 MGy !

Signal width vs bias voltage, sapphires





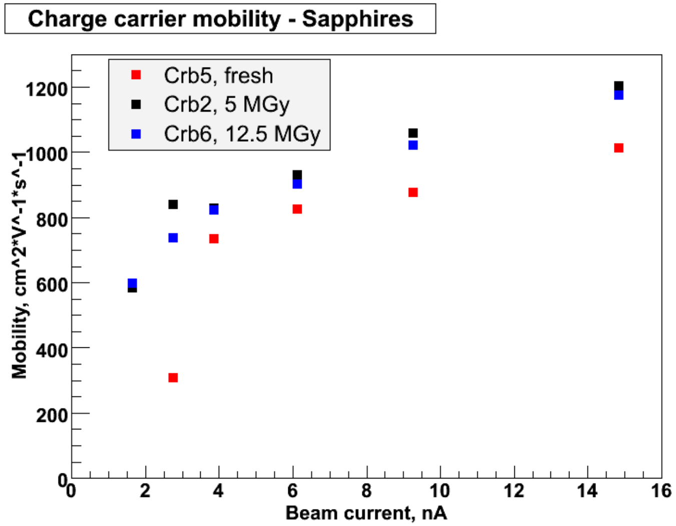
Charge carrier mobility estimation, sapphires



$$I^0 = \frac{N}{d} v_{dr}$$

$$v_{dr} = \mu E$$ → **mobility**

If the method is right:



Summary

1. The signals from scCVD diamonds of different thicknesses and sapphires were investigated at different irradiation stages

2. Signal shape is not completely defined by the bias voltage and signal readout scheme, but also the properties of the sensor

3. The amplitude of the signal from sapphire drops slower with the absorbed dose than integral charge

4. The simulations of sensor behavior in order to understand the signal shape are needed

5. The work on data analysis is ongoing

Testbeam crew