



# Investigation of CVD Diamonds as Sensor Material for BeamCal

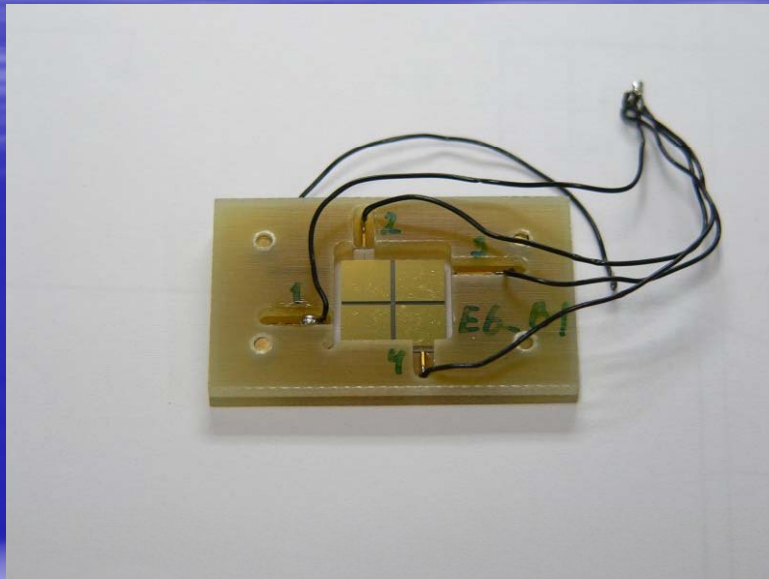
Alexandr Ignatenko

FCAL Collaboration Meeting, Orsay  
October 6-7, 2007

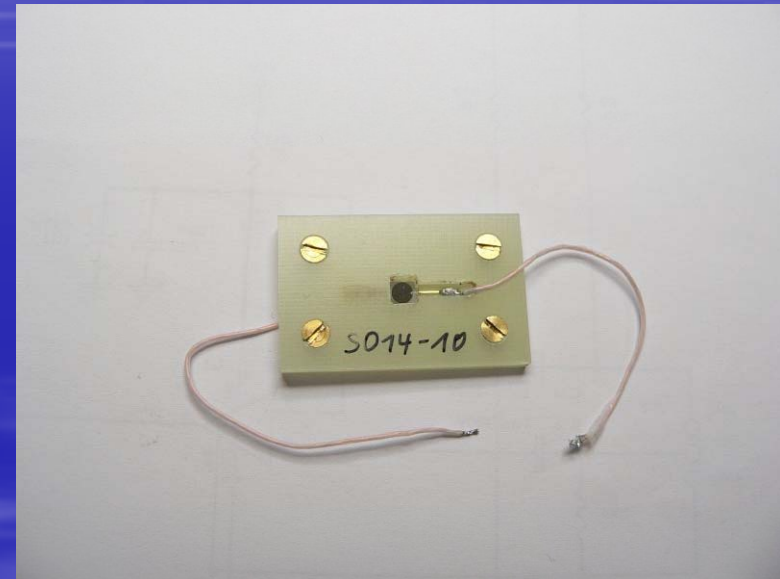
# Overview

- Poly- and single crystalline CVD diamond samples
- pCVD diamonds investigation
  - ✦ Results from testbeam'06
  - ✦ Results from testbeam'07
- scCVD diamond investigation
  - ✦ Results from testbeam'07
  - ✦ Initial polarization studies
- Summary

# Poly- and single crystalline CVD diamond samples



**pCVD diamonds**  
active area 10x10 mm<sup>2</sup>,  
Ti-Pt-Au metallization  
thickness 500 μm



**scCVD diamond**  
area 5x5 mm<sup>2</sup>, thickness 340 μm,  
metallization Ø3mm

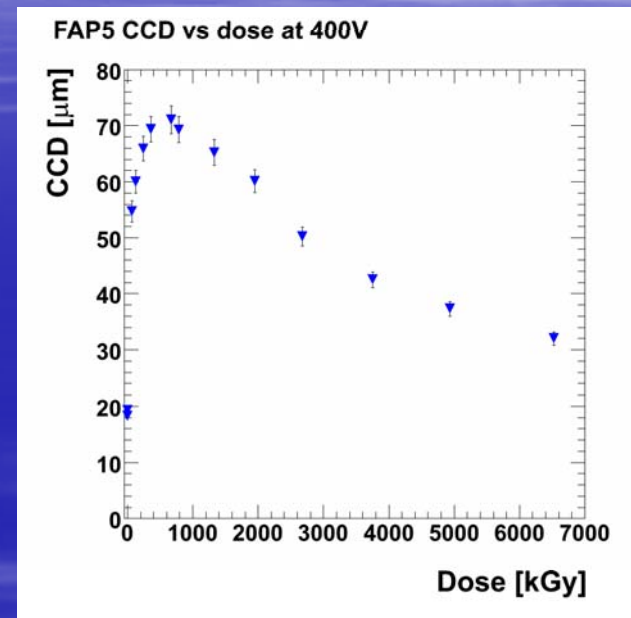
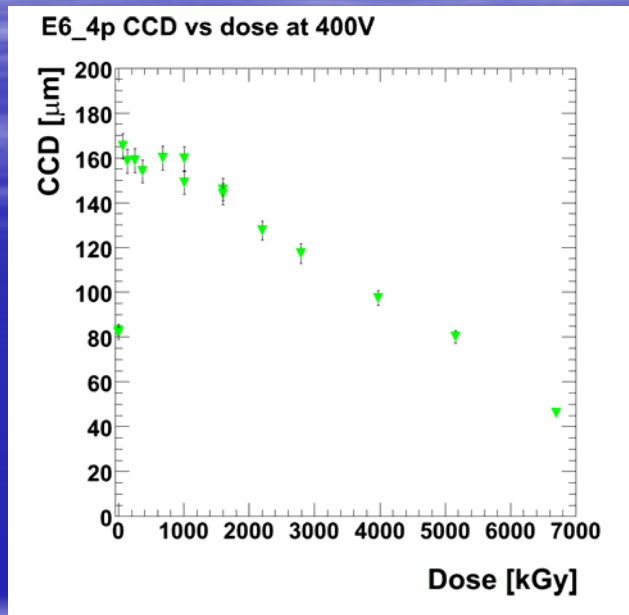
# pCVD diamonds investigation

October 6-7, 2007

FCAL Collaboration Meeting

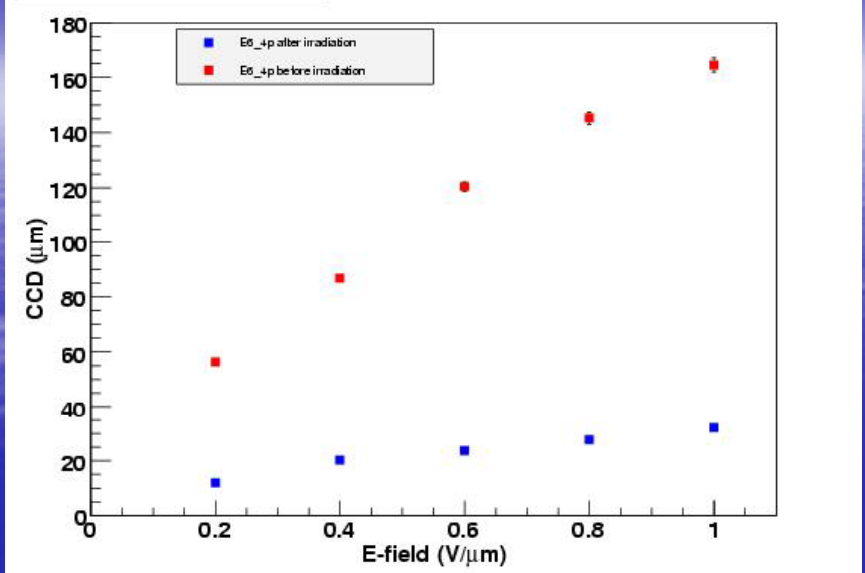
4

# pCVD diamonds investigation



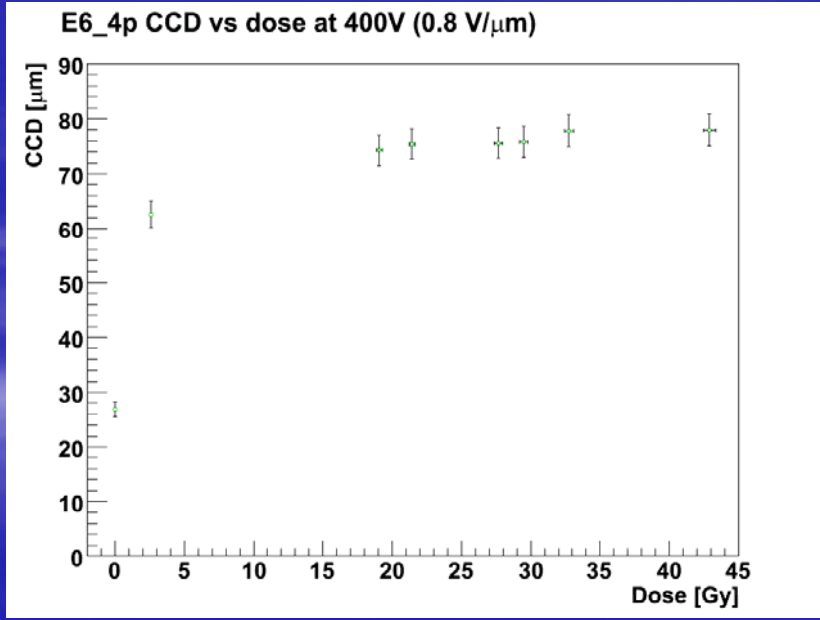
Rather similar behavior: first pumping, then CCD decrease

E6\_4p CCD vs E-field

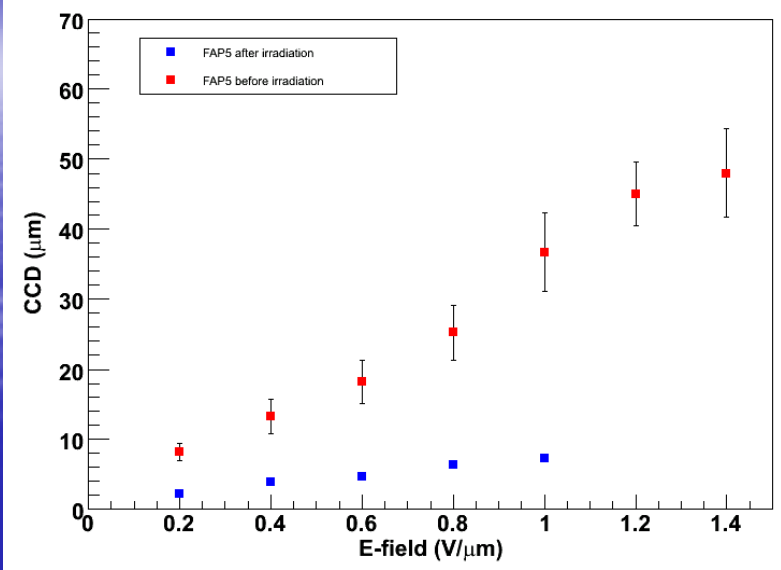


← The CCD decreased after the irradiation

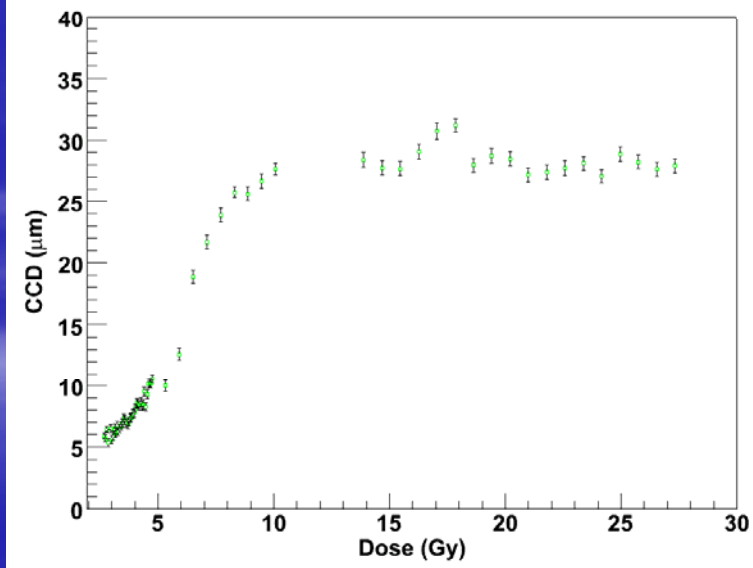
Recovers at small doserates →



FAP 5 CCD vs E-field

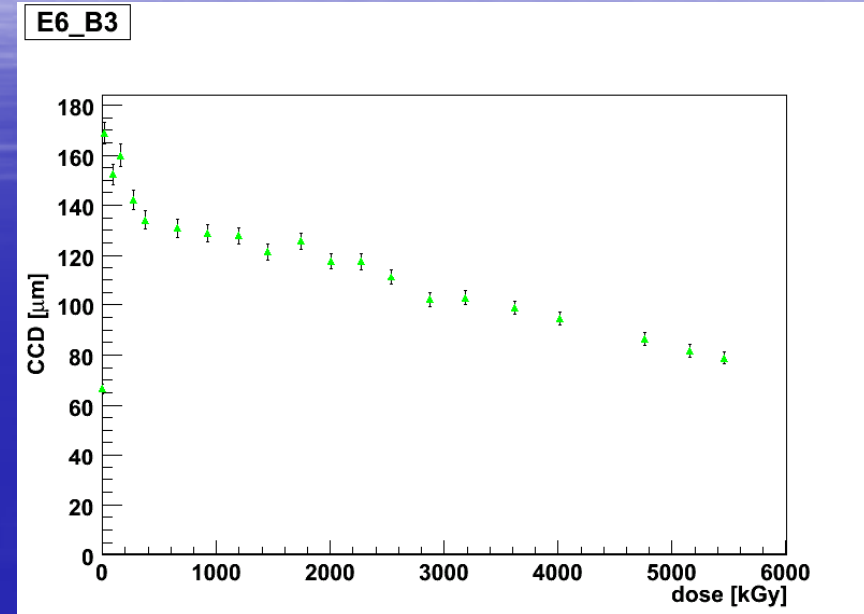
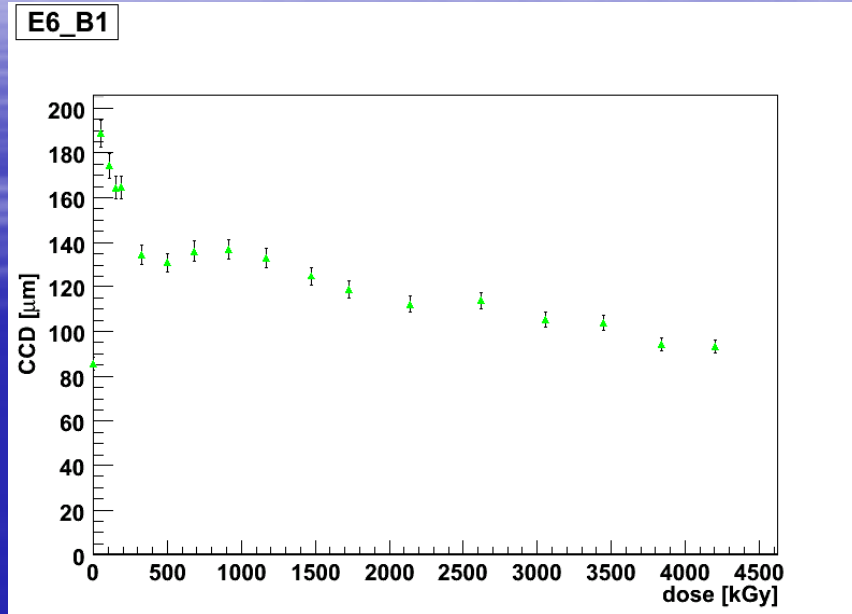


FAP5 CCD vs dose at 0.8V/μm





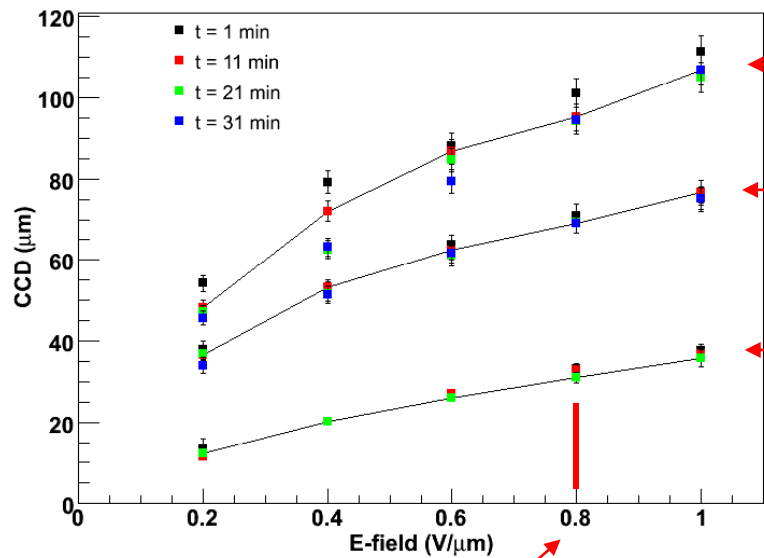
# Results from testbeam'07



Similar behavior: first pumping, then the CCD decreases



E6\_B1 CCD vs E-field



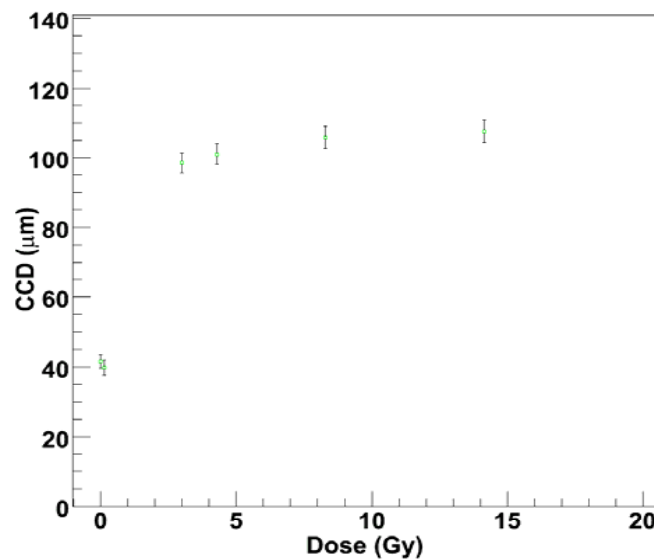
Before irradiation

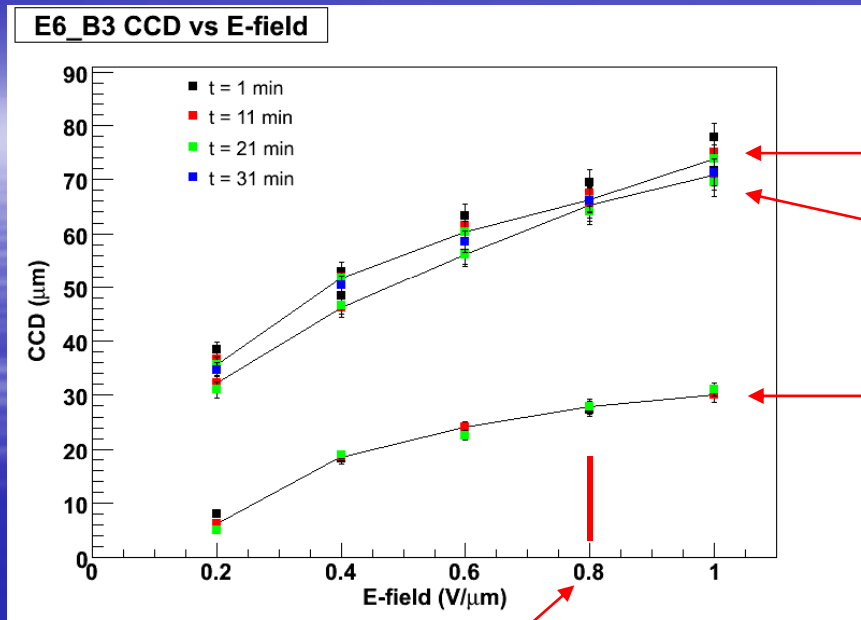
After irradiation before UV illumination

After irradiation, UV illuminated

Value used at testbeam

E6\_B1 CCD vs dose at 0.8V/μm





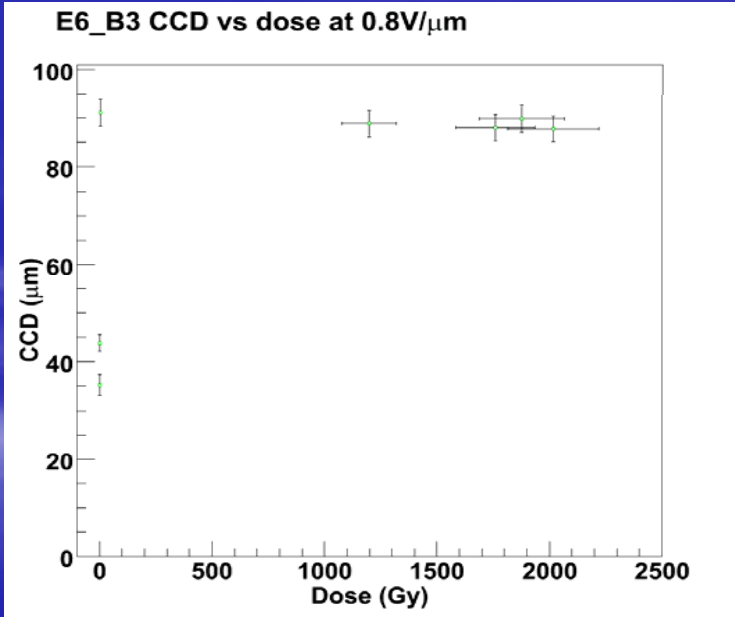
Before irradiation

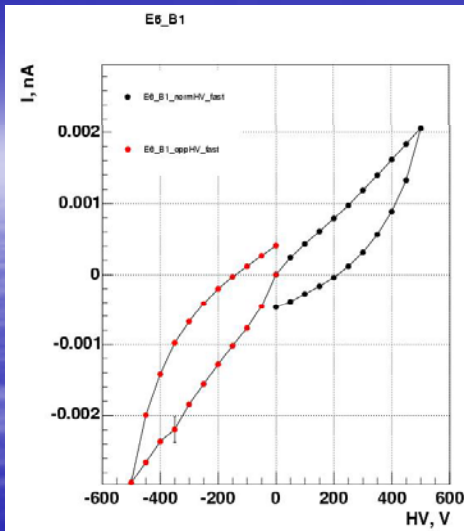
After irradiation before UV illumination

After irradiation, UV illuminated

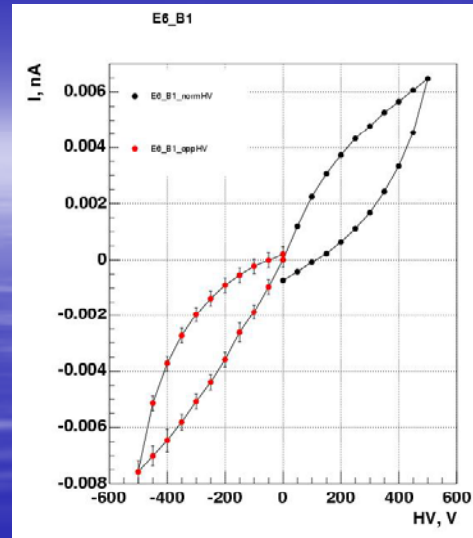
Value used at testbeam

Revealed the CCD larger than that before irradiation



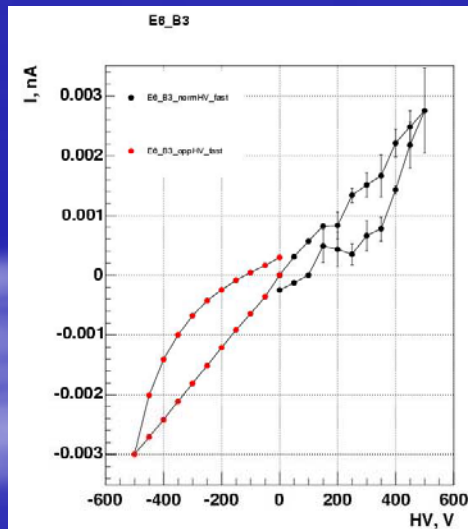


Before

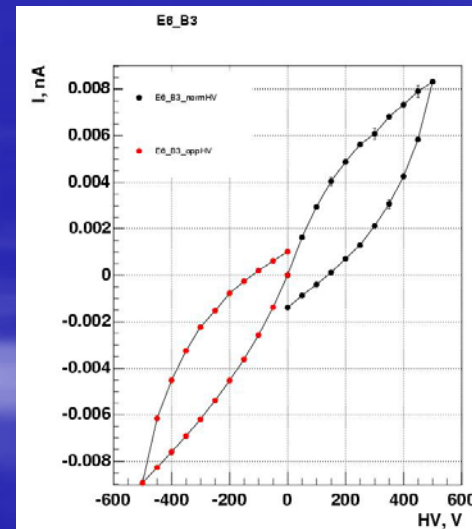


After

I-V characteristics



Before



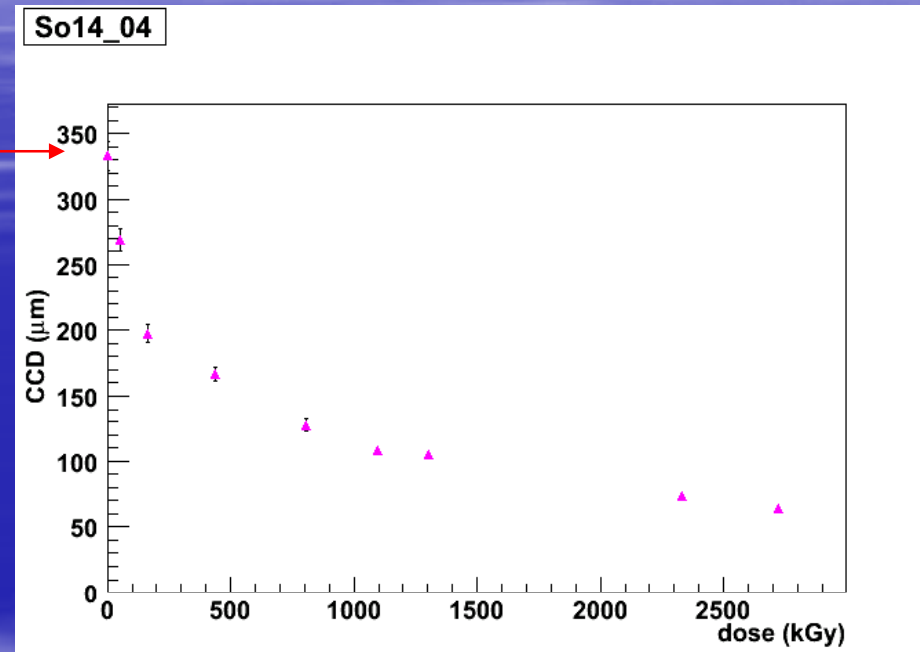
After

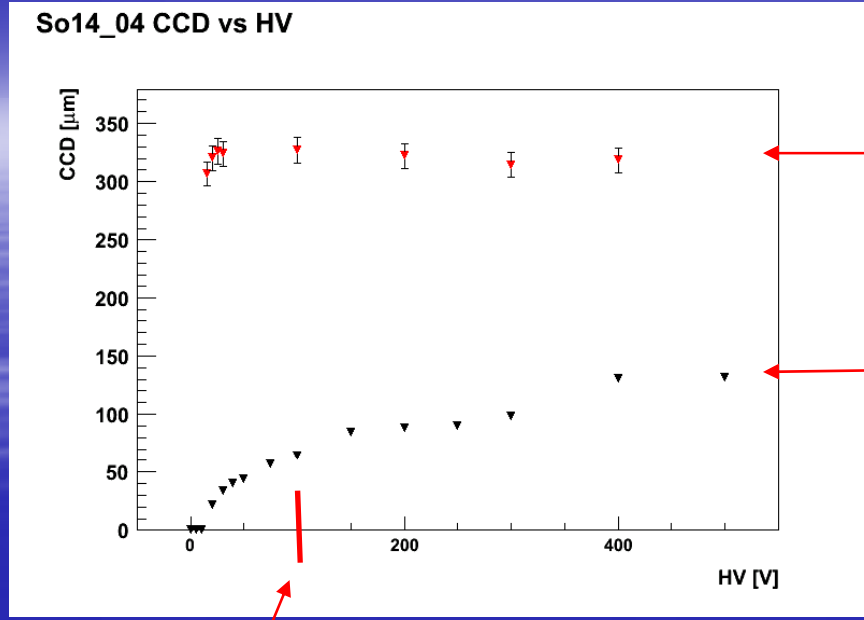
No significant increase of currents

# scCVD diamond investigation

# scCVD diamond investigation

100% efficient





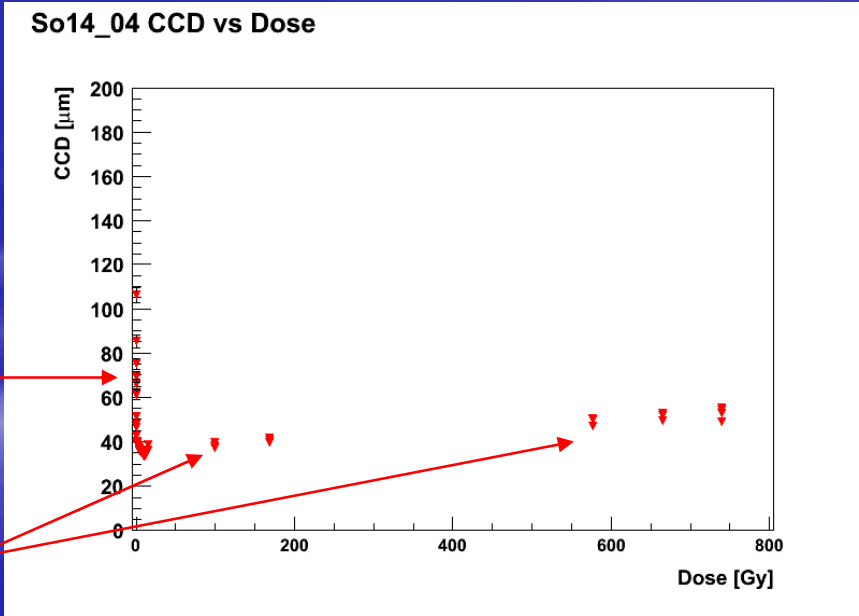
Before irradiation

After irradiation

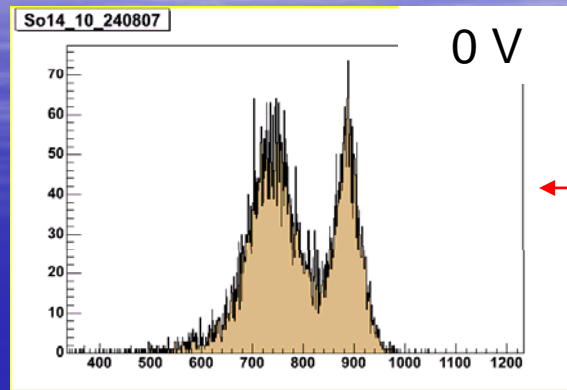
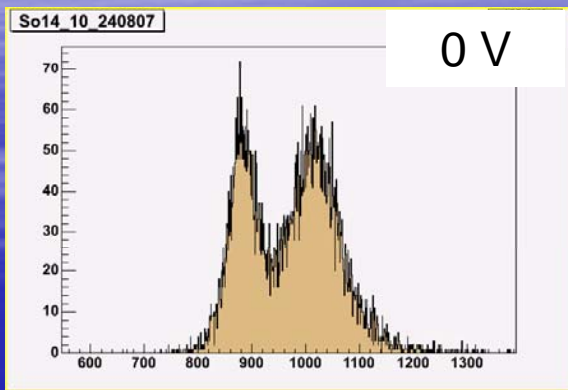
Value used at testbeam

Time dependence

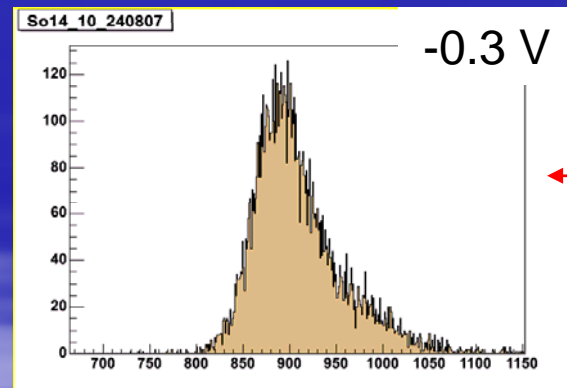
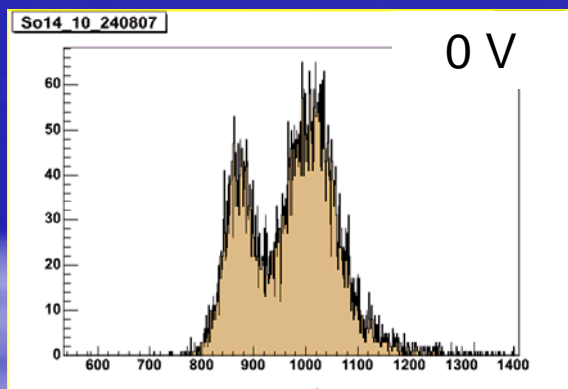
Small CCD increase



# Initial polarization studies



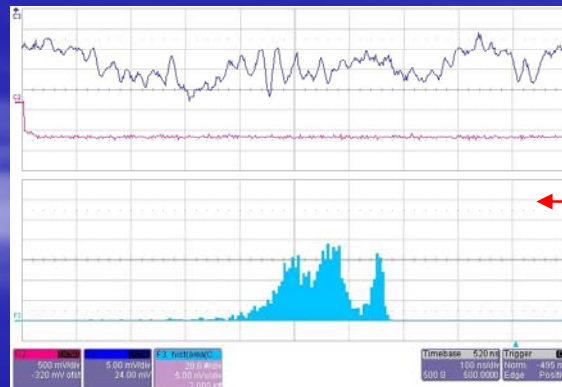
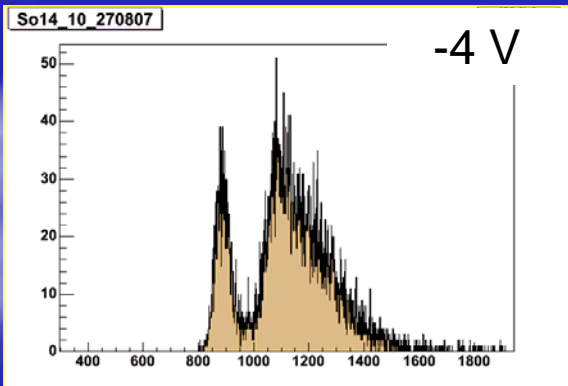
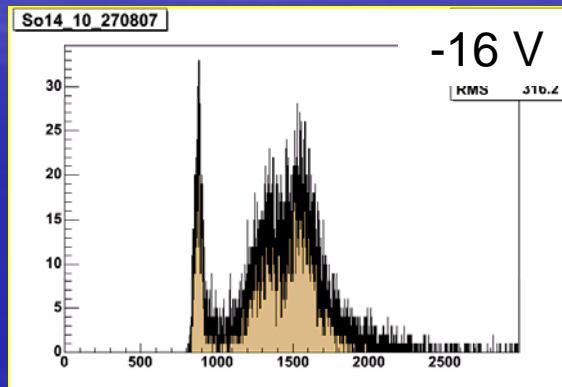
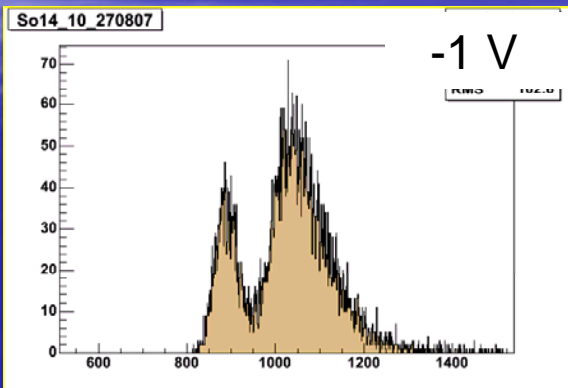
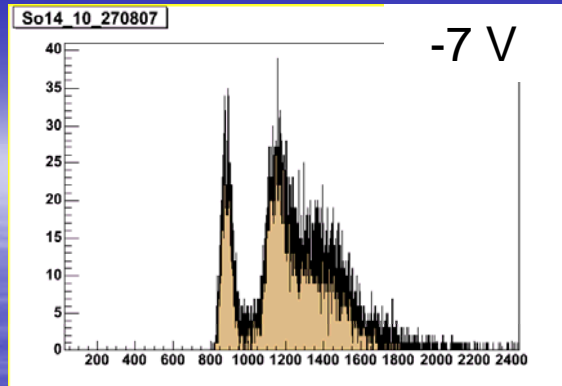
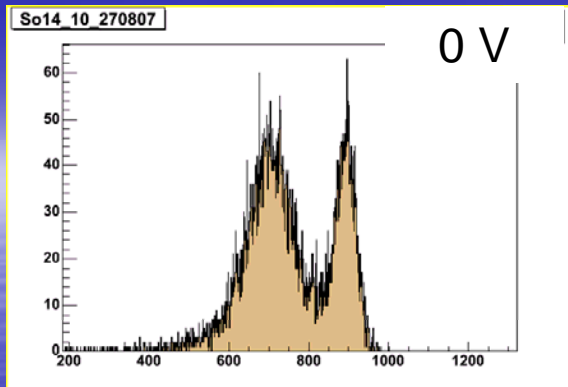
Reverse connection to the PA



Direct connection to the PA

Box with the sample rotated  
 $90^\circ$

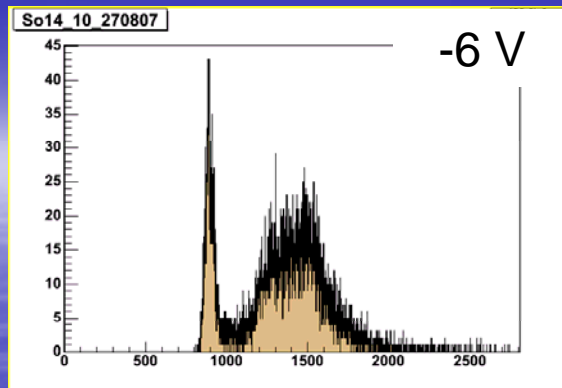
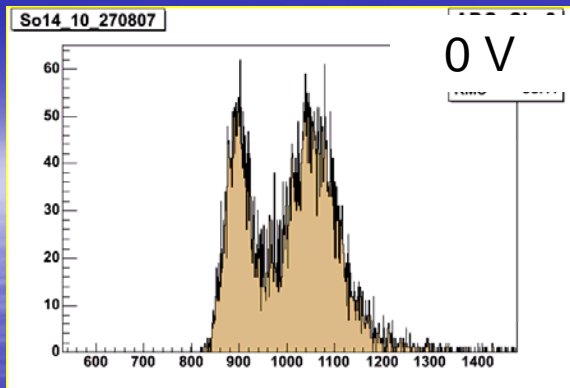




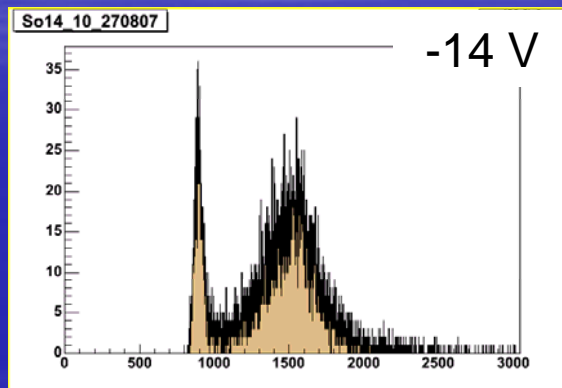
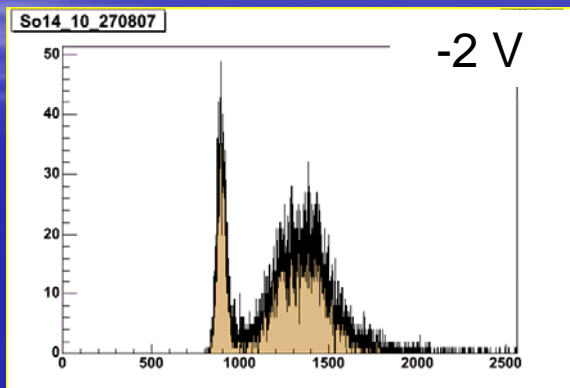
Direct connection to the PA

2 peaks can be observed  
Ratio of their heights changes with bias voltage

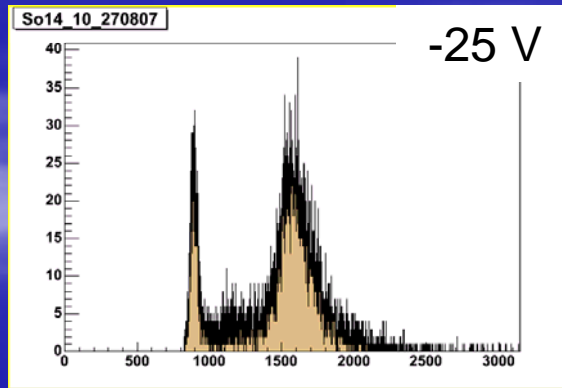
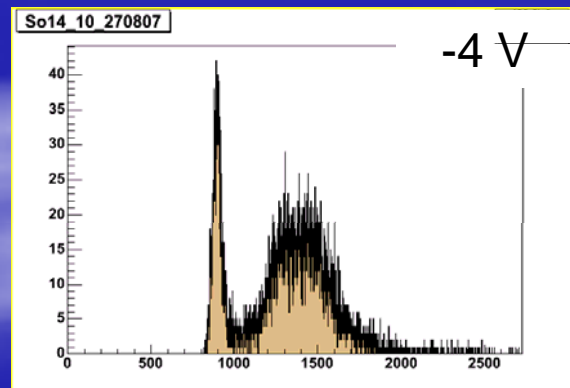
Spectrum made with oscilloscope to check the ADC operation



Reverse connection to the PA



An indication to 2 peaks



# Summary

1. Both poly- and single crystalline CVD diamond sensors stood the absorbed doses of several MGy and still were able to operate properly.
2. Values of CCD after irradiation being less than that before, increased after absorption additional (low) doses.

## To be done:

1. Understand the mechanism of damage.
2. Clarify the dependence of CCD on dose, dose rate and other factors.
3. Discuss with manufacturers the possibility to provide more radiation hard samples in future.