Annealing effects on the CCE of silicon microstrip detectors

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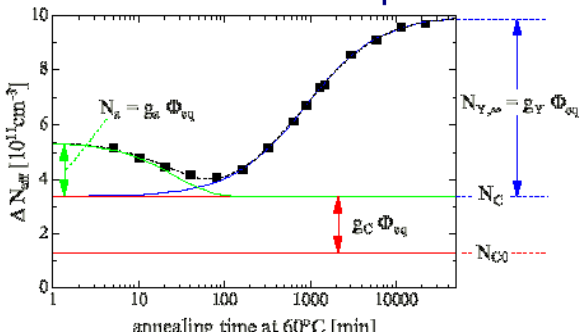
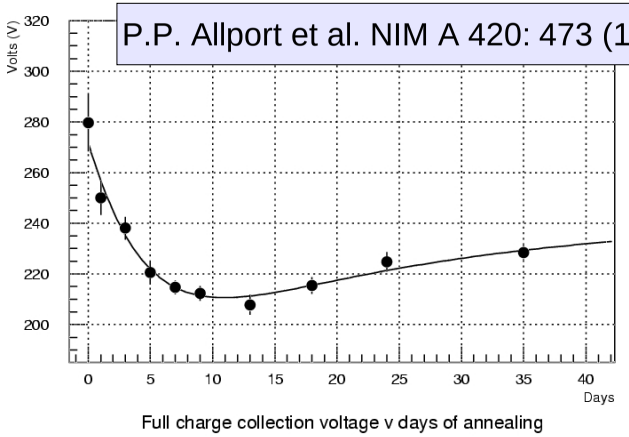
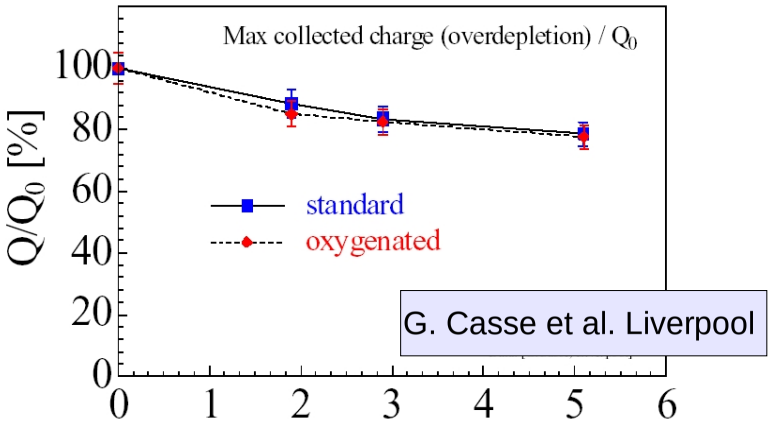
Introduction

- The annealing of irradiated silicon microstrip sensors has a well established effect on V_{dep} through N_{eff}:





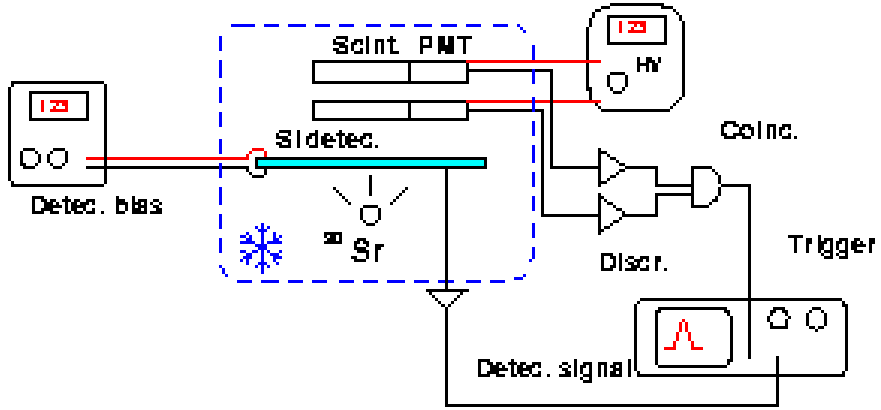
- The irradiation degrades the Charge Collection Efficiency (CCE)

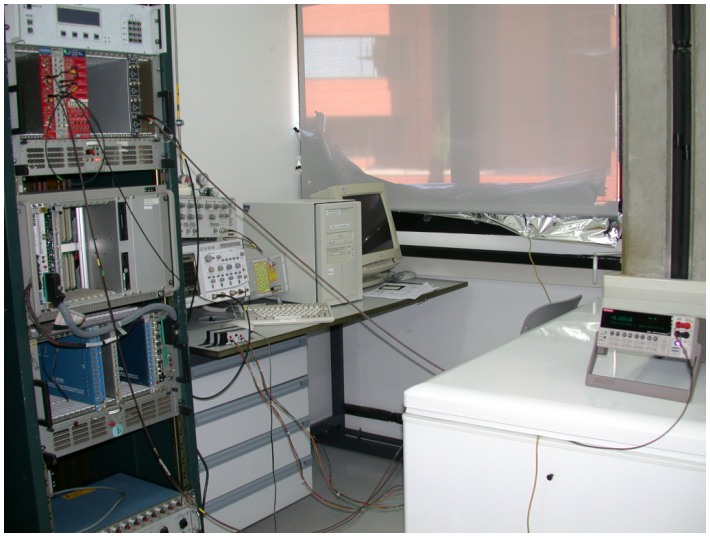


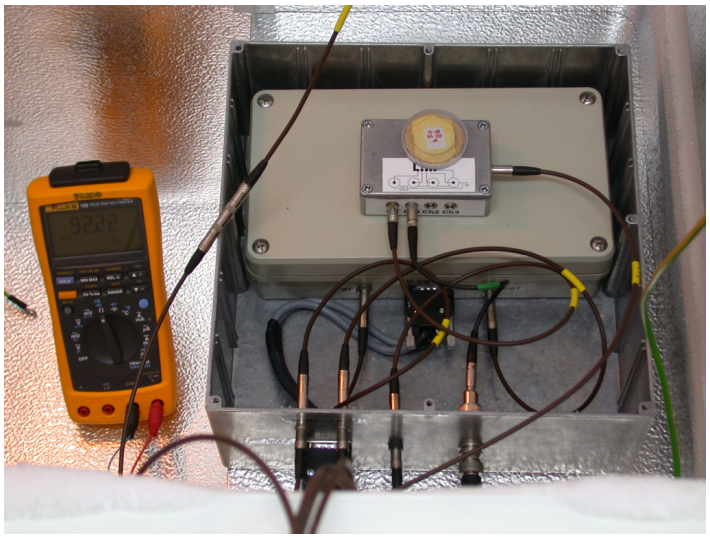
- The aim of this work is to study the effect (if any) of the annealing on to the CCE of irradiated silicon microstrip detectors

CCE & IV setups

- β−source with scintillator's trigger setup. IV measured at −23ºC.





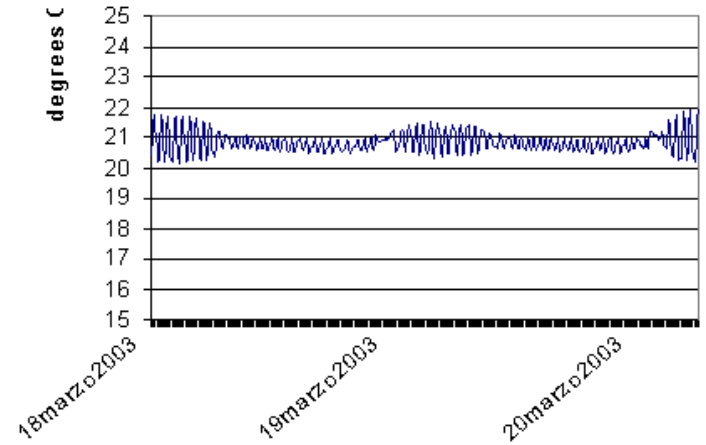


CV setup & Annealing

- CV setup: inside class 1000 clean room (ATLAS assembly)
  - Detectors are kept in a cooling box
  - Temperature ~ 0ºC

High leakage currents !

- Annealing: performed at room temperature (inside clean room): 21ºC

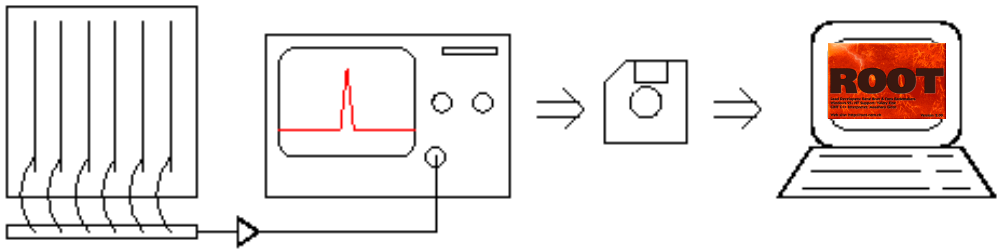


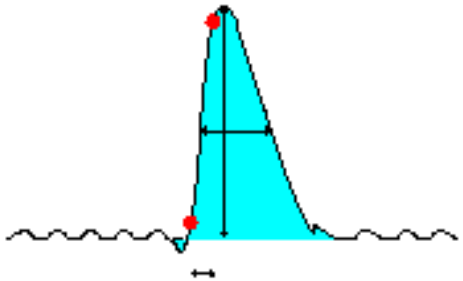
Samples & Data Analysis

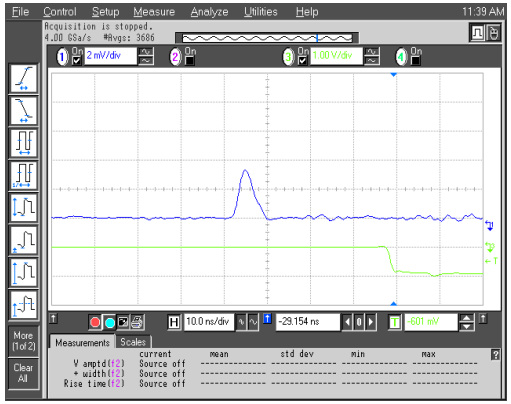
- Sensors used in this study:
  - Hamamatsu silicon microstrip (100 strips) baby detectors (ATLAS like)
  - p−on−n, standard substrate
  - Irradiation: 24 GeV/c PS protons. Dose: 2.7 and 7.5x10^{14} p/cm^2

- IV (−23ºC) and CV (0ºC) measurements

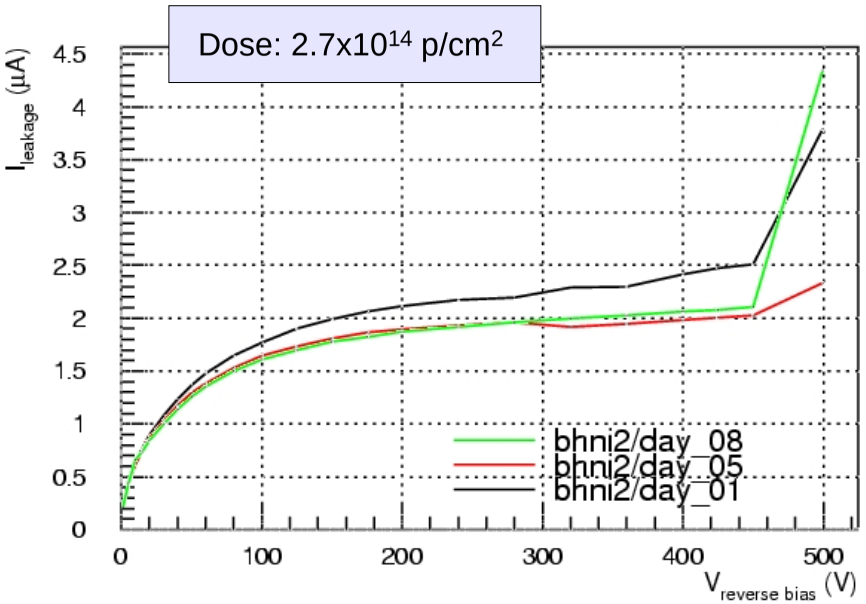
- Pulse shape analysis:
  - FWHM & rise time
  - Amplitude
  - Collected charge



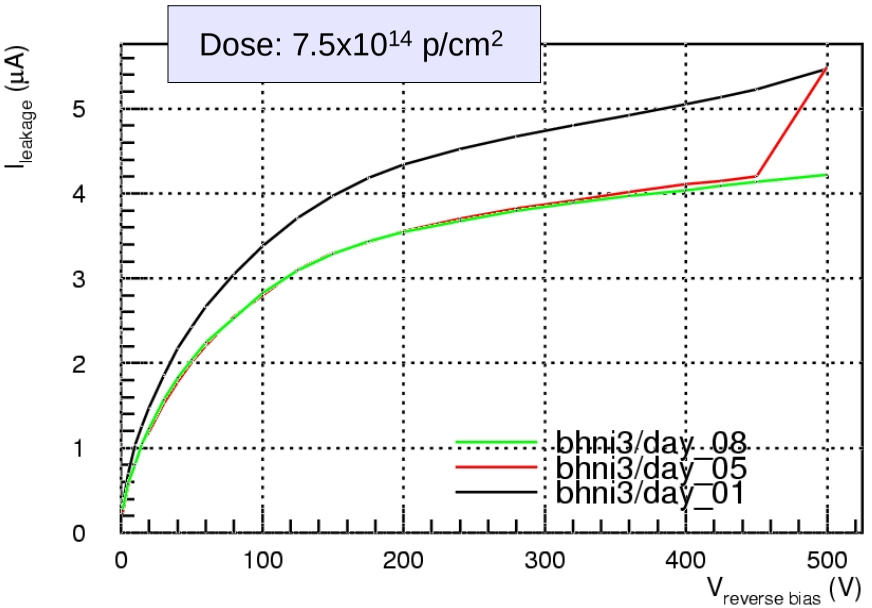




IV measurements

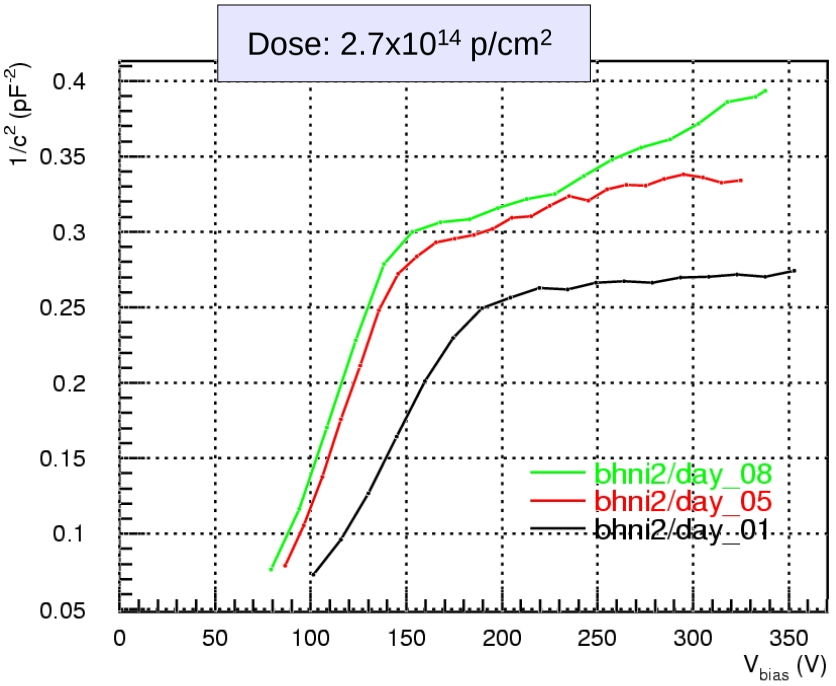


Leakage current v reverse bias voltage

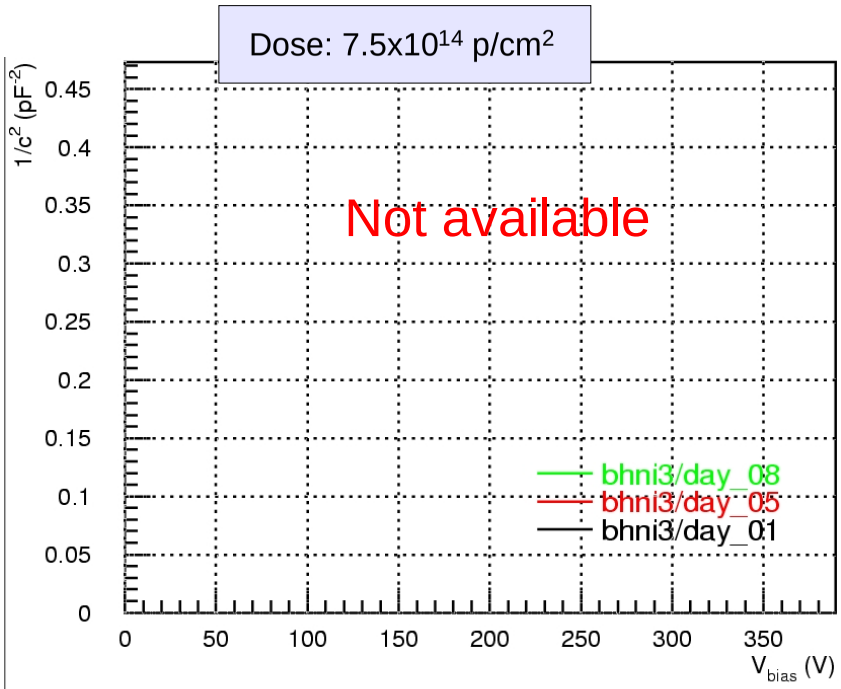


Leakage current v reverse bias voltage

CV Measurements



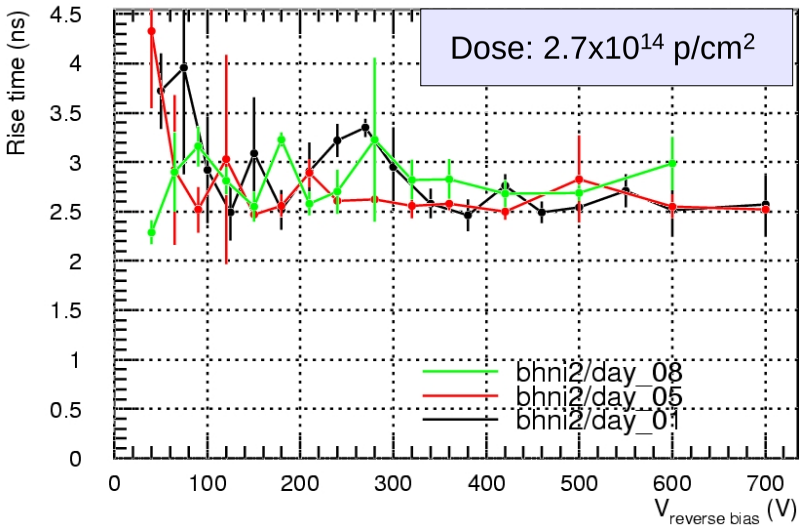
$1/c^2$ v reverse bias voltage



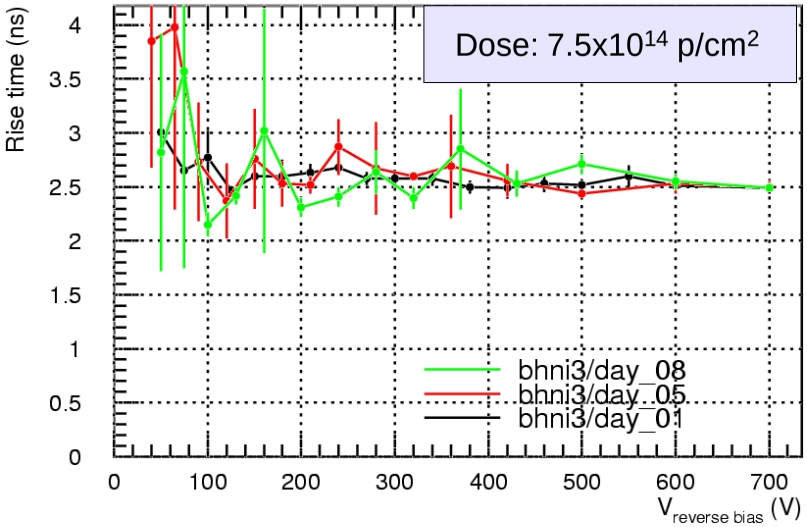
$1/c^2$ v reverse bias voltage

T annealing	V dep (V)
1 day	188 ± 3
5 day	150 ± 3
8 days	143 ± 3

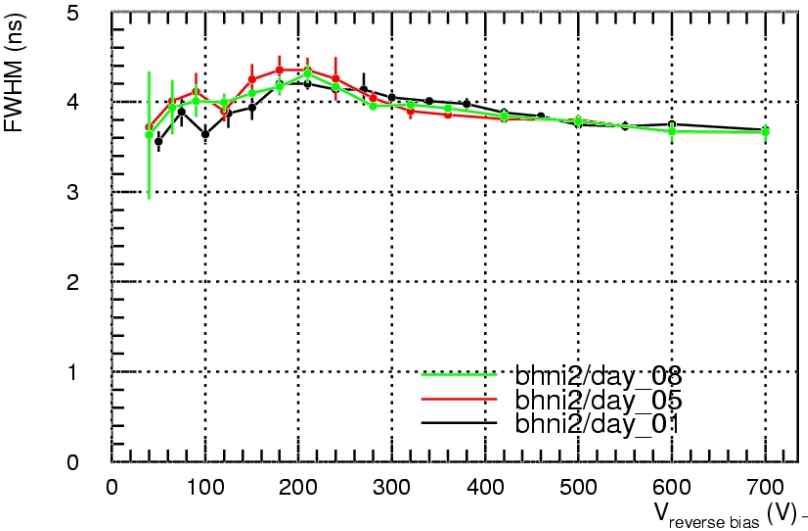
Rise time & FWHM



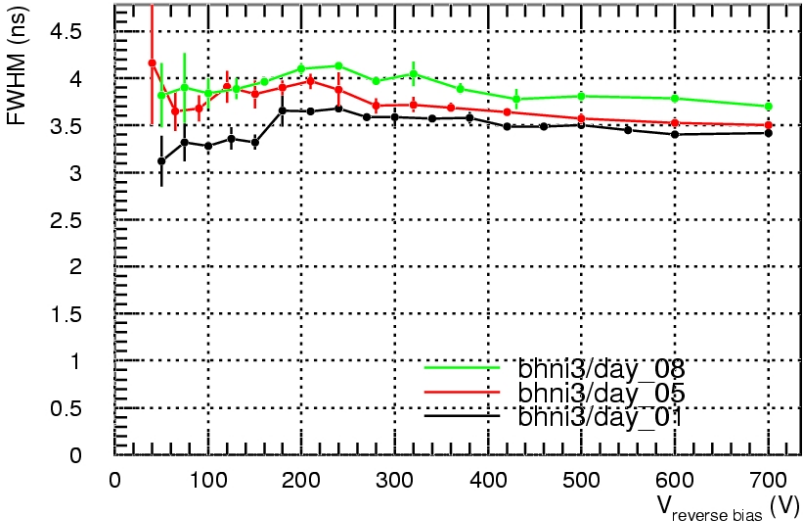
Signal rise time v reverse bias voltage



Signal rise time v reverse bias voltage

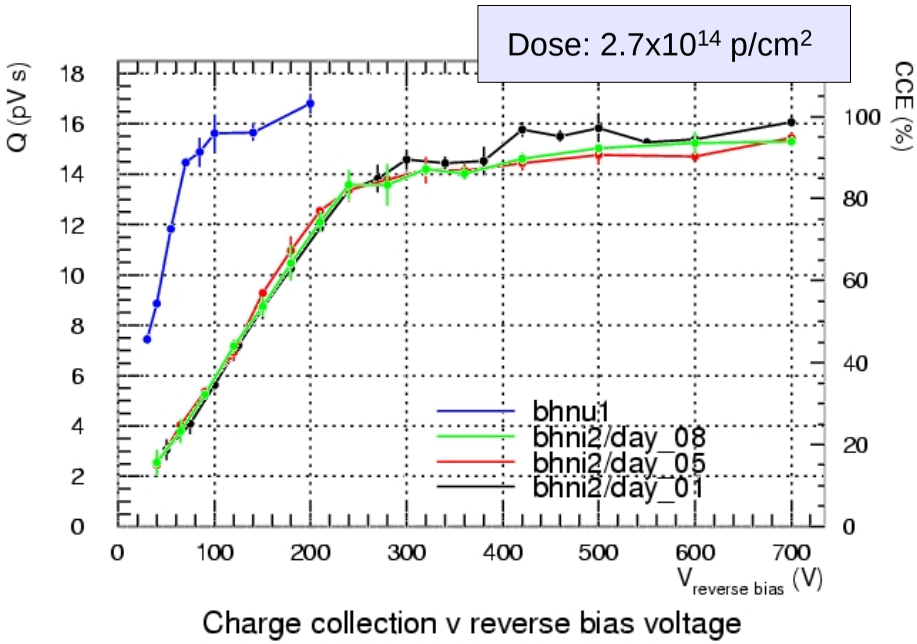


Signal FWHM v reverse bias voltage

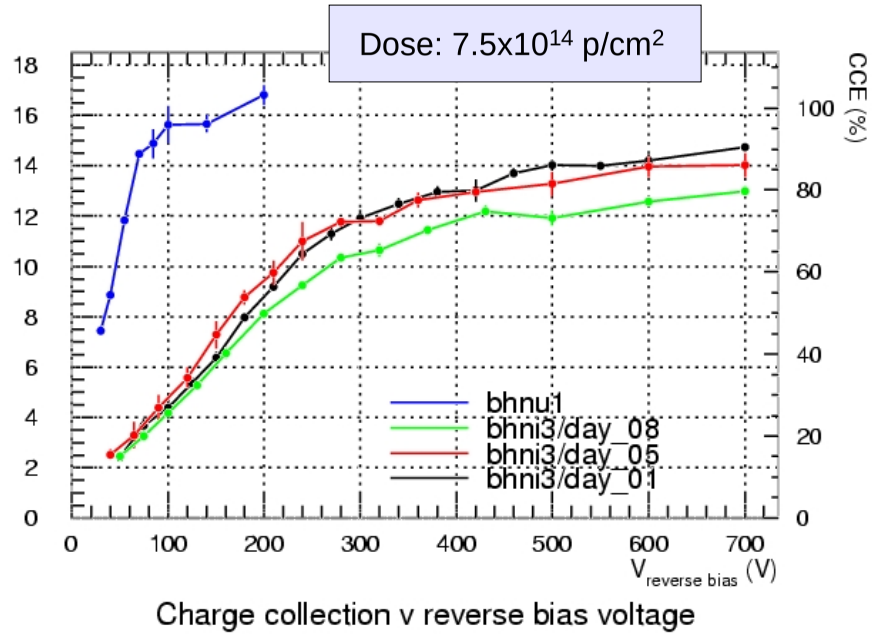


Signal FWHM v reverse bias voltage

CCE



Charge collection v reverse bias voltage

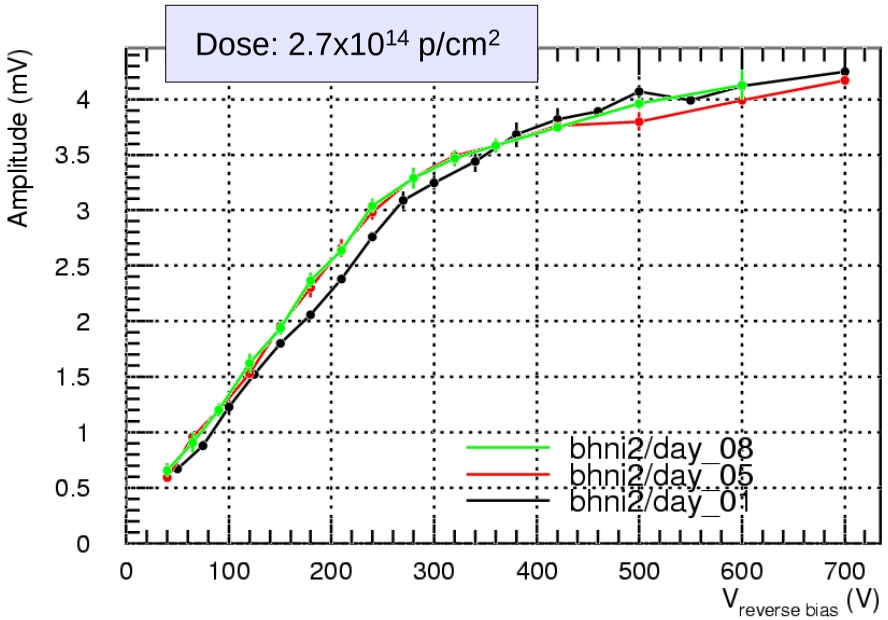


Charge collection v reverse bias voltage

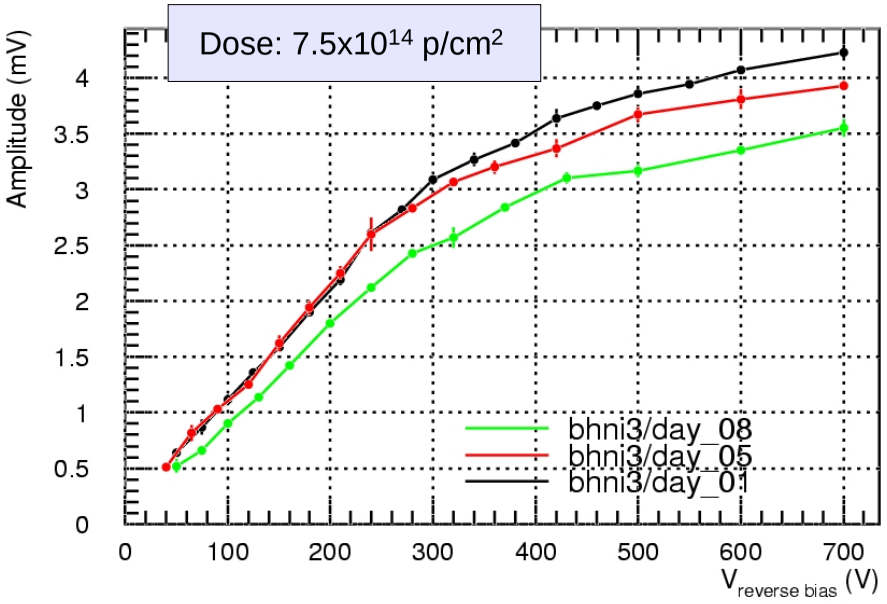
T annealing	CCE (%)
1 day	97 ± 2
5 day	91 ± 2
8 days	93 ± 2

T annealing	CCE (%)
1 day	88 ± 3
5 day	85 ± 3
8 days	77 ± 3

Signal Amplitude



Signal amplitude v reverse bias voltage



Signal amplitude v reverse bias voltage

Summary

- The effect of the short term annealing on to the signal of irradiated silicon microstrip (p−in−n, standard substrate) has been investigated.
- The CCE and the pulse shape have been studied using a b−source setup.
- The signal rise time still unchanged.
- CCE, FWHM and signal amplitude vary during the short term annealing.
- The experimental results show that CCE decreases during the short term annealing.