First Results of SiBT test beam 2009

Sandor Czellar, Jaakko Härkönen, Ivan Kassamakov, Matti Kortelainen, Tapio Lampén, Panja Luukka, Henri Moilanen, Teppo Mäenpää, Eija Tuominen, Esa Tuovinen
(Helsinki Institute of Physics)

Saptaparna Bhattacharya, Meenakshi Narain (Brown University)

Lenny Spiegel (FNAL)

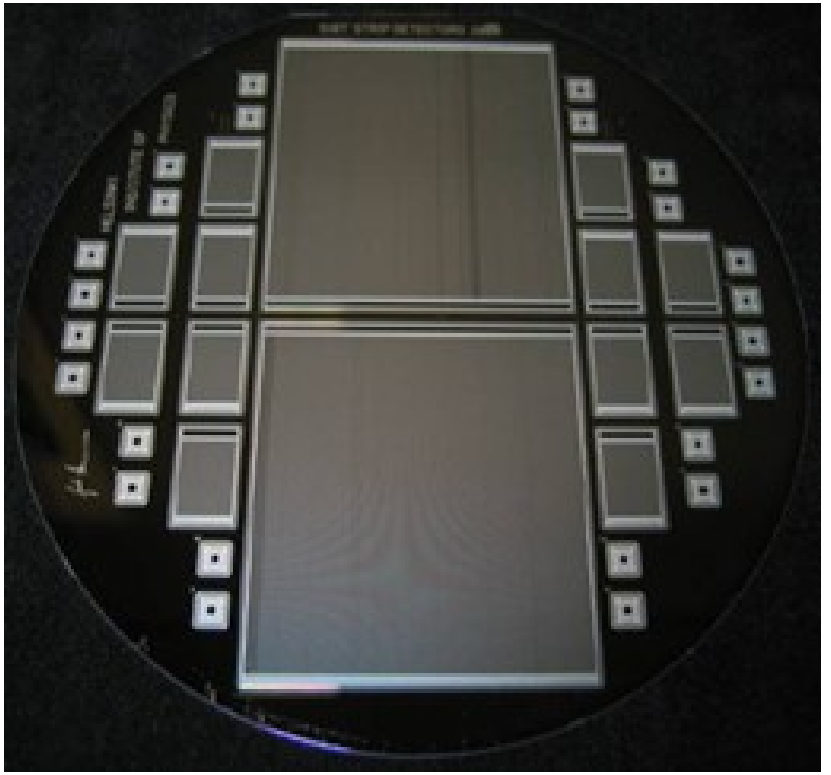
Tobias Barvich, Alexander Dierlamm, Martin Frey, Frank Hartmann, Maike Neuland, Hans-Jürgen Simonis, Pia Steck (Universität Karlsruhe)

Burt Betchart, Regina Demina, Yuri Gotra, Doug Orbaker, Sergey Korjenevski
(University of Rochester)

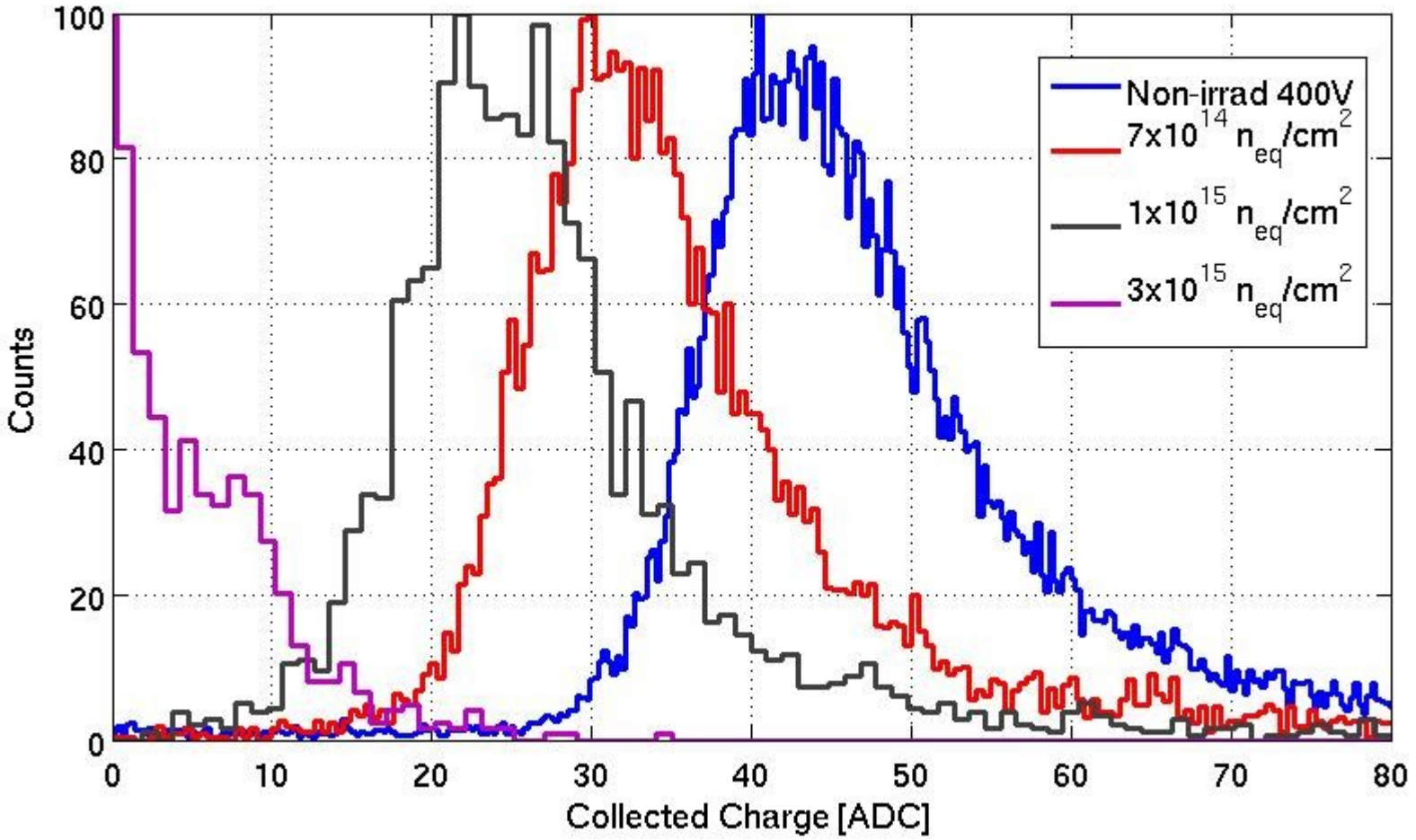
http://www.hip.fi/research/cms/tracker/SiBT/php/home.php

Outline

- Summary of 2008 results
- Two sensor modules will be covered in this talk
  1) $n^+/p^-/p^+$ made on p-type MCz-Si
     irradiated with 2×10^{15} n_{eq}/cm^2.
  2) $p^+/n^-/n^+$ n-type Fz-Si
     irradiated 1×10^{14} n_{eq}/cm^2.
- CCE vs V
- Simulation of experimental results

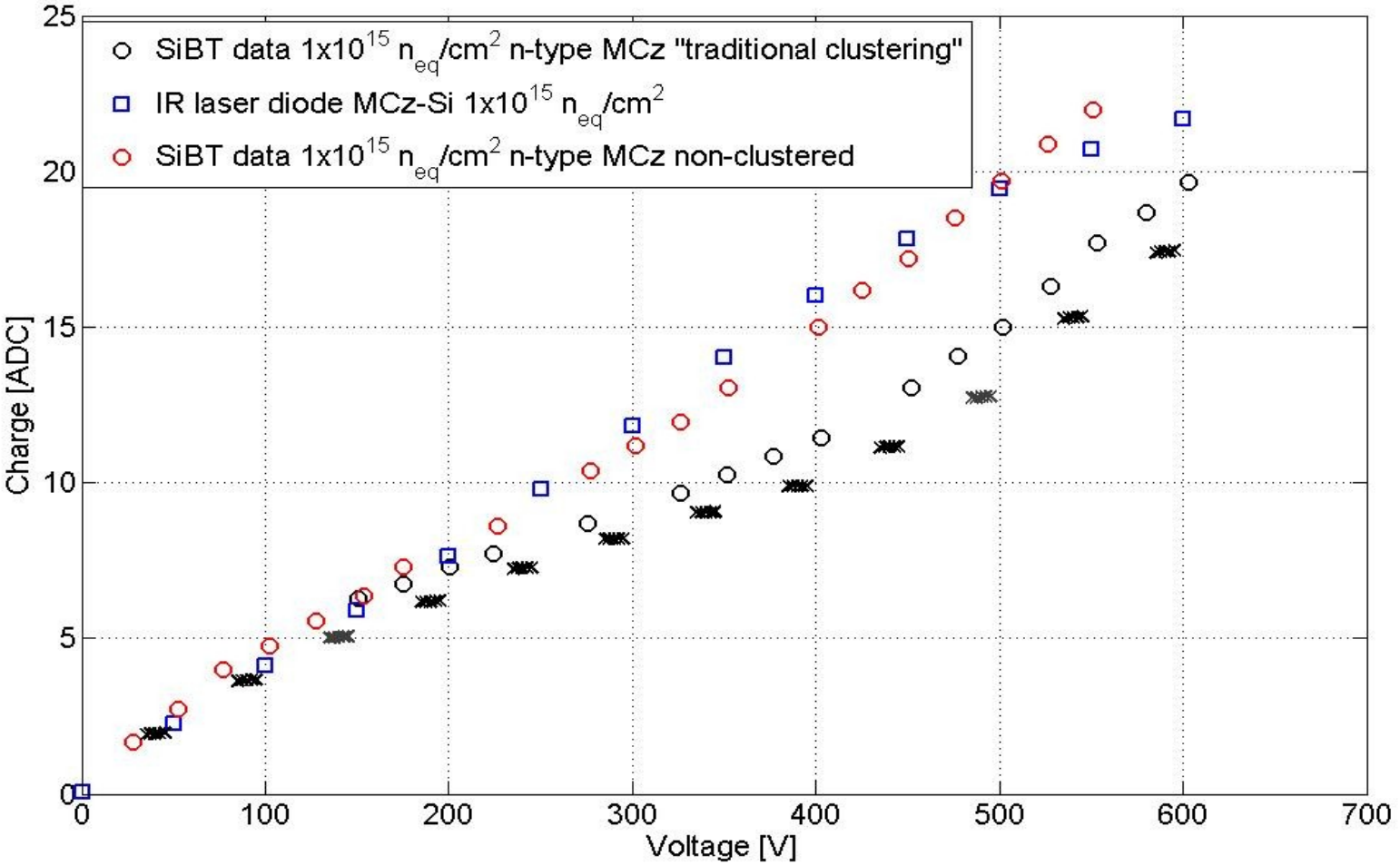


Results 2008



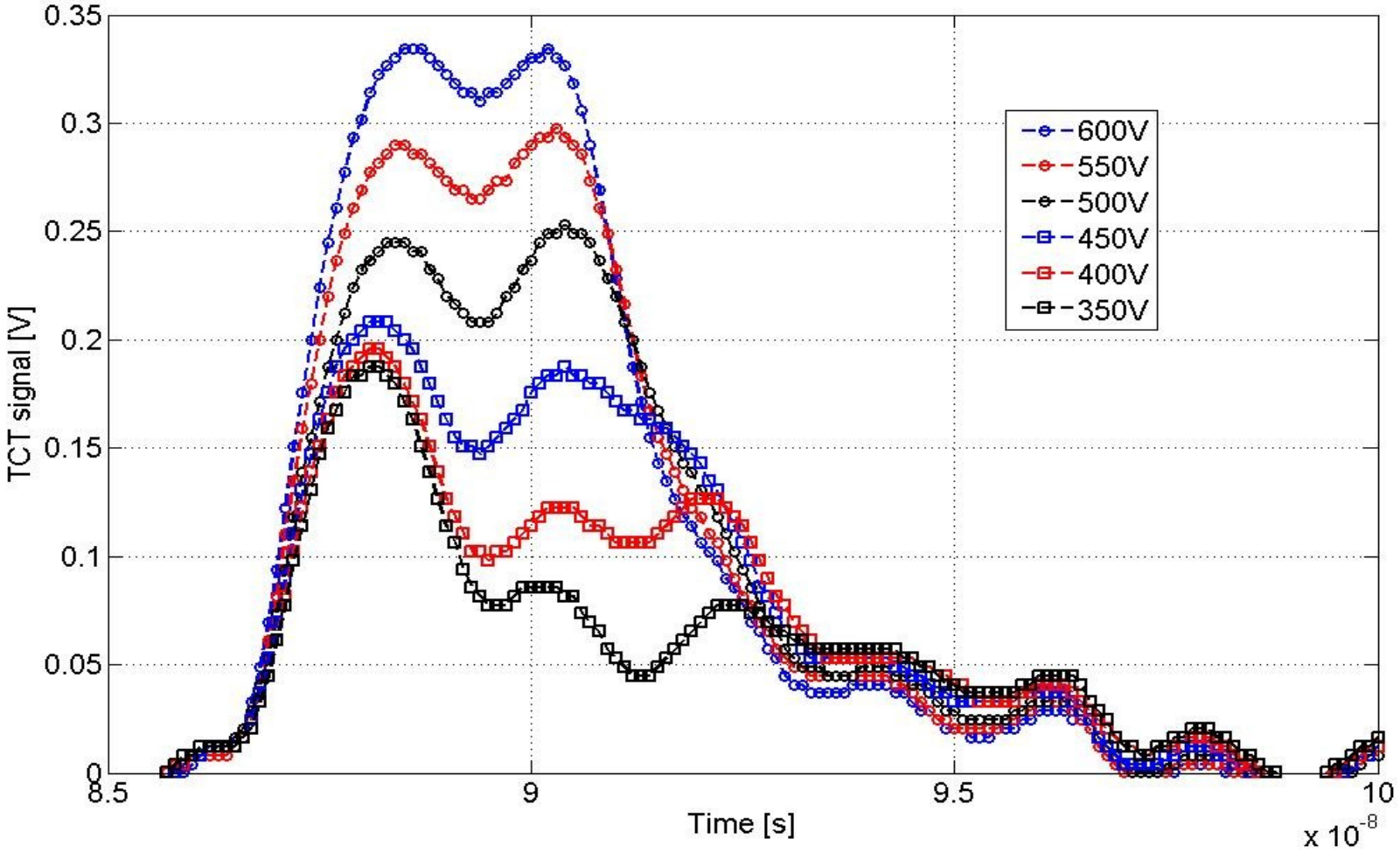
- In 2008 we measured n-type MCz-Si up to $3\times10^{15}\,n_{eq}/cm^2$
- Non-irradiated / full charge ~40 ADC counts
- At $1\times10^{15}\,n_{eq}/cm^2$ Signal MPV ~20 > 50% CCE, S/N > 10

N-type MCz-Si 1×10^{15} n_{eq}/cm^2



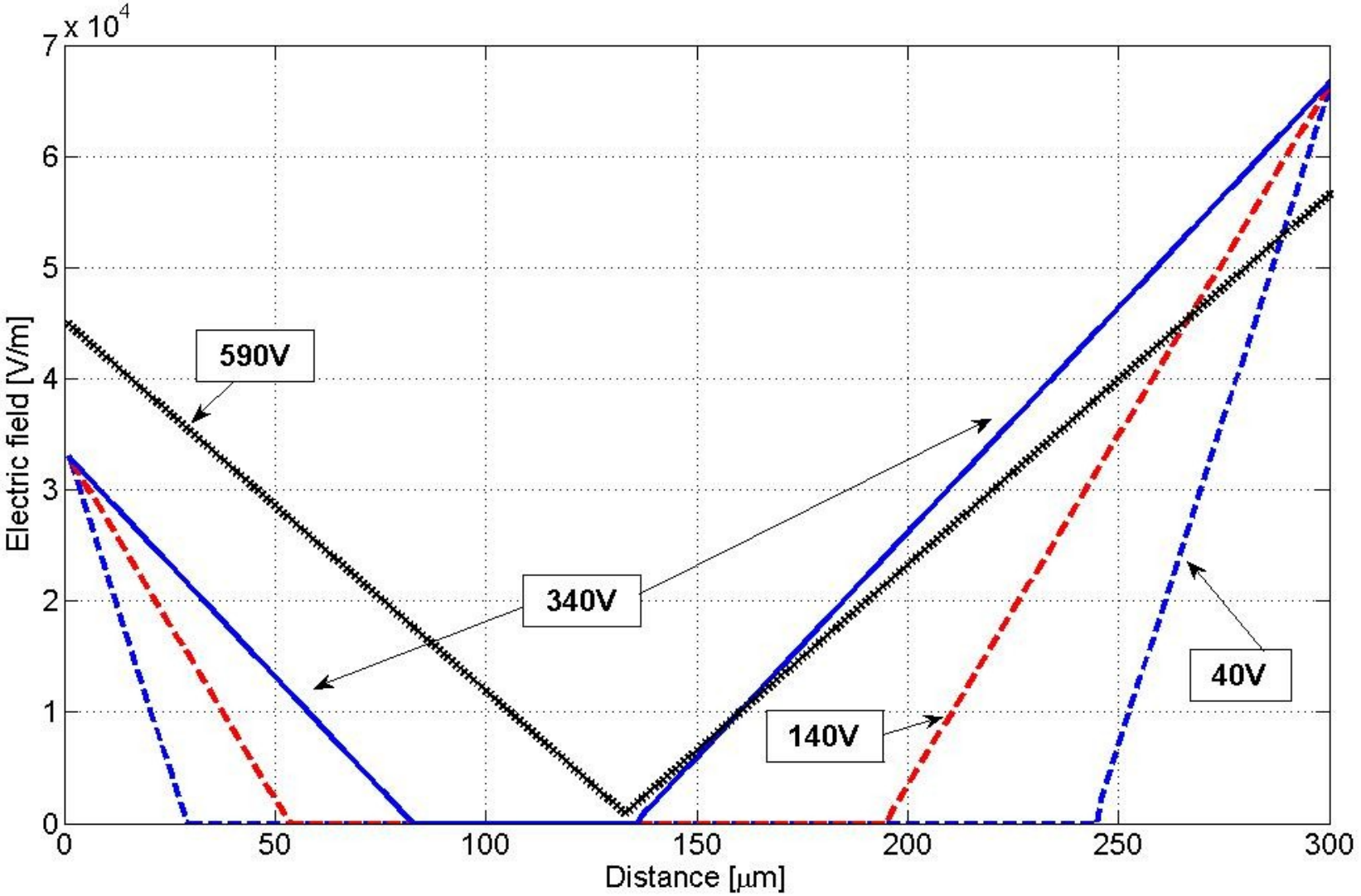
Test beam data, IR laser measurement on diode, simulation

Red laser TCT on 1×10^{15} n_{eq}/cm^2 n-type MCz-Si

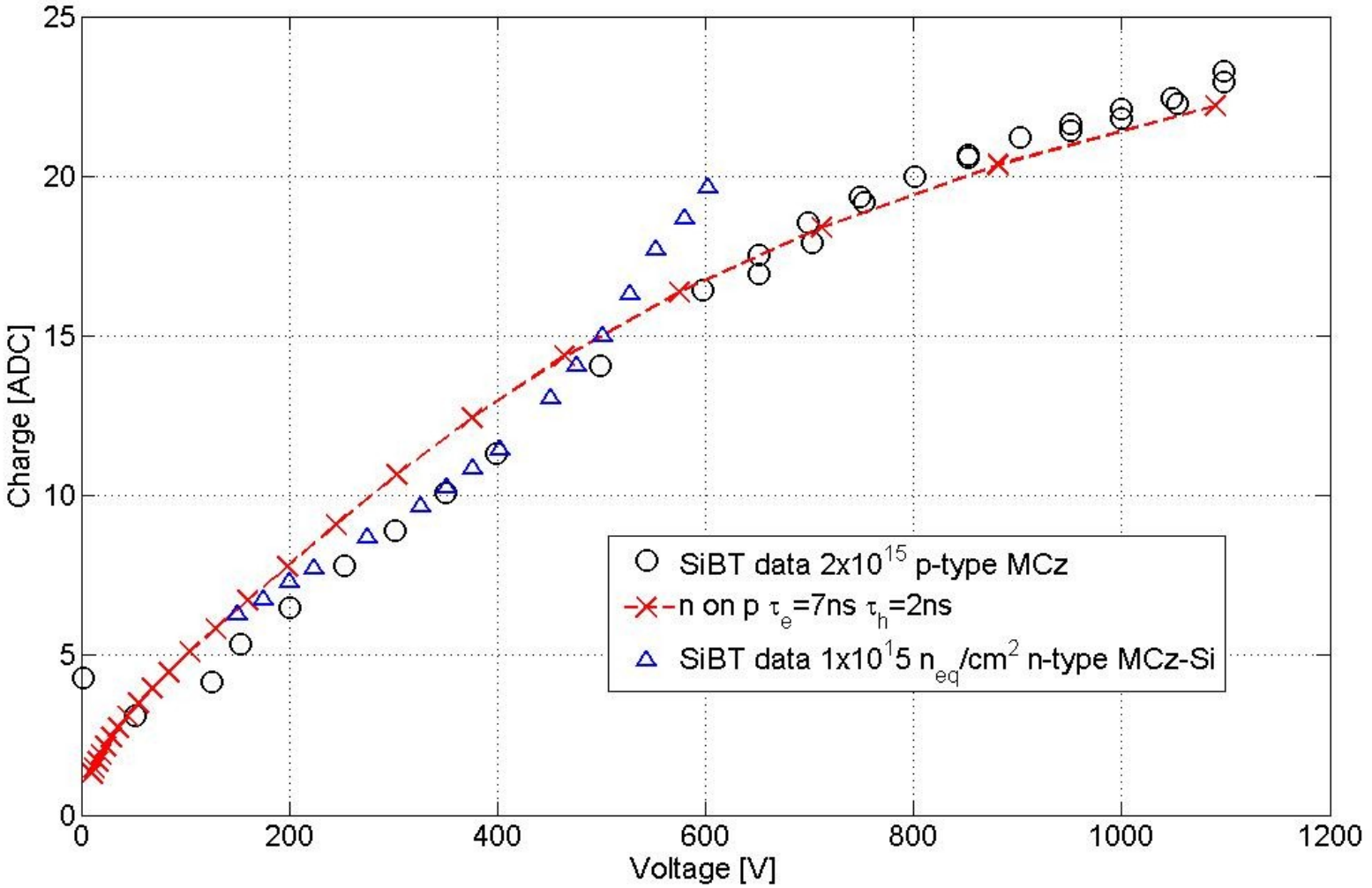


Data “as measured”, not trapping corrected

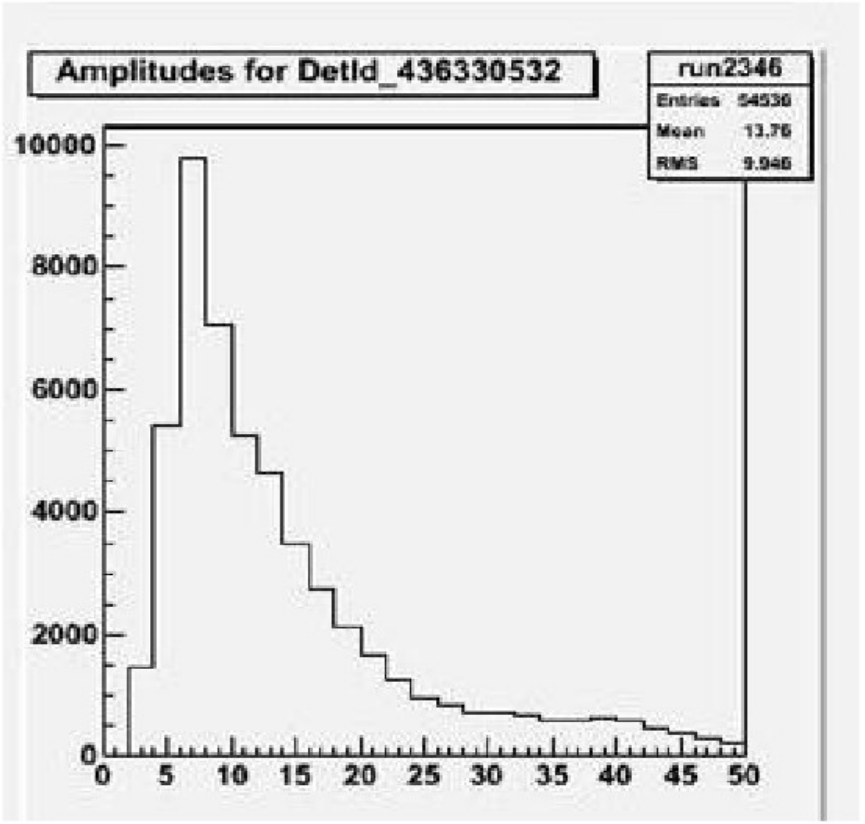
Electric field distribution used in CCE vs V calculation



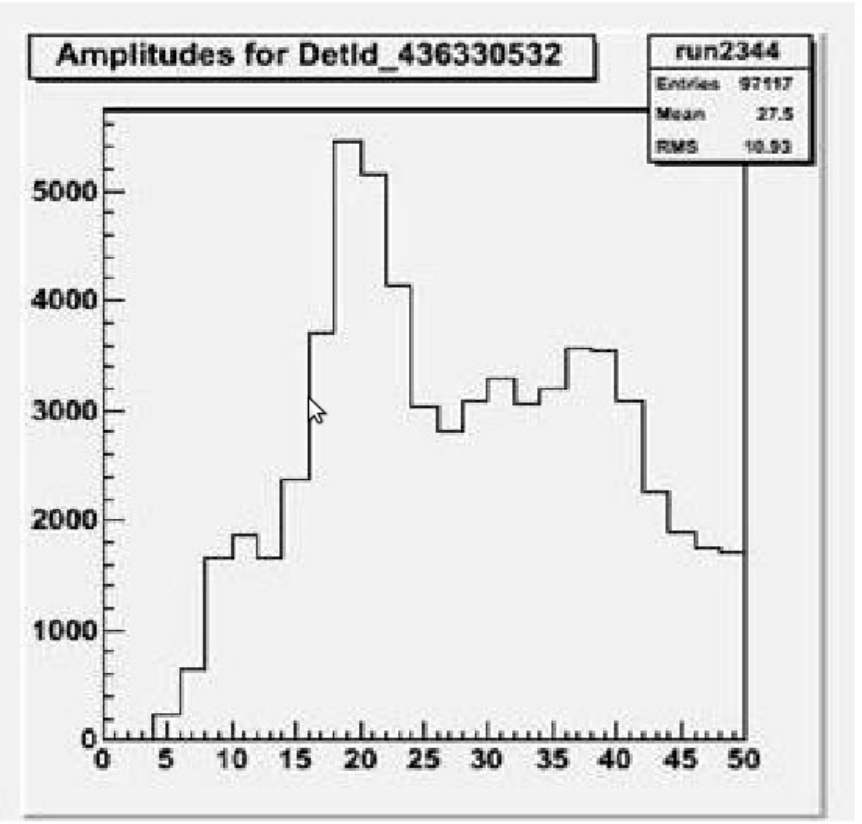
Results 2009 / MCz-Si $n^+/p^-/p^+$ 2×10^{15} n_{eq}/cm^2



Fz-Si $p^+/n^-/n^+$ 1×10^{14} n_{eq}/cm^2



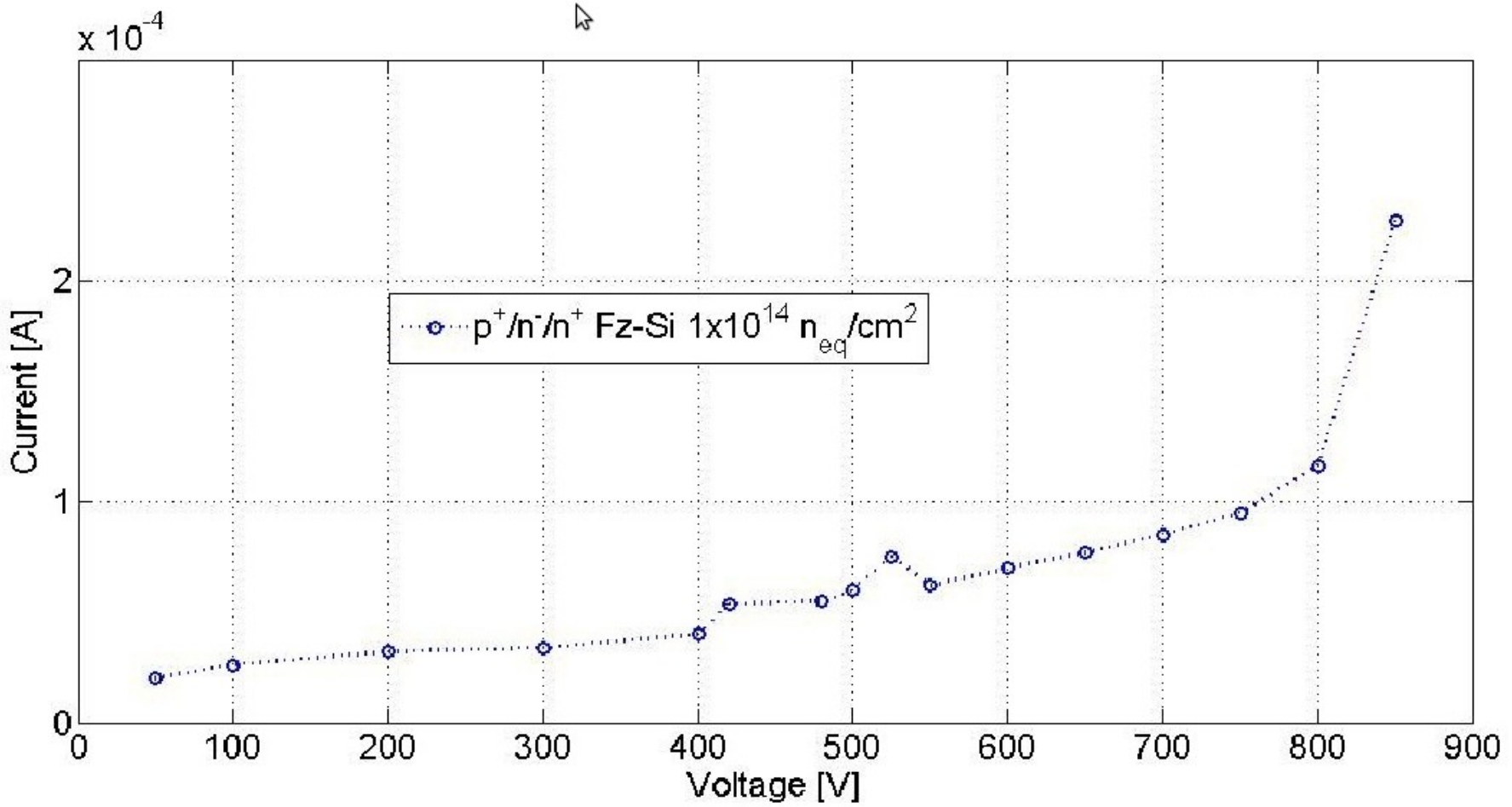
V_{bias}=500V $I_{reverse}$=63μA



V_{bias}=850V $I_{reverse}$=116μA

On-line monitor screenshot

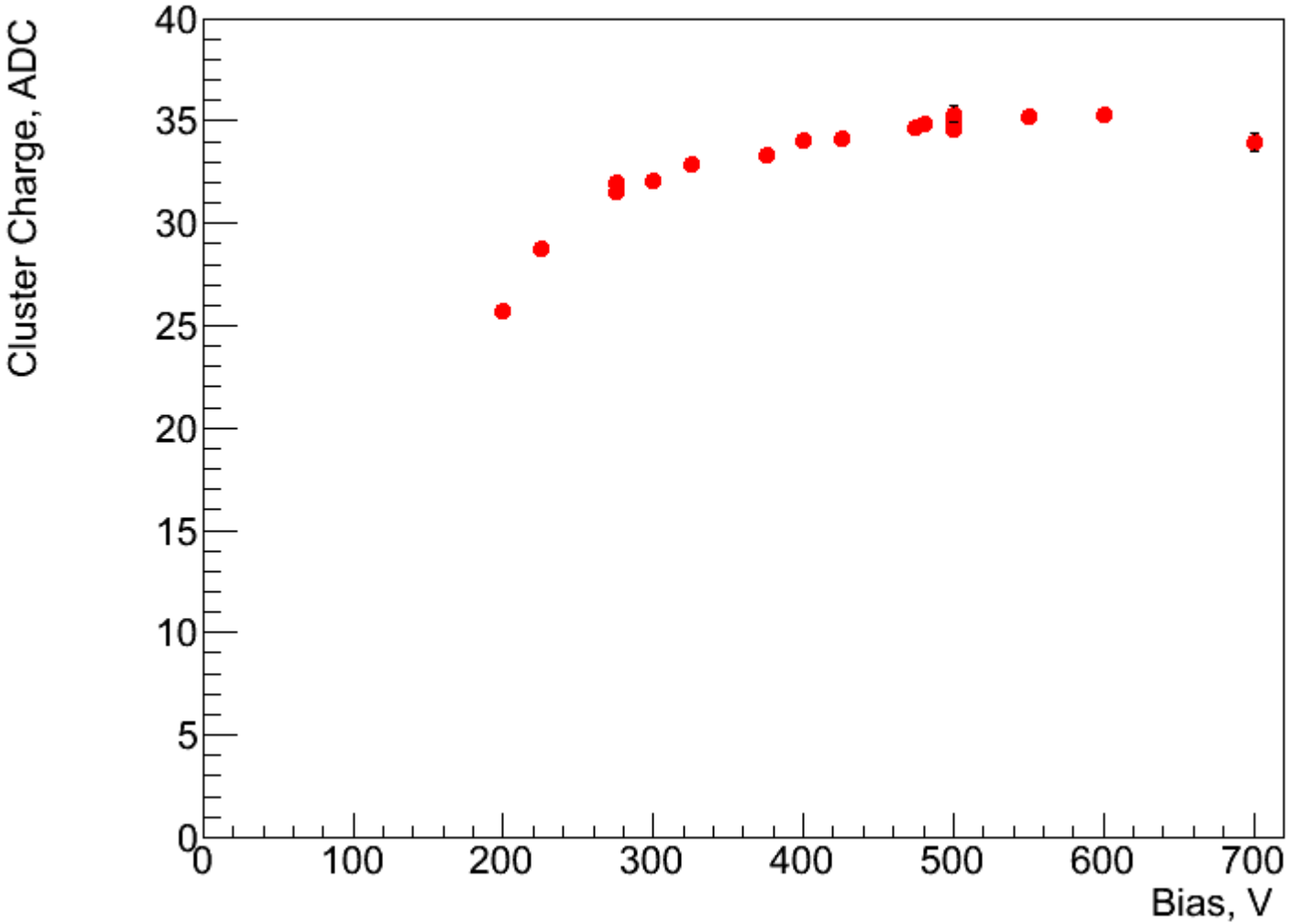
IV characteristic of module



Recorded during data taking with CAEN power supply, T= -10°C

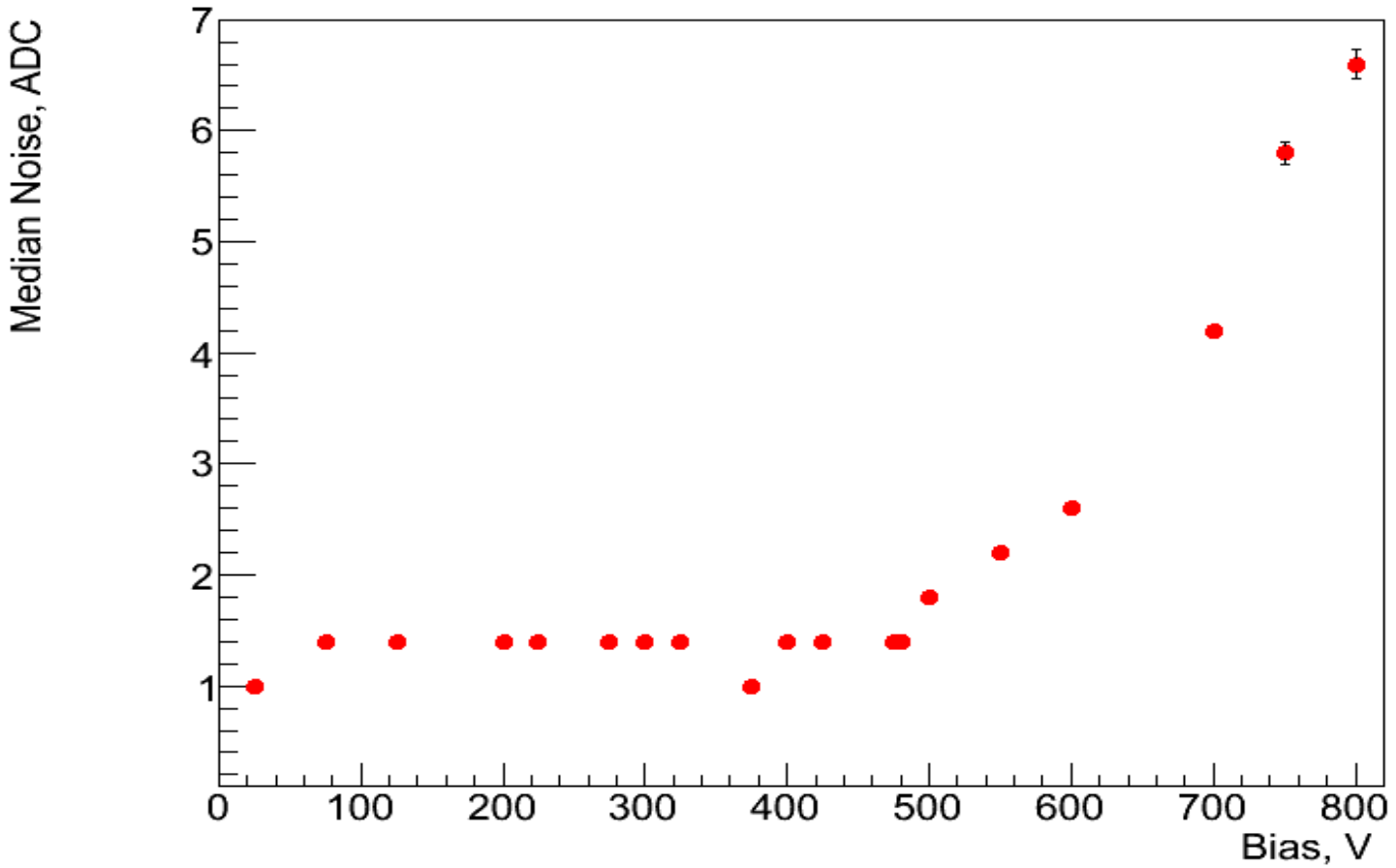
Data analysis of n-type Fz-Si 1×10^{14} n_{eq} /cm^2

by Yuri Gotra, FNAL

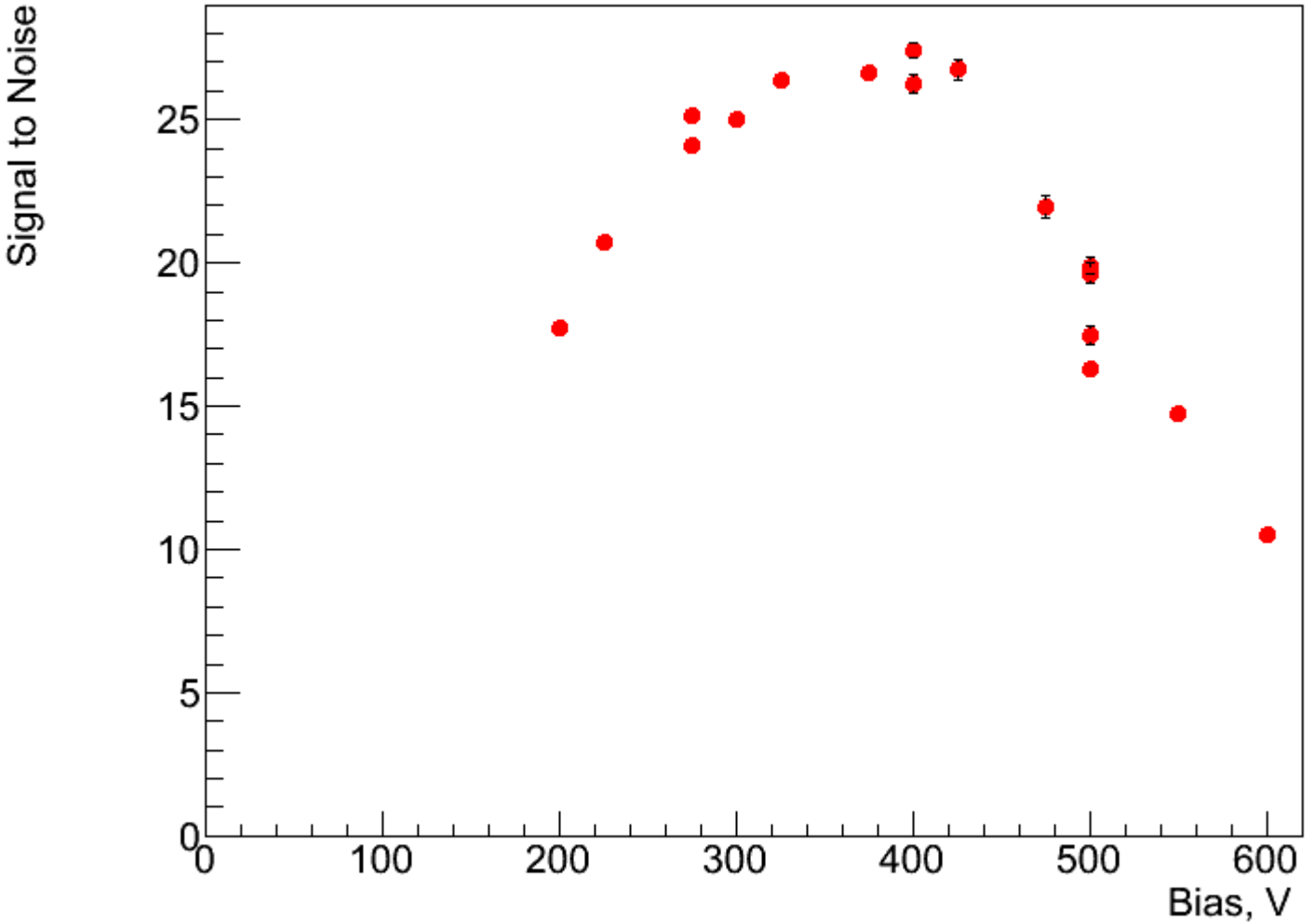


Signal vs V

Noise vs Voltage



Signal to Noise vs Voltage



Summary

- **N-type MCz-Si 1×10^{15} n_{eq} /cm^2**
  - >40% CCE @ 600V
  - Results producible with calculations with classical transport equations and IR laser measurements

- **P-type MCz-Si 2×10^{15} n_{eq} /cm^2**
  - >40% CCE @ 600V
  - >60% CCE @ 1100V
  - Results producible with calculations with classical transport equations.
  - No “avalanche multiplication” observed
  - Essentially same CCE as in n-type MCz-Si irradiated with 50% smaller fluence.

- **n-type Fz-Si 1×10^{14} n_{eq} /cm^2**
  - >90% CCE @ 400V
  - S/N ratio 27 with pitch adapter providing AC coupling
  - CMSSW on-line monitor sees significant increase in collected charge when sensor breaks down.
  - The charge increase in not attributed with particle hit clusters
  - Noise will drastically increase when running detector in this mode