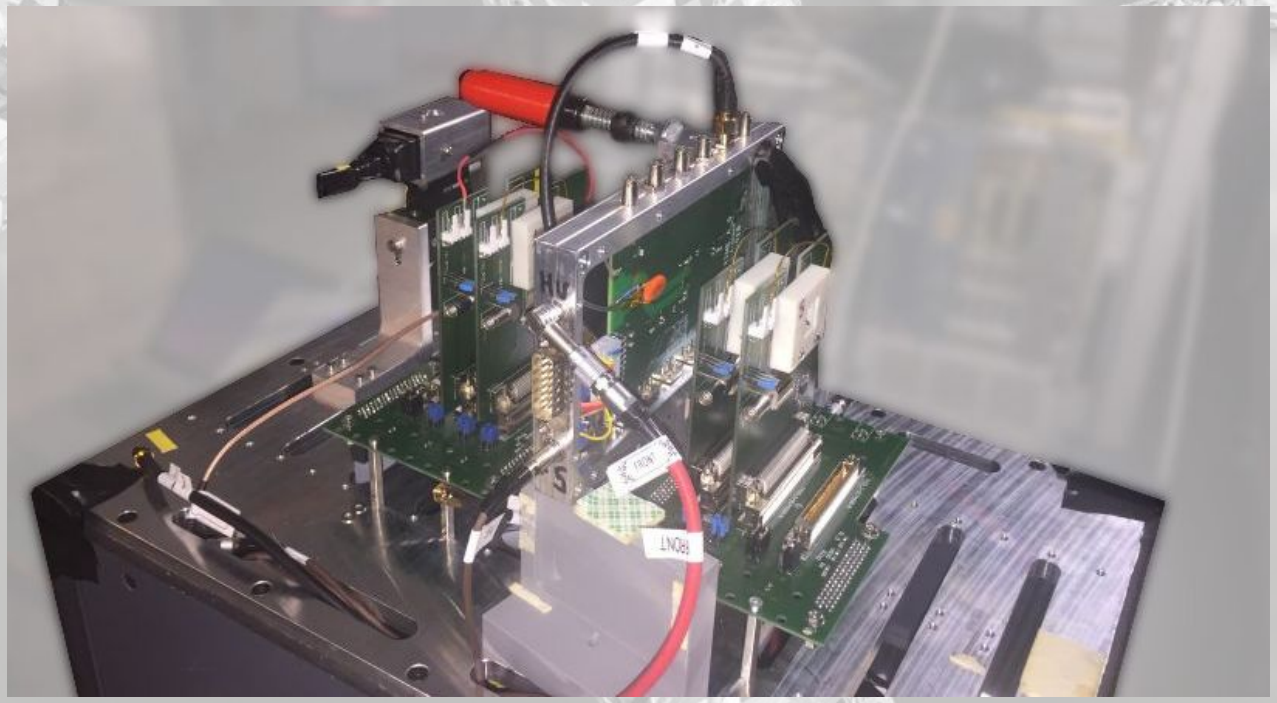
ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

IPA



Single and Double Channel Measurements of the BCM' at PSI

RD42 Meeting, Ljubljana

Michael Reichmann

8th November 2018

Table of Contents

Section 1

Introduction

Introduction

- after troubles at CERN also measured BCM' at PSI
  - high particle rate
  - much lower spatial resolution of the telescope
- measured two diamonds with different readout boxes:

	??	II6-H8
manufacturer	II-VI Inc.	II-VI Inc.
diamond type	poly-crystal	poly-crystal
size	$\sim$4 mm $\times$ 4 mm	$\sim$4 mm $\times$ 4 mm
thickness	$\sim$500 µm	$\sim$500 µm
amplifier	new OSU fast Amp	new OSU fast Amp
readout box	1	2

- maximum 1 out of 4 amplifier channels per chip can be read out at once
- box 1: original box that blew up the electronics at CERN
  - internal LV distribution
  - maximum HV of 300 V
- box 2: different casing with all LV components of box 1 but different HV connector

Measurements

- avoid noise from programming pc:
- lock programming into the amps before every change of channel or chip configuration
  - connect 500 mV supply voltage
  - hook up DB connector to the readout boxes
  - program chip
  - disconnect DB
  - ground supply voltage line
- every data run is preceded by a pumping run at high rate of the same duration

Box	Chip	Channel	Bias [V]	Events [M]
1	1	1	±200	0.8
1	1	1	±300	0.8
1	2	1	±200	0.8
1	2	1	±300	0.8
1	1 & 2	1	±200	0.8
2	1 & 2	1	±500	1.6
2	1 & 2	1	±1000	1.6

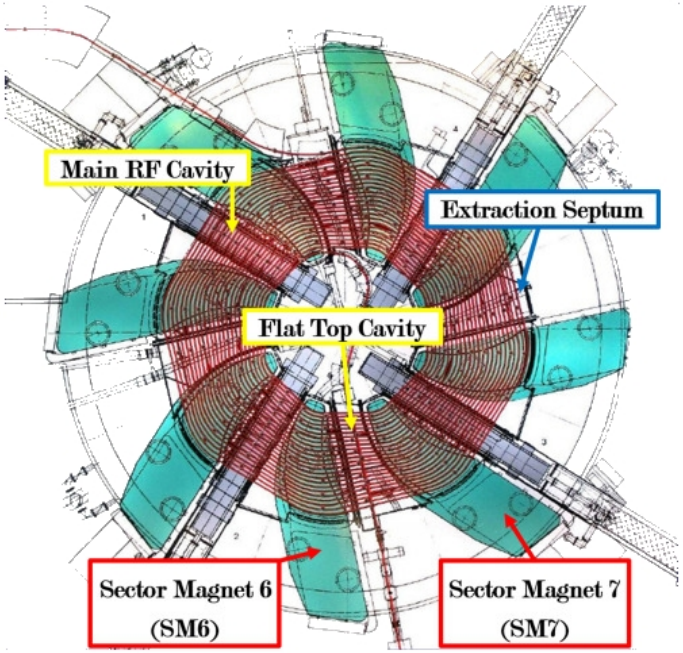
Section 2

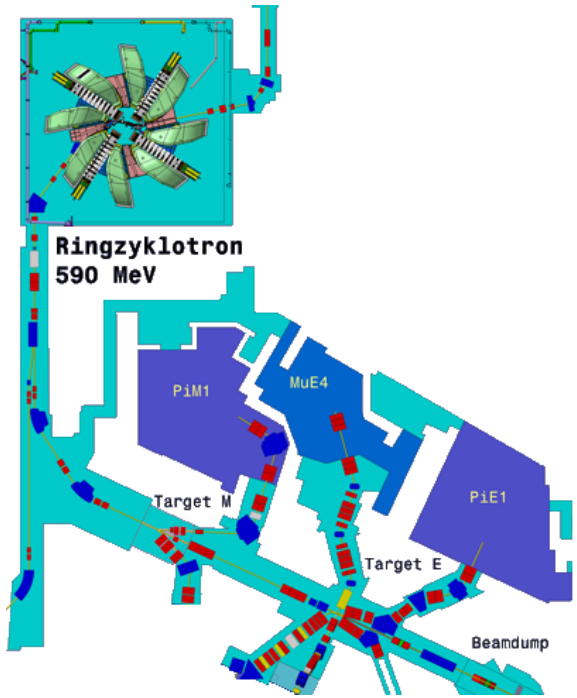
Test Site

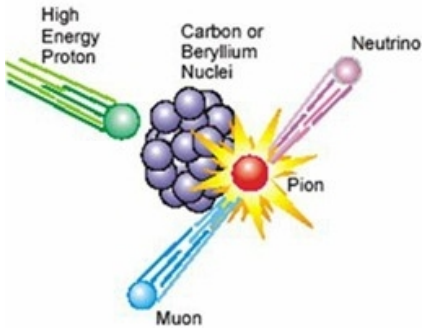

SCHWEISSWERK BÜLACH AG

Test Site

- High Intensity Proton Accelerator (HIPA) at PSI → beam line PiM1
- clean positive pion beam (∼98 % π^+) with momentum of 260 MeV/c
  - 75 % of the signal size at CERN! (120 GeV/c)
- **significant multiple scattering → worsens resolution**







Section 3

Results

Box 1

- all pads/channels of the two amplifier chips are connected to the same HV line
- pumping at higher rate induces leakage current in the sensor

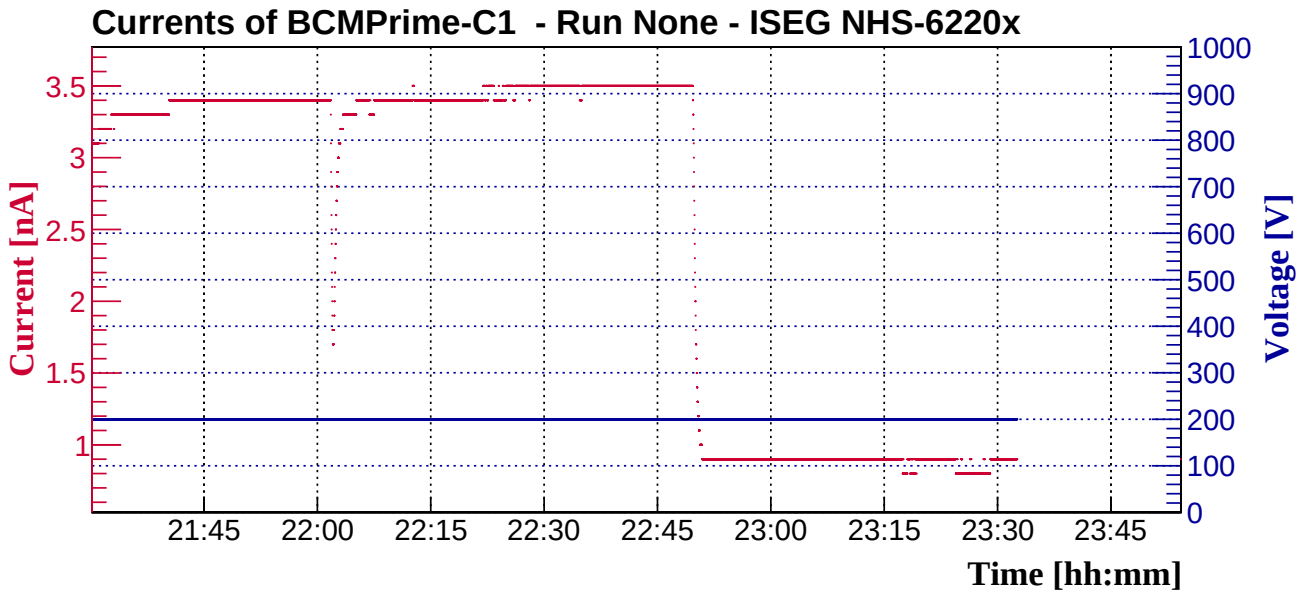


Figure: Box 1 at +200 V

- stable behaviour at +200 V

Box 1

- all pads/channels of the two amplifier chips are connected to the same HV line
- pumping at higher rate induces leakage current in the sensor

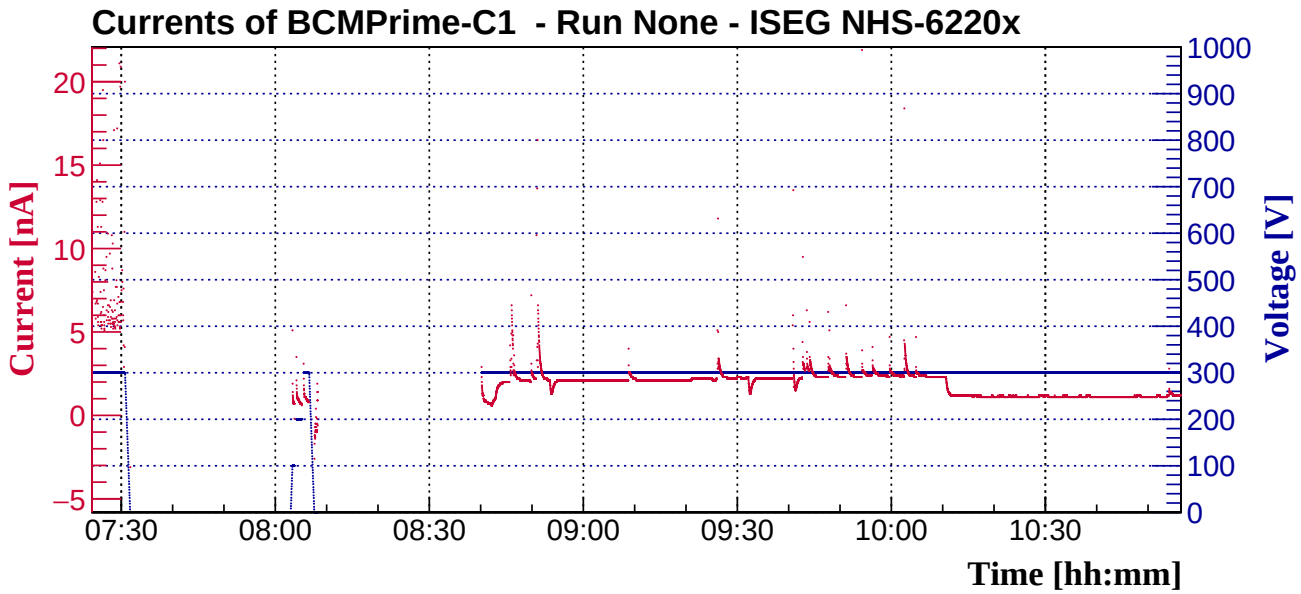


Figure: Box 1 at +300 V

- stable behaviour at +200 V
- erratic currents up to $\mathcal{O}(2\,\mu A)$ at high rates at +300 V

Box 2

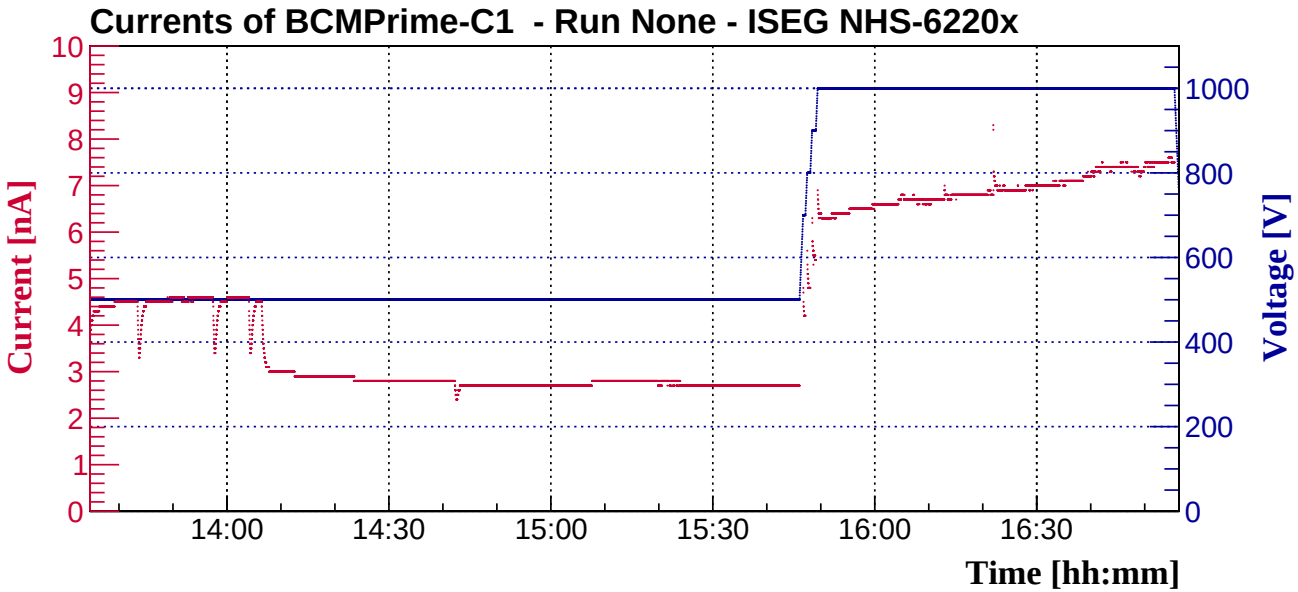


Figure: Box 2 at positive voltage

- very stable behaviour up to $\pm 1\,\mathrm{kV}$
- slight increase at $+1\,\mathrm{kV}$

Box 2

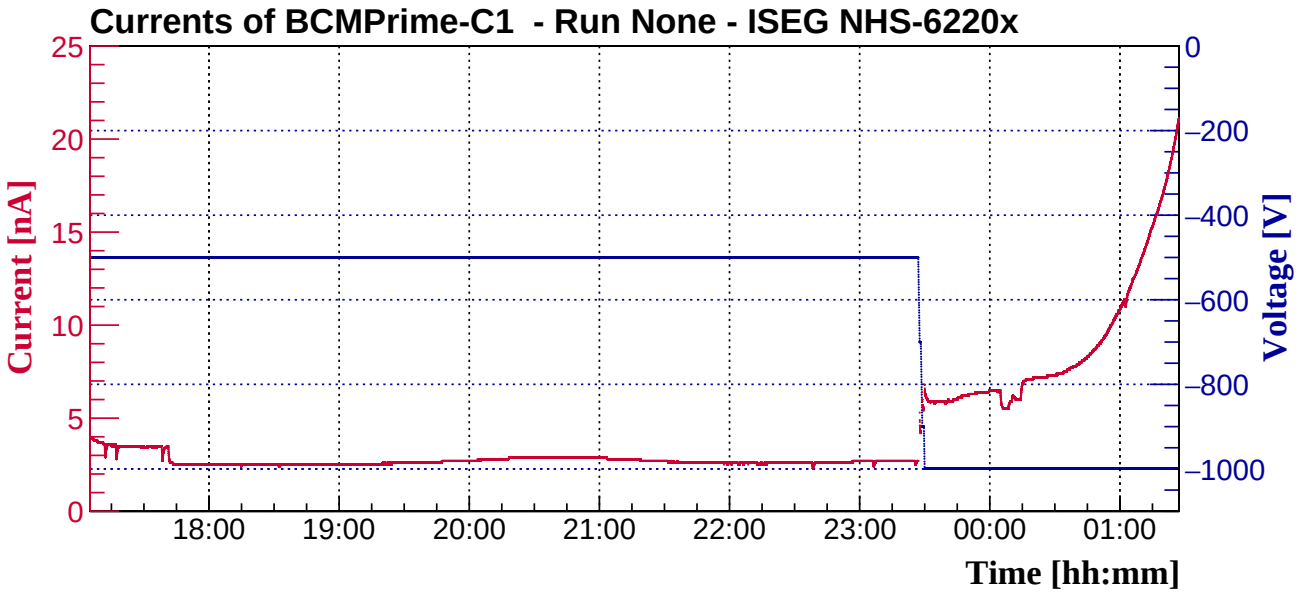


Figure: Box 2 at negative voltage

- very stable behaviour up to $\pm 1\,\mathrm{kV}$
- slight increase at $+1\,\mathrm{kV}$
- exponential increase at $-1\,\mathrm{kV}$

Box 2

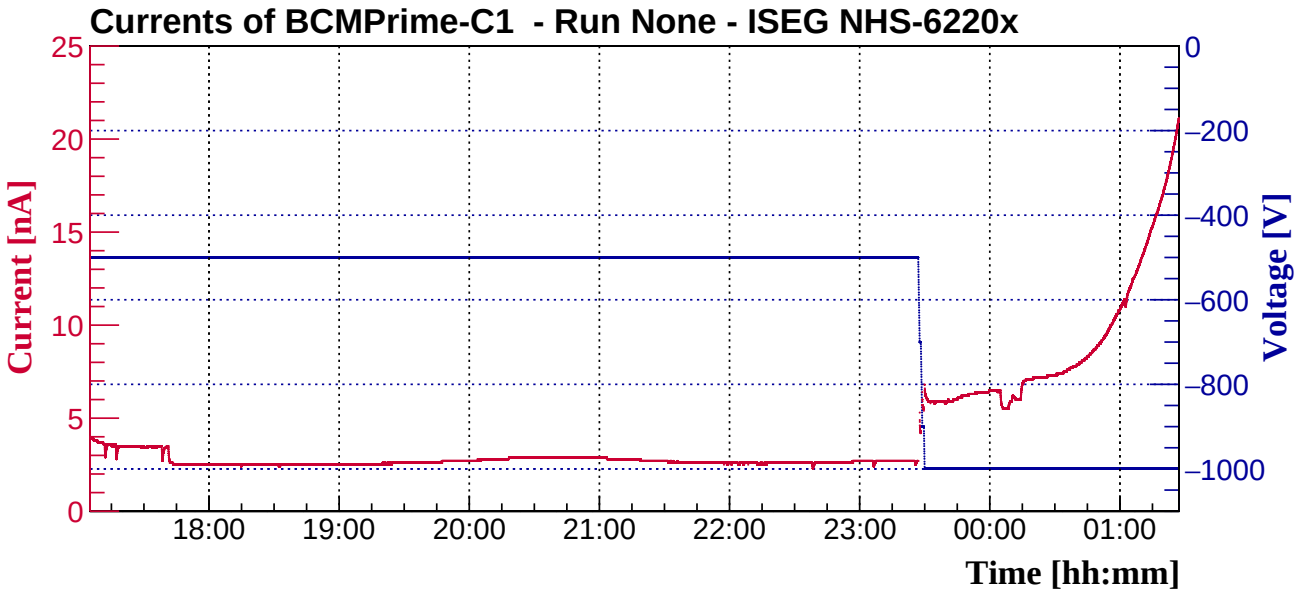


Figure: Box 2 at negative voltage

- very stable behaviour up to $\pm 1\,\mathrm{kV}$
- slight increase at $+1\,\mathrm{kV}$
- exponential increase at $-1\,\mathrm{kV}$
- current positive independed of bias ...

Positive Bias

- all signal polarities are opposite of the bias
- pumping at higher rate induces leakage current in the sensor

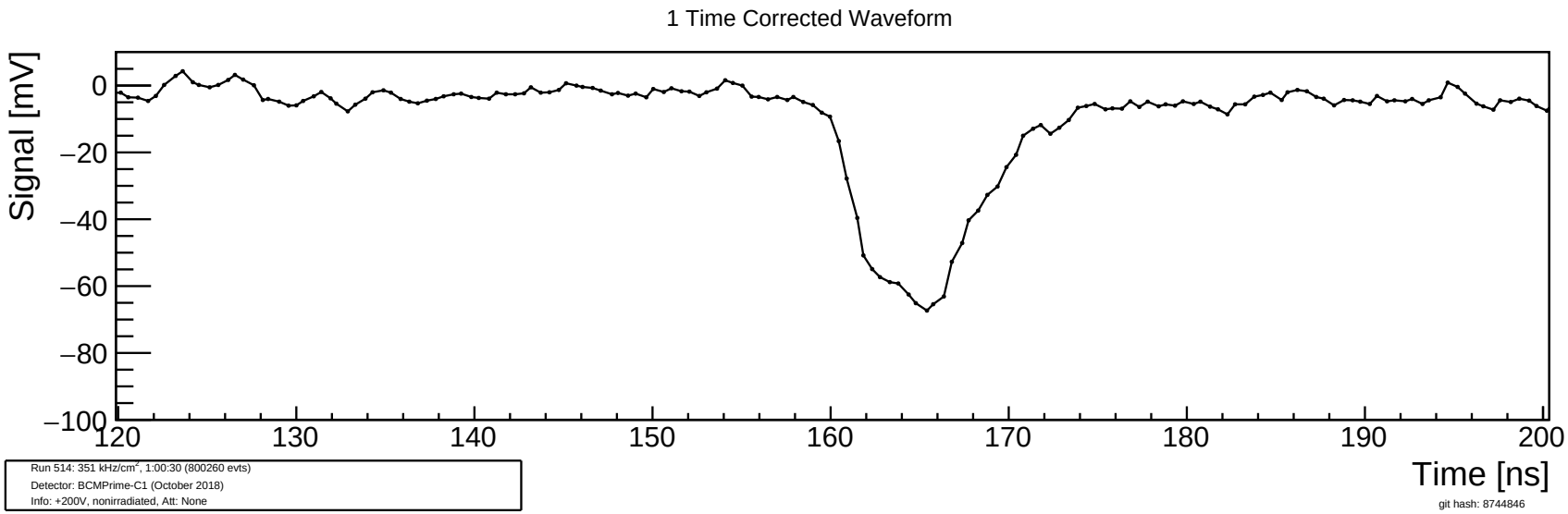


Figure: Single waveform 0 +200 V

- pulses usually have a flattish top and probably don't reach the maximum

Positive Bias

- all signal polarities are opposite of the bias
- pumping at higher rate induces leakage current in the sensor

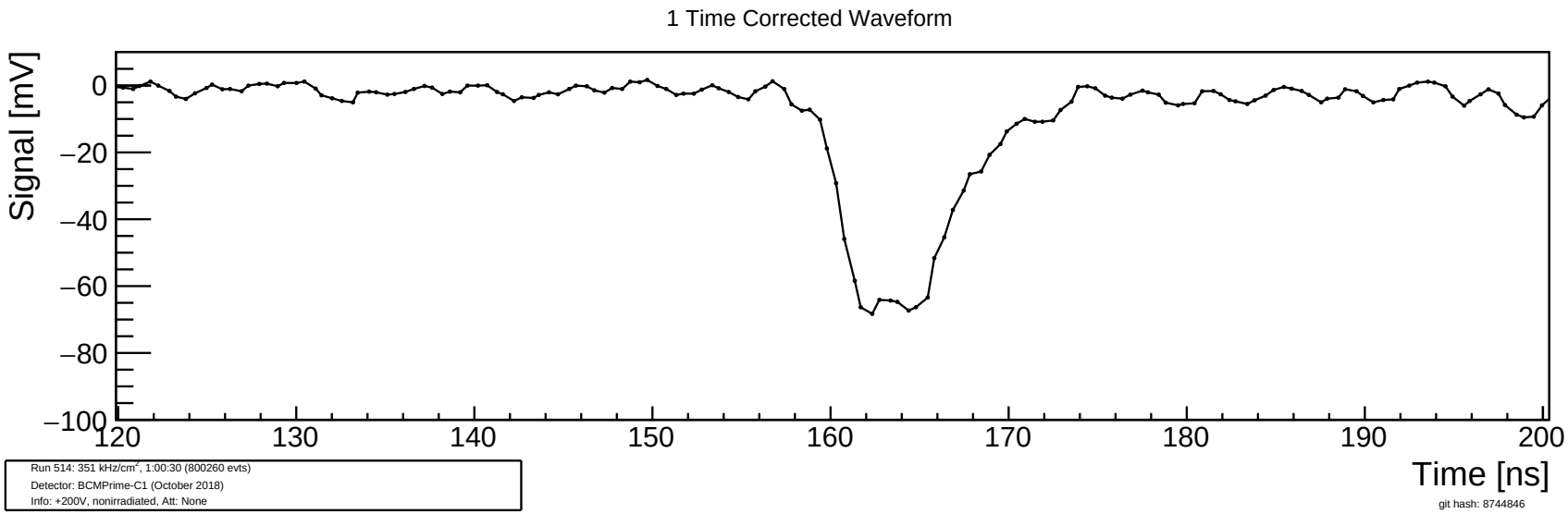


Figure: Single waveform 1 +200 V

- pulses usually have a flattish top and probably don't reach the maximum

Positive Bias

- all signal polarities are opposite of the bias
- pumping at higher rate induces leakage current in the sensor

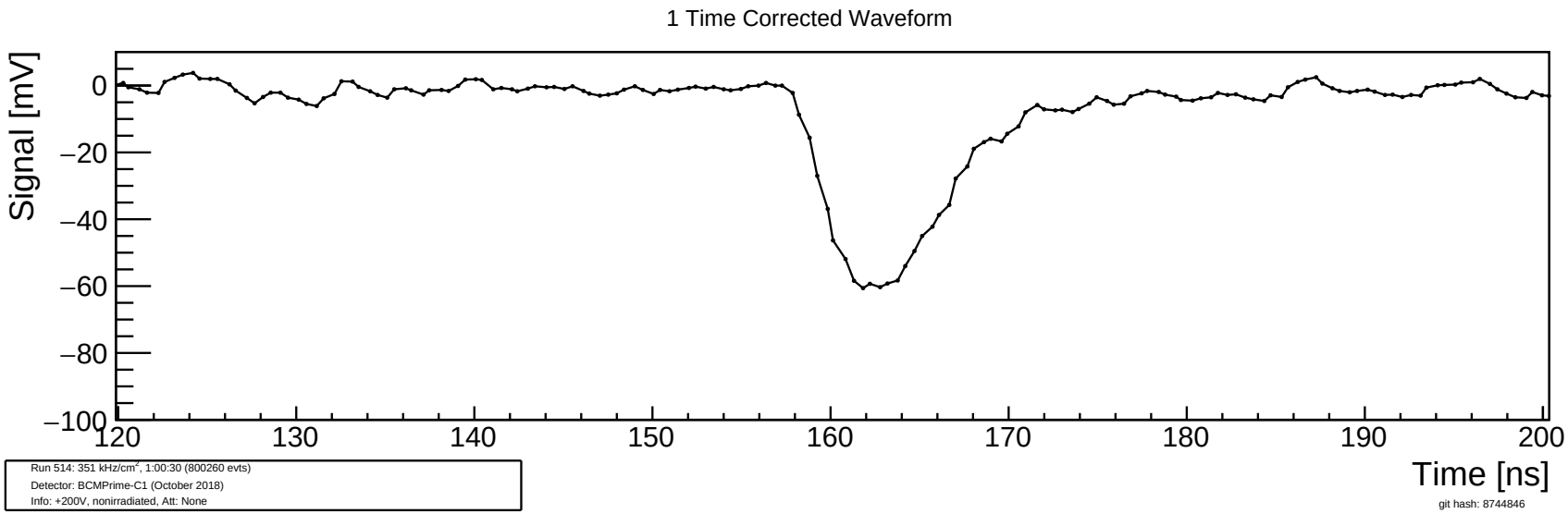


Figure: Single waveform 2 +200 V

- pulses usually have a flattish top and probably don't reach the maximum

Positive Bias

- all signal polarities are opposite of the bias
- pumping at higher rate induces leakage current in the sensor

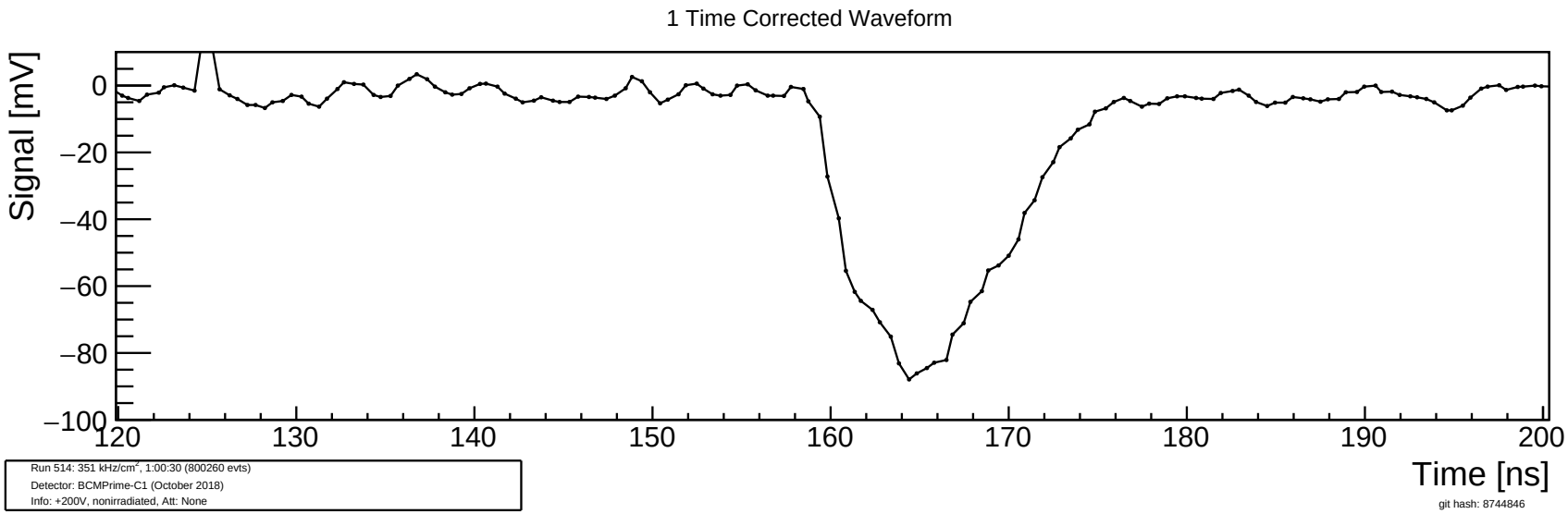


Figure: Single waveform 3 +200 V

- pulses usually have a flattish top and probably don't reach the maximum

Positive Bias

- all signal polarities are opposite of the bias
- pumping at higher rate induces leakage current in the sensor

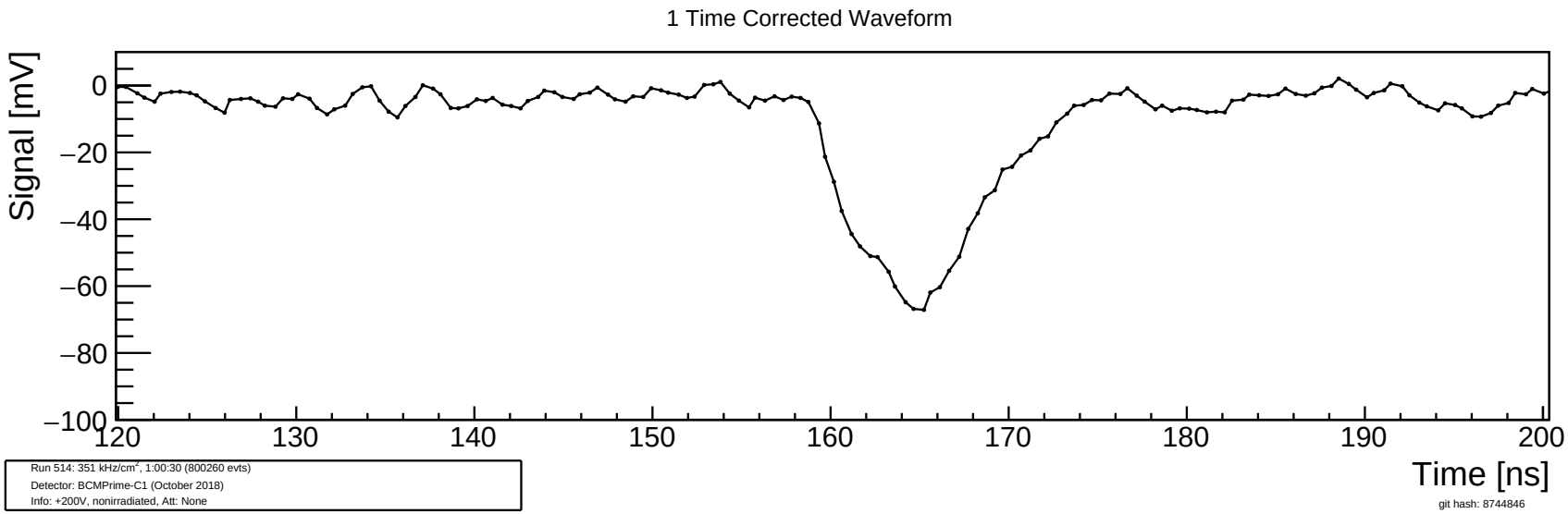


Figure: Single waveform 4 $+200\,\mathrm{V}$

- pulses usually have a flattish top and probably don't reach the maximum

Positive Bias

- all signal polarities are opposite of the bias
- pumping at higher rate induces leakage current in the sensor

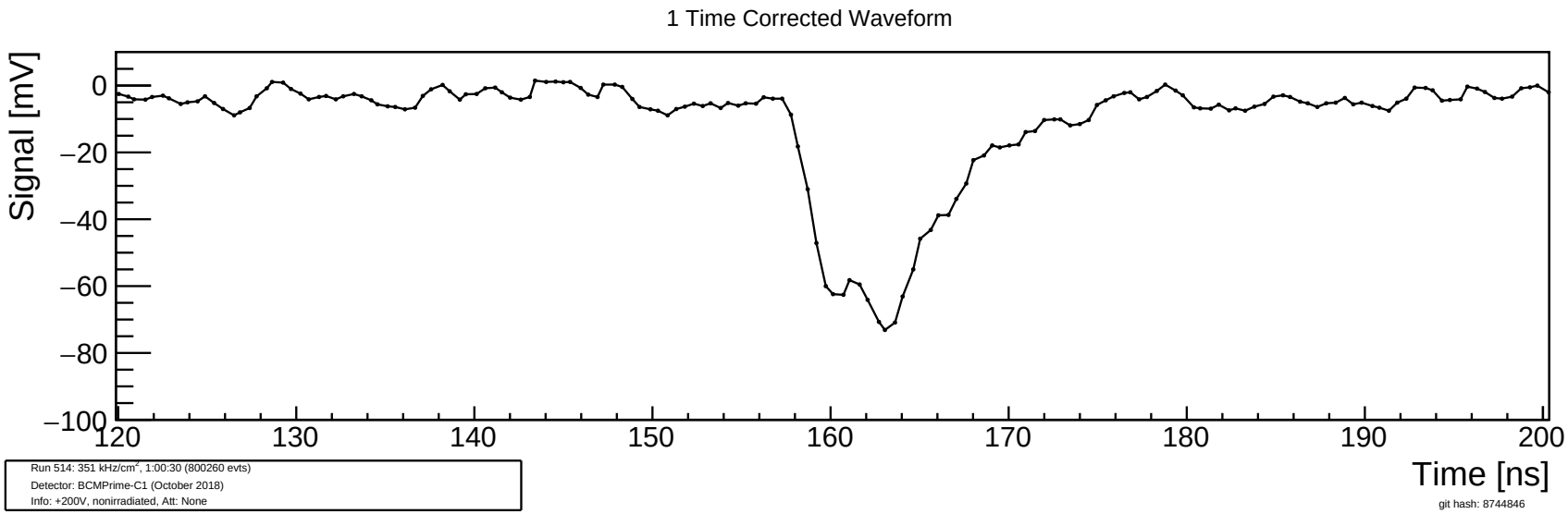


Figure: Single waveform 5 +200 V

- pulses usually have a flattish top and probably don't reach the maximum

Positive Bias

- all signal polarities are opposite of the bias
- pumping at higher rate induces leakage current in the sensor

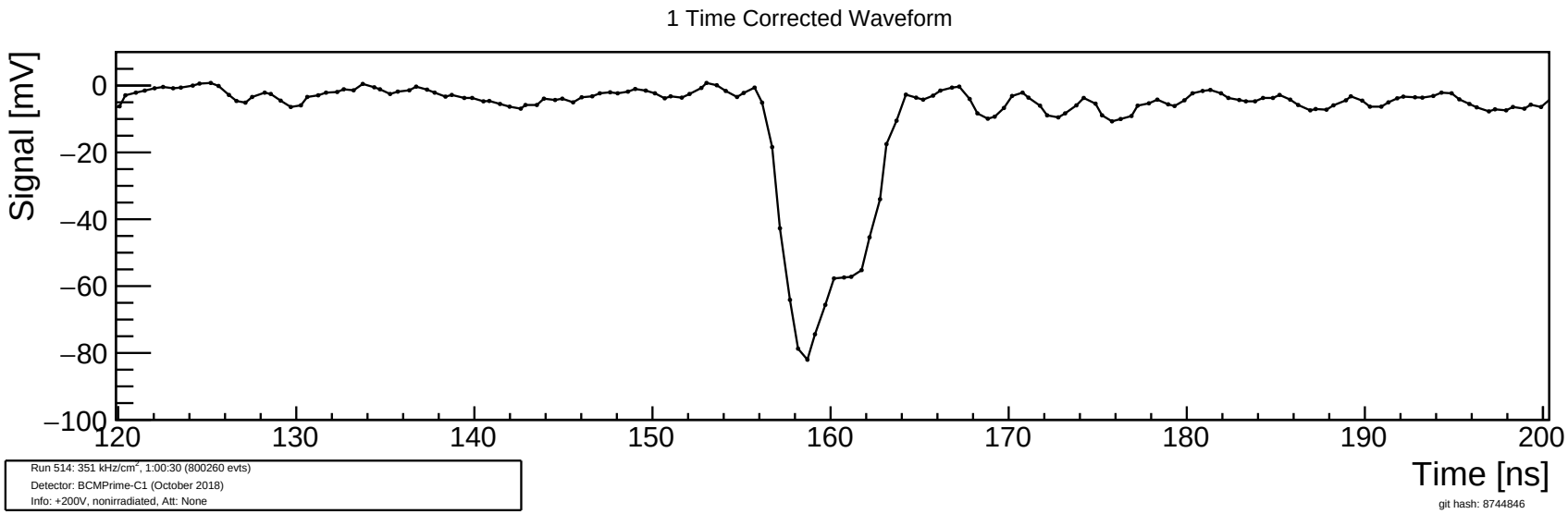


Figure: Single waveform 6 +200 V

- pulses usually have a flattish top and probably don't reach the maximum

Section 4

Conclusion

Conclusion

- successfully measured two BCM' modules at PSI
- only channel 1 of each chip working at low noise
- possible to read out two channels of independent chips at the same time
- SNR at 1 kV:
- shape of negative signals becomes flat before reaching the highest point
- rise time at positive voltage:
- coupling between connected and non-connected channels


Del Fin