

Single and Double Channel Measurements of the BCM' at PSI

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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 | ~4 mm × 4 mm | ~4 mm × 4 mm |
| thickness | ~500 μm | ~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 |

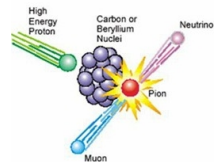
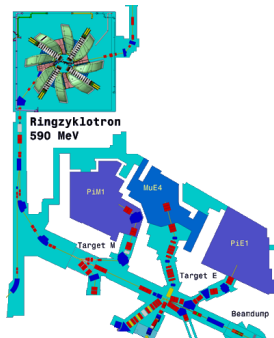
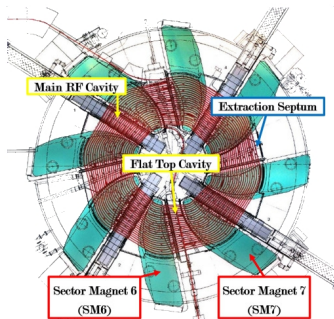
Section 2

Test Site



Test Site

- High Intensity Proton Accelerator (HIPA) at PSI → beam line PiM1
- clean positive pion beam ($\sim 98\% \pi^+$) 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

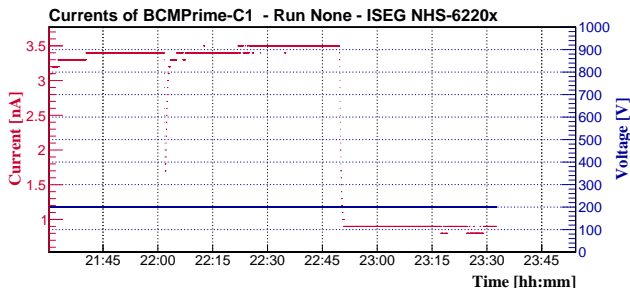


Figure: Box 1 at +200 V

- 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

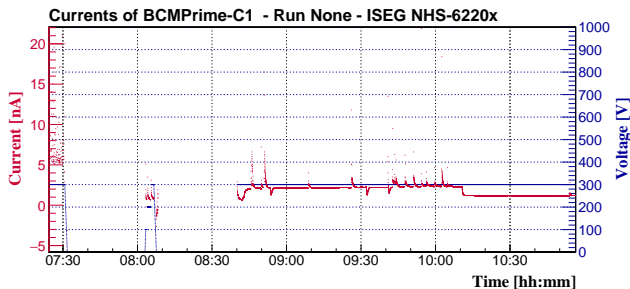


Figure: Box 1 at +300 V

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

Box 2

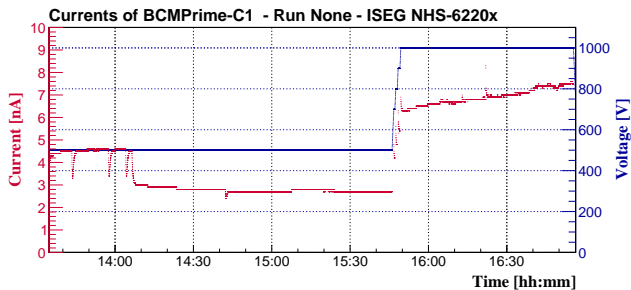


Figure: Box 2 at positive voltage

- very stable behaviour up to ± 1 kV
- slight increase at +1 kV

Box 2

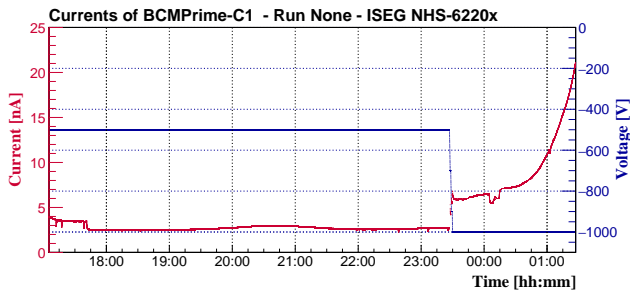


Figure: Box 2 at negative voltage

- very stable behaviour up to ± 1 kV
- slight increase at +1 kV
- exponential increase at -1 kV

Box 2

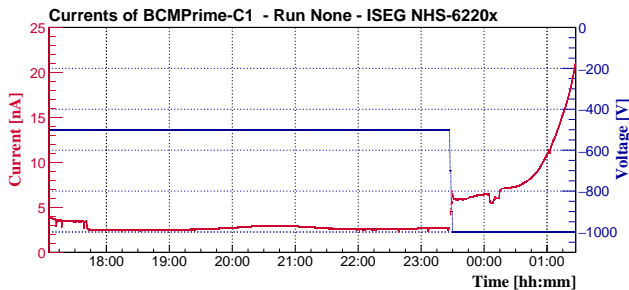


Figure: Box 2 at negative voltage

- very stable behaviour up to ± 1 kV
- slight increase at $+1$ kV
- exponential increase at -1 kV
- current positive independent of bias ...

Positive Bias

- all signal polarities are opposite of the bias

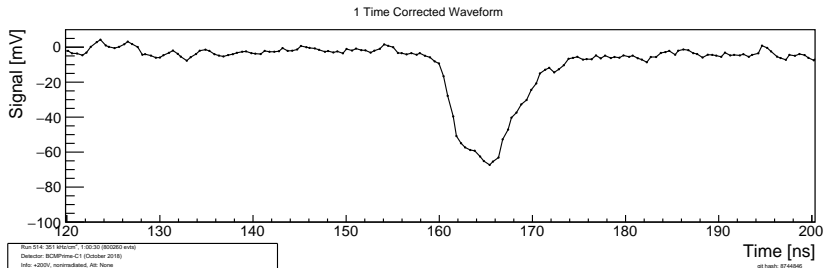


Figure: Single waveform 0 +200 V

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

Positive Bias

- all signal polarities are opposite of the bias

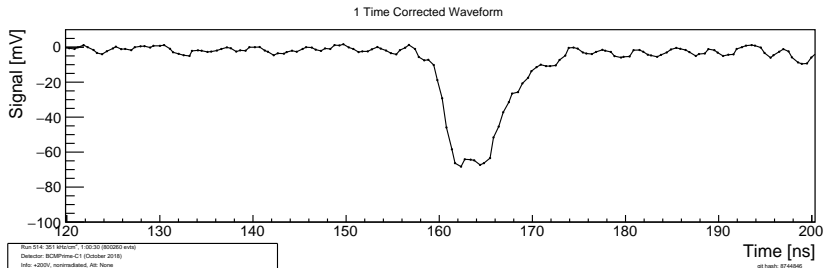


Figure: Single waveform 1 +200 V

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

Positive Bias

- all signal polarities are opposite of the bias

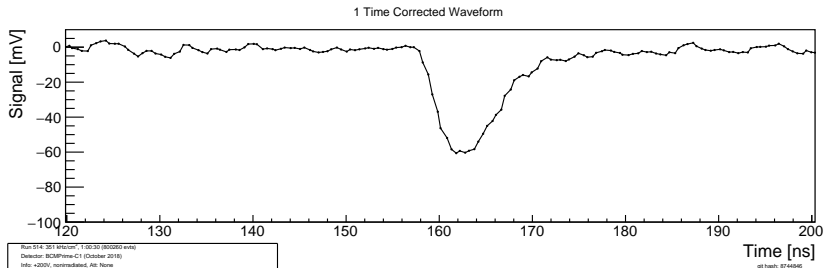


Figure: Single waveform 2 +200 V

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

Positive Bias

- all signal polarities are opposite of the bias

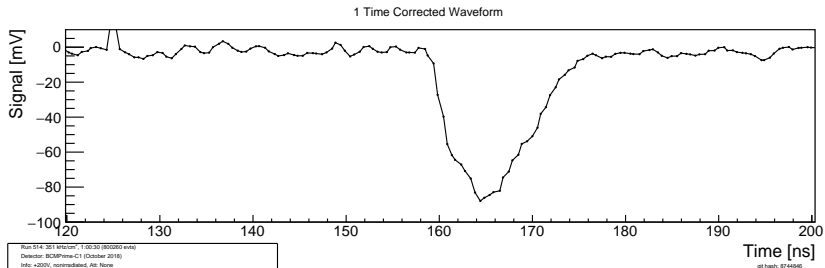


Figure: Single waveform 3 +200 V

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

Positive Bias

- all signal polarities are opposite of the bias

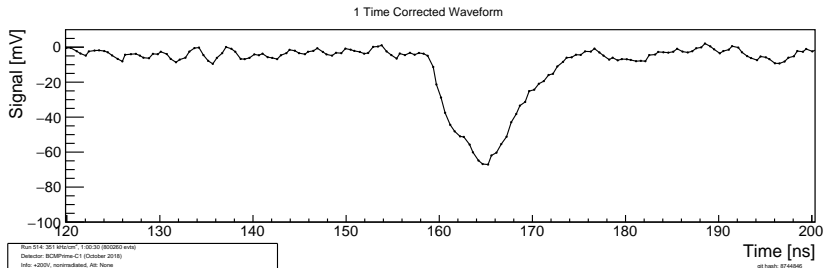


Figure: Single waveform 4 +200 V

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

Positive Bias

- all signal polarities are opposite of the bias

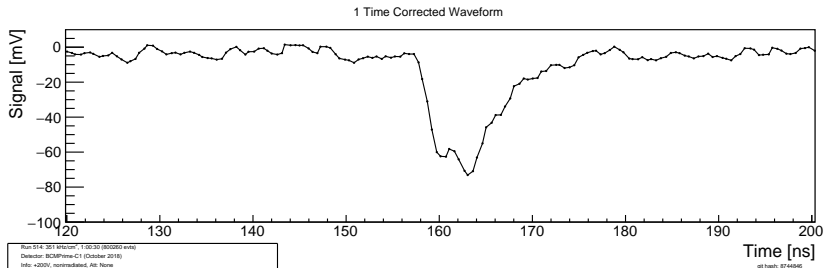


Figure: Single waveform 5 +200 V

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

Positive Bias

- all signal polarities are opposite of the bias

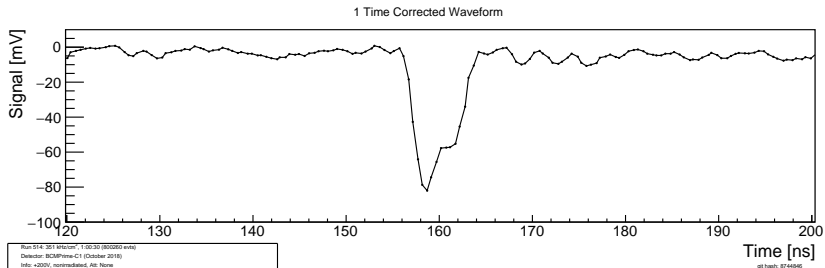


Figure: Single waveform 6 +200 V

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

Negative Bias

- all signal polarities are opposite of the bias

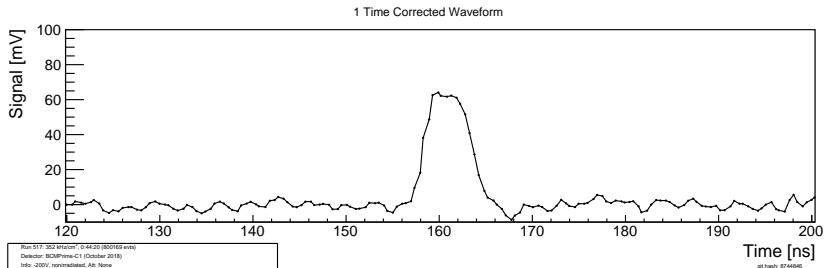


Figure: Single waveform 0 –200 V

- pulses show a second peak while coming down

Negative Bias

- all signal polarities are opposite of the bias

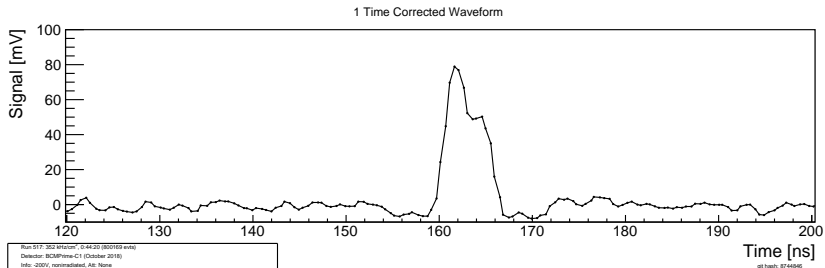


Figure: Single waveform 1 –200 V

- pulses show a second peak while coming down

Negative Bias

- all signal polarities are opposite of the bias

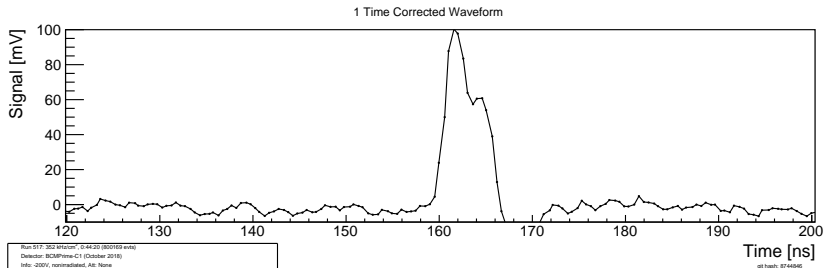


Figure: Single waveform 2 –200 V

- pulses show a second peak while coming down

Negative Bias

- all signal polarities are opposite of the bias

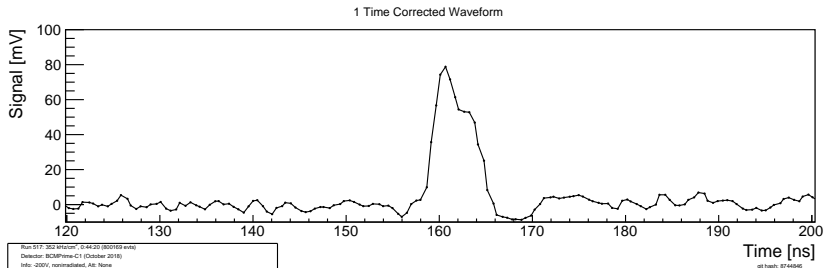


Figure: Single waveform 3 –200 V

- pulses show a second peak while coming down

Negative Bias

- all signal polarities are opposite of the bias

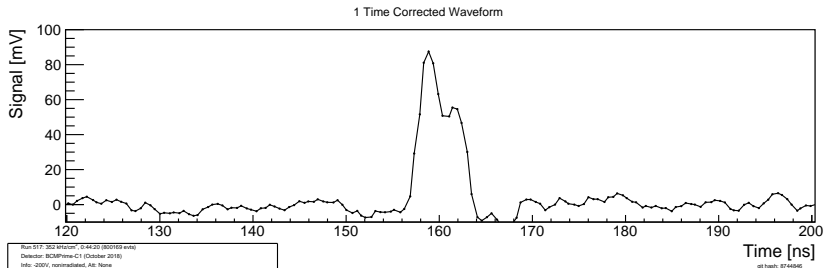


Figure: Single waveform 4 –200 V

- pulses show a second peak while coming down

Negative Bias

- all signal polarities are opposite of the bias

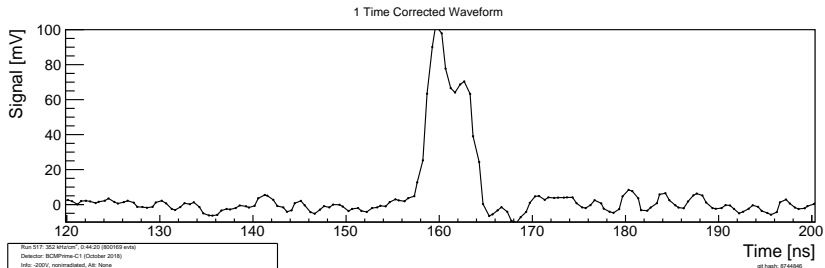
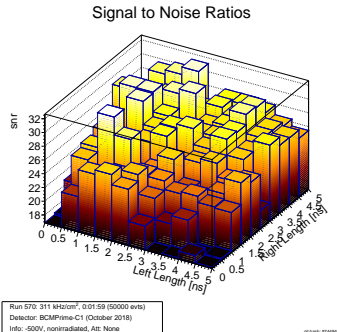


Figure: Single waveform 5 –200 V

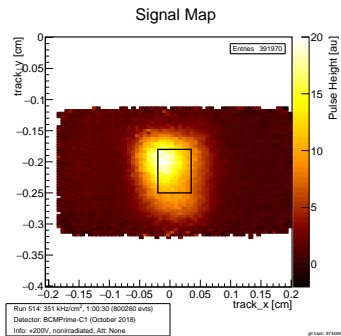
- pulses show a second peak while coming down

Waveform Integration / SNR

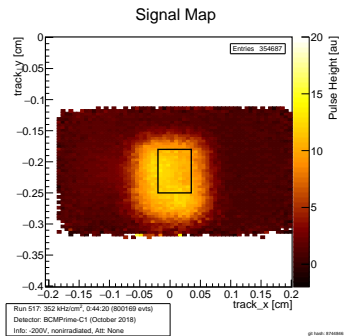


- choosing the integration width around the peak of the pulse
- chosen values: 1.5 ns before and 3 ns after the pulse

Signal Maps



(a) +200 V



(b) +200 V

- test

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 Fun

