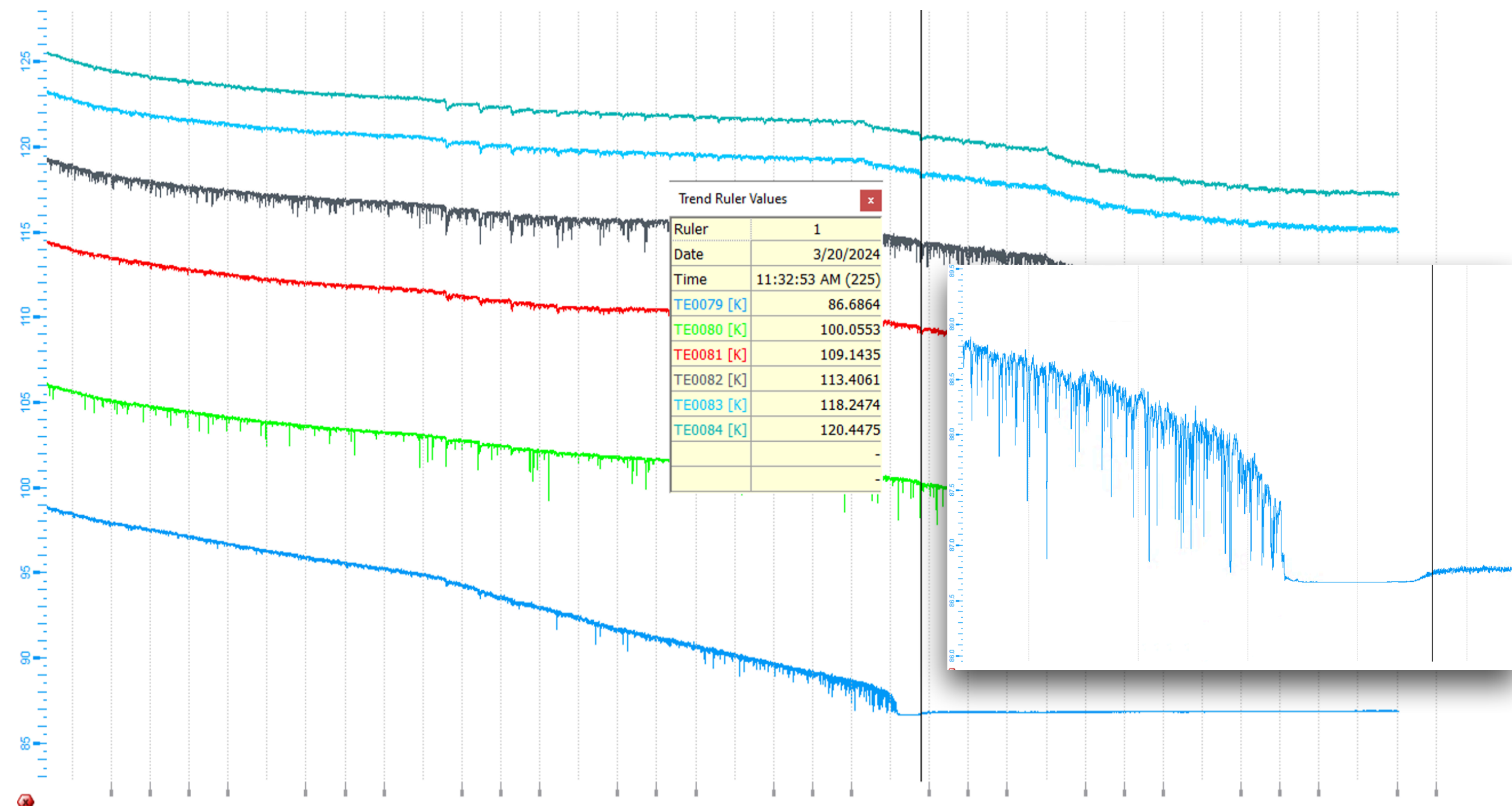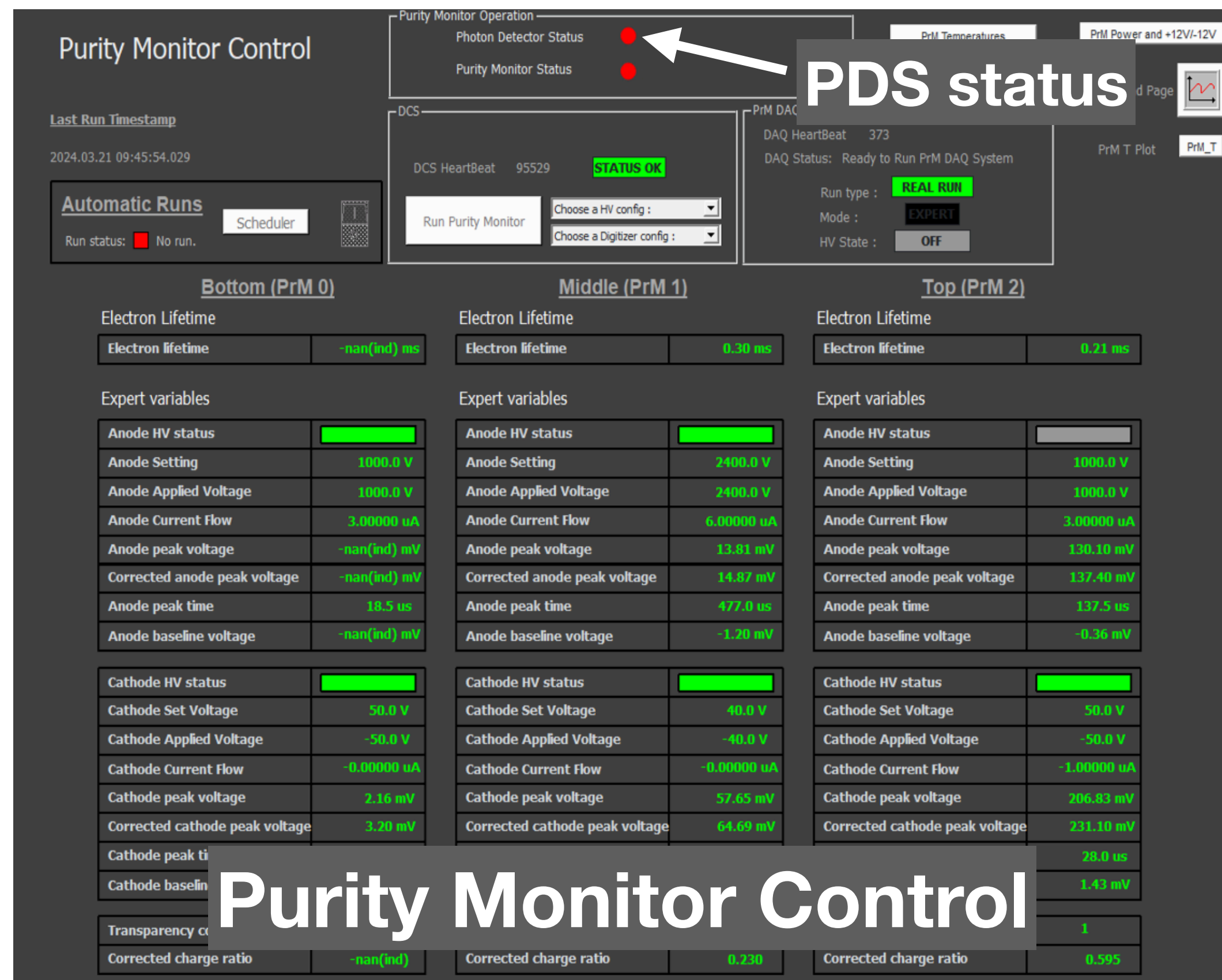# Purity Monitor Update

Wenjie Wu (UC Irvine)

CALCI Consortium Meeting

**March 21, 2024**

Purity monitors in PD-HD

- 3 purity monitors installed. 2 of them (top and bottom) from the SP run, and the middle PrM is new with longer drift distance.

- Temperature sensors installed above and below each purity monitor, 6 in total.

Purity Monitor Control

Temperature measurements

Purity monitors status

- 3 purity monitors are working properly

  - From the reading in argon gas, there might be a gradient of purity from bottom to top (getting worse)

  - Keep taking data while purity monitors are in gas

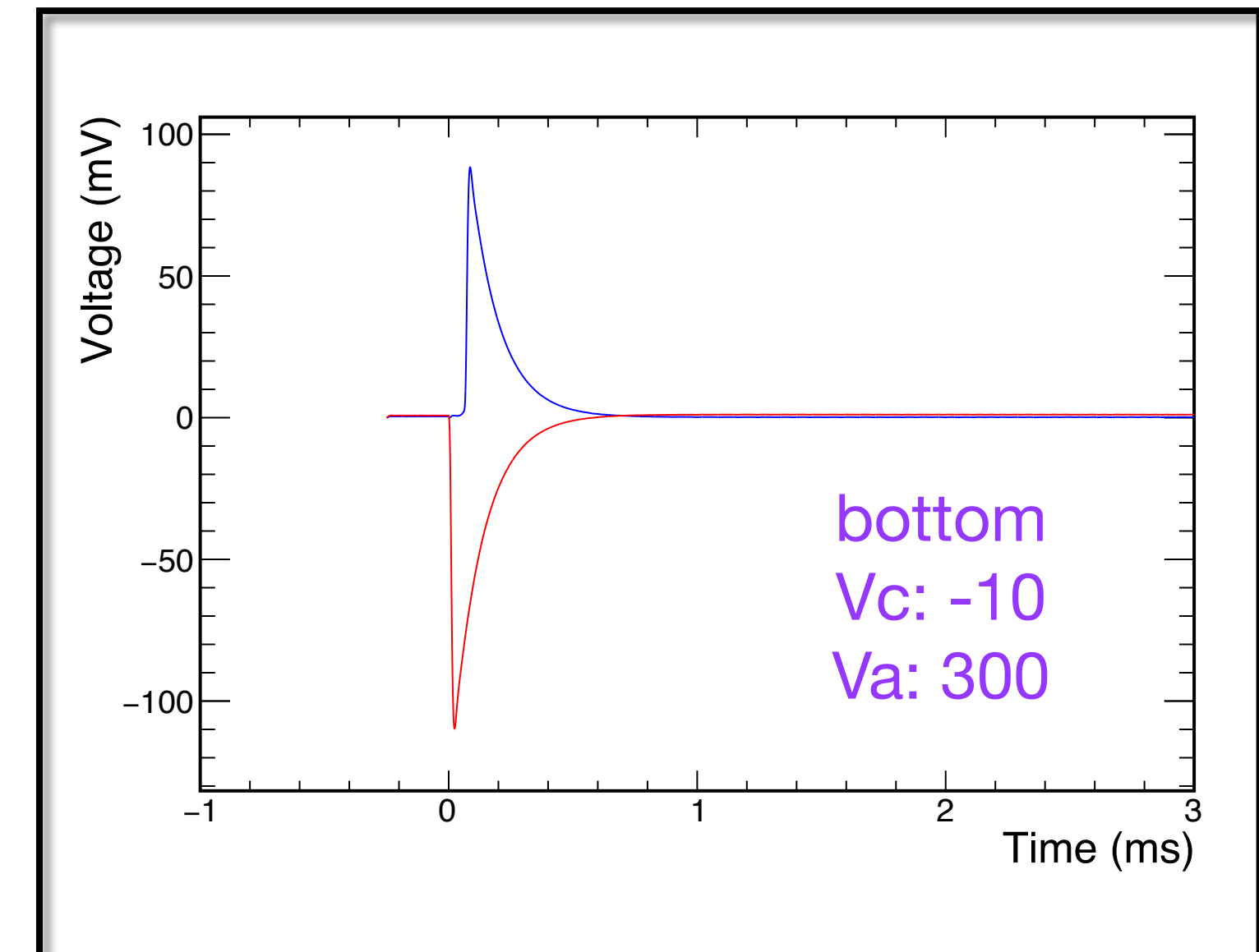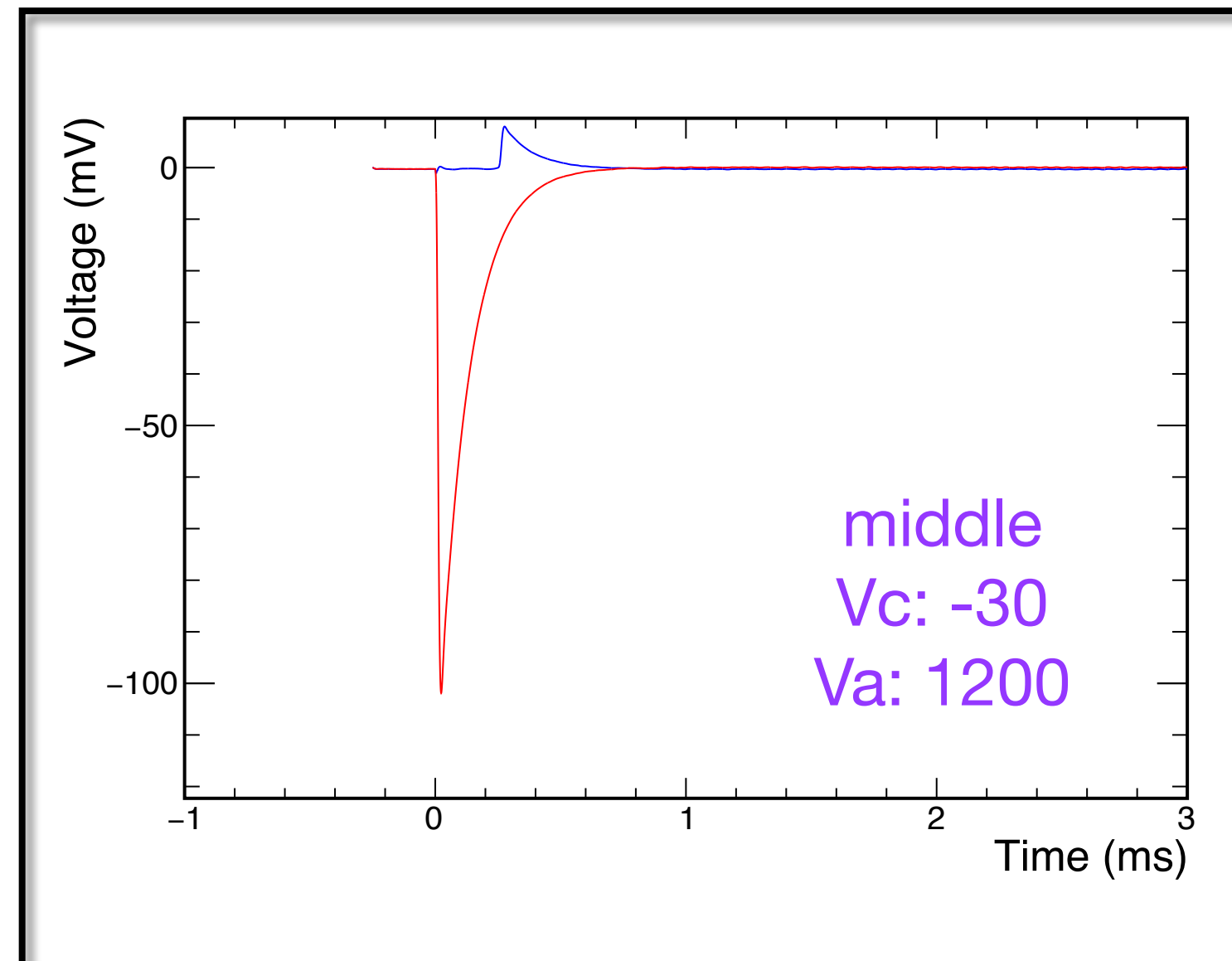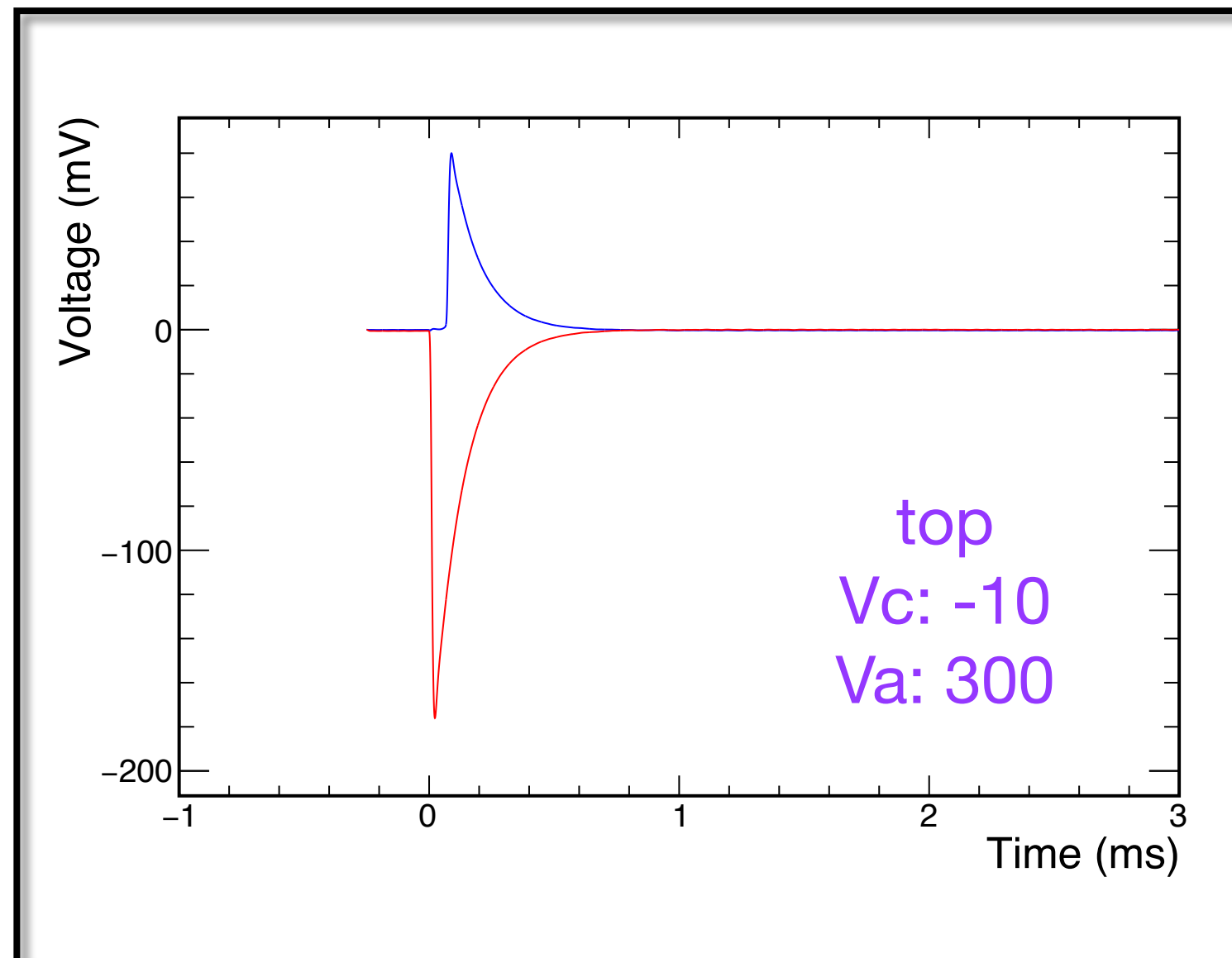 - Keep monitoring the purity of liquid once they're immersed, during filling and recirculation
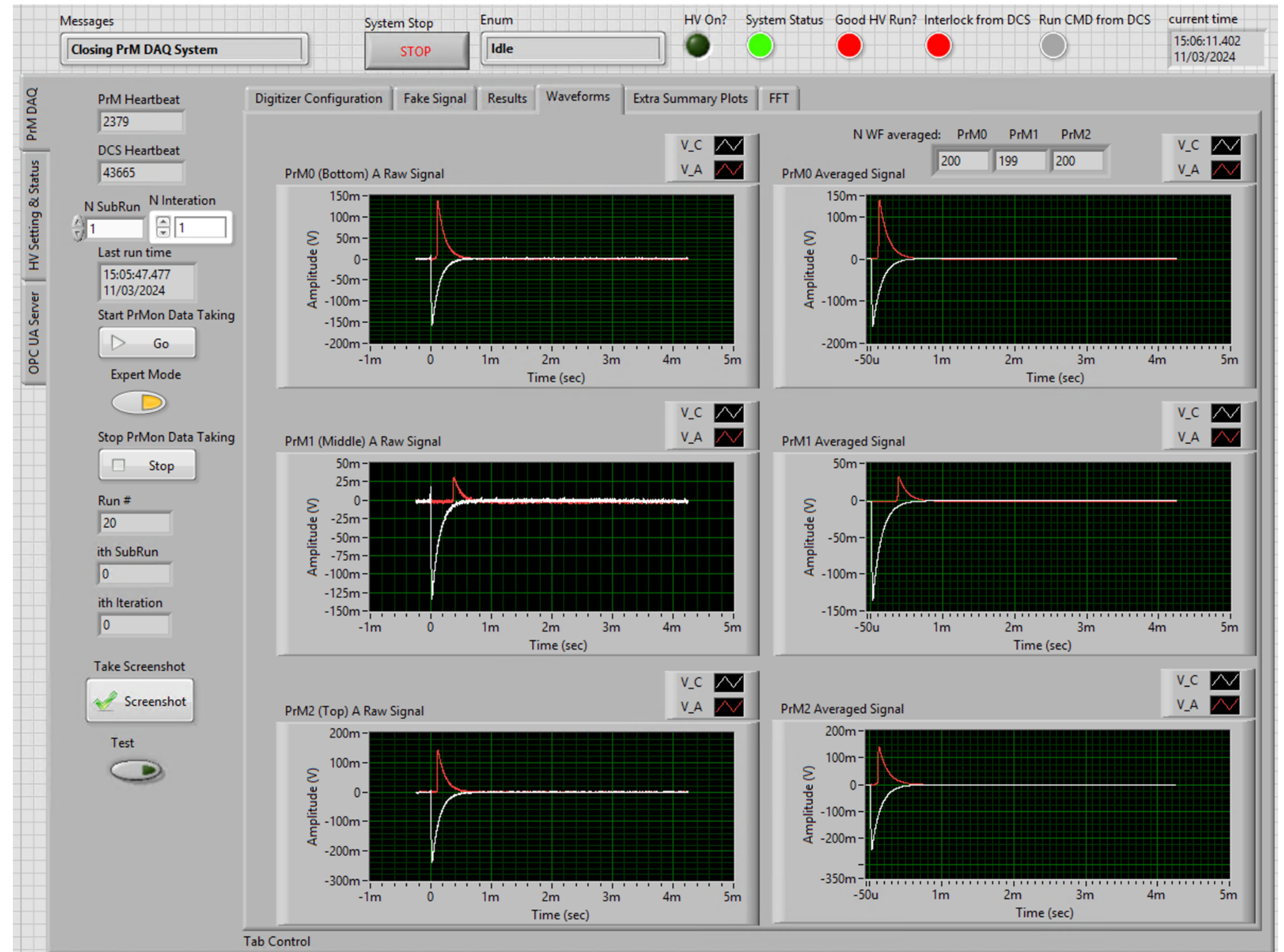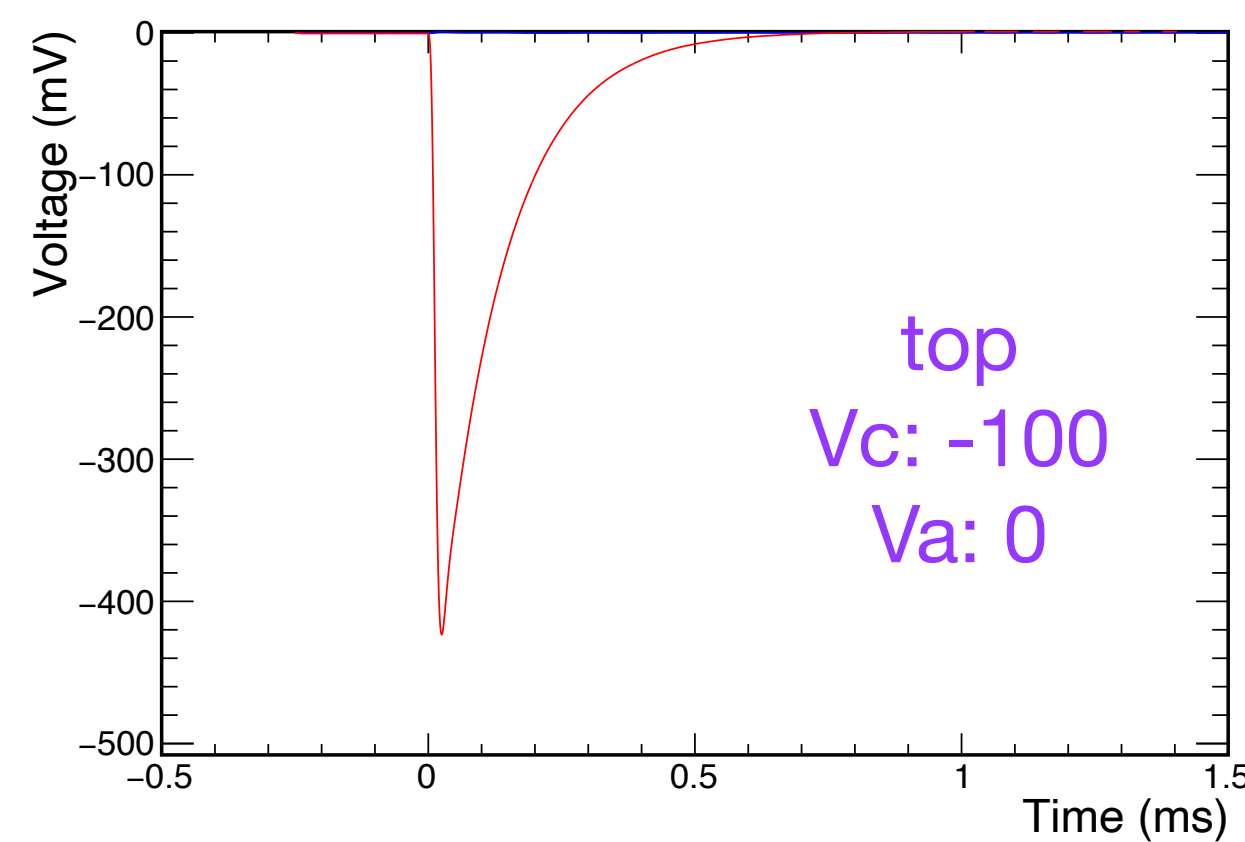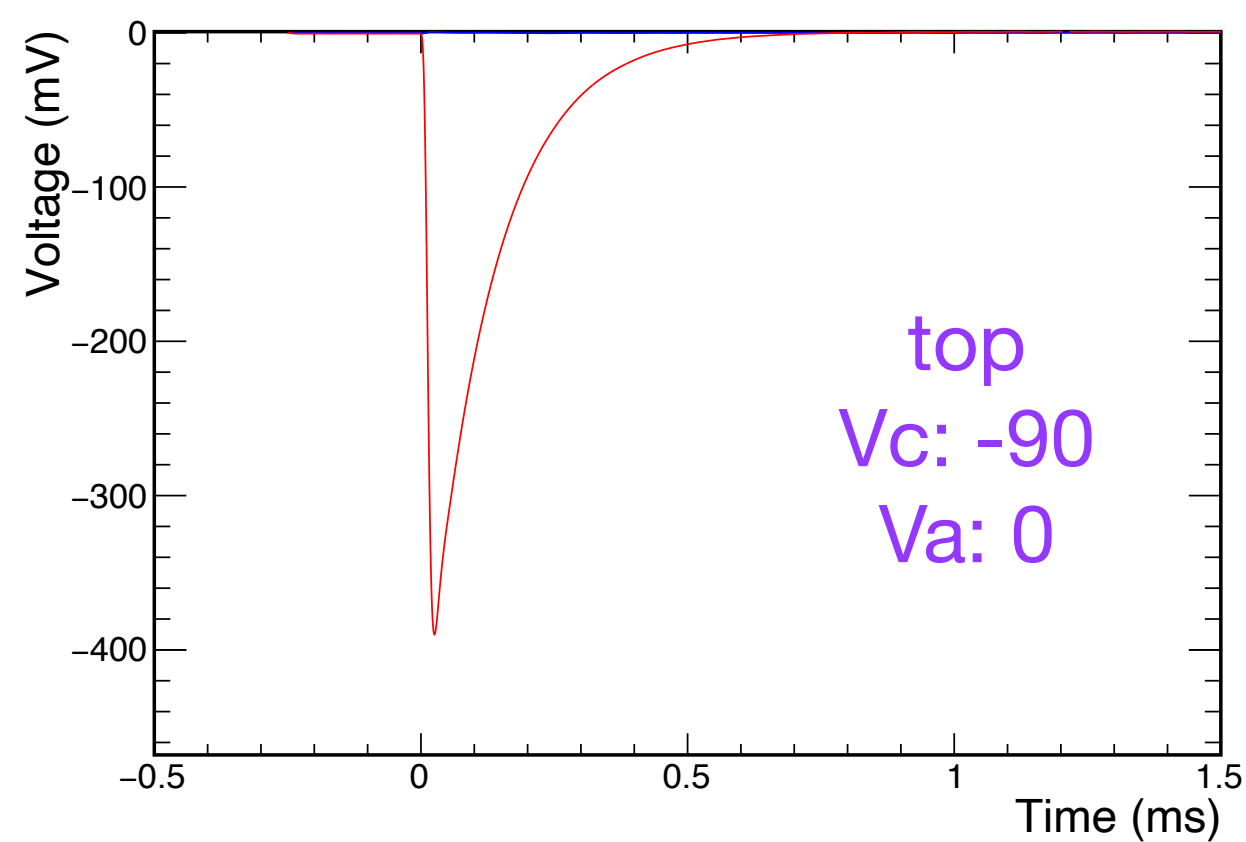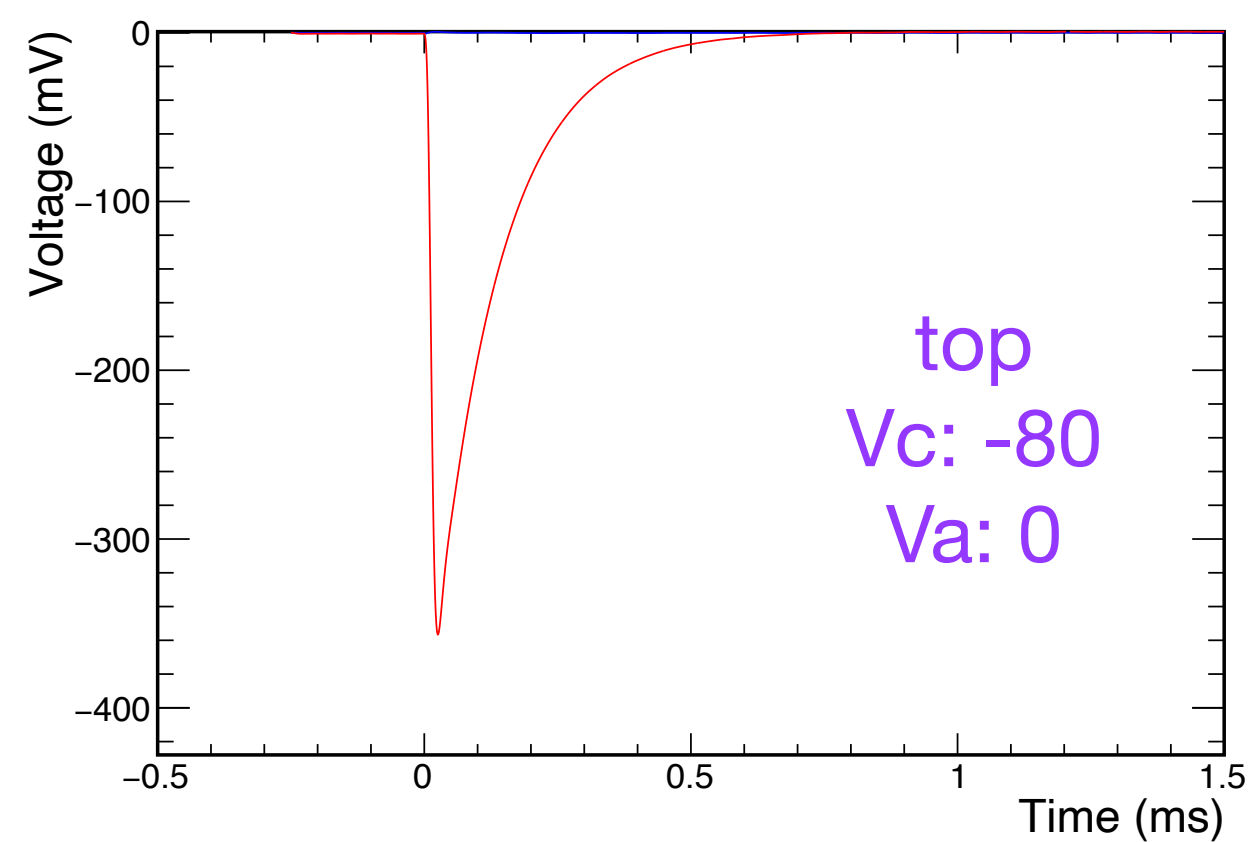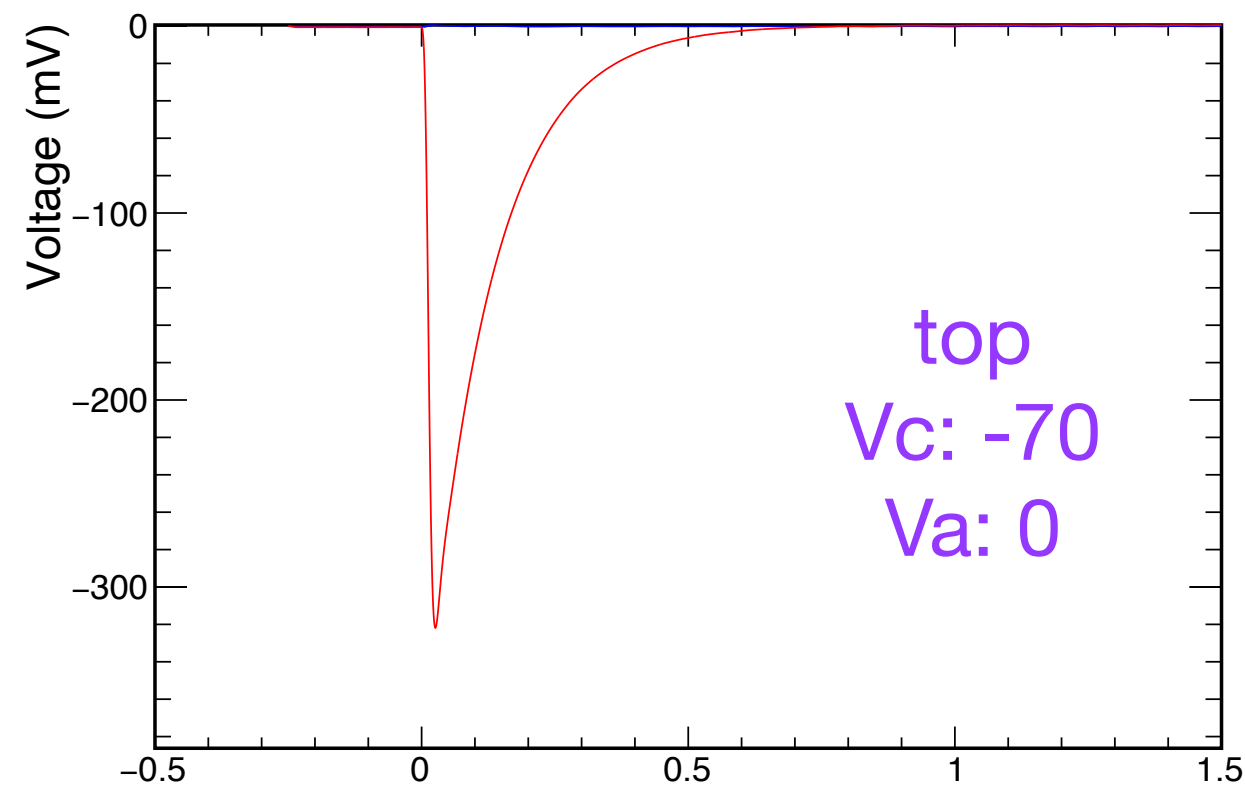
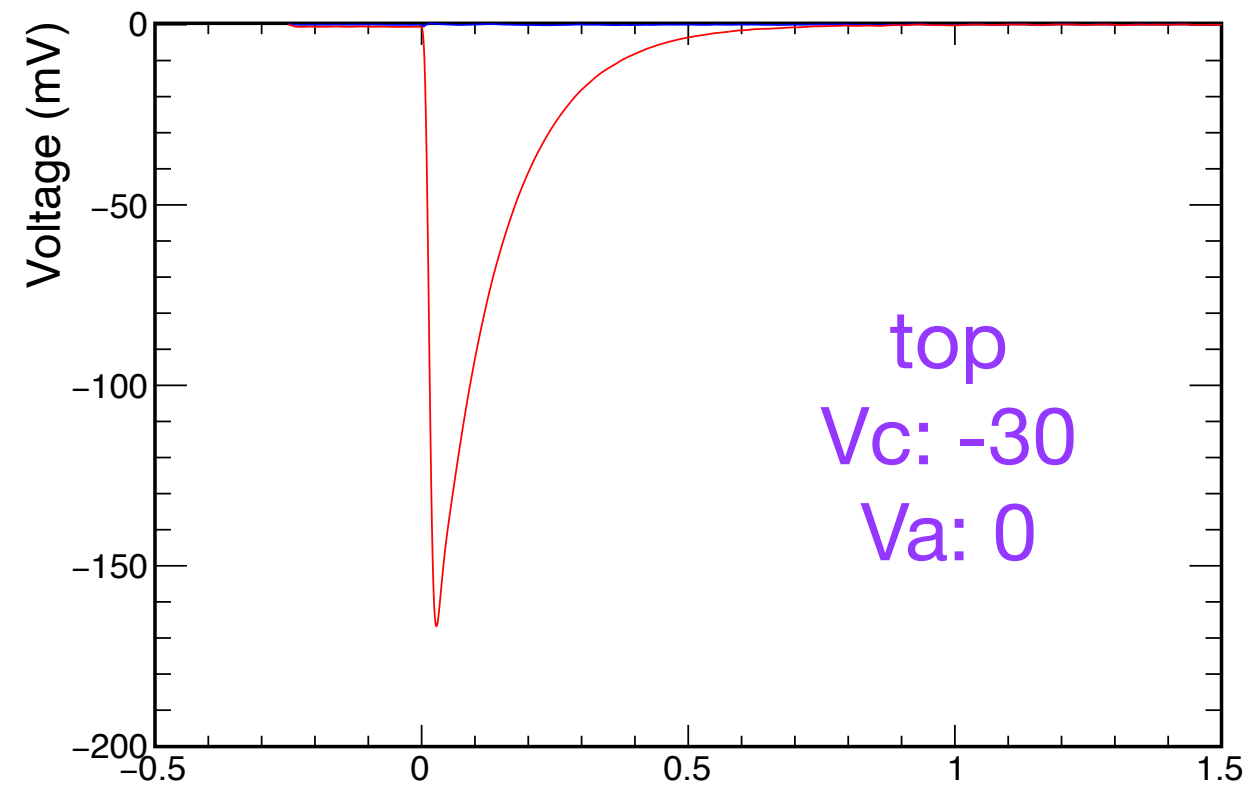# First look in the argon gas before cooldown

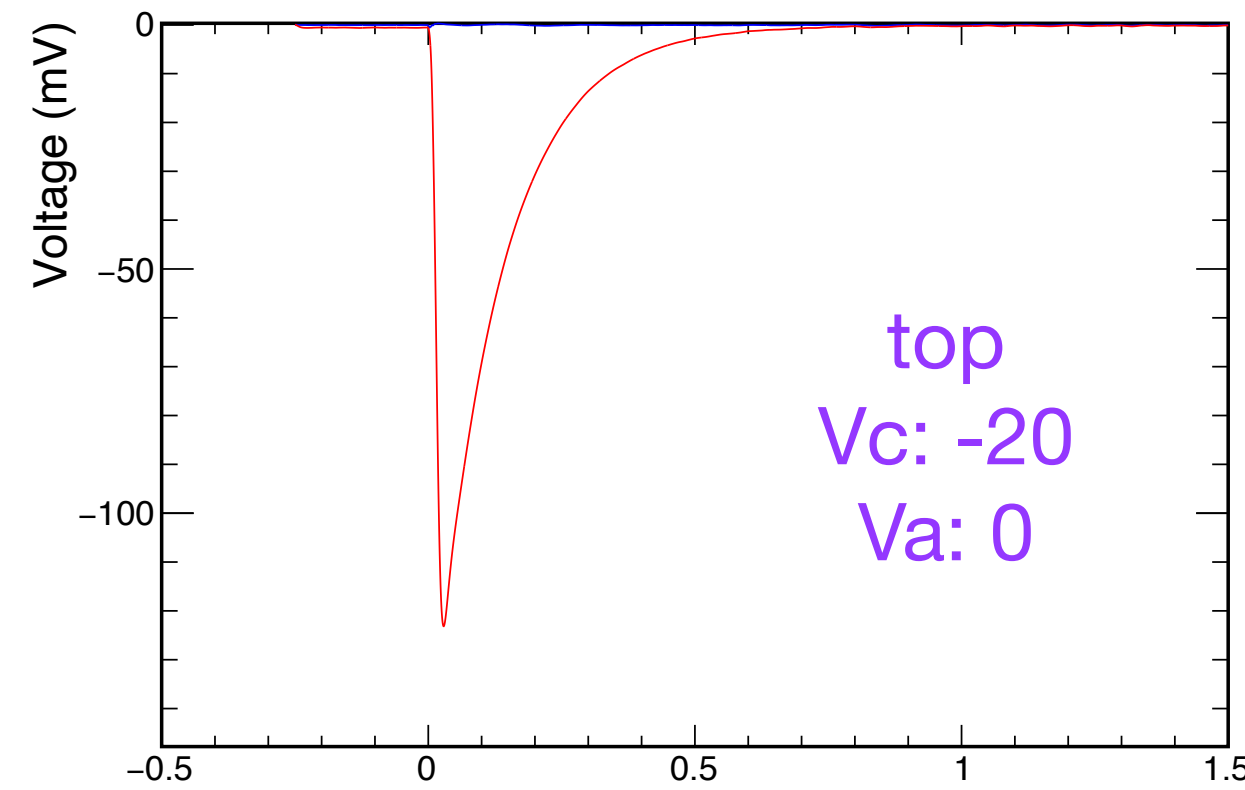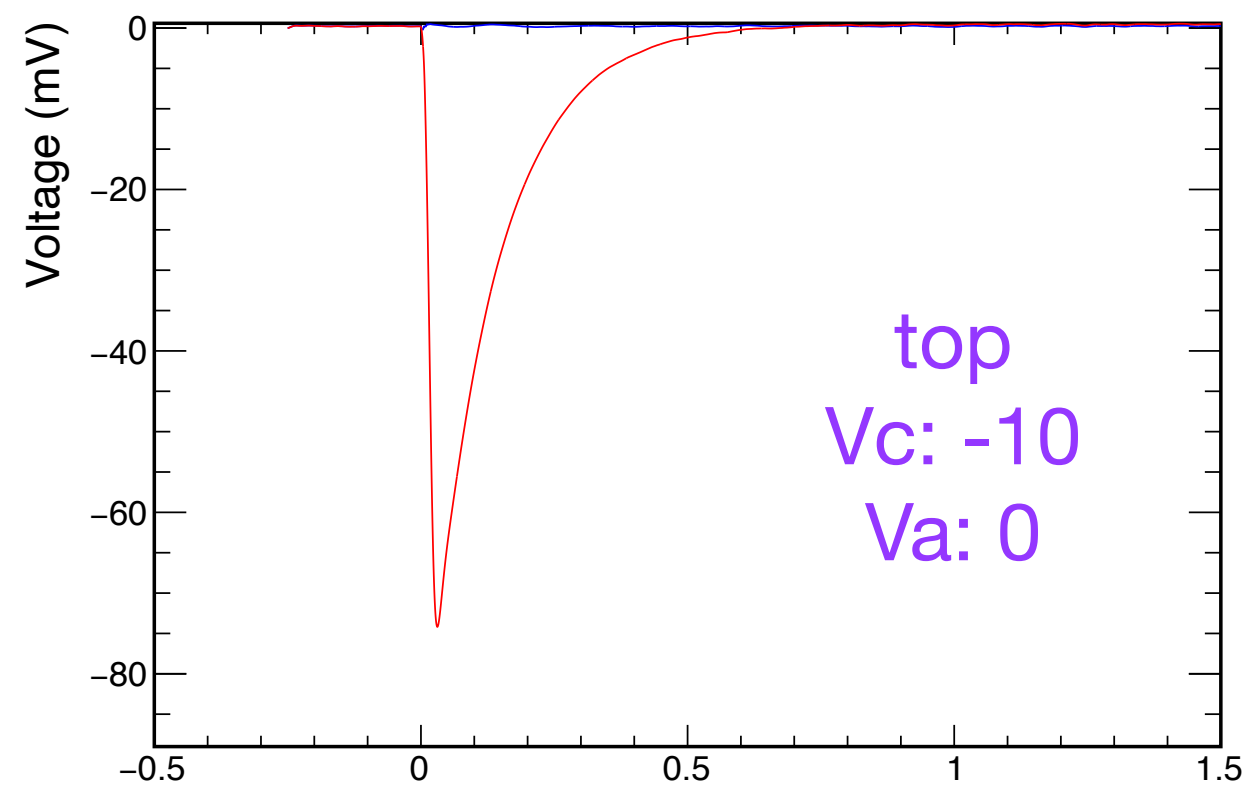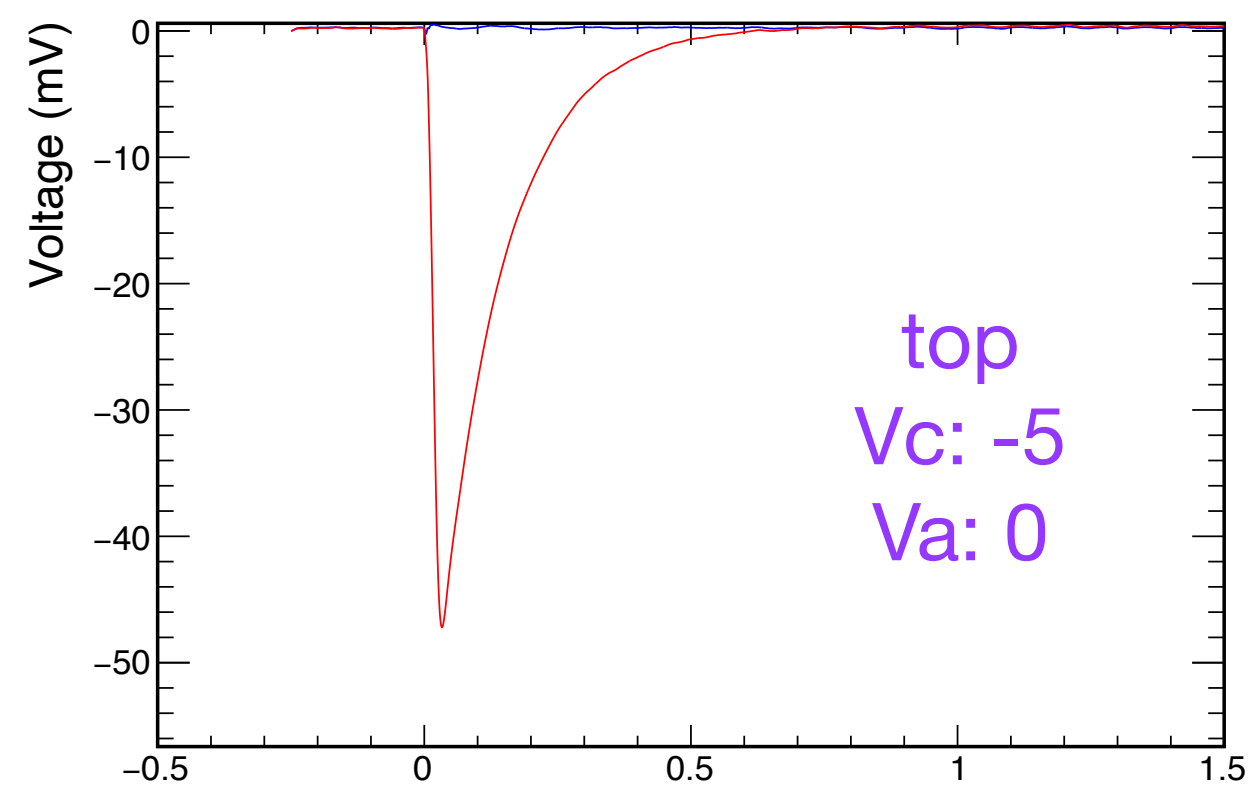3/6/2024 ~9am, Temperature: 304 K

Middle PrM has smaller cathode signal when the voltage setting are the same

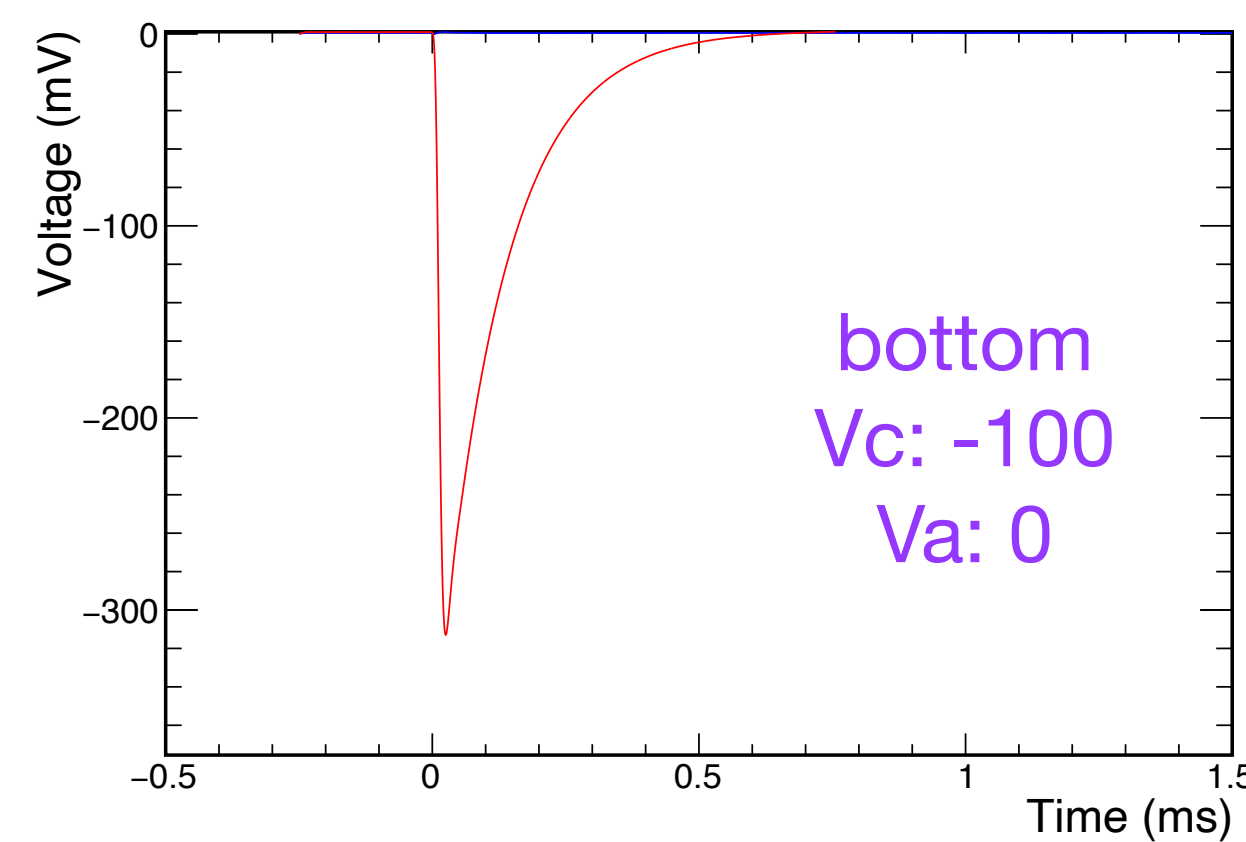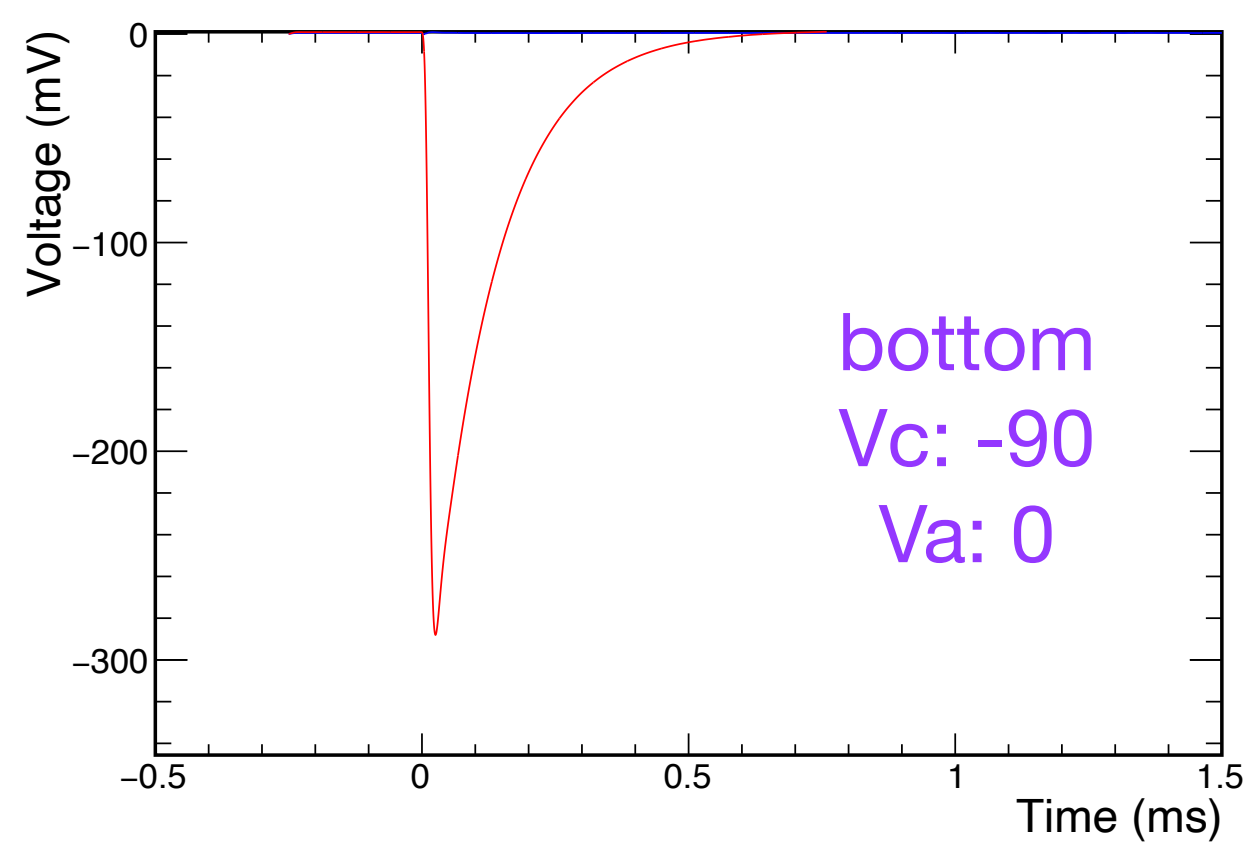**Middle PrM has smaller anode signal because of the long drift distance**
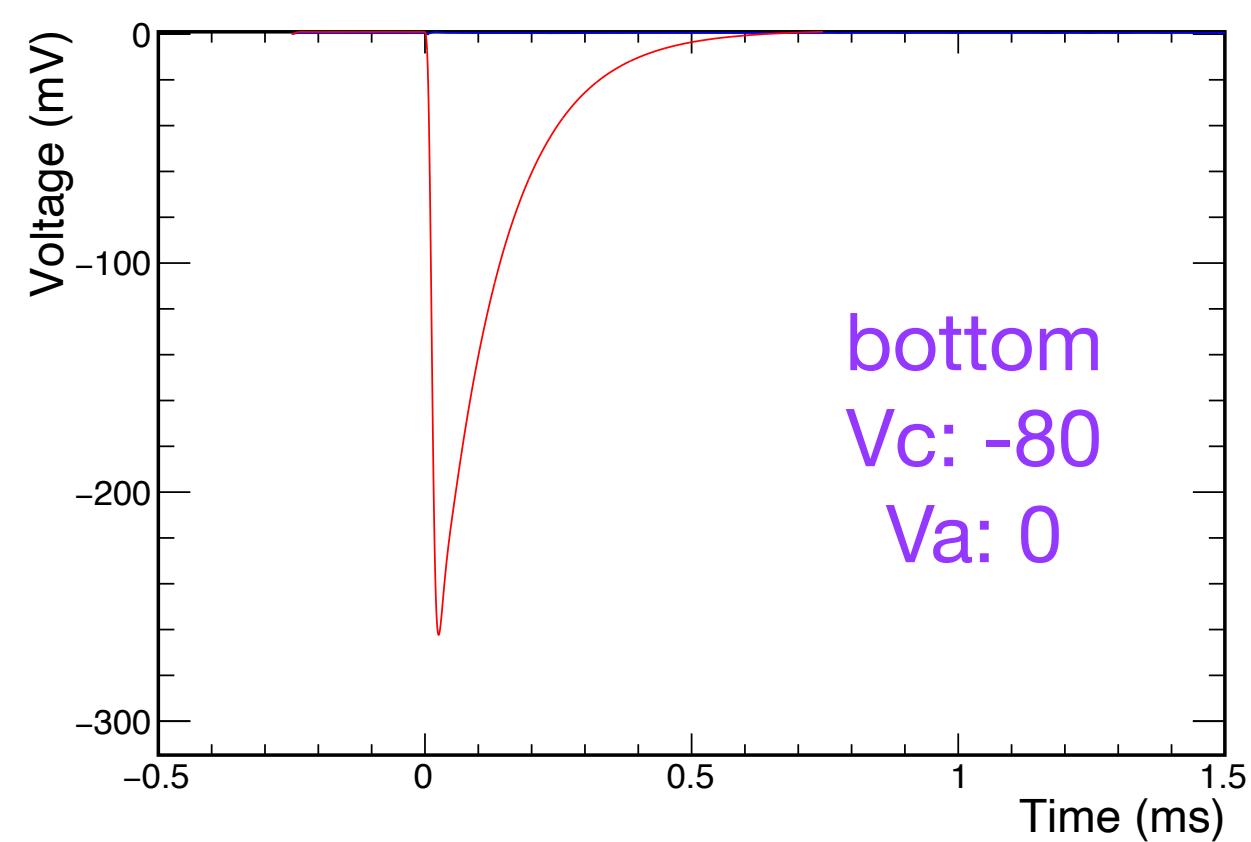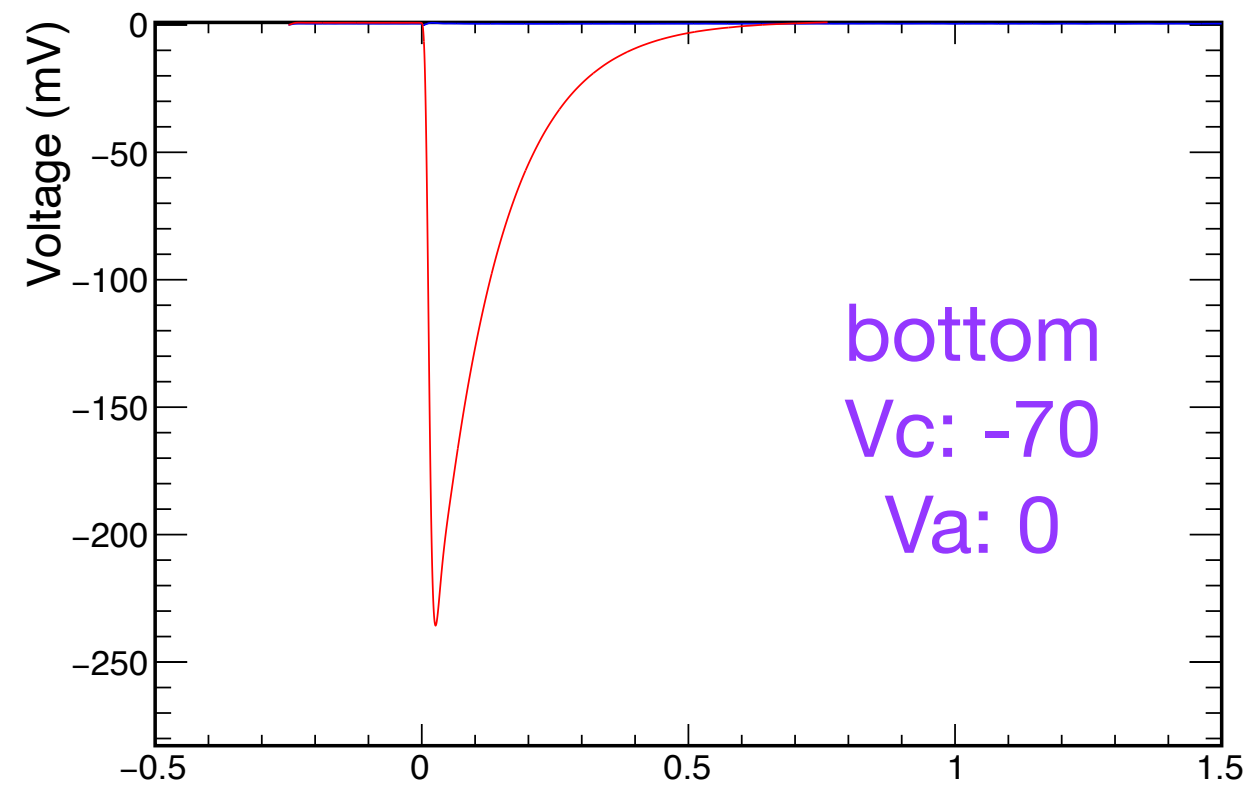
Va = 0, Vary Vc: top PrM (temp. = ~221 K)
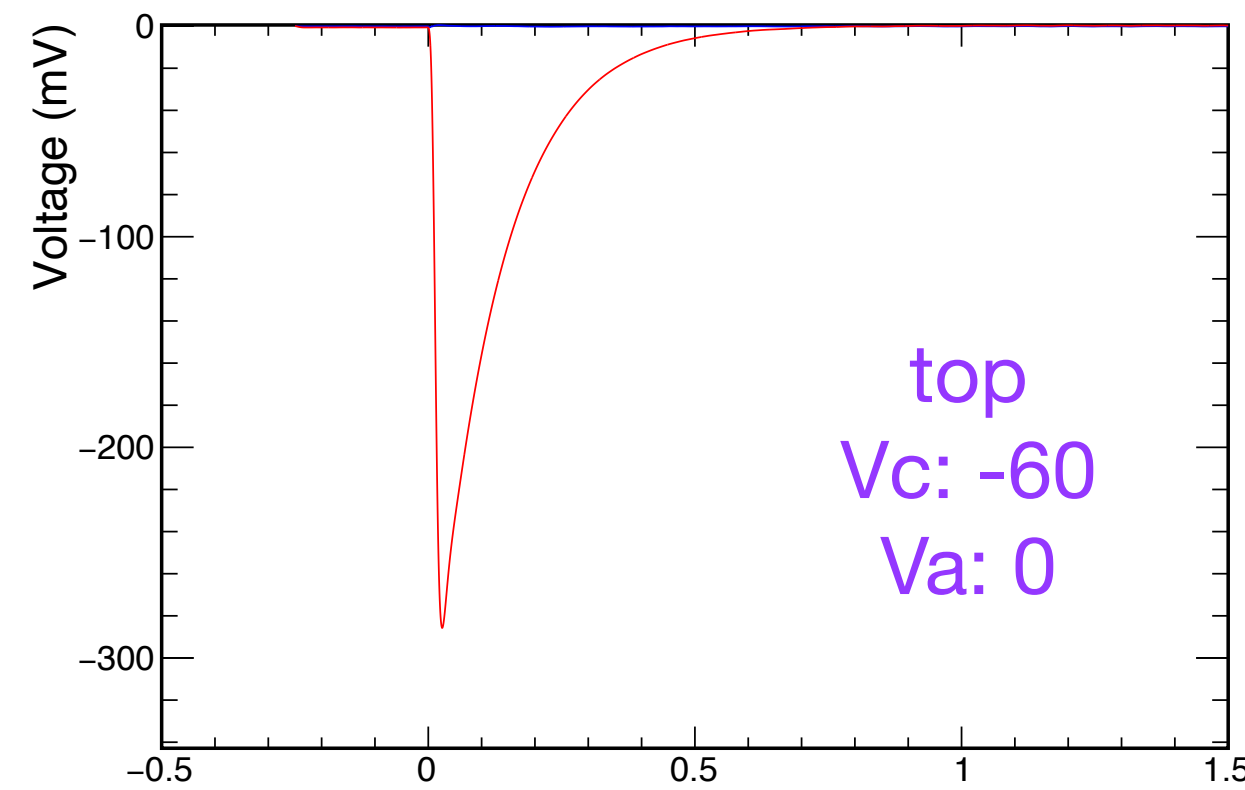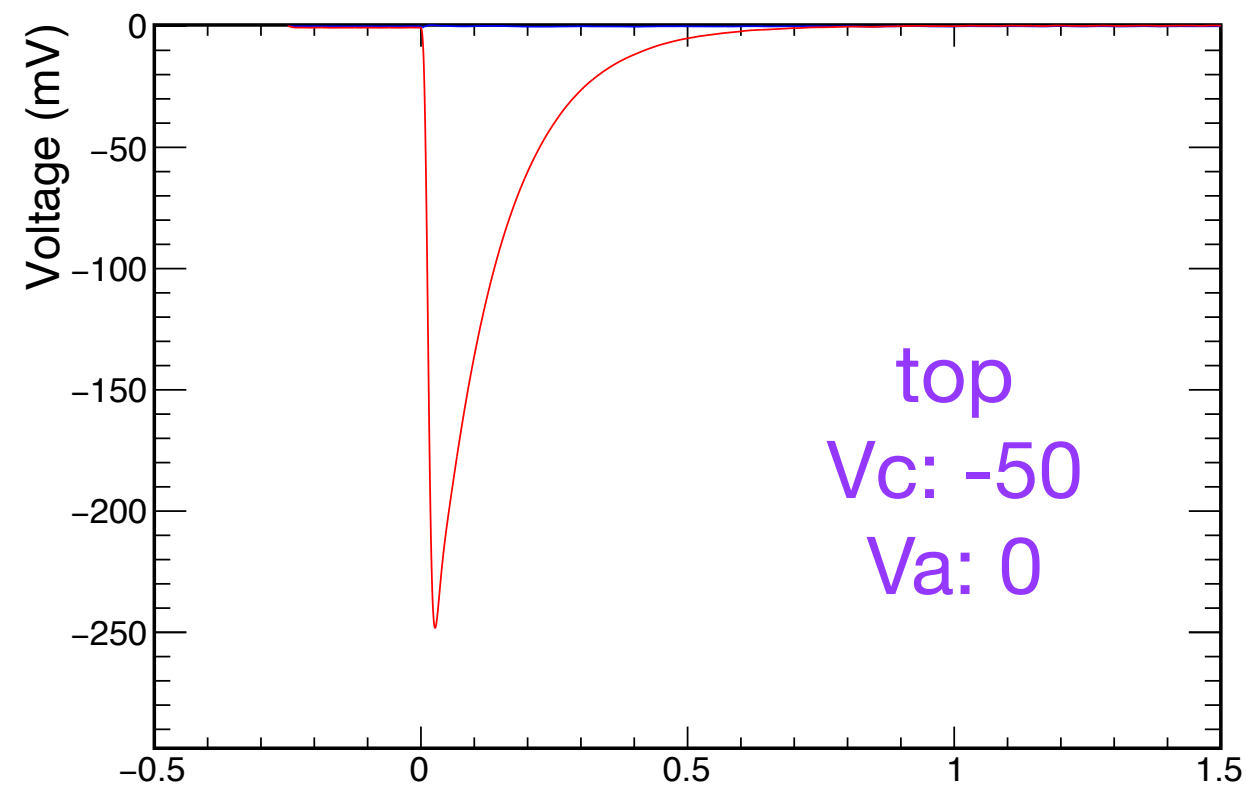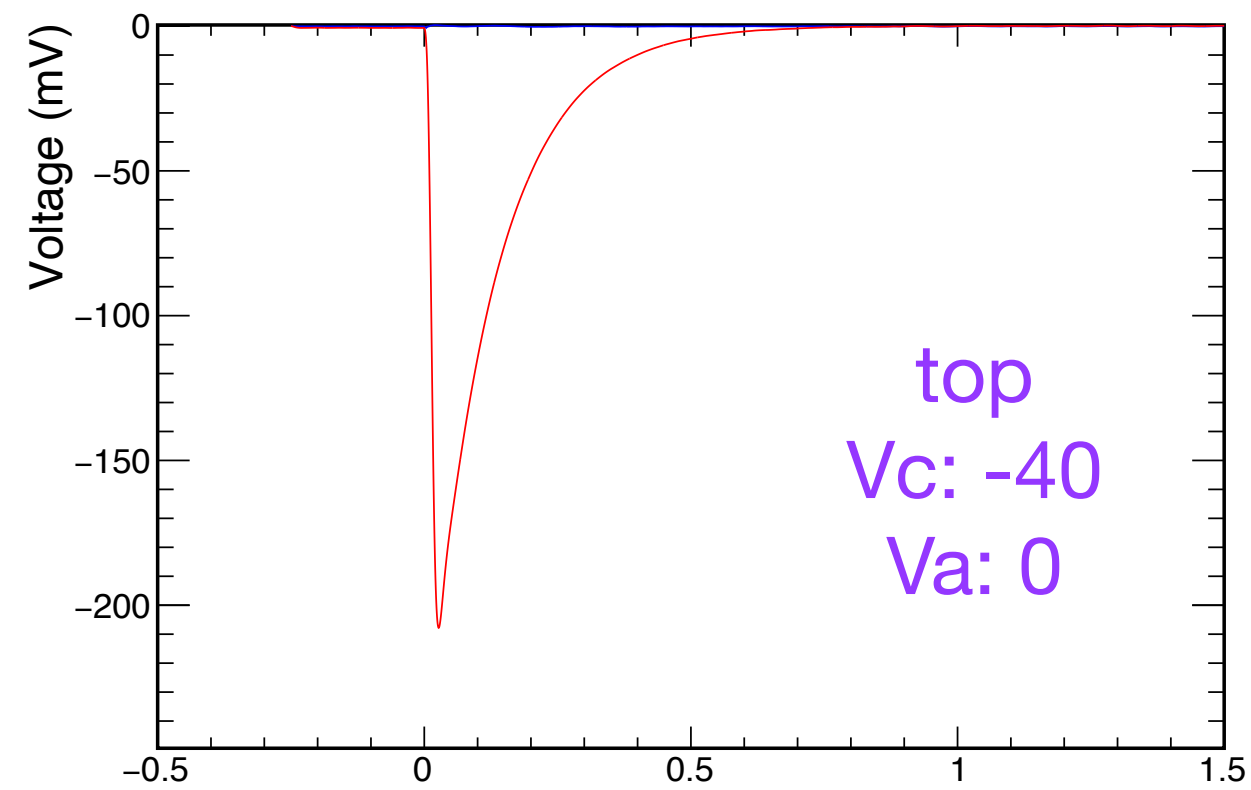
Va = 0, Vary Vc: bottom PrM (temp. = ~207 K)
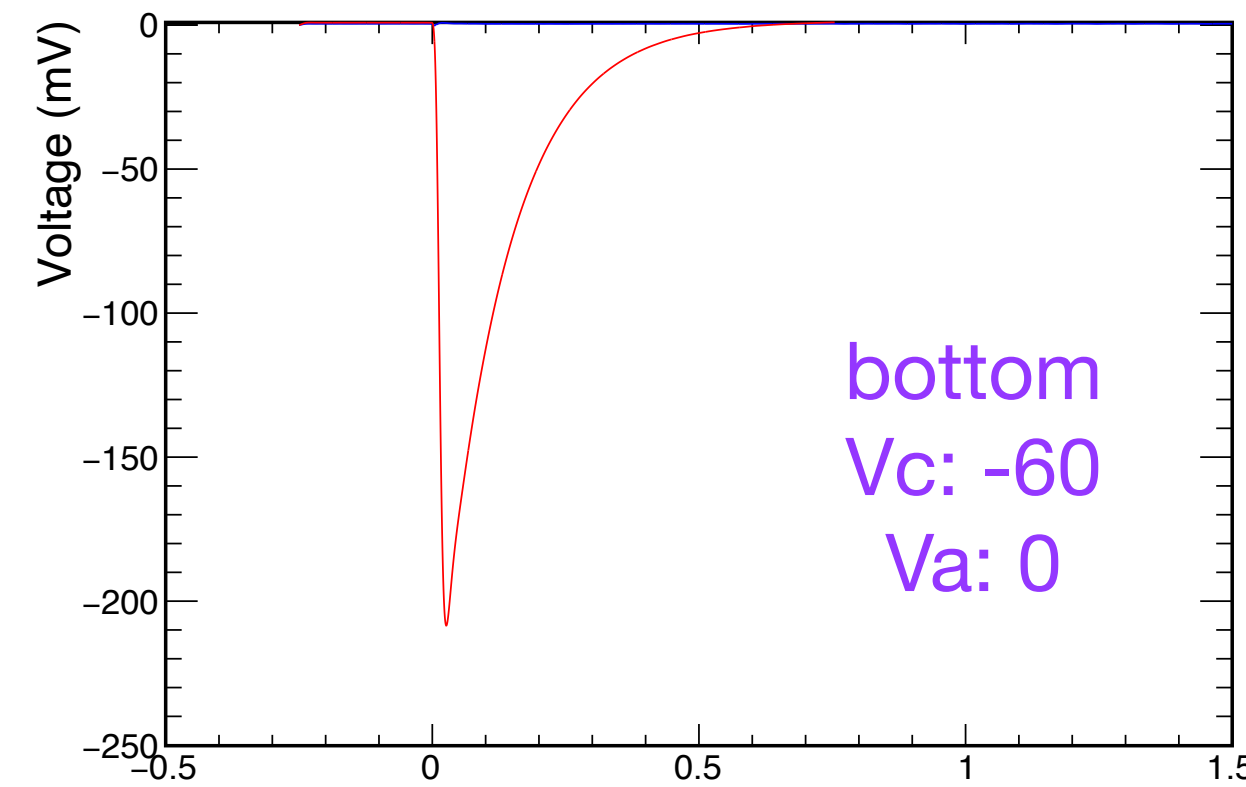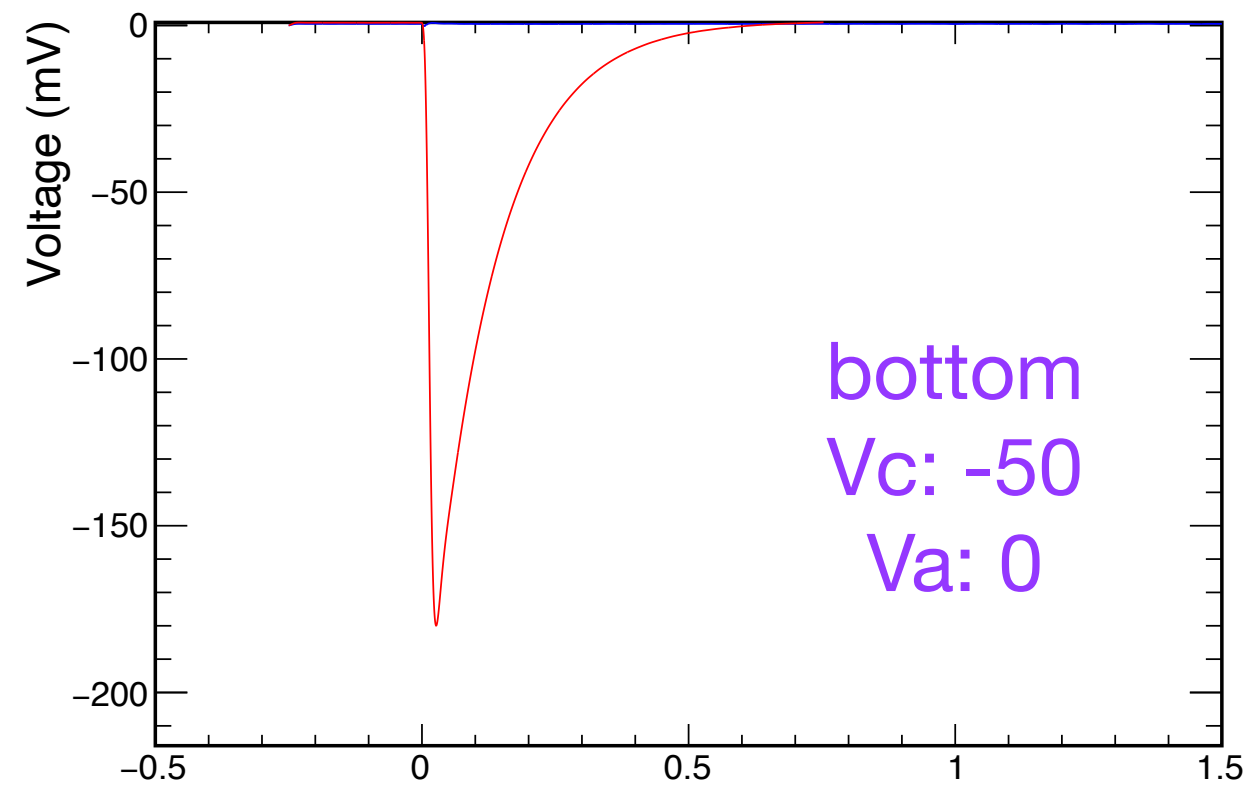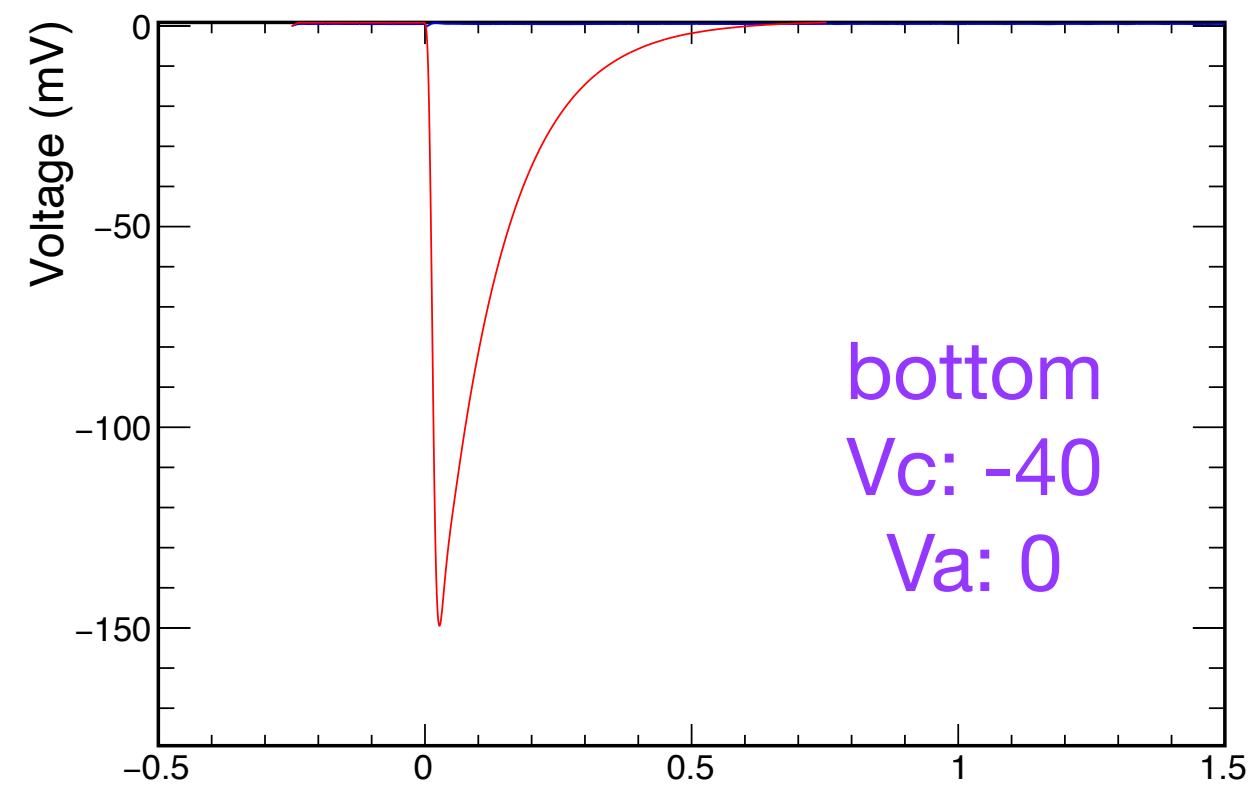
Va = 0, Vary Vc: middle PrM (temp. = ~213 K)
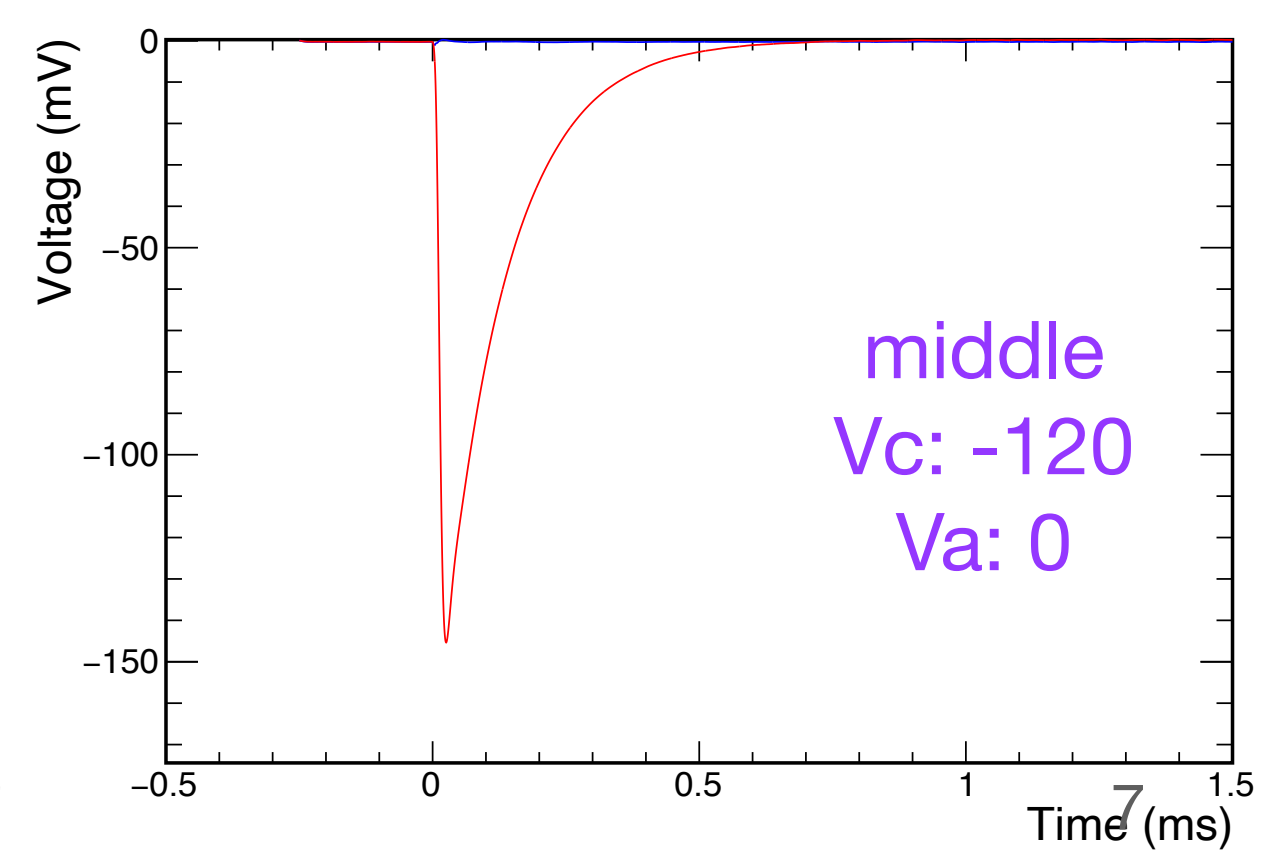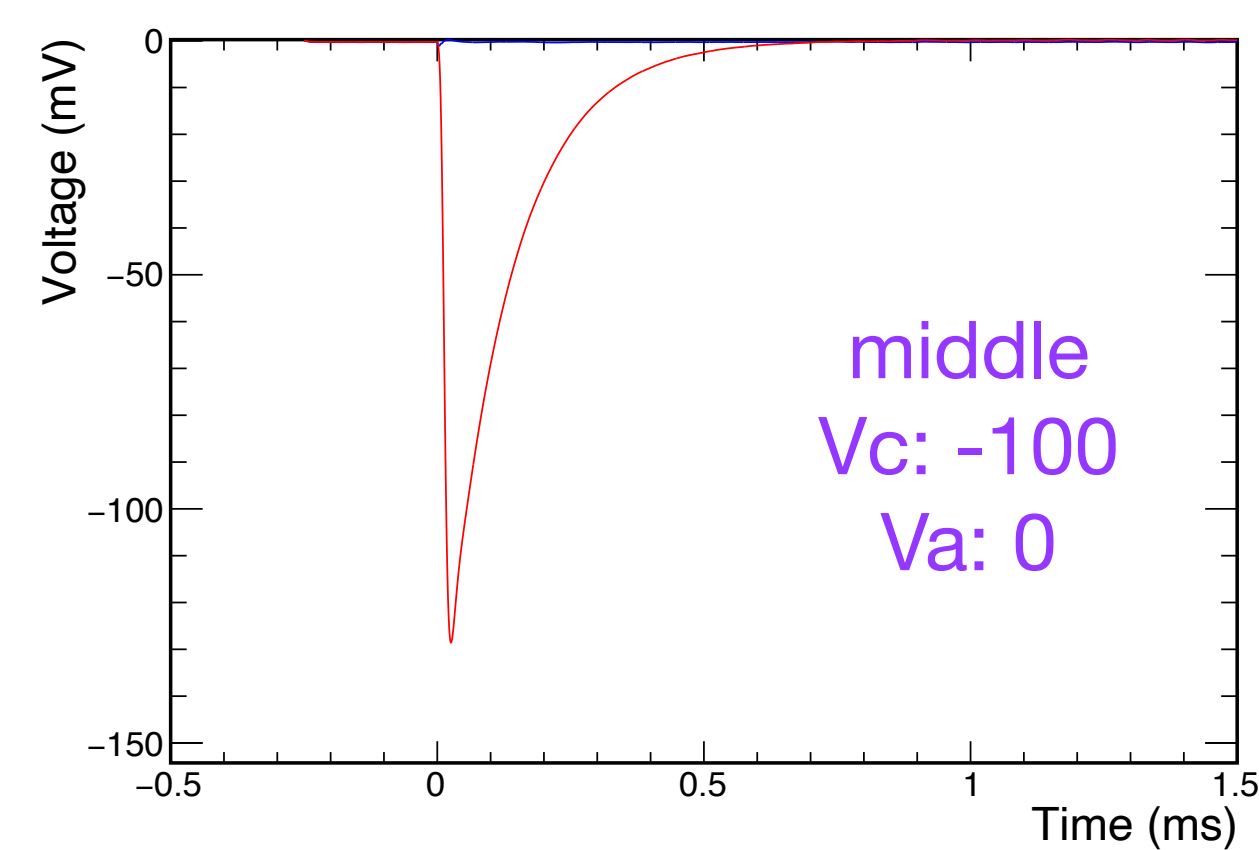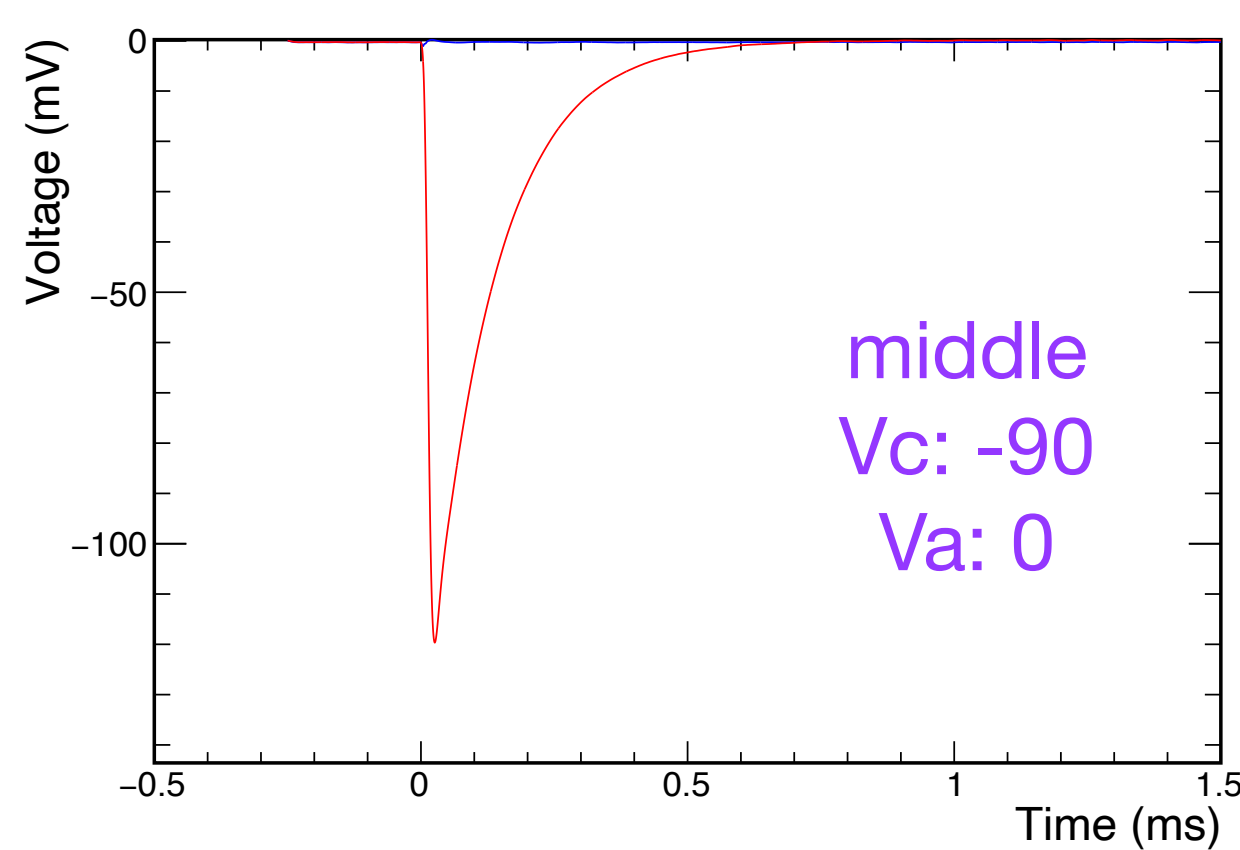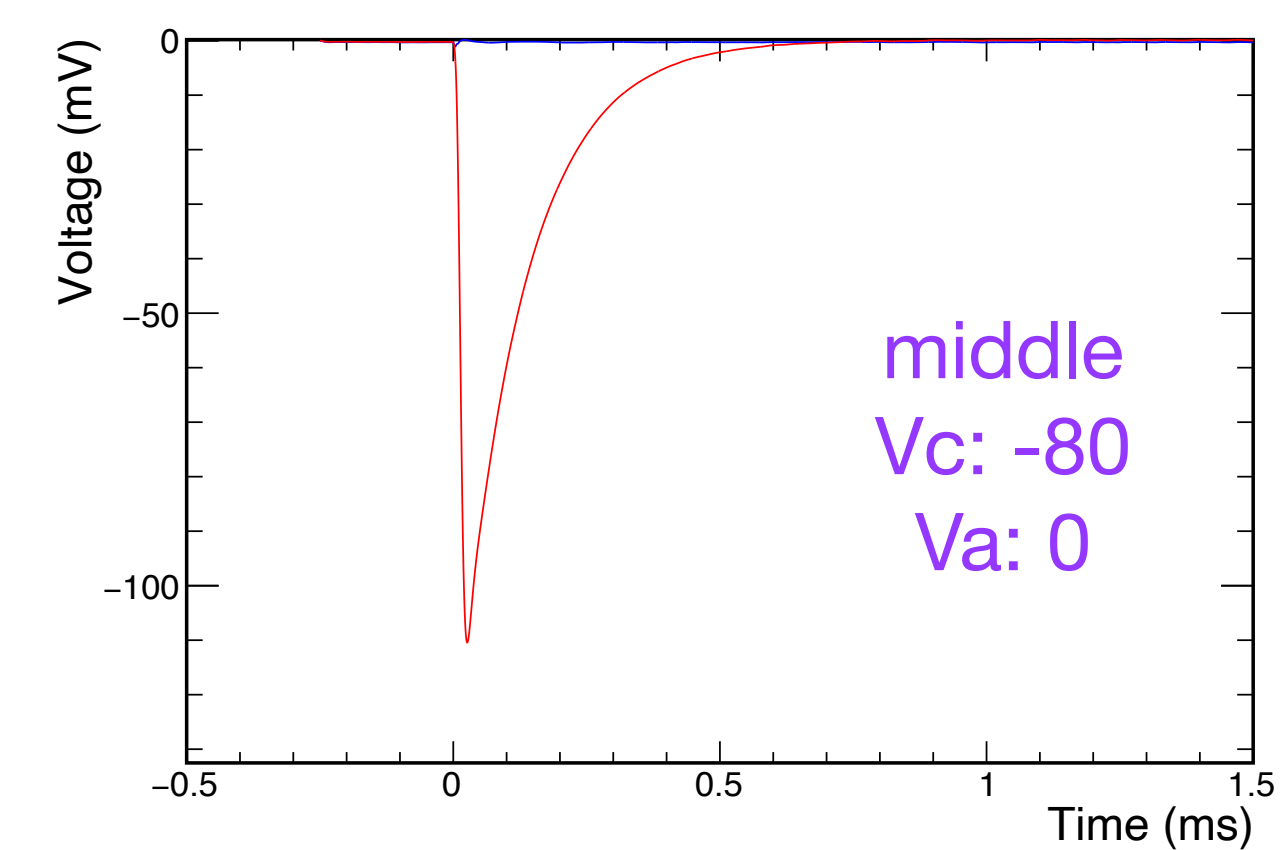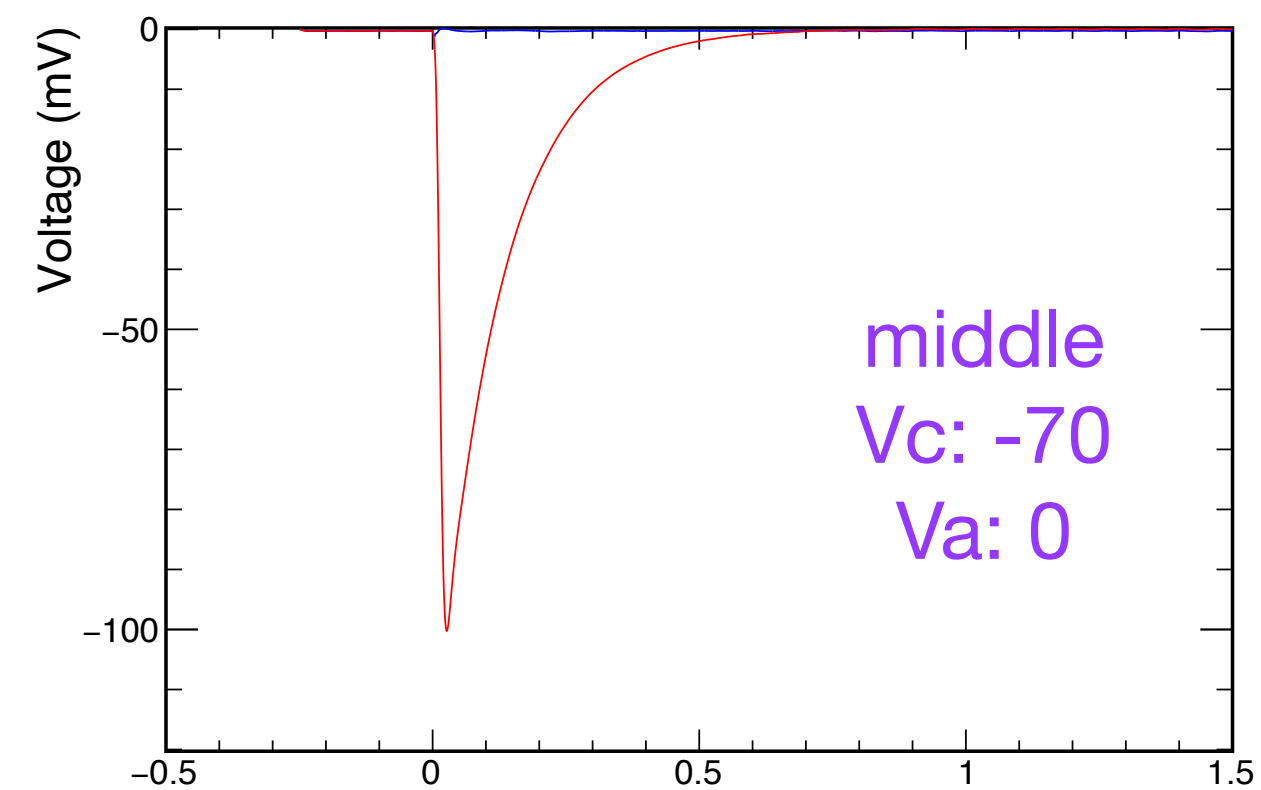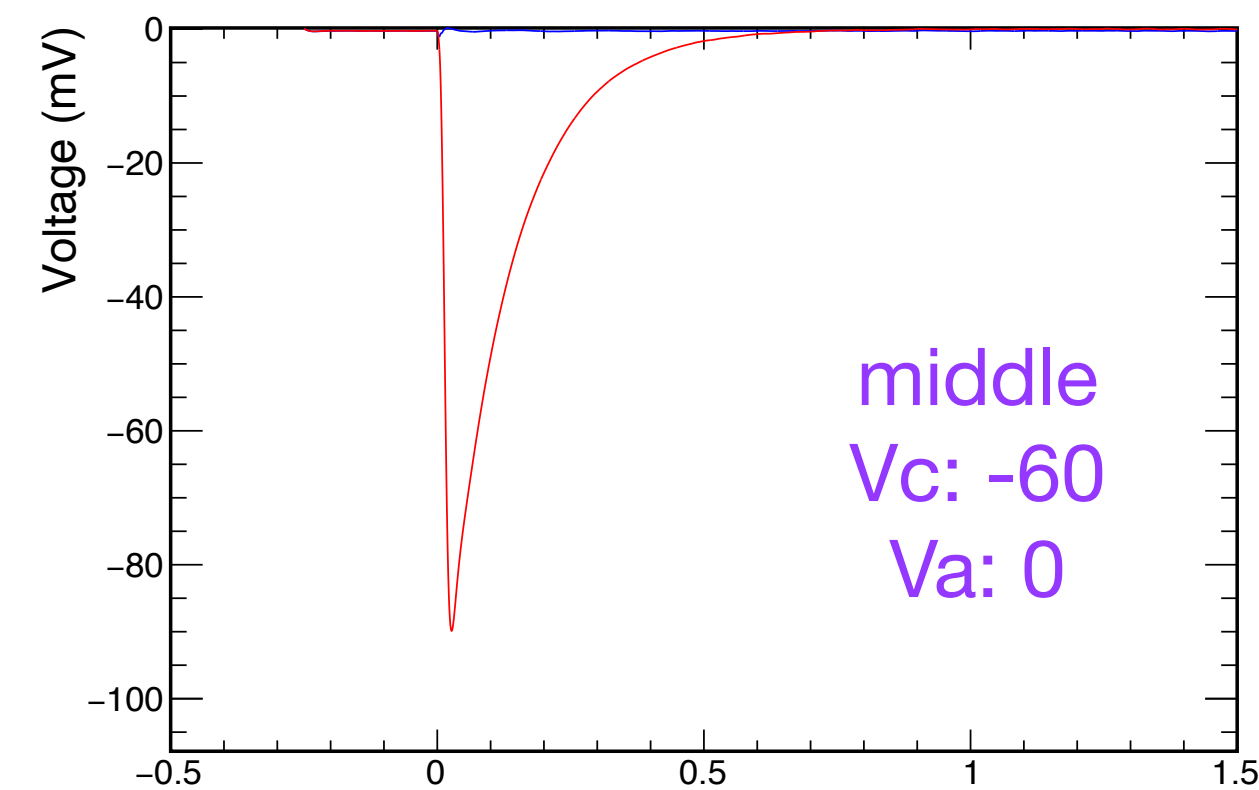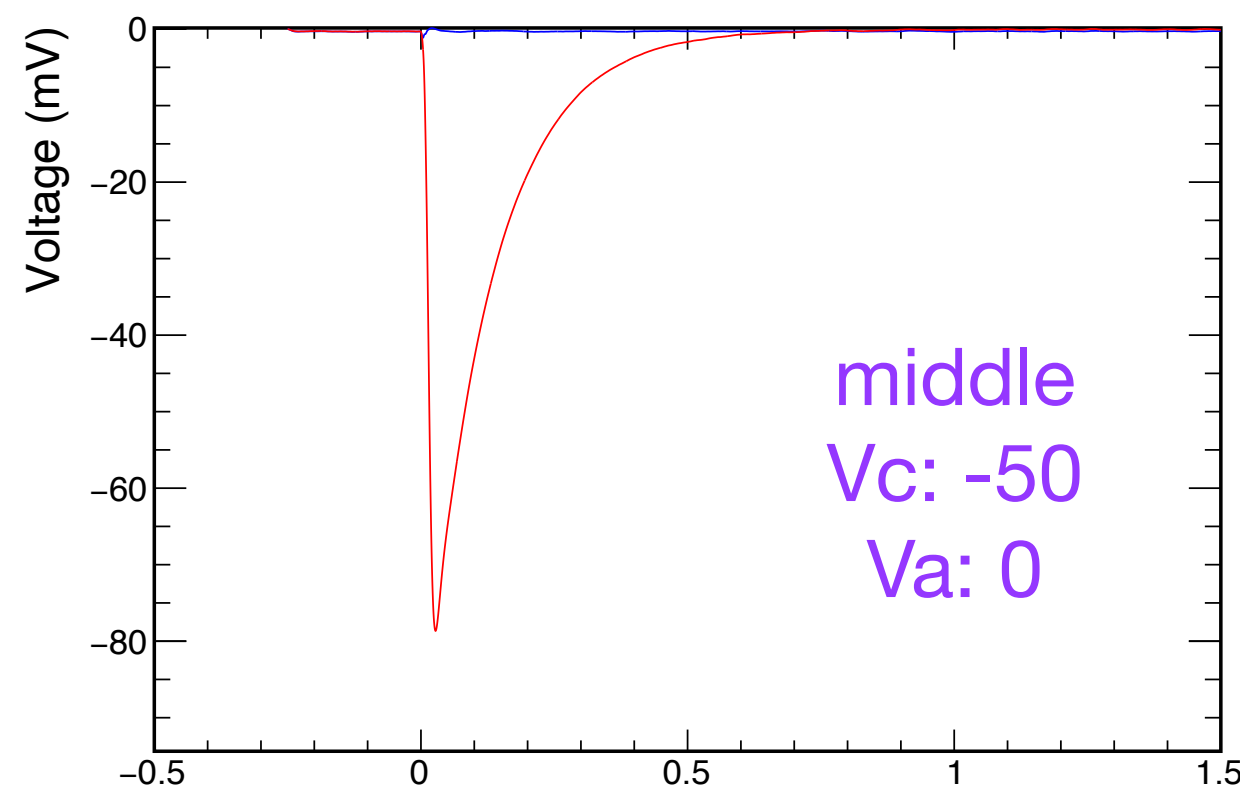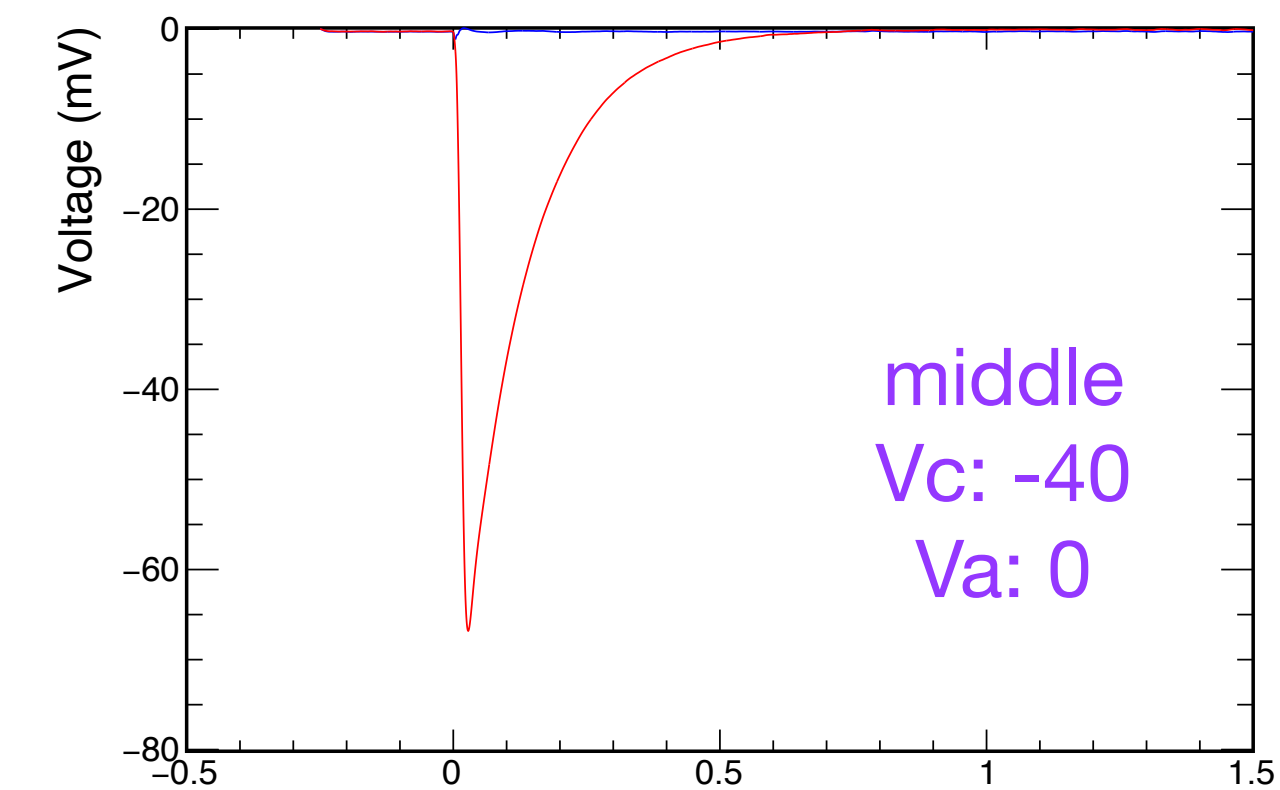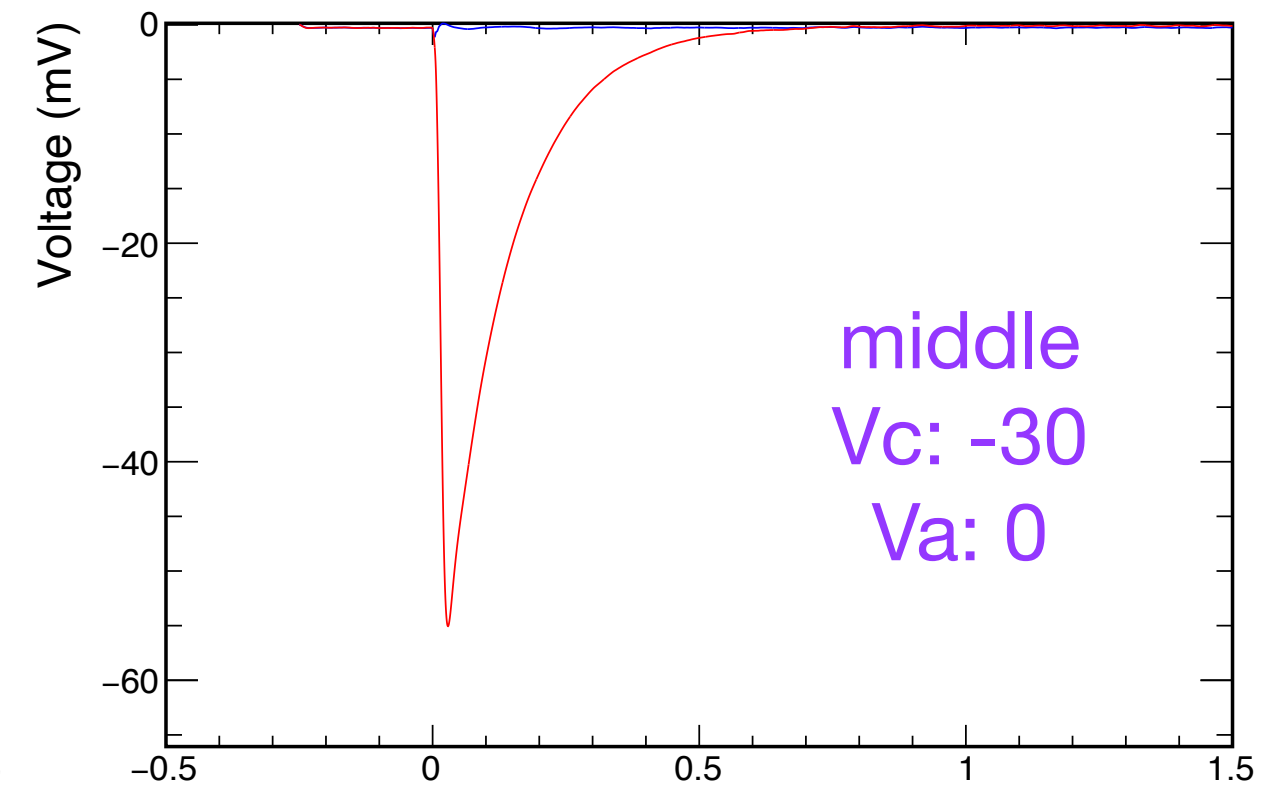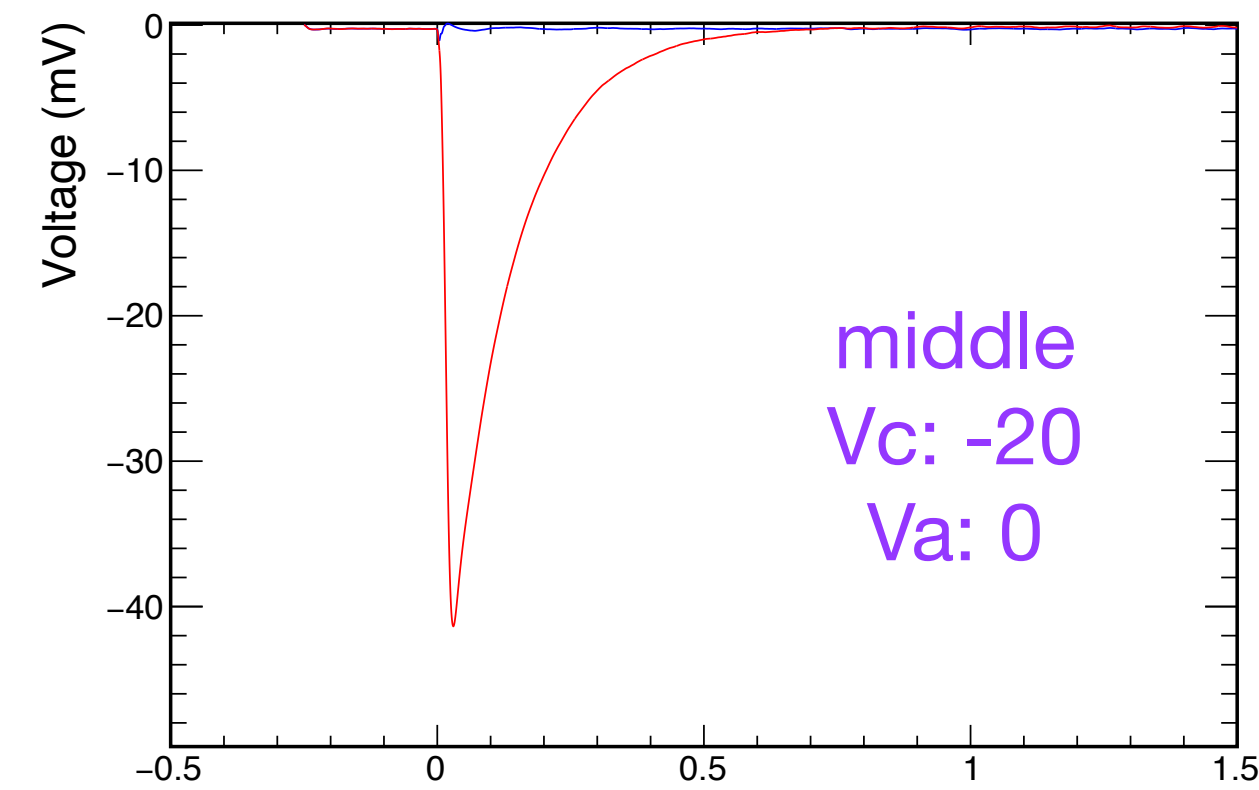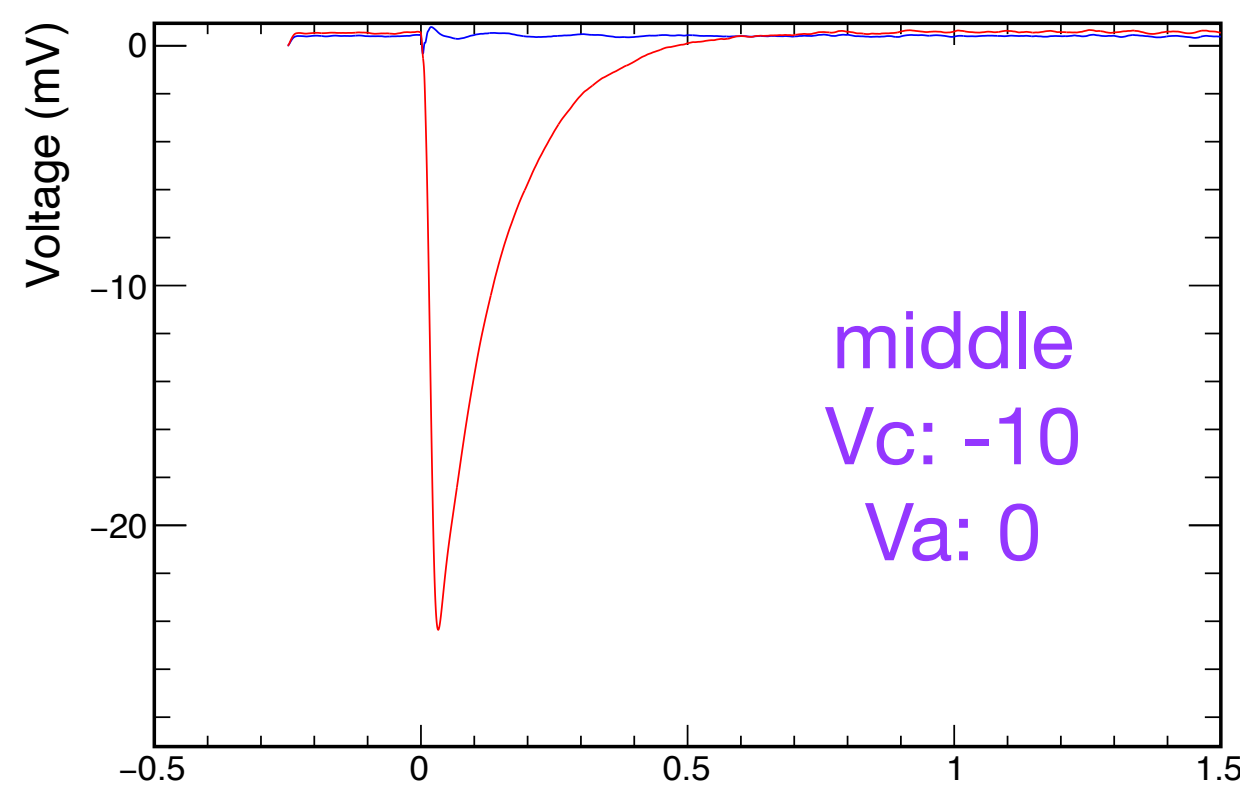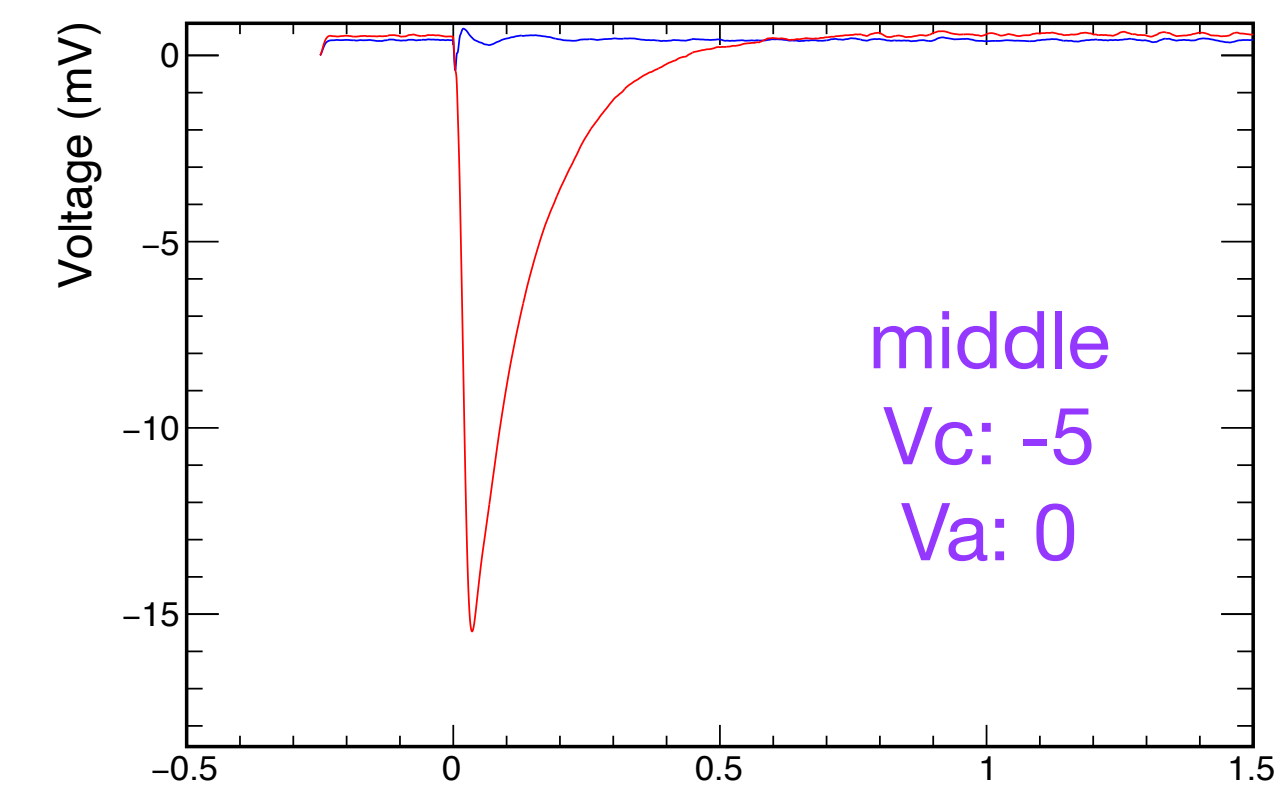
Va = 0, Vary Vc: middle PrM (temp. = ~213 K)
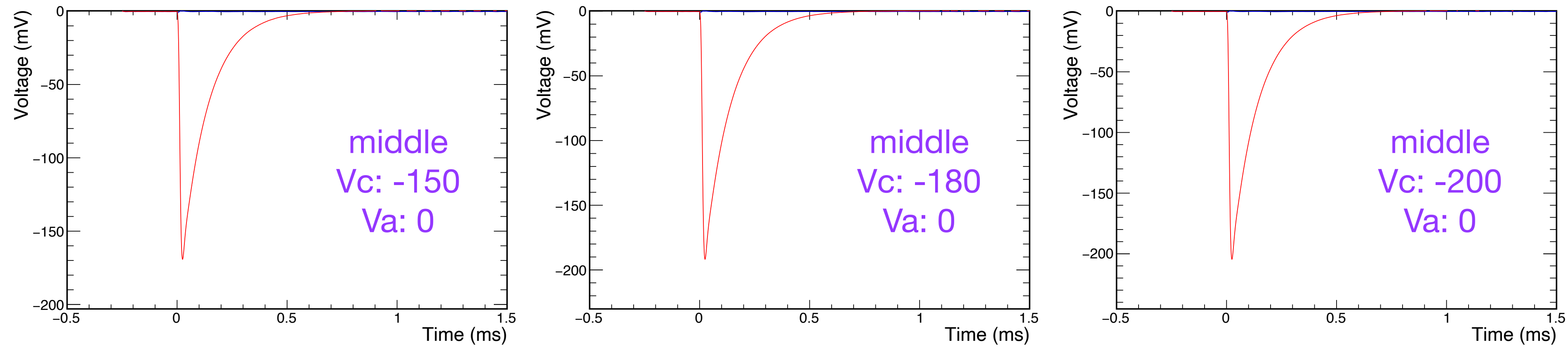
Middle PrM has smaller signal strength when the voltage setting for all PrMs are the same

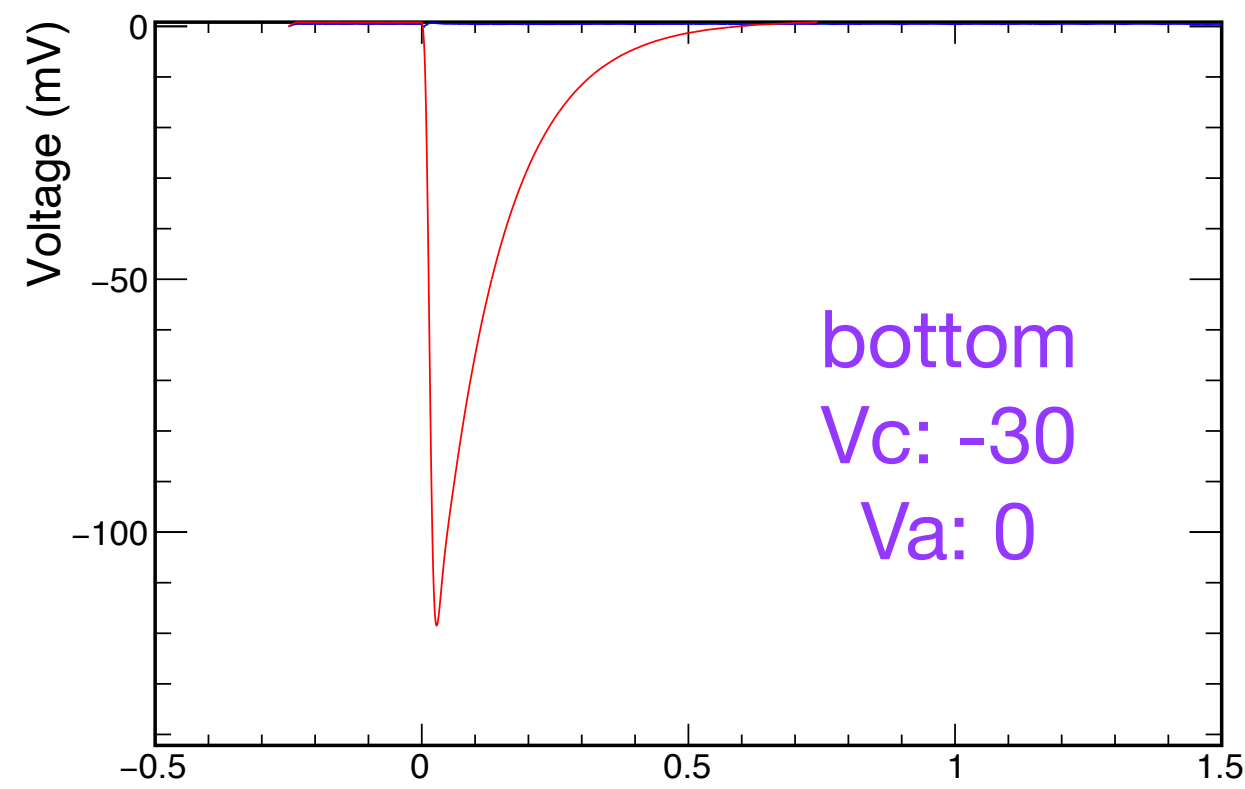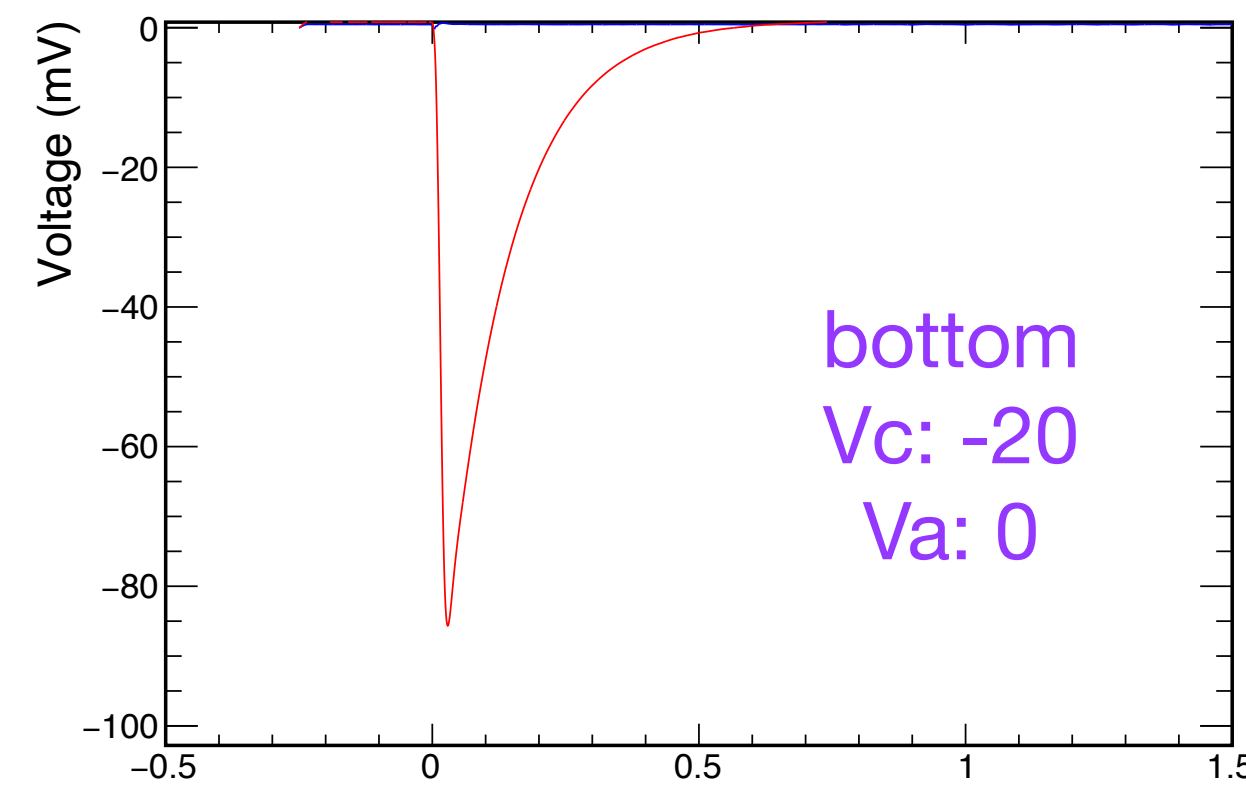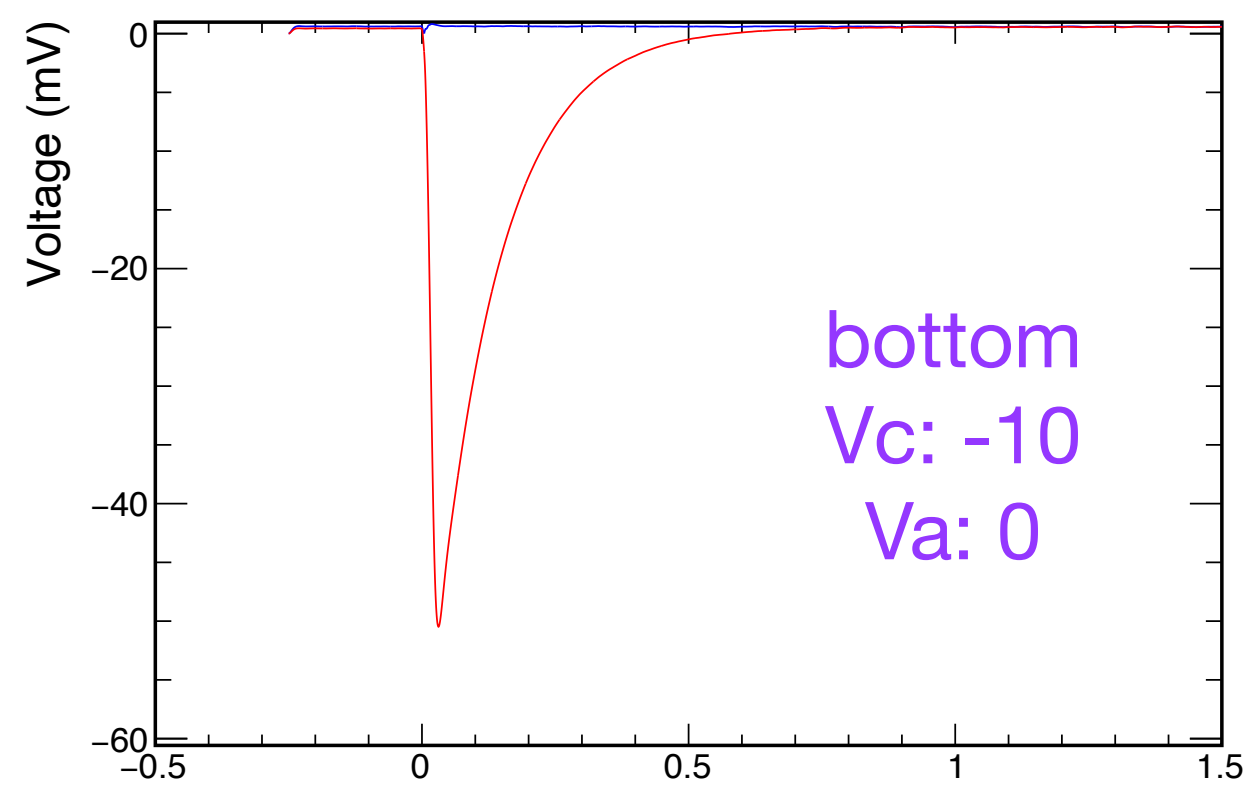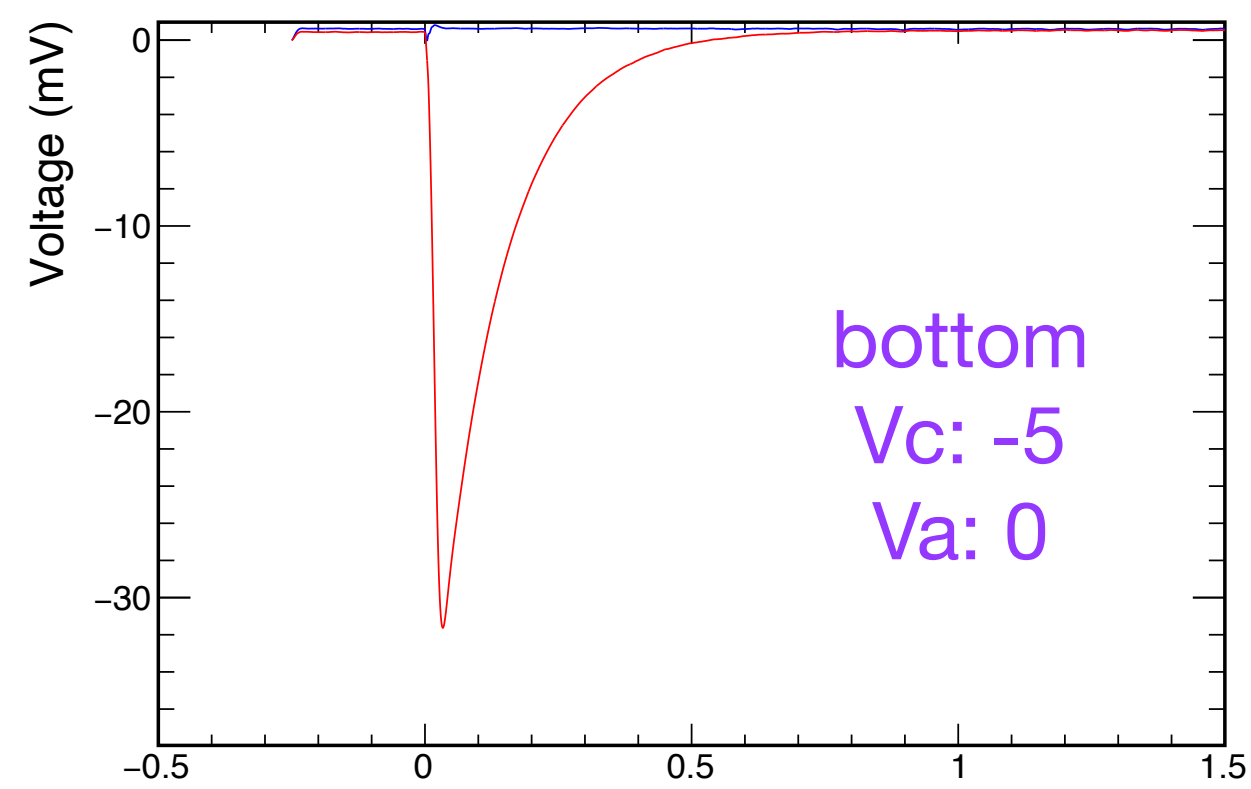- We tried moving around the optical fibers, and switching the electronic readout channels. It's getting the same behavior

- It might be the difference of the photocathode

- The signals were all very large in the vacuum thus not shown up until it's in argon gas

We can still get decent signals from the long PrM with high voltage applied

Raw Cathode Voltage

Top - (Vc: -50, Va: 1000)
Middle - (Vc: -20, Va: 2400)
Bottom - (Vc: -50, Va: 1000)

Liquid argon is getting to the cathode of the bottom PrM
(It's not zero, it's small signal in liquid)
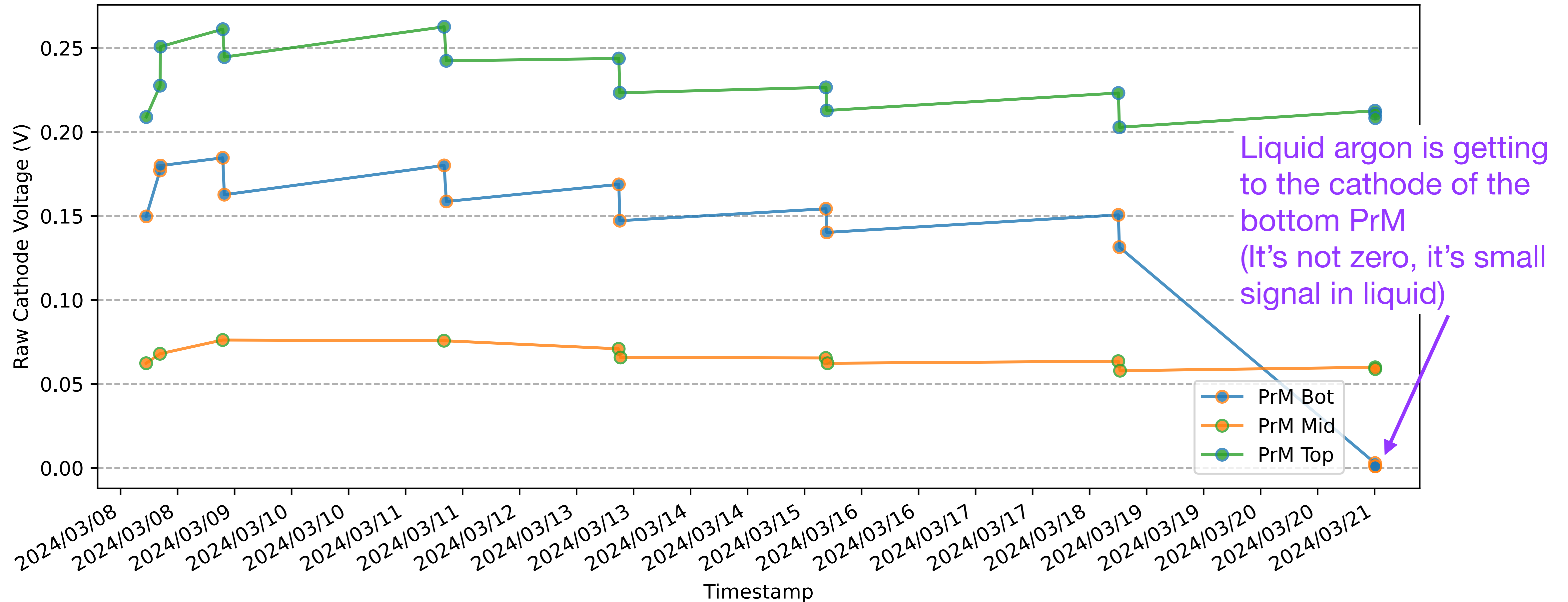
Drift time

Top - (Vc: -50, Va: 1000)
Middle - (Vc: -20, Va: 2400)
Bottom - (Vc: -50, Va: 1000)

Liquid argon is getting to the cathode of the bottom PrM (Missing anode signal)

PrM signals on Mar. 21

Liquid argon is getting to the cathode of the bottom PrM (anode is still in argon gas)
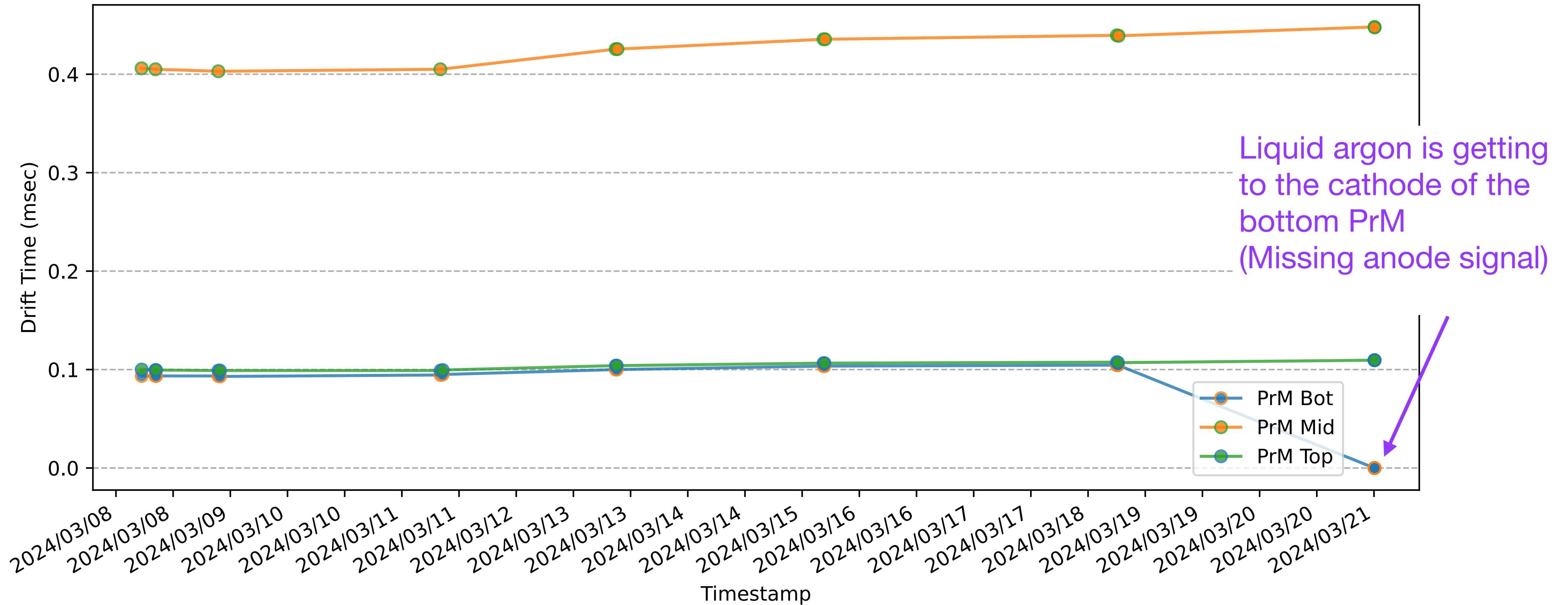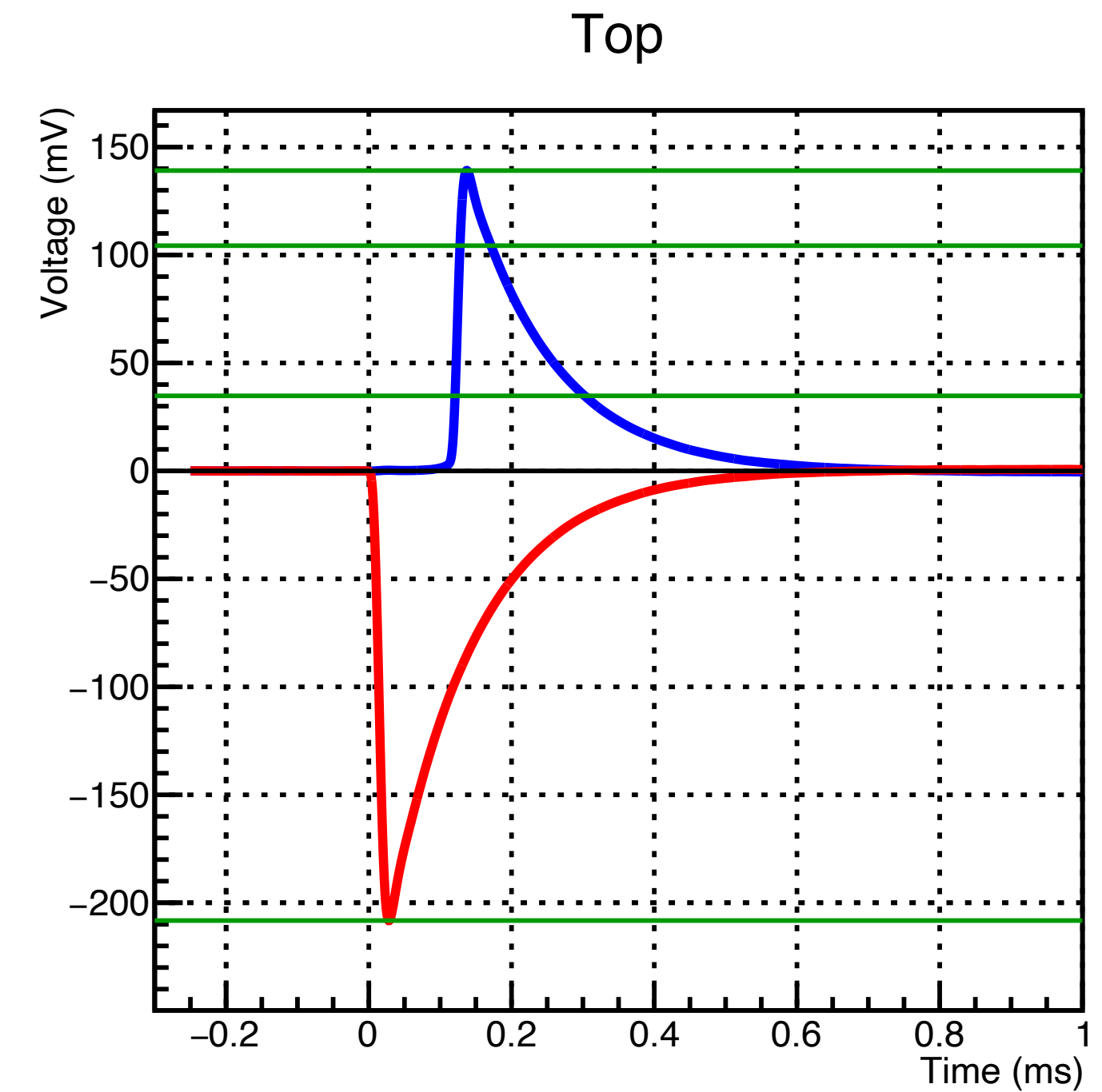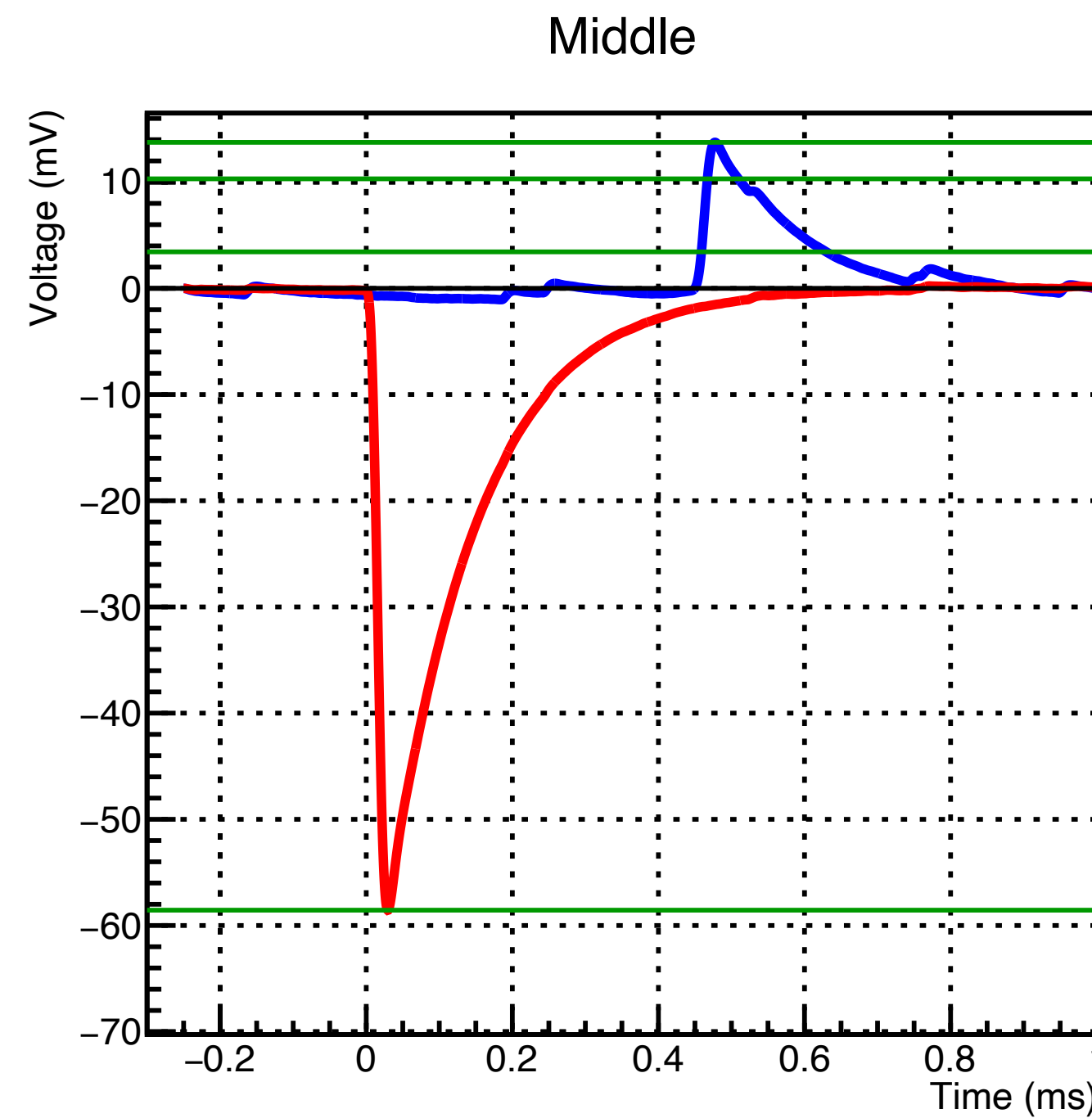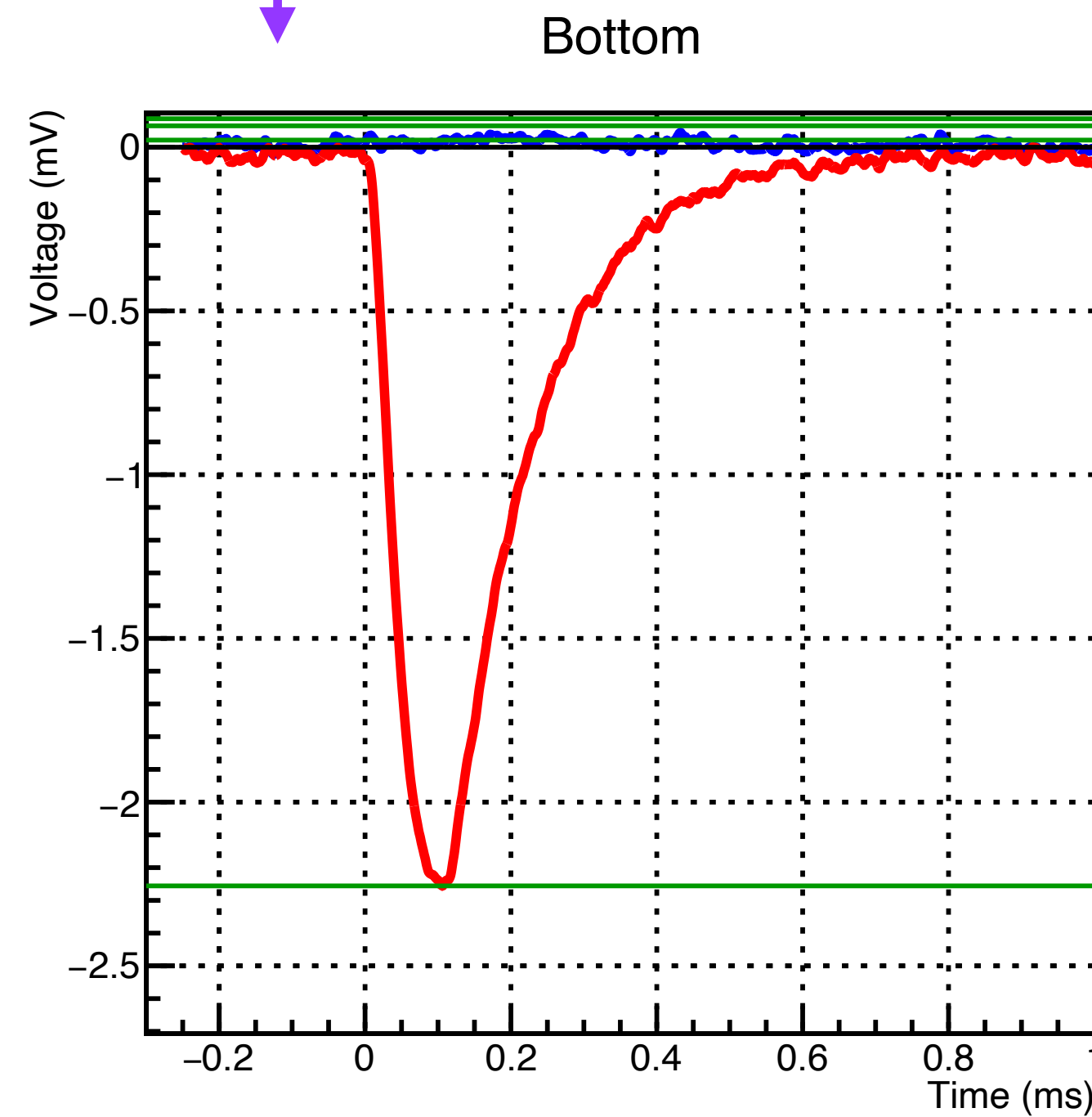

Bottom

Middle

Top

Summary

- Purity monitors are working properly

  - Bottom PrM is about to be immersed very soon

Next steps:

- Trying to analyze the data with the full waveform model

$$\text{Rising edge} : V(t) = V_0 \frac{1 - \exp(-t/\text{RC})}{t_{\text{rise}}/\text{RC}},$$

$$\text{Observed maximum voltage} : V_{\max} = V(t_{\text{rise}}) = V_0 \frac{1 - \exp(-t_{\text{rise}}/\text{RC})}{t_{\text{rise}}/\text{RC}},$$

$$\text{Falling edge} : V(t) = V_{\max} \exp(-\frac{t - t_{\text{rise}}}{\text{RC}}),$$

- Trying to analyze the lifetime using only the cathode signal, when the purity is not good