Purity Monitor Update

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CALCI Consortium Meeting

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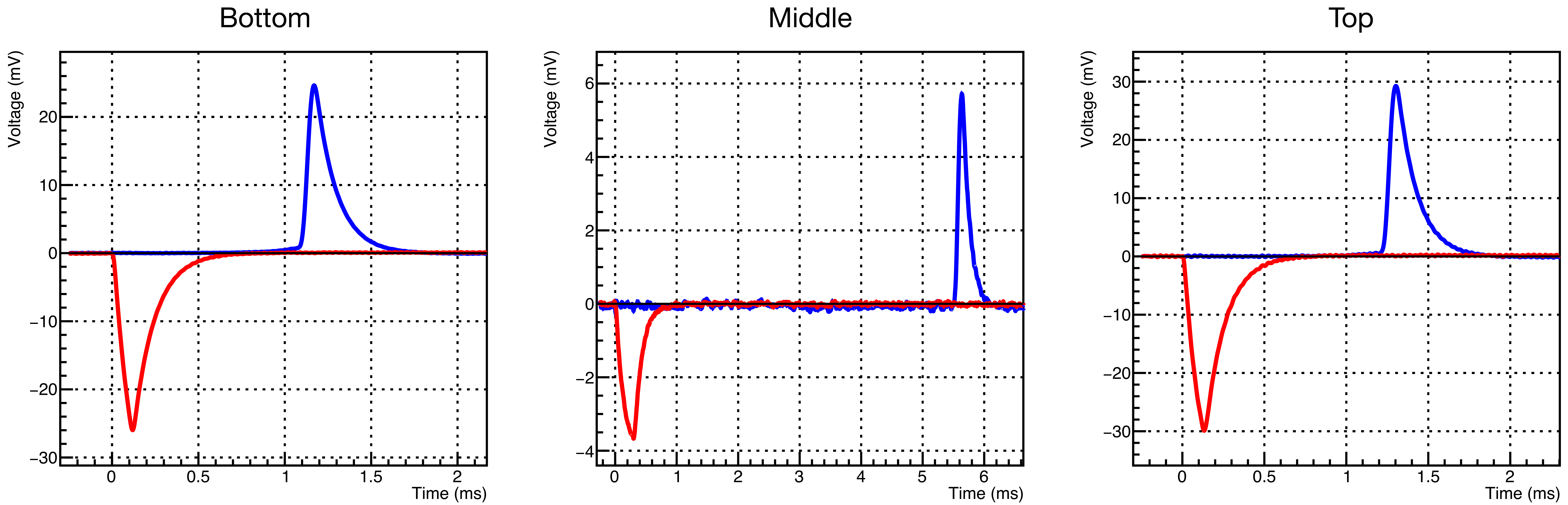
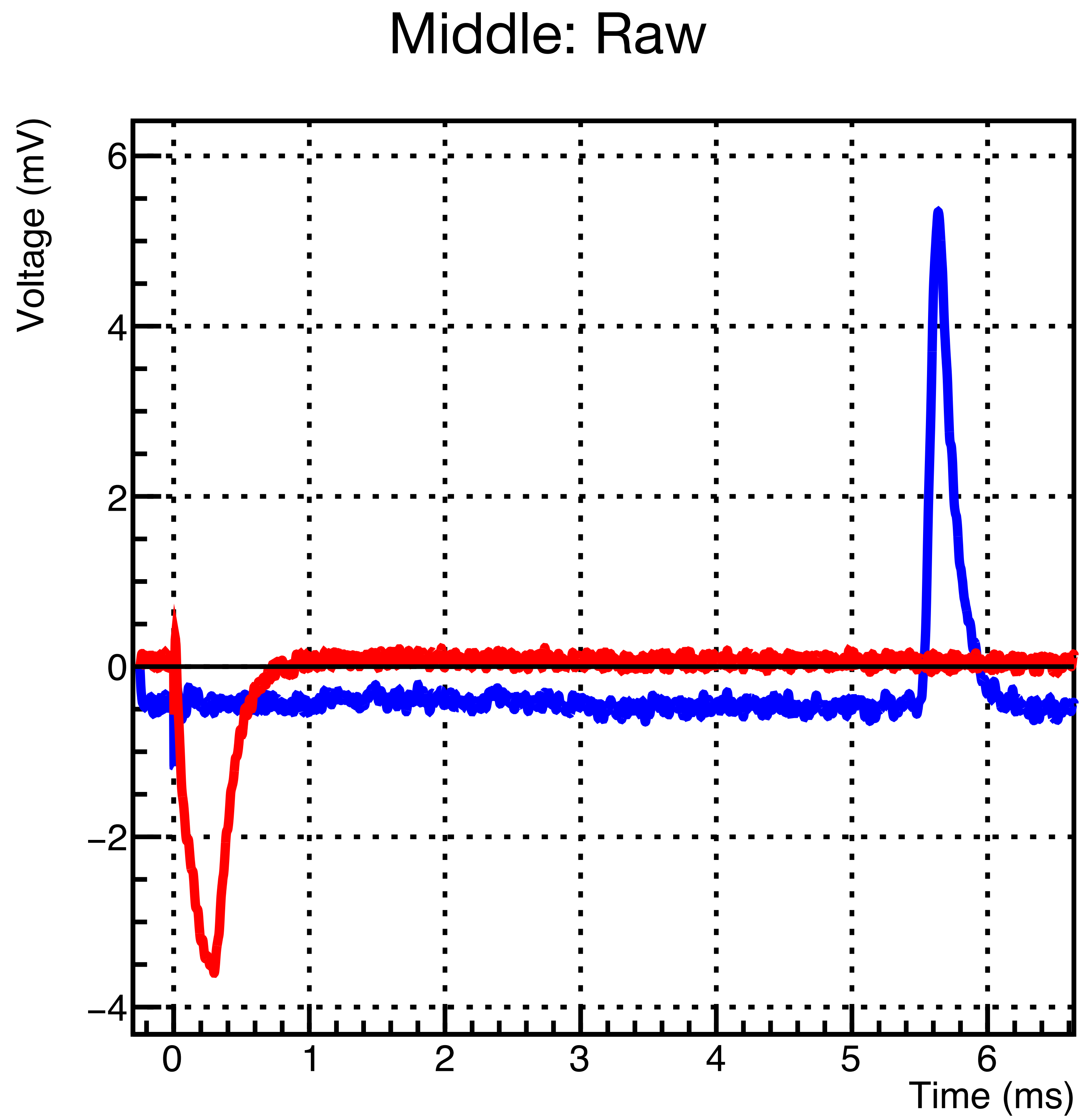
Purity monitors in PD-HD

- 3 purity monitors installed
  - 2 of them (top and bottom) from the SP run
  - middle PrM is new with a longer drift distance (64 cm)



Signal Processing

- Subtract baseline measured with 0/0 V on anode/cathode



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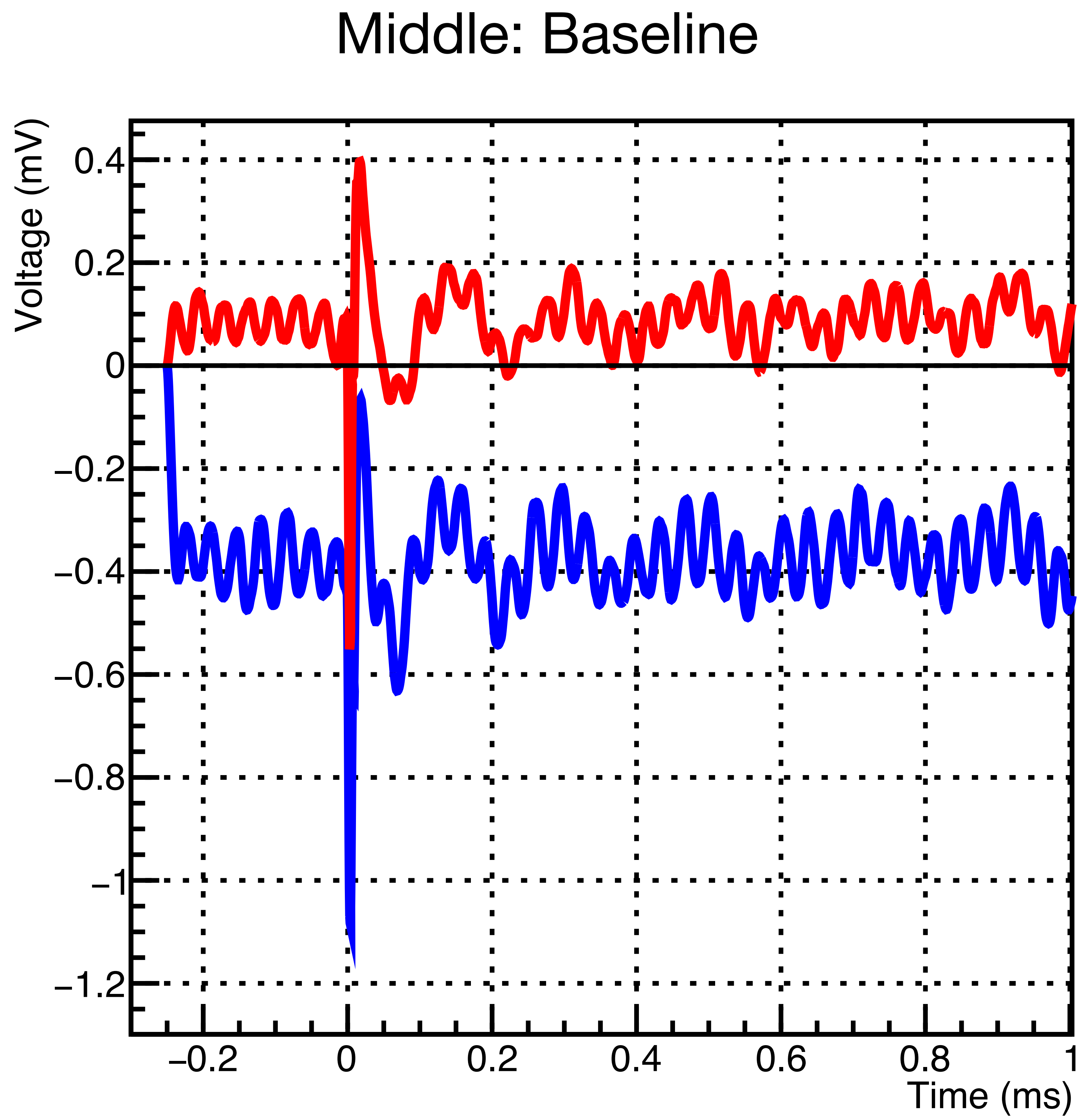
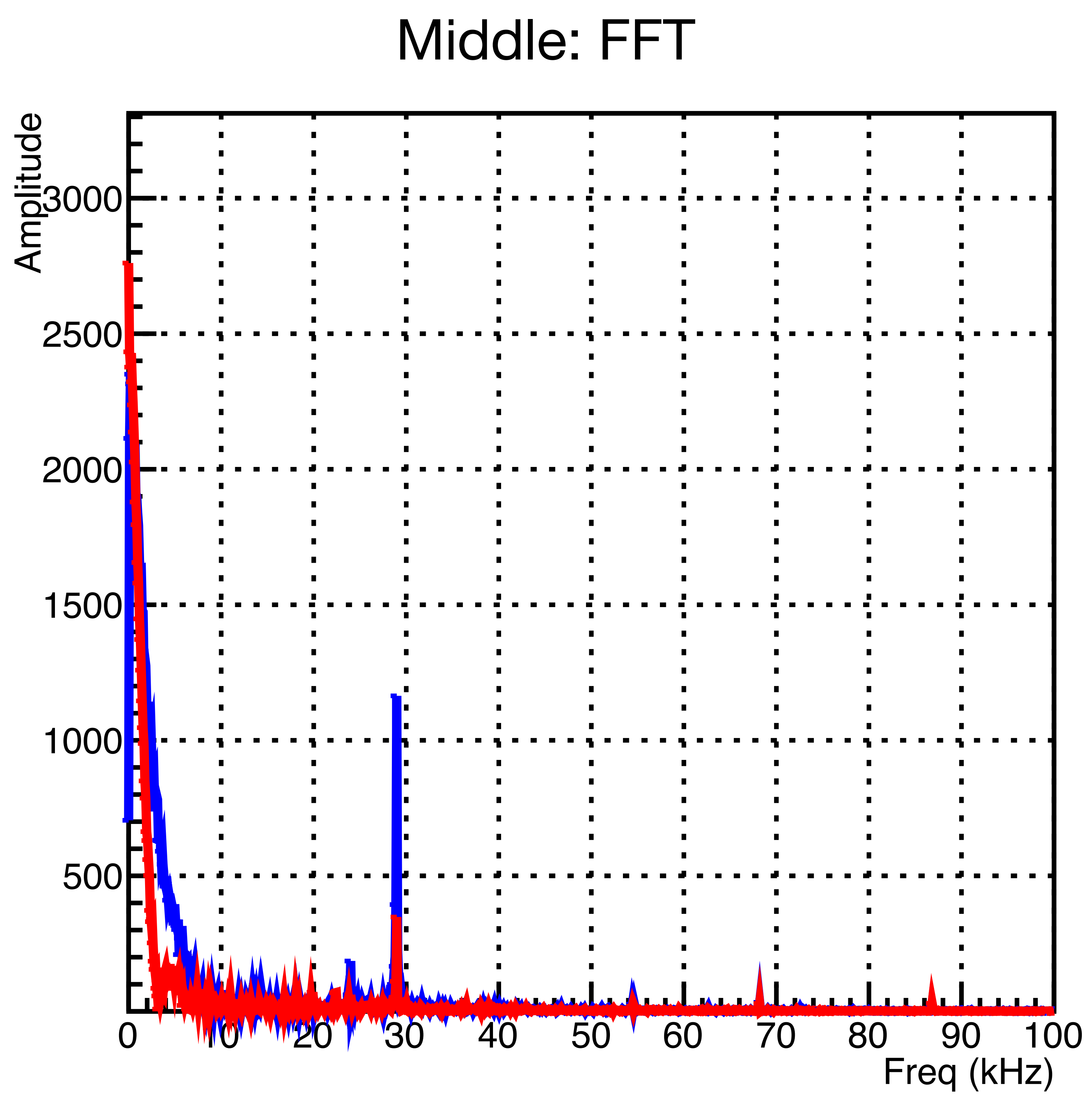


Signal Processing

- Subtract baseline measured with 0/0 V on anode/cathode
- Filter out an external noise with a high frequency (~30 kHz)



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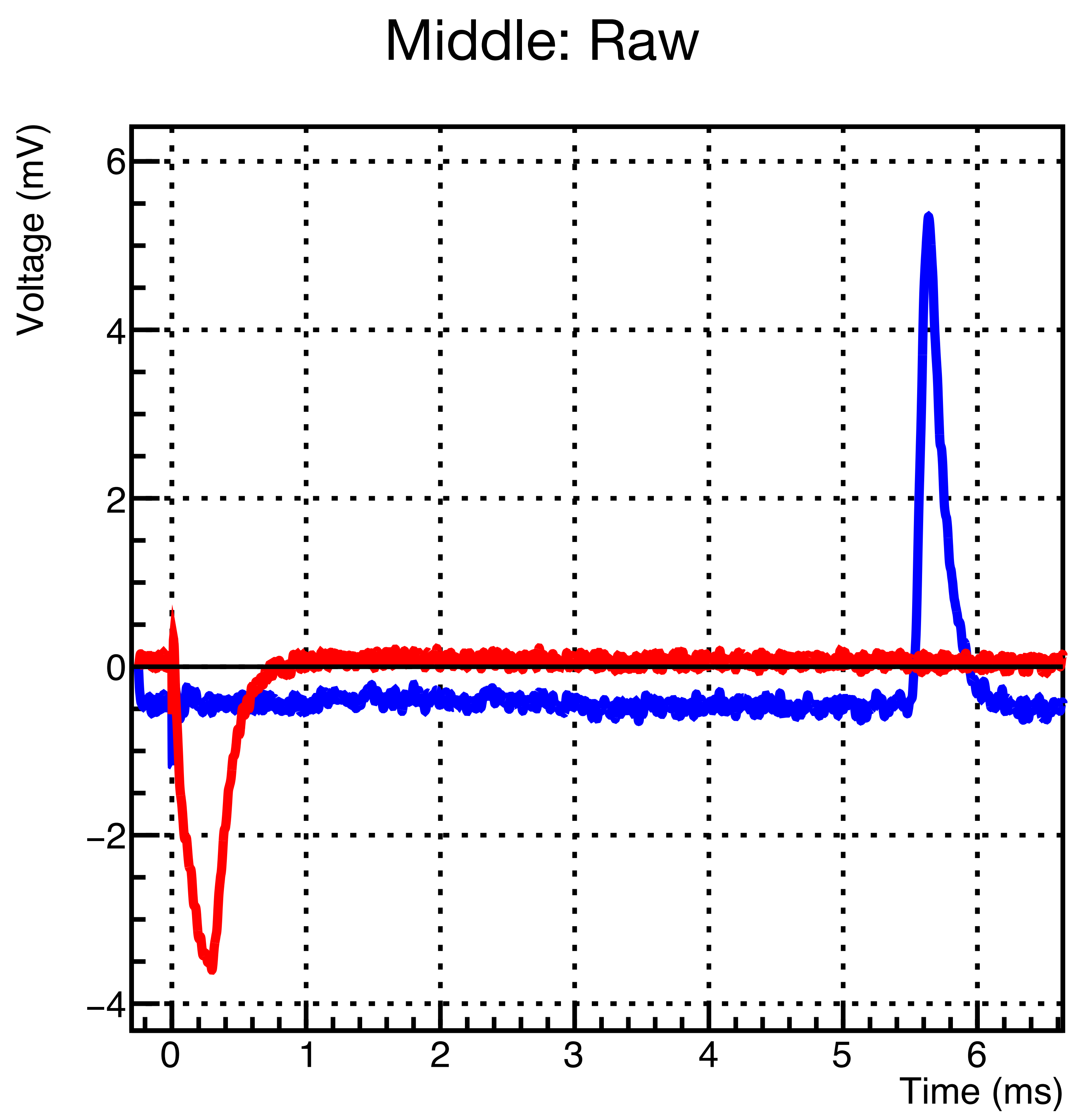
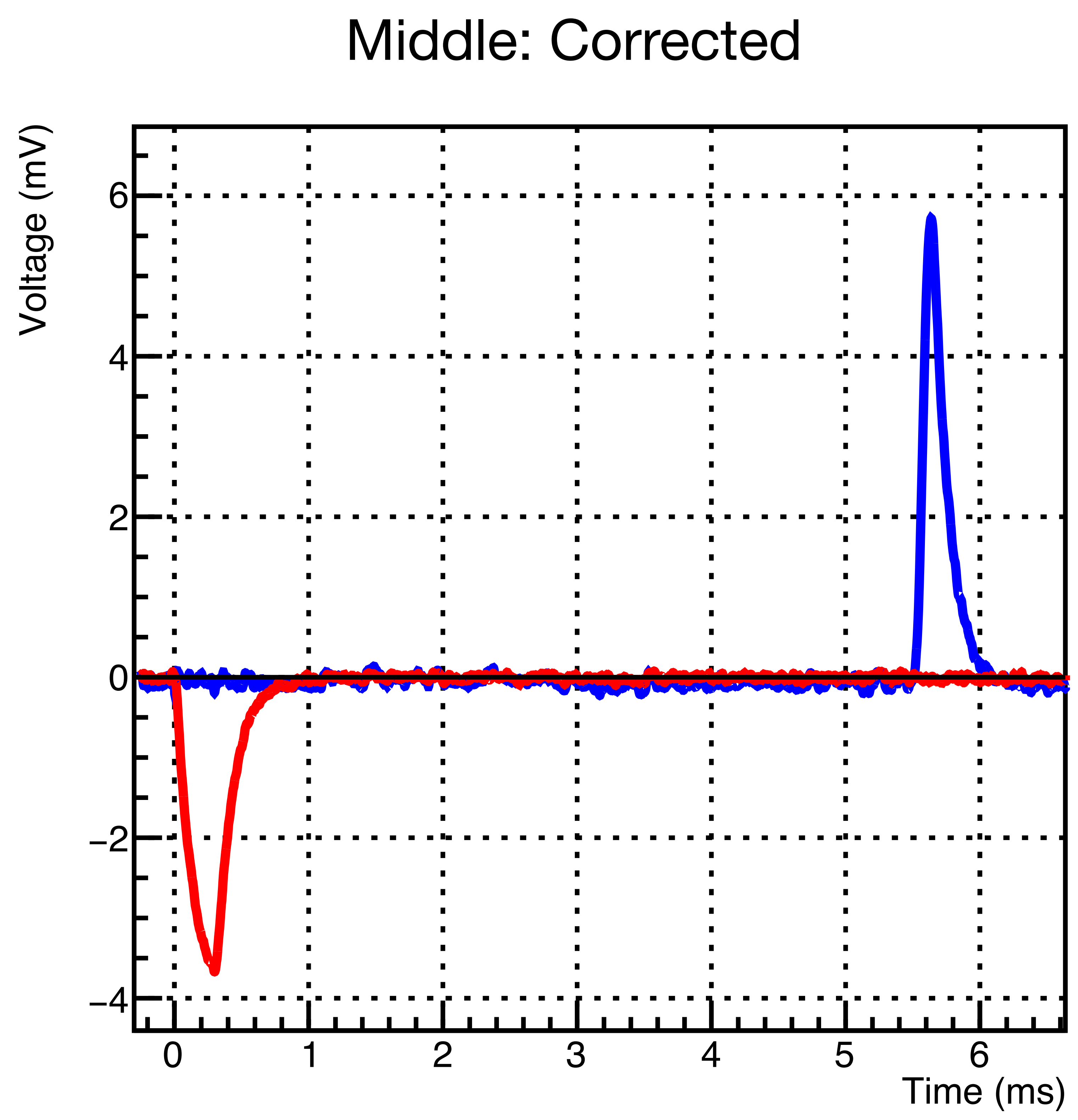




Waveform model

RC integrator circuit response to a current source:

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

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

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

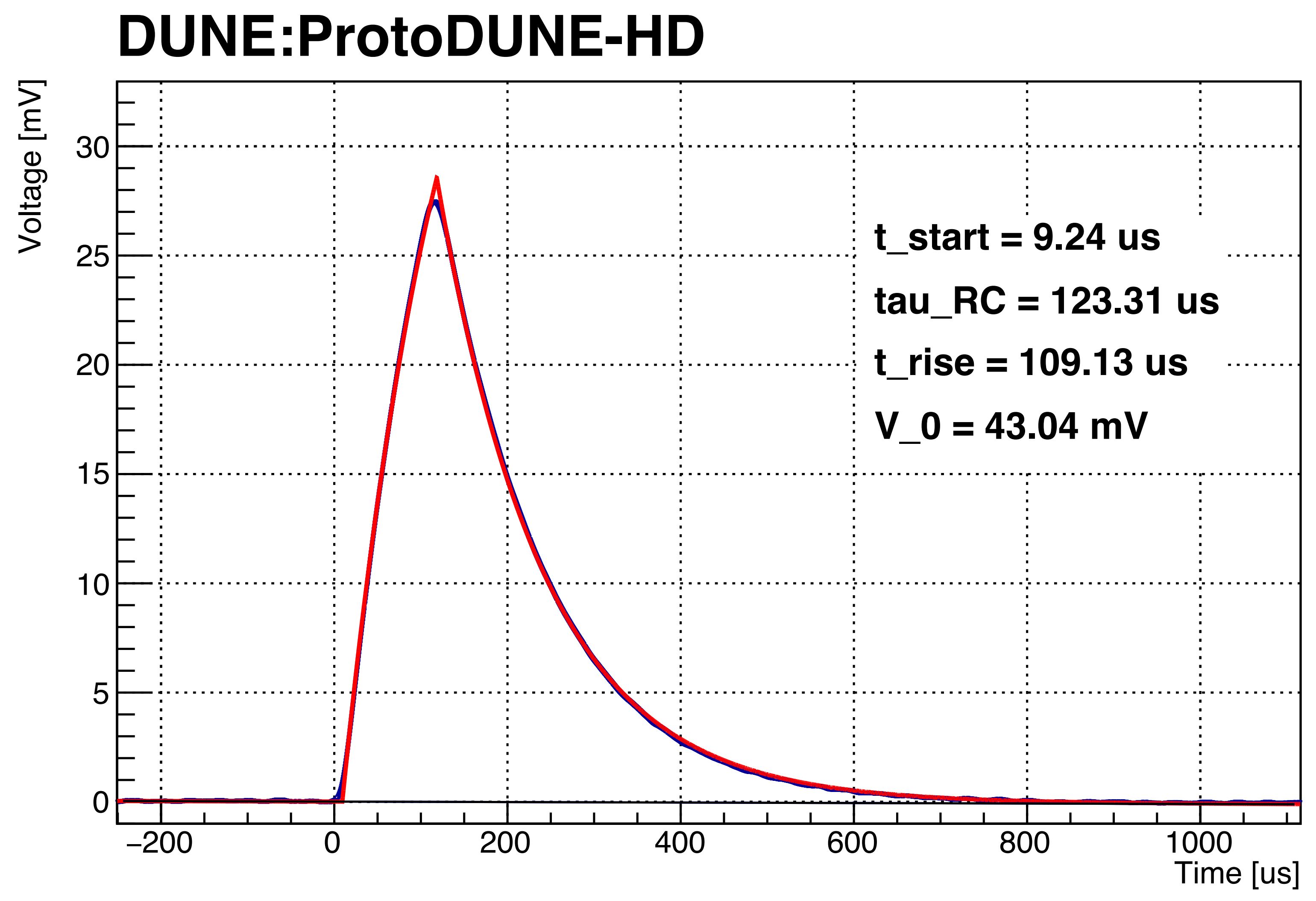
Additional term for anode

induced current due to the shielding inefficiency of the anode grid

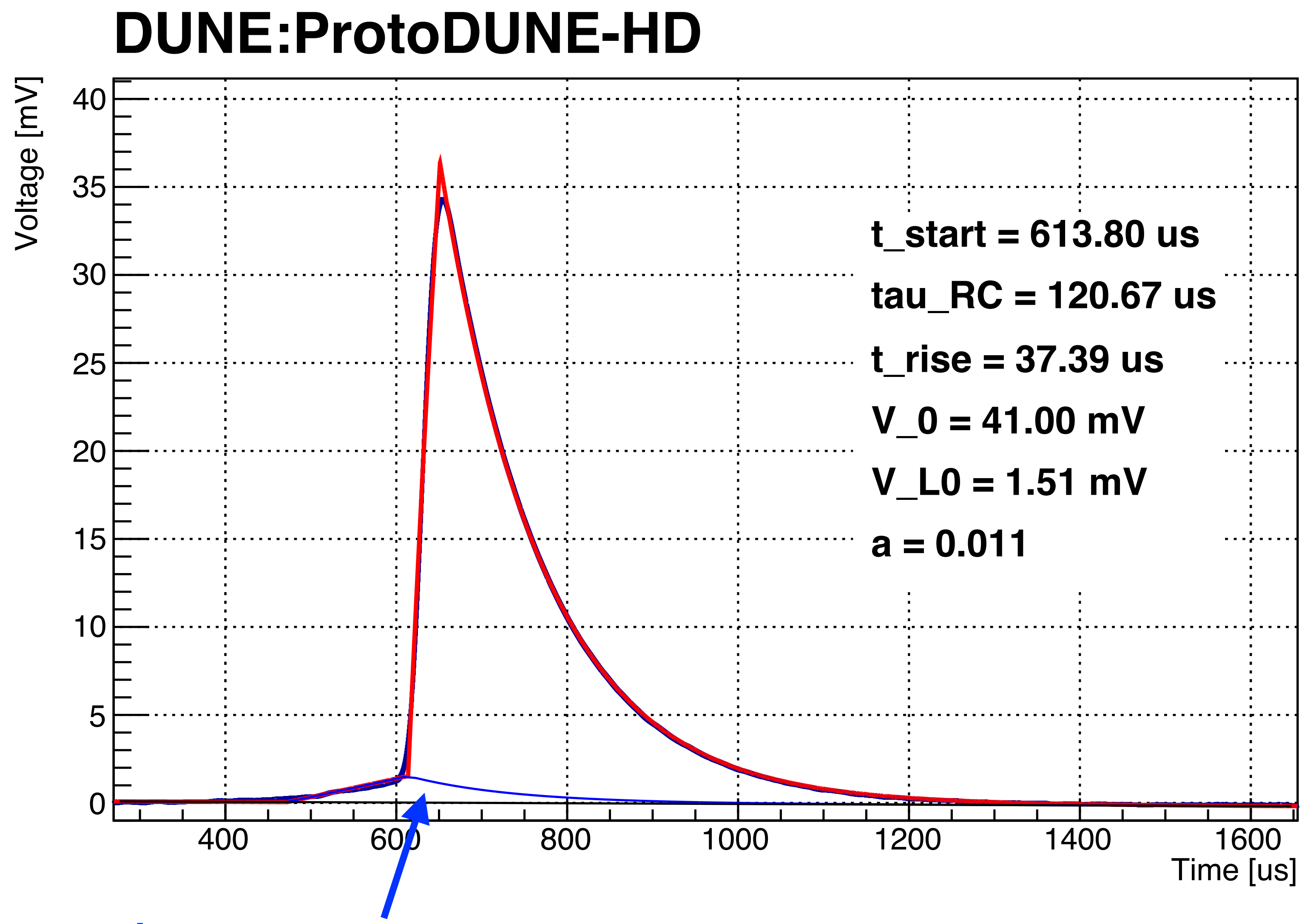
$$V_L(t) = V_{L0} + at,\ t < 0,$$

$$V_L(t) = V_{L0} \exp(-\frac{t}{\tau_{RC}}),\ t > 0.$$

Bottom, Cathode



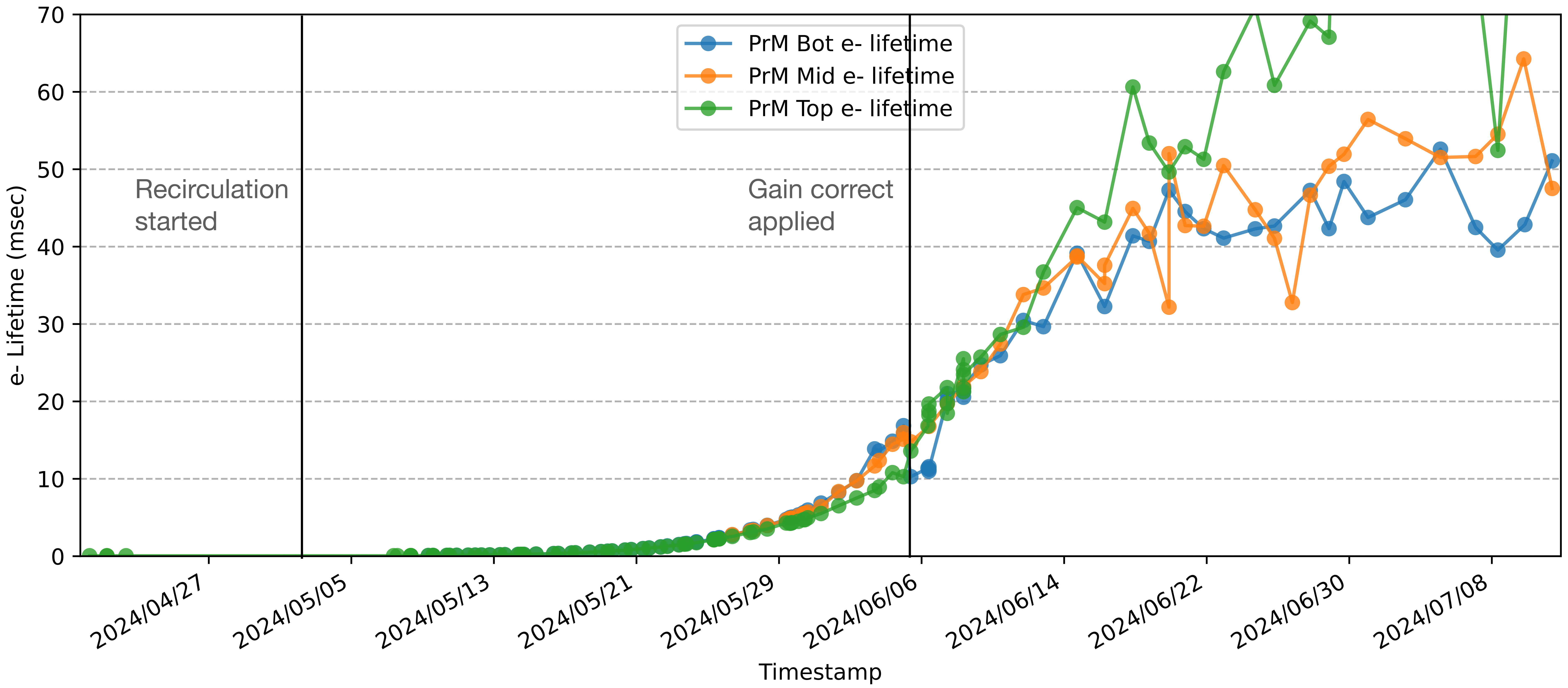
Bottom, Anode



Induced current

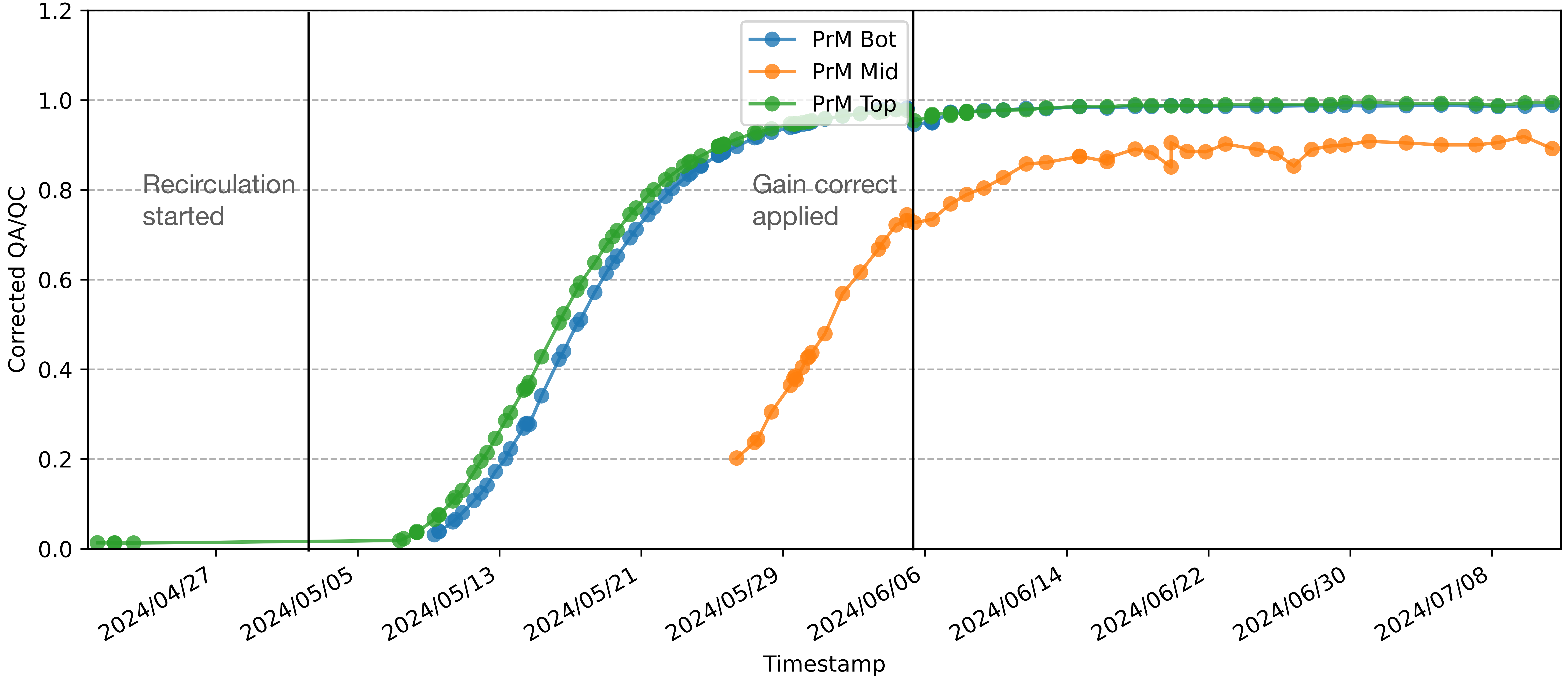
Electron lifetime

- Purity is exceptional good: over 40 ms
- Measurement is super sensitive to the fitting results: small fluctuation on Qa/Qc induces large fluctuation on measured lifetime

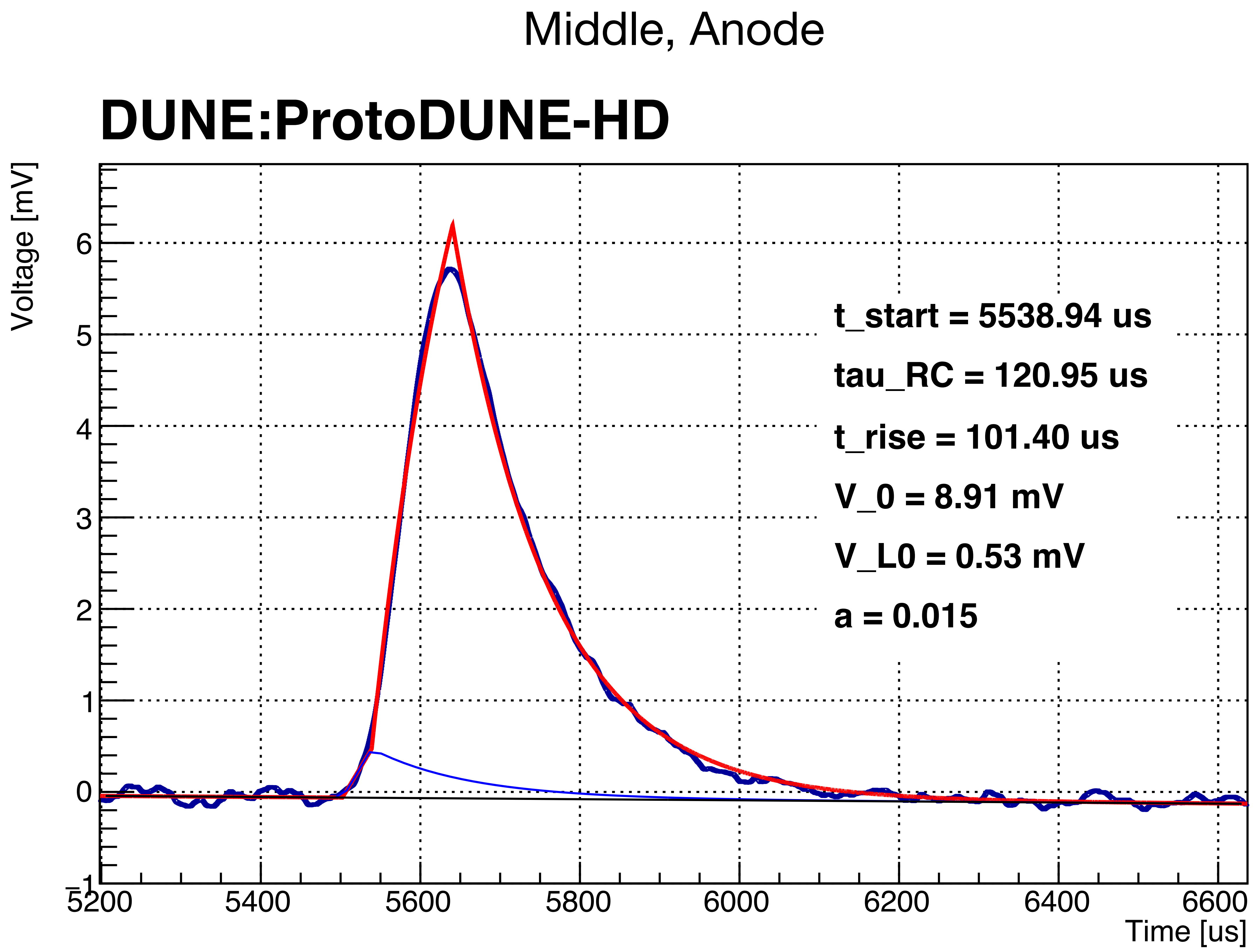


Qa/Qc

- Top and bottom PrMs are very close to 1
- Middle PrM is more sensitive to high purity due to the long drift distance



Ongoing work

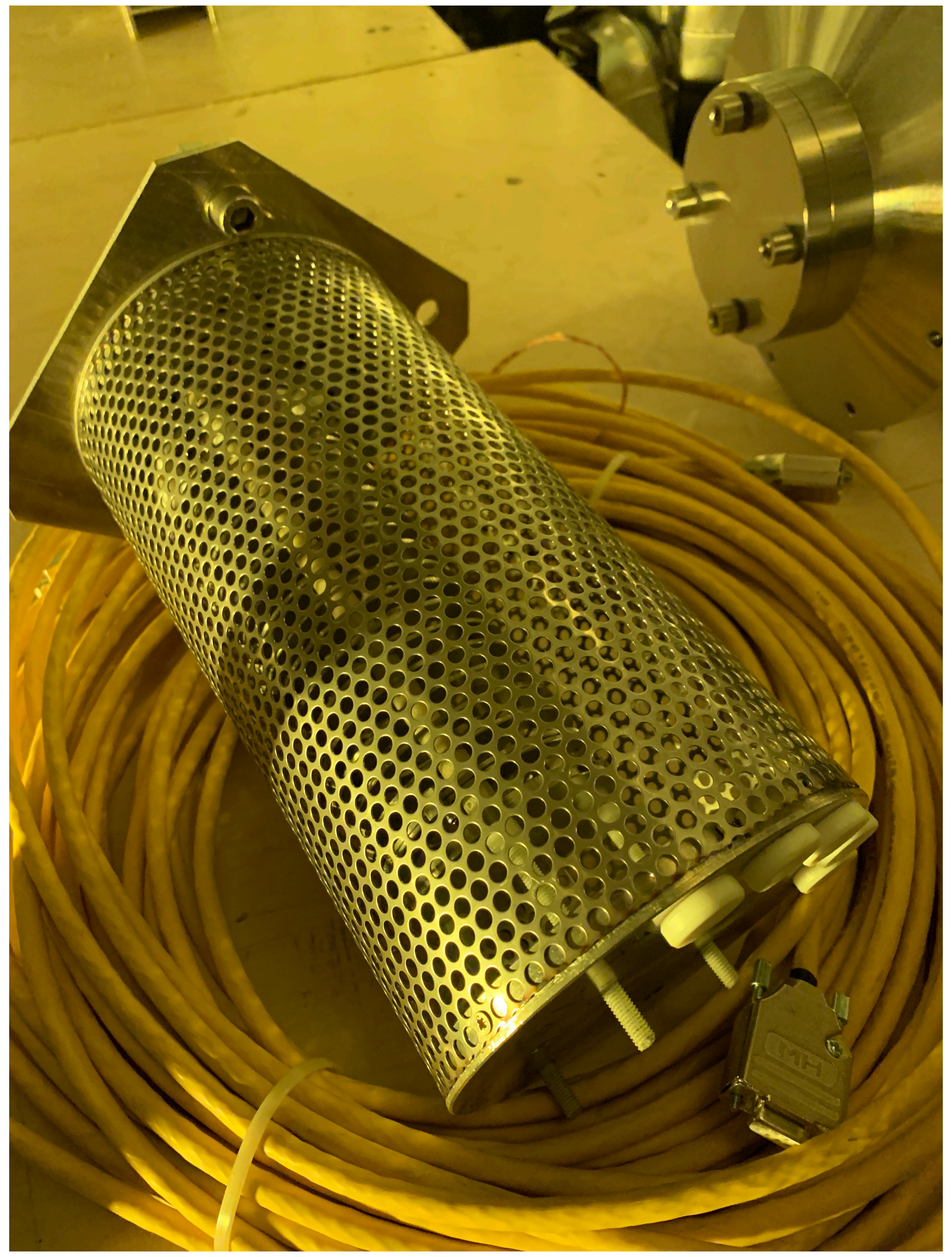


A few improvements to the fitting are ongoing

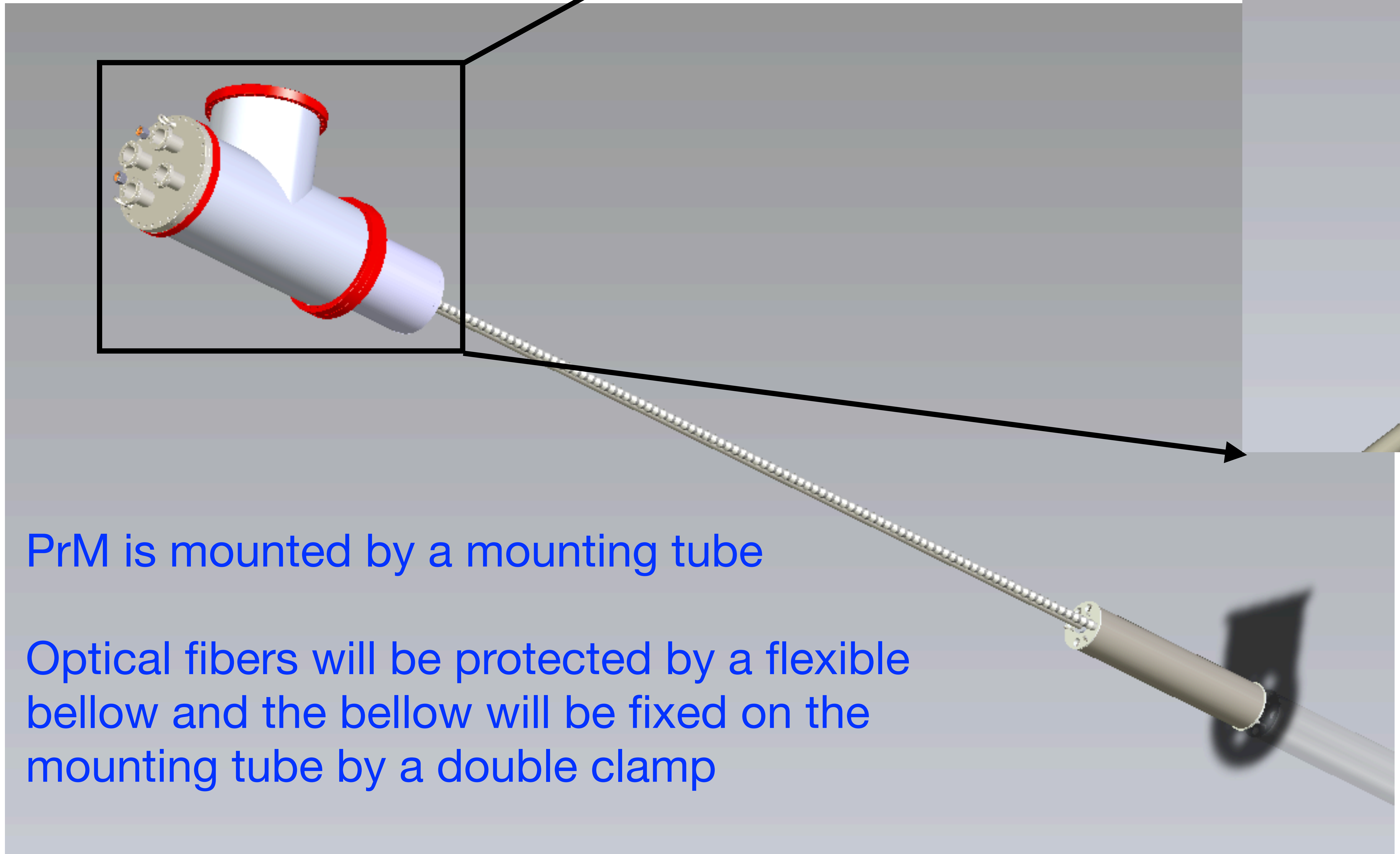
- The peak caused by the induced current of the middle PrM is suppressed by the long drift time, but not detected by the fitting
  - Expand the fitting range based on the drift time
  - Calculate the inefficiency based on the grid geometry and fix the parameter in the fitting
- The primary peak is smeared by the diffusion effect
  - Implement the convolution of the diffusion effect in the fitting

Purity monitors in PD-VD

- 3 PrMs from ProtoDUNE-I DP will all be re-used
  - Two short PrMs (UCL), One long PrM (UCI)

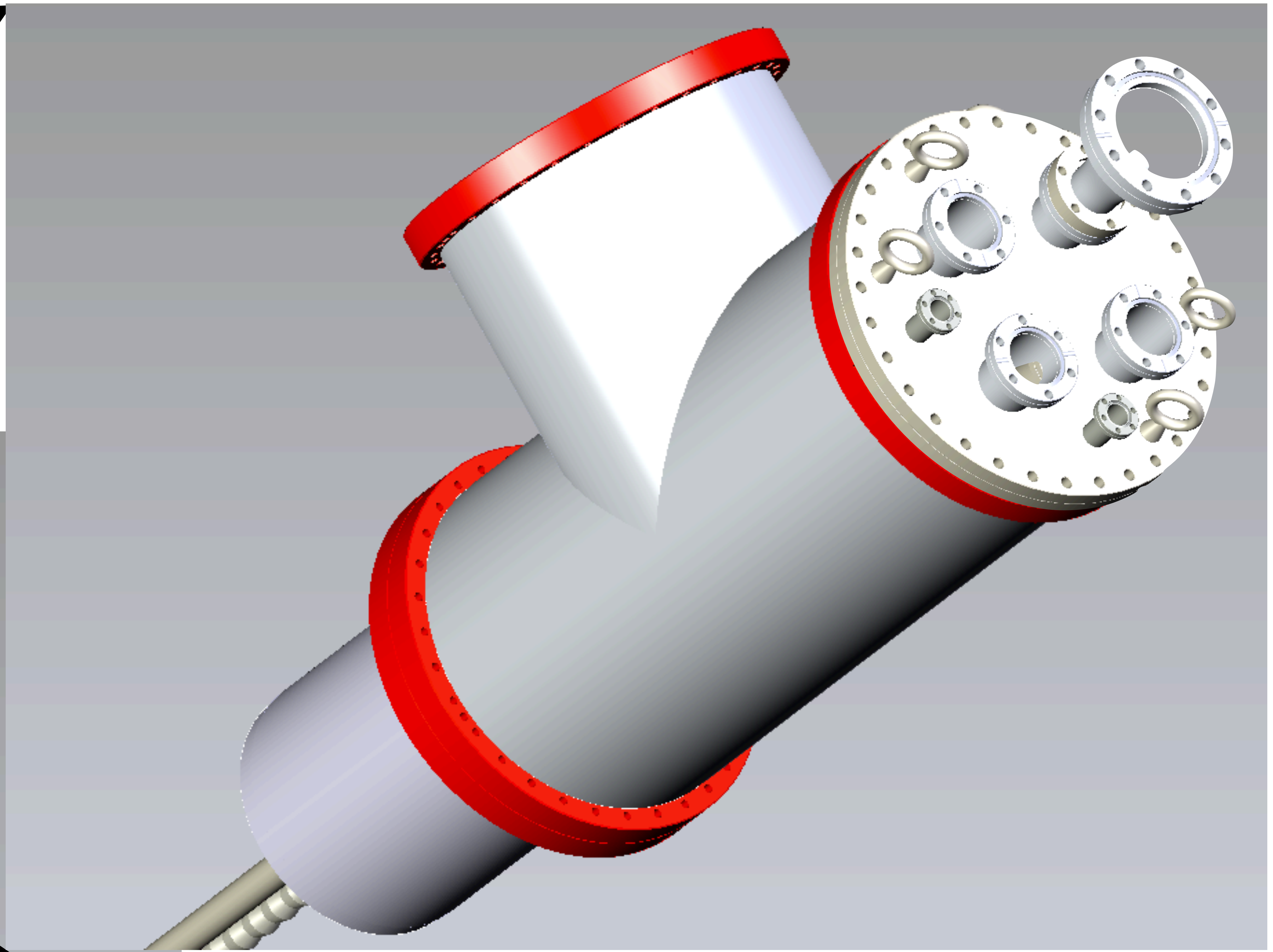


Installation Plan



PrM is mounted by a mounting tube

Optical fibers will be protected by a flexible bellow and the bellow will be fixed on the mounting tube by a double clamp



An extension pipe is needed in order to incorporate all feedthroughs
- 3 for electric feedthroughs
- 1 for optical fiber feedthrough
- 2 extra 1.33CF for redundancy

Installation Plan

- The long PrM is stored in the long pipe at the moment, with cables and fibers installed
- We shipped a new flash lamp to CERN as the light source for this PrM
- Given the lessons we learned from HD, it's important to have the PrM tested in argon gas before installation
  - Fill the long pipe with argon gas
  - Test the feedthrough and the PrM in argon gas, instead of the vacuum test only
- Plan to have two people on-site in September for the preparation of the installation