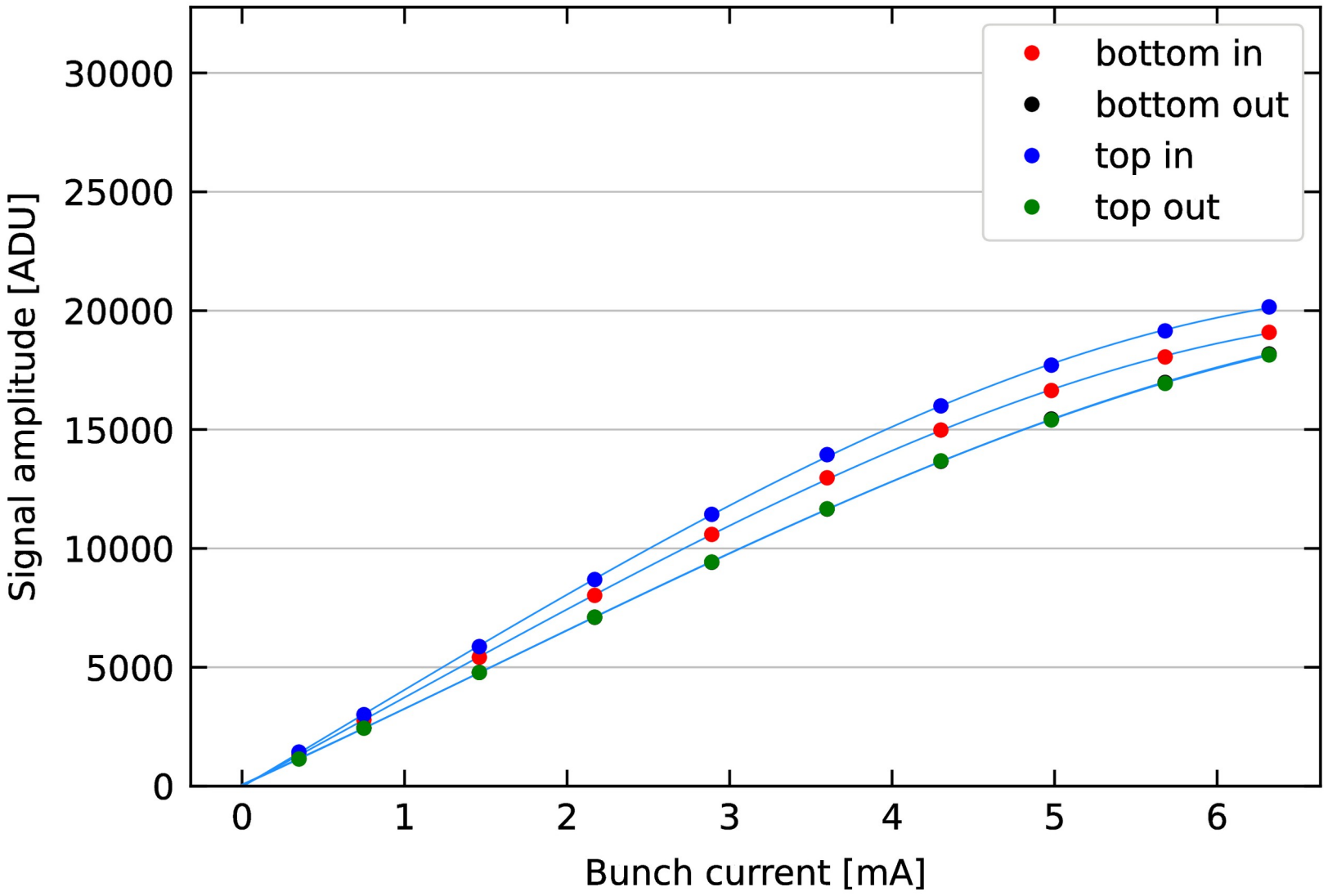
CBPM 12W triplet gain study

Antoine

CBPM meeting: March 24, 2023

PREVIOUSLY: signal amplitude vs bunch current

12W <u>cubic</u> fit to data (w/o uncertainty)



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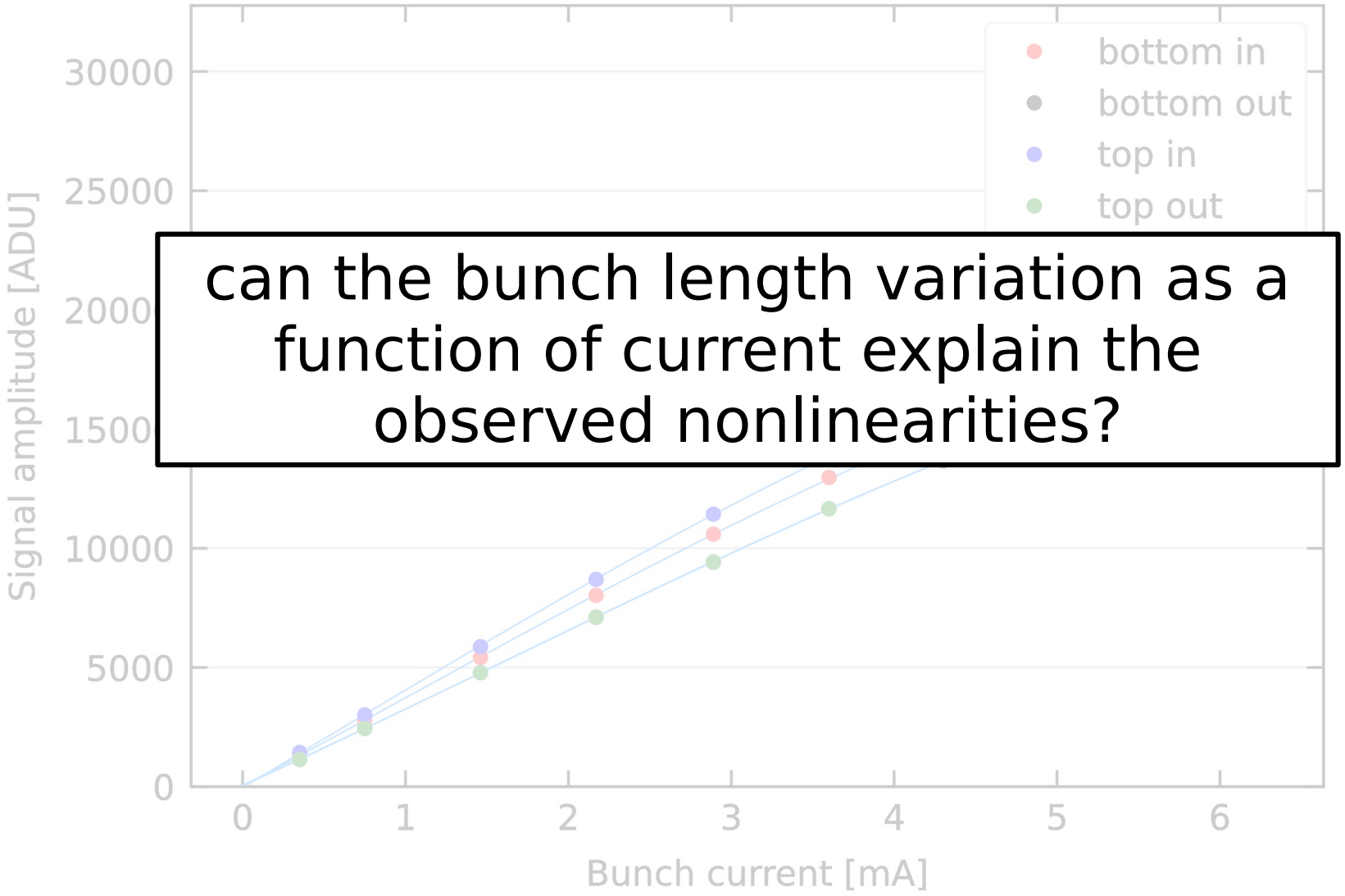


can the bunch length variation as a function of current explain the observed nonlinearities?

Bunch length and nonlinearities

Study:

1) let's use Suntao's bunch length vs current information
2) produce bunch profiles at various bunch currents
3) take the derivative of bunch profiles → button waveform/amplitude

Given proper reference scaling, we can compare measured and predicted amplitude as a function of bunch current

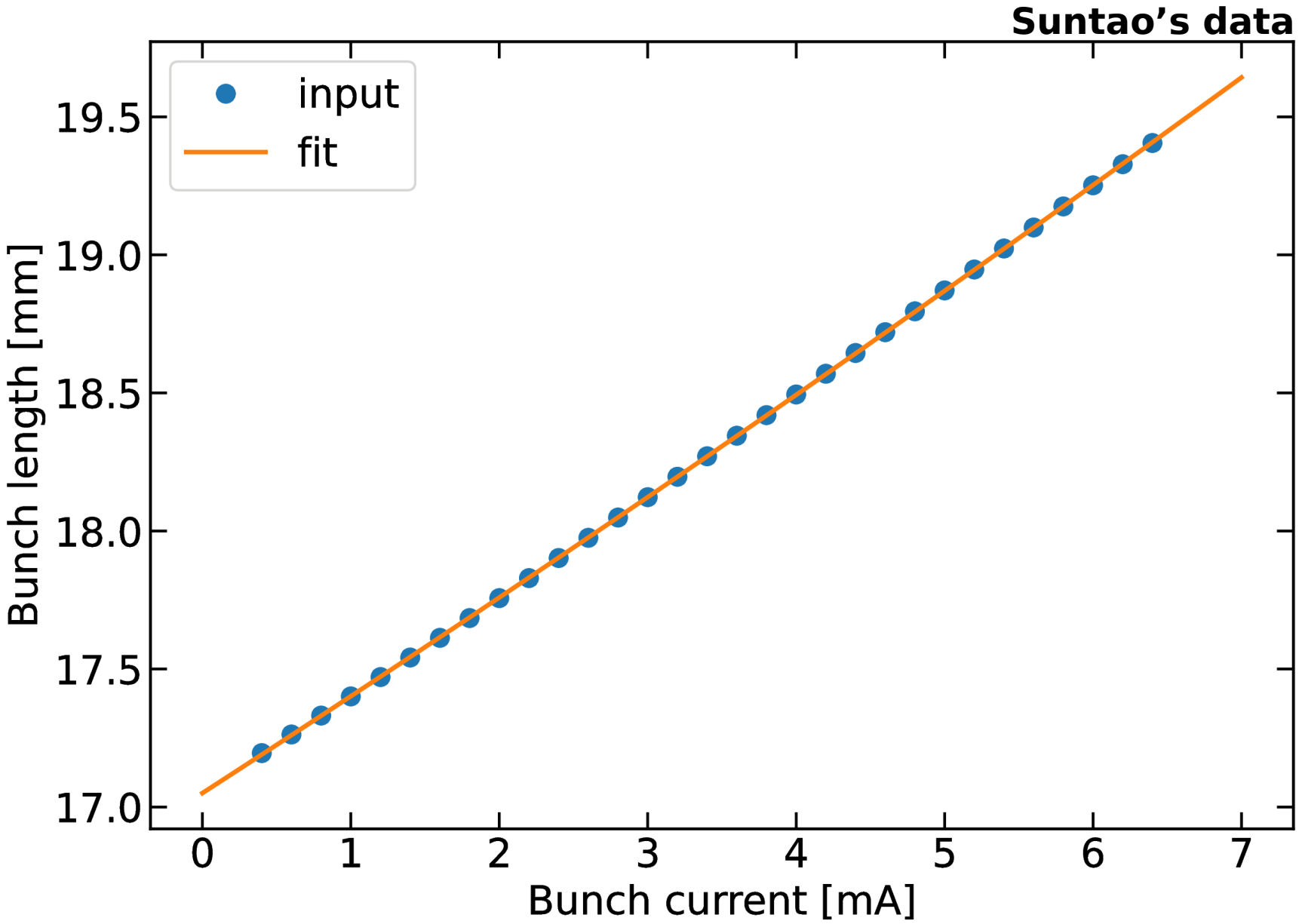
What's missing:

✗ electronics effects (low-pass filters)

✗ wakefield and relativistic E&M

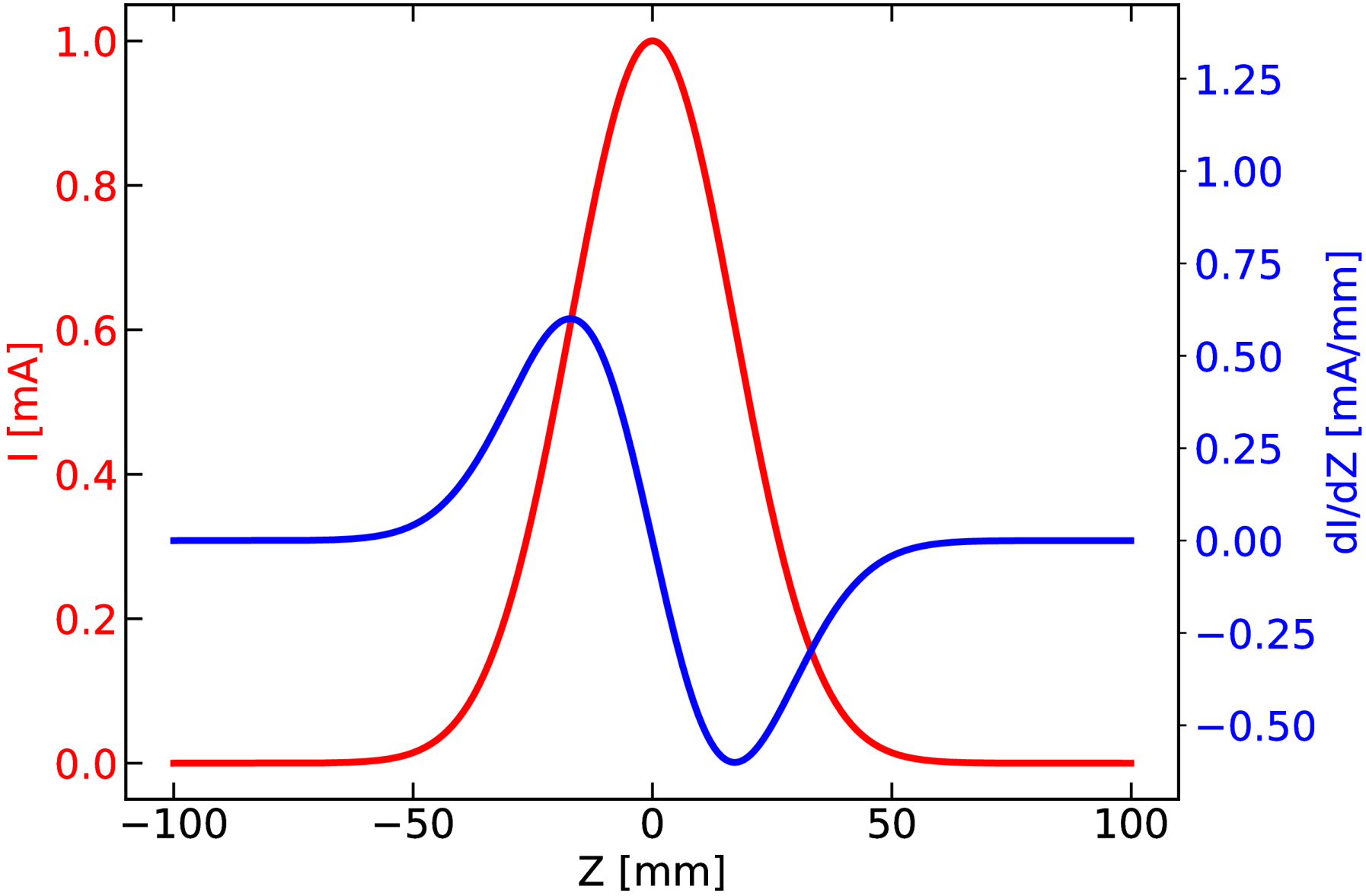
Bunch length versus current

Restricted to current values we care about today



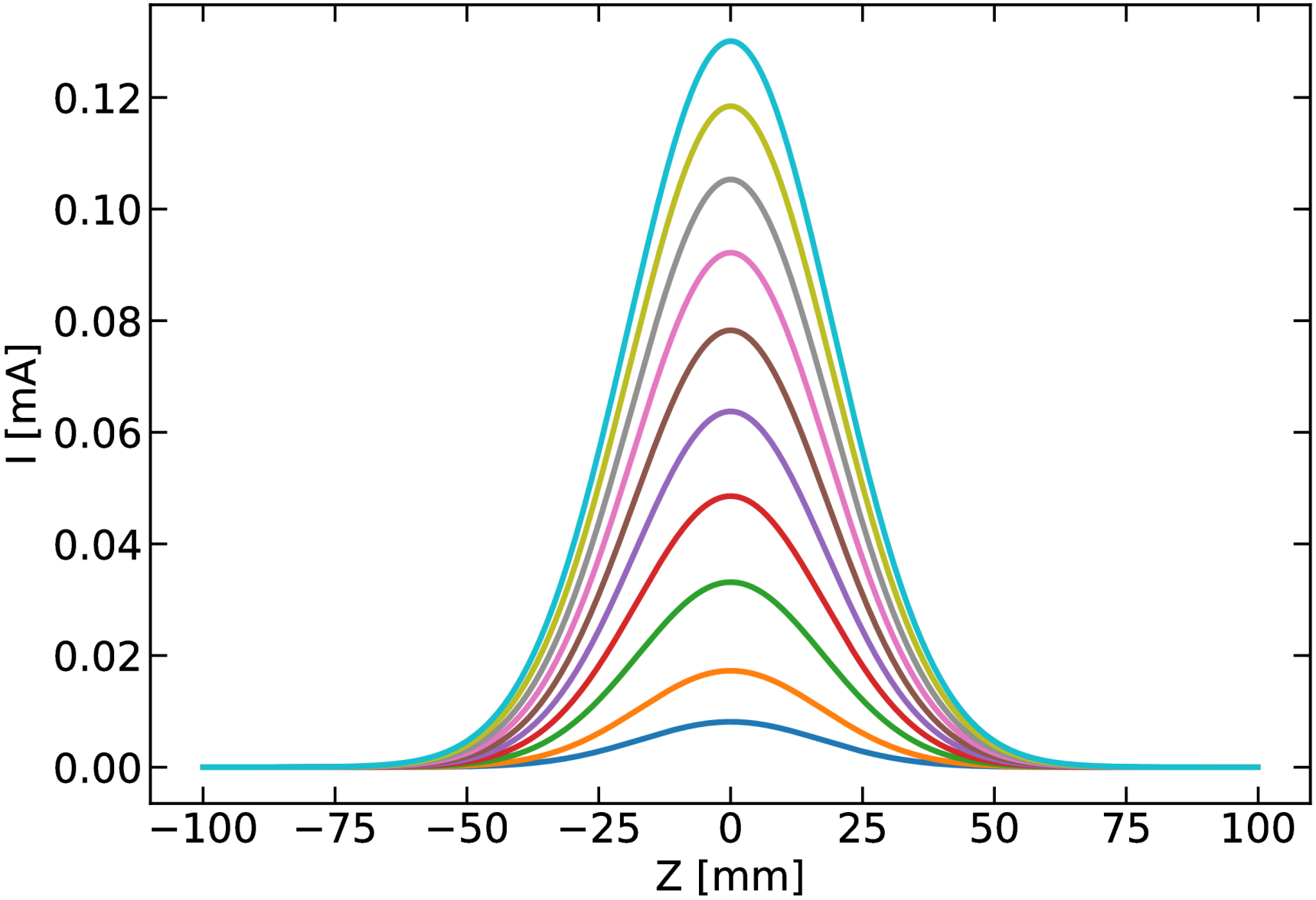
Bunch profile and button response

Gaussian beam profile and its derivative (button response)



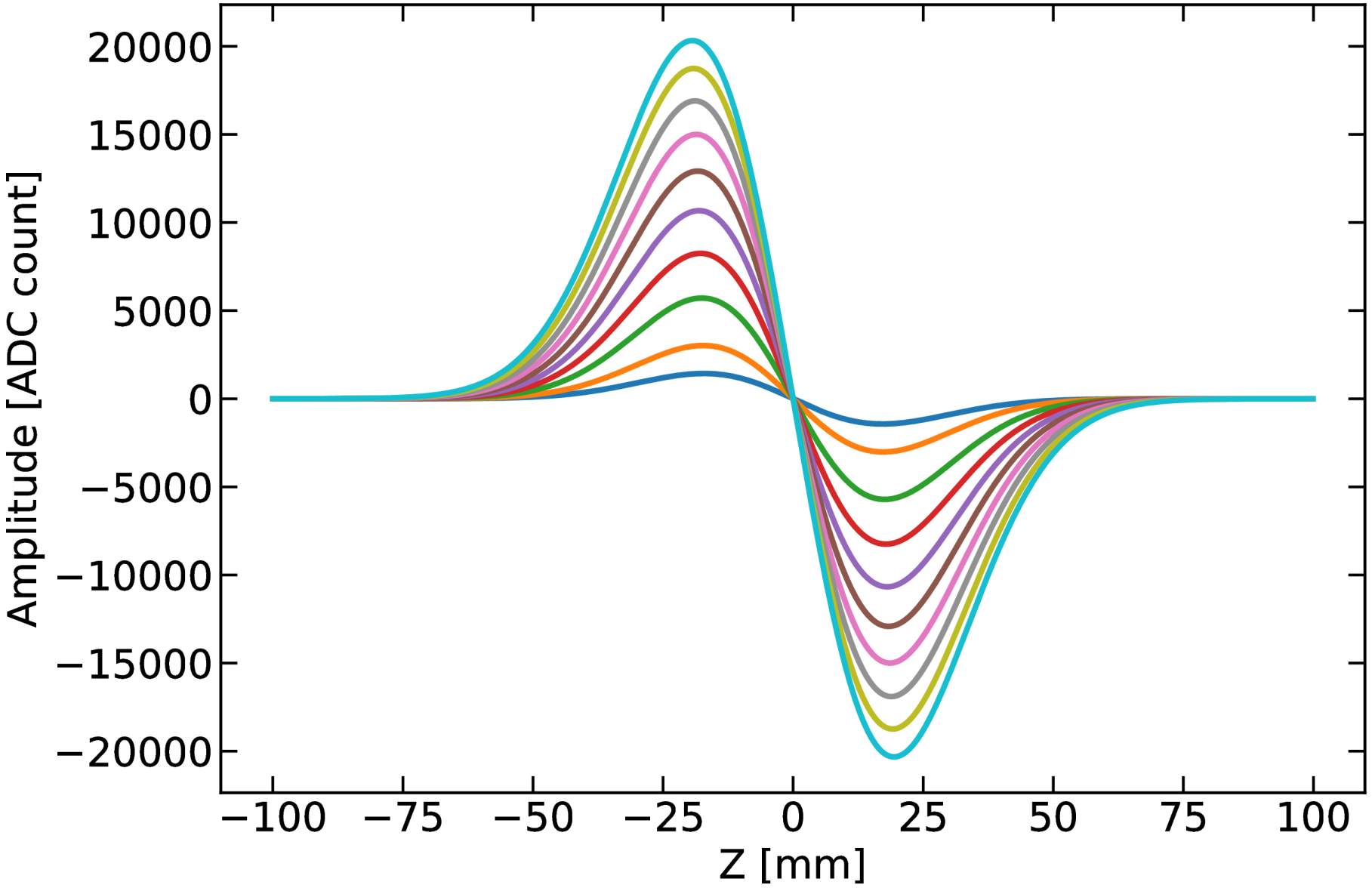
All bunch profiles

Profile’s integral normalized to bunch current



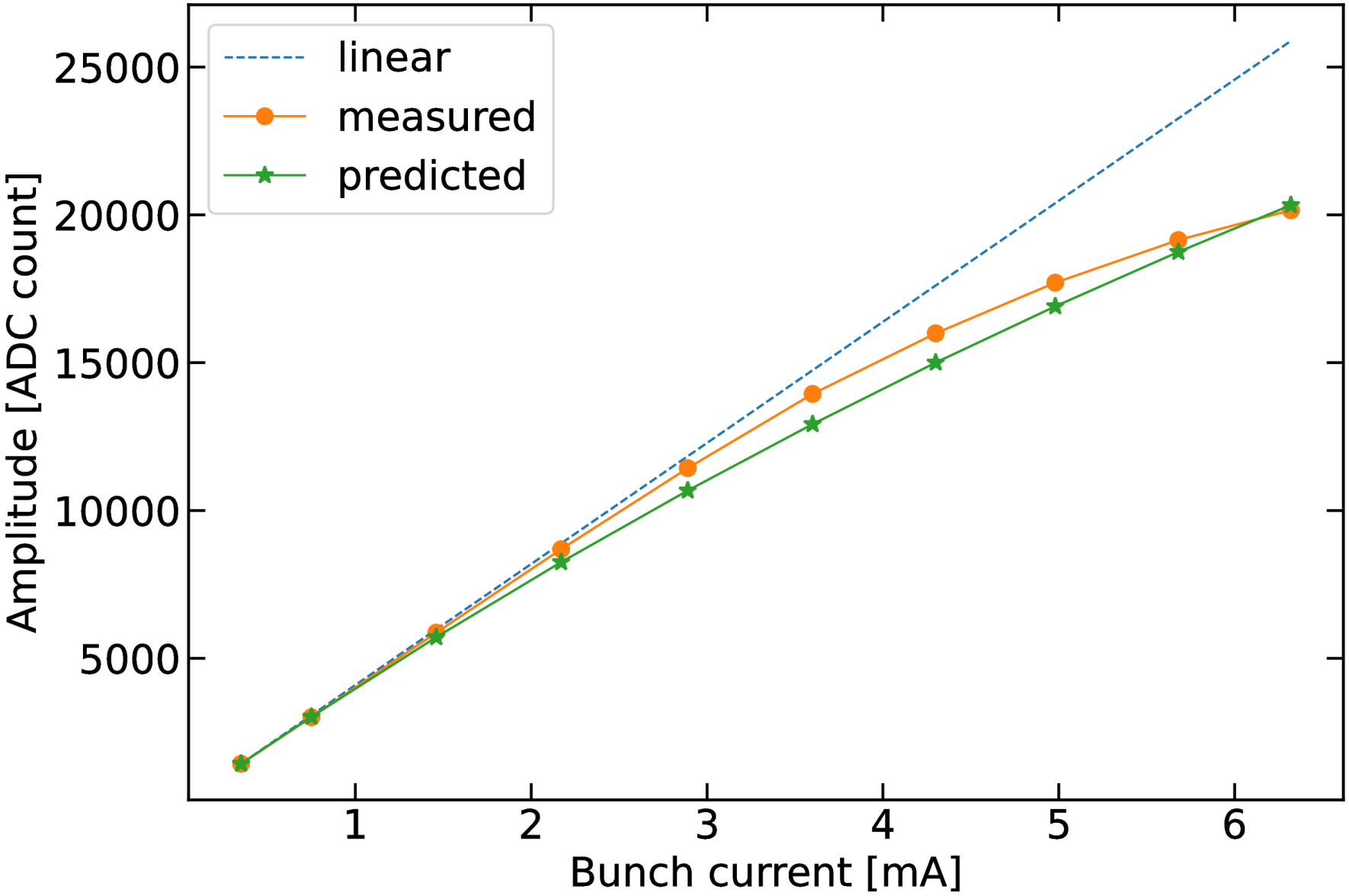
All waveforms

Waveform amplitude reference = measured amplitude at 0.35 mA



Measured vs predicted

Prediction amplitude reference = measured amplitude at 0.35 mA



Not good enough?

That’s weird that we get more nonlinearities than measured…

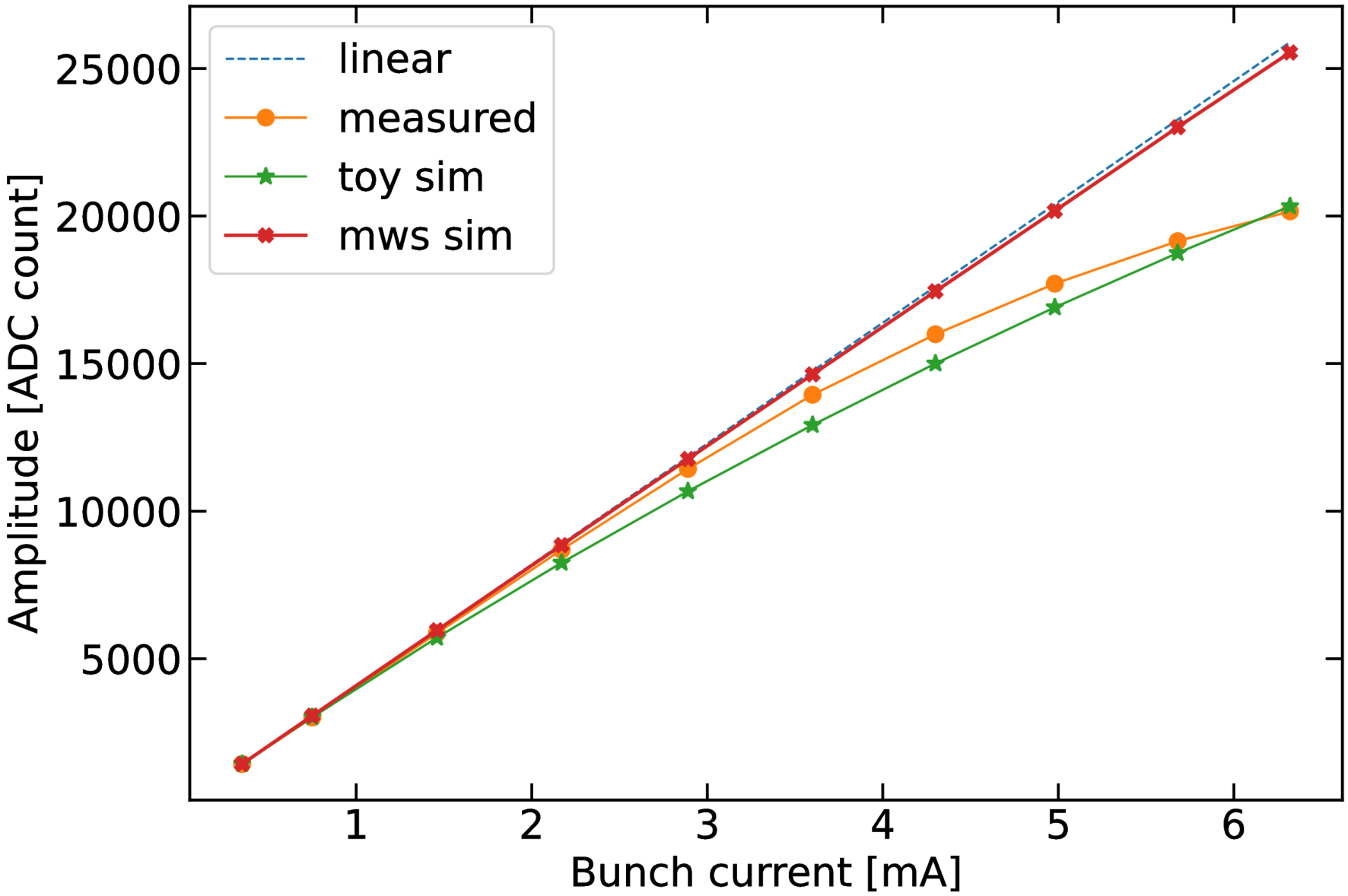
We probably want a more accurate study that includes:

- ✗ relativistic E&M wakefield
- ✗ 1.2 GHz and 0.6 GHz low-pass filter

Simulation done using CST Microwave studio

Measured vs predicted

Simulation amplitude reference = measured amplitude at 0.35 mA



So…?

Almost no nonlinearities expected from the increasing bunch length…

Let’s look at the data collected Tuesday March 21 (FIXED GAIN only):

✗ instr elog 2088, 2087

✗ 2 AFEs of module sitting at 12W (ctacf133) were modified by Len for more signal amplification following Bob’s design (see details here): x2.5 amplitude measured on the bench

from Bob

Object is to test fixed gain and variable gain with full signal amplitude.

1. Remove: R67 49.9 ohm (extra termination)
   Replace: DNP

2. Remove: R63, R66, R68 16.9 ohm (6dB attenuator)
   Replace: 0 ohm jumper

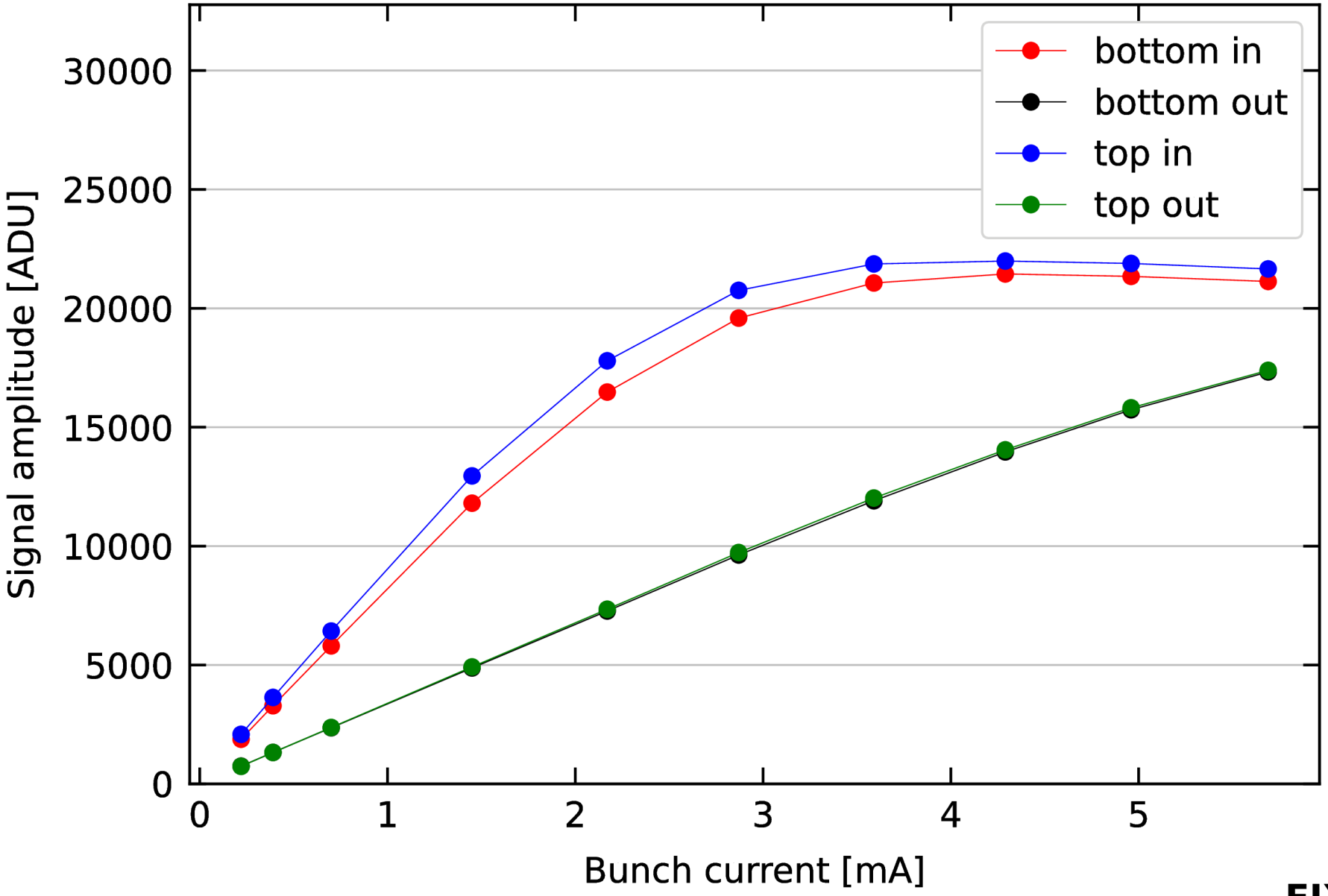
3. Remove: R58, R84 49.9 ohm (excess termination)
   Replace: 100 ohm

4. Remove: R72, R96 49.9 ohm (extra termination)
   Replace: DNP

5. Remove R71, R75, R94, R98 33 ohm (excess termination)
   Replace: 100 ohm

Signal amplitude vs bunch current

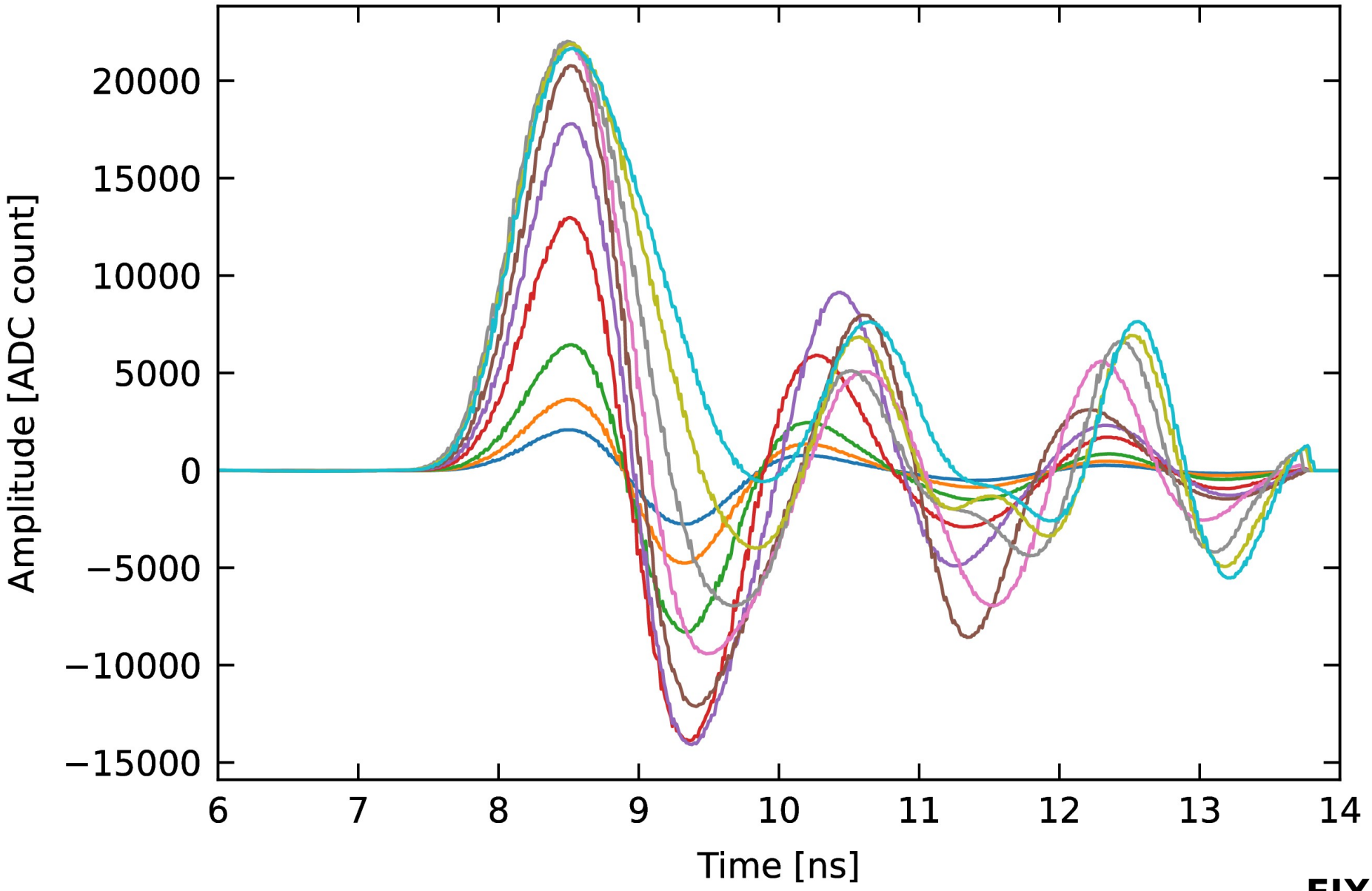
12W (ctactf133), peak-aligned at each current step



FIXED GAIN

Waveforms

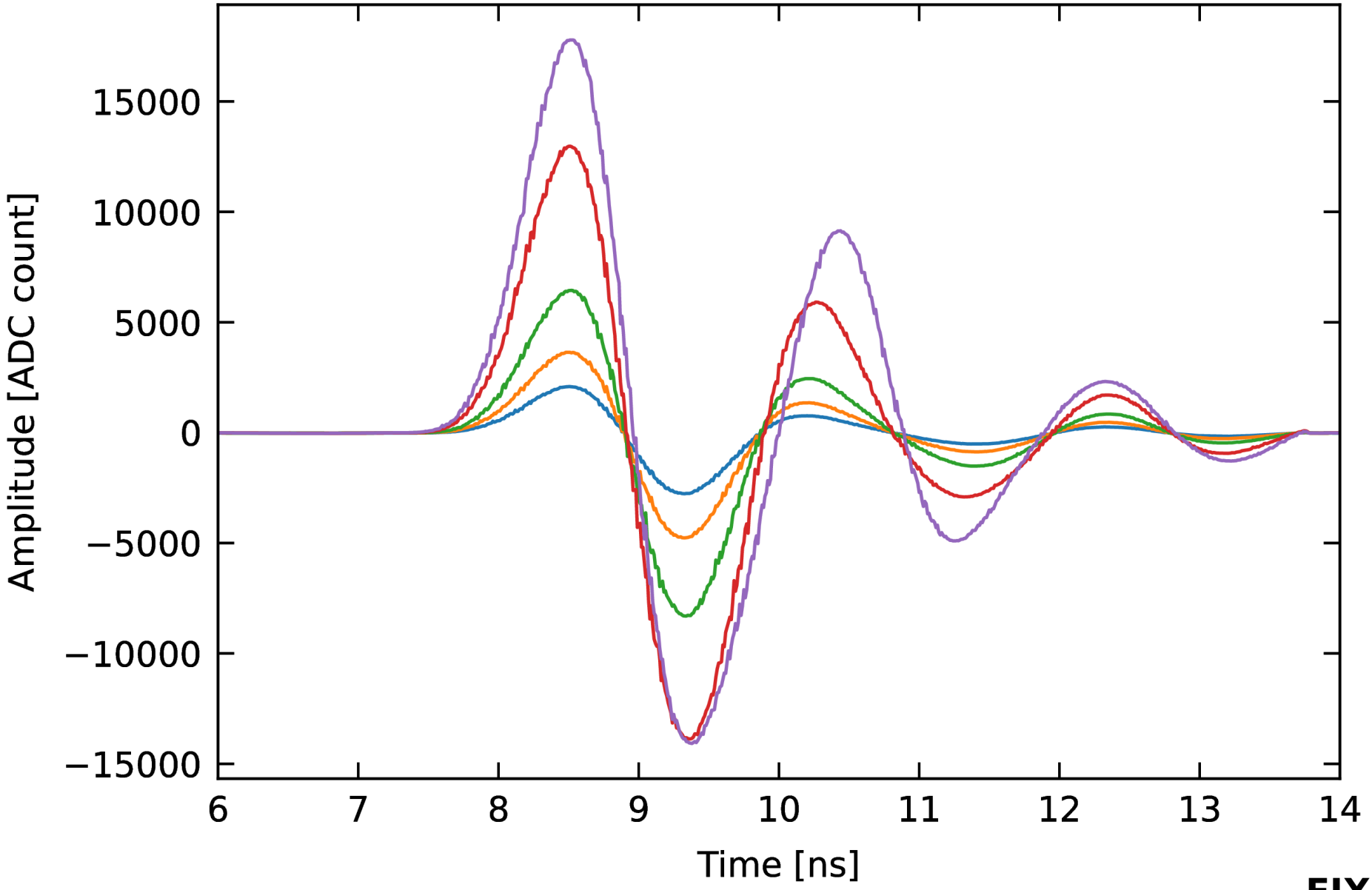
bot in



FIXED GAIN

Waveforms

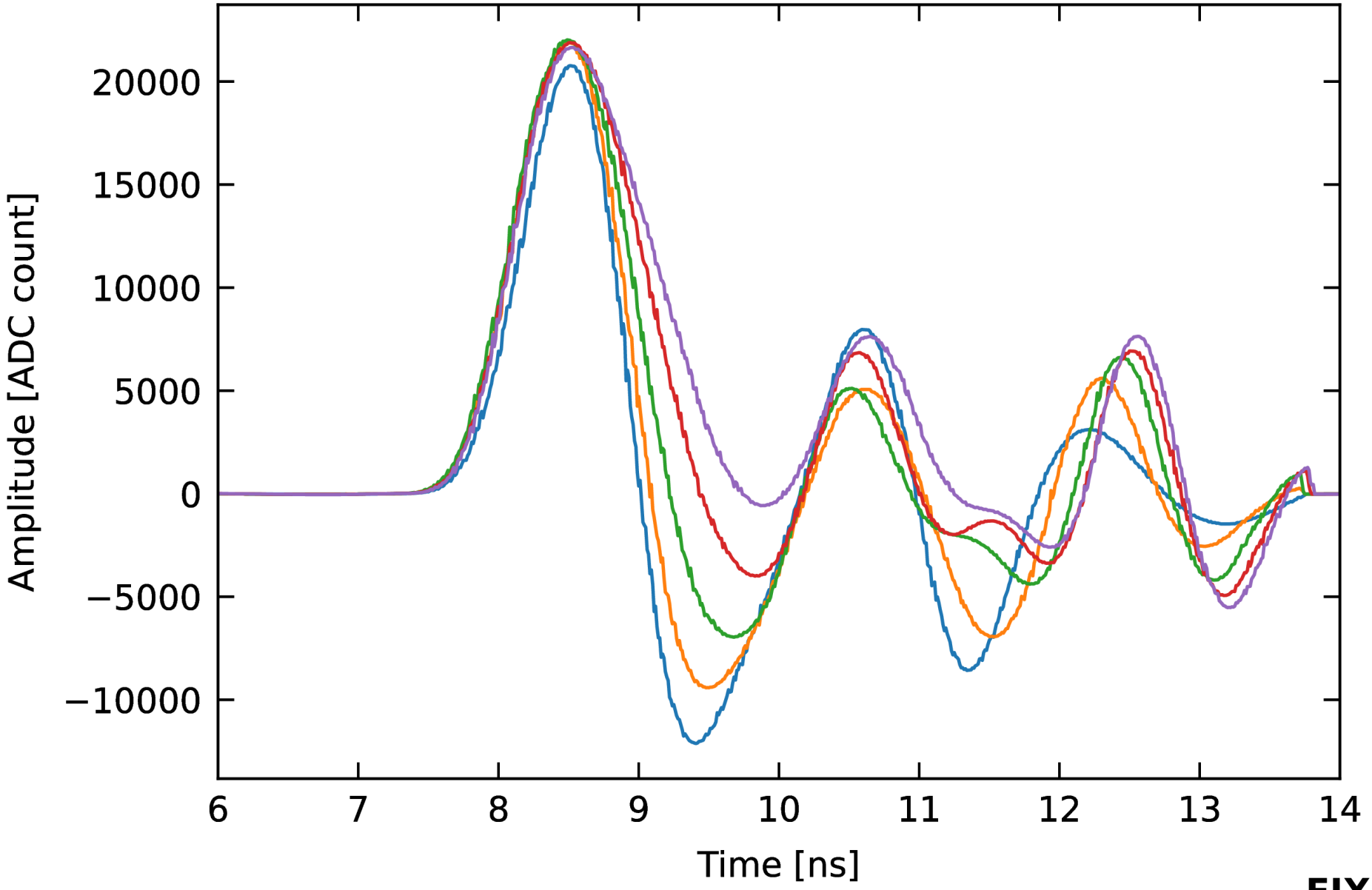
bot in, lowest 5 currents



FIXED GAIN

Waveforms

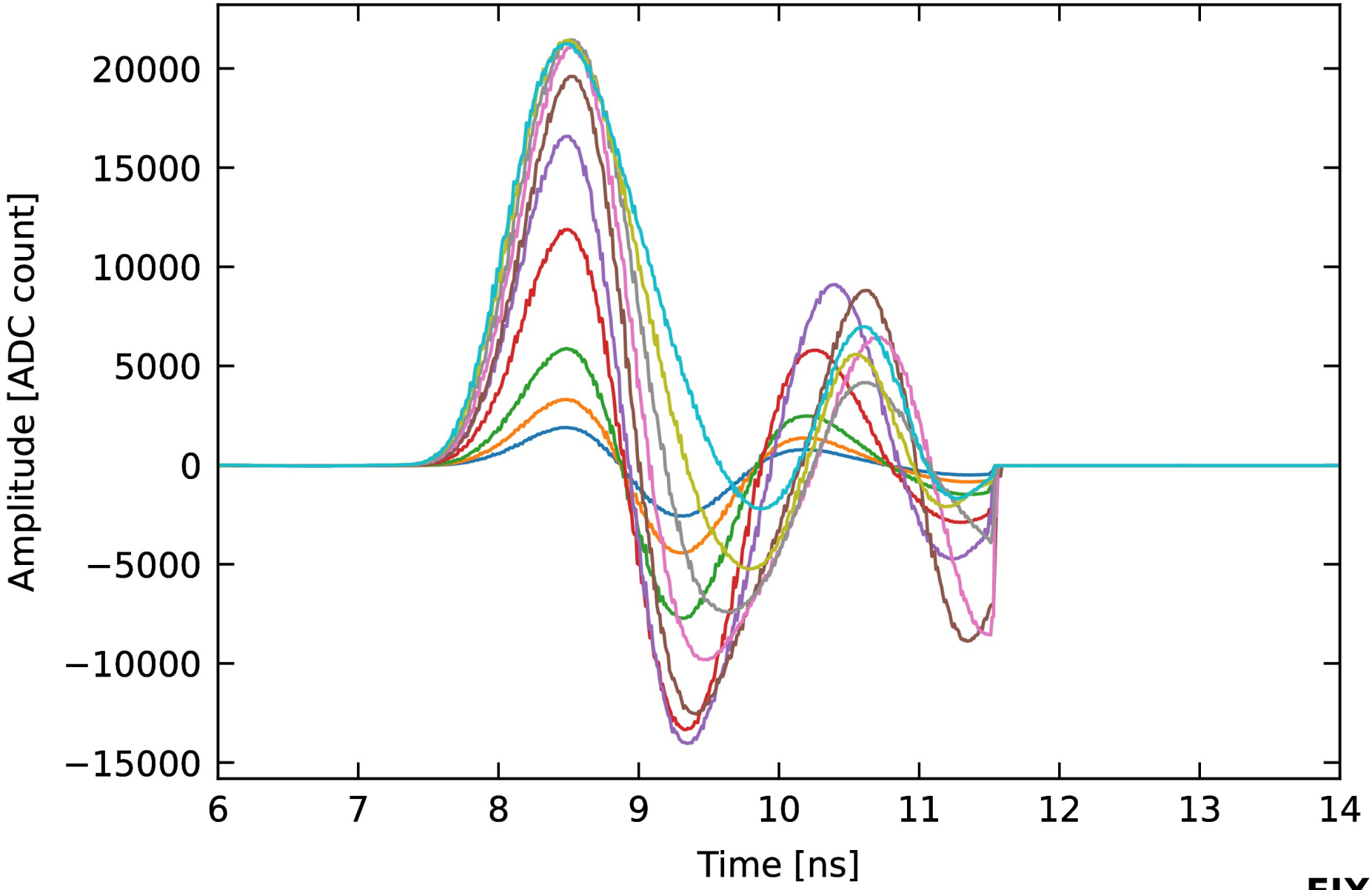
bot in, highest 5 currents



FIXED GAIN

Waveforms

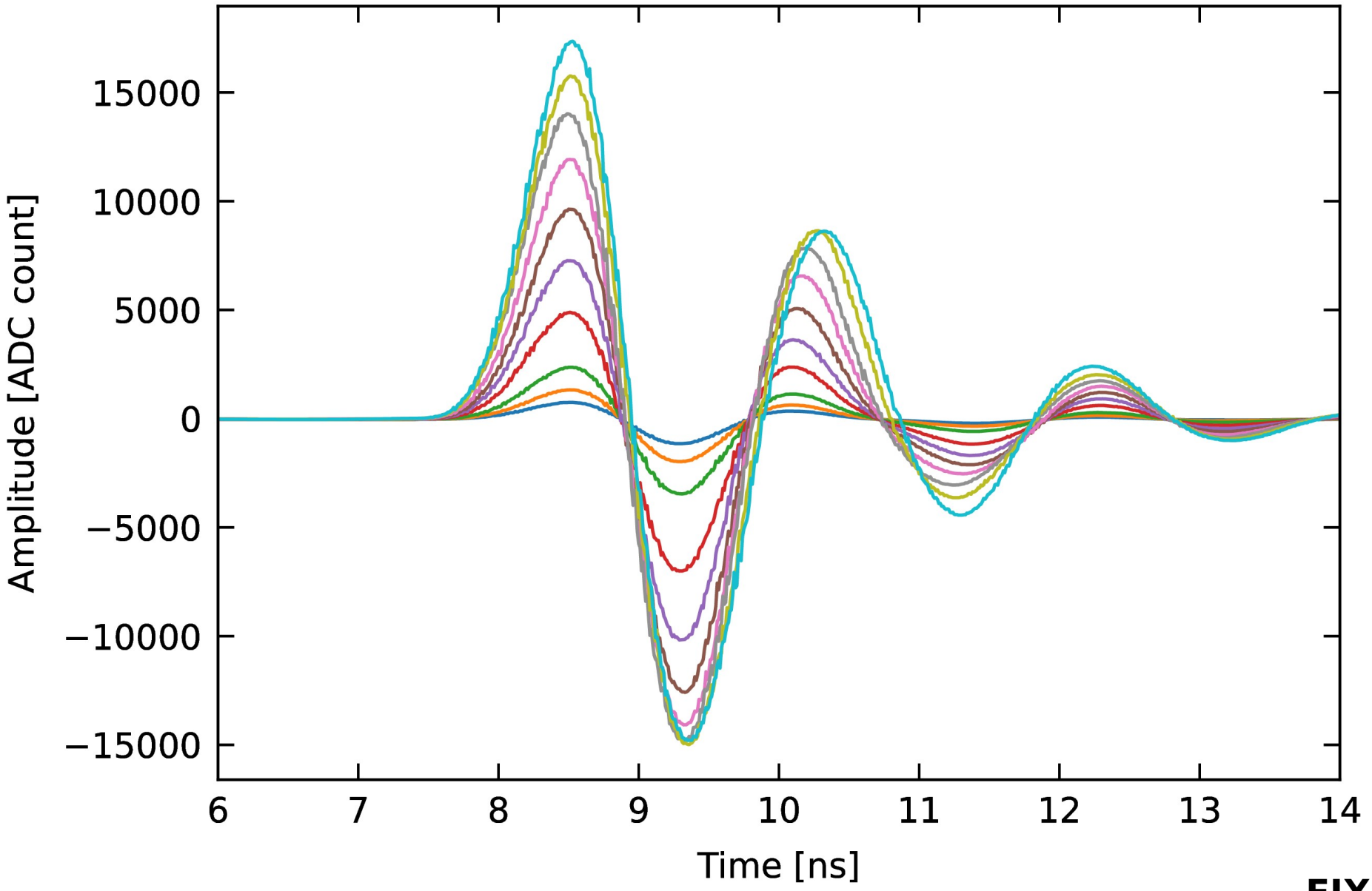
top in



FIXED GAIN

Waveforms

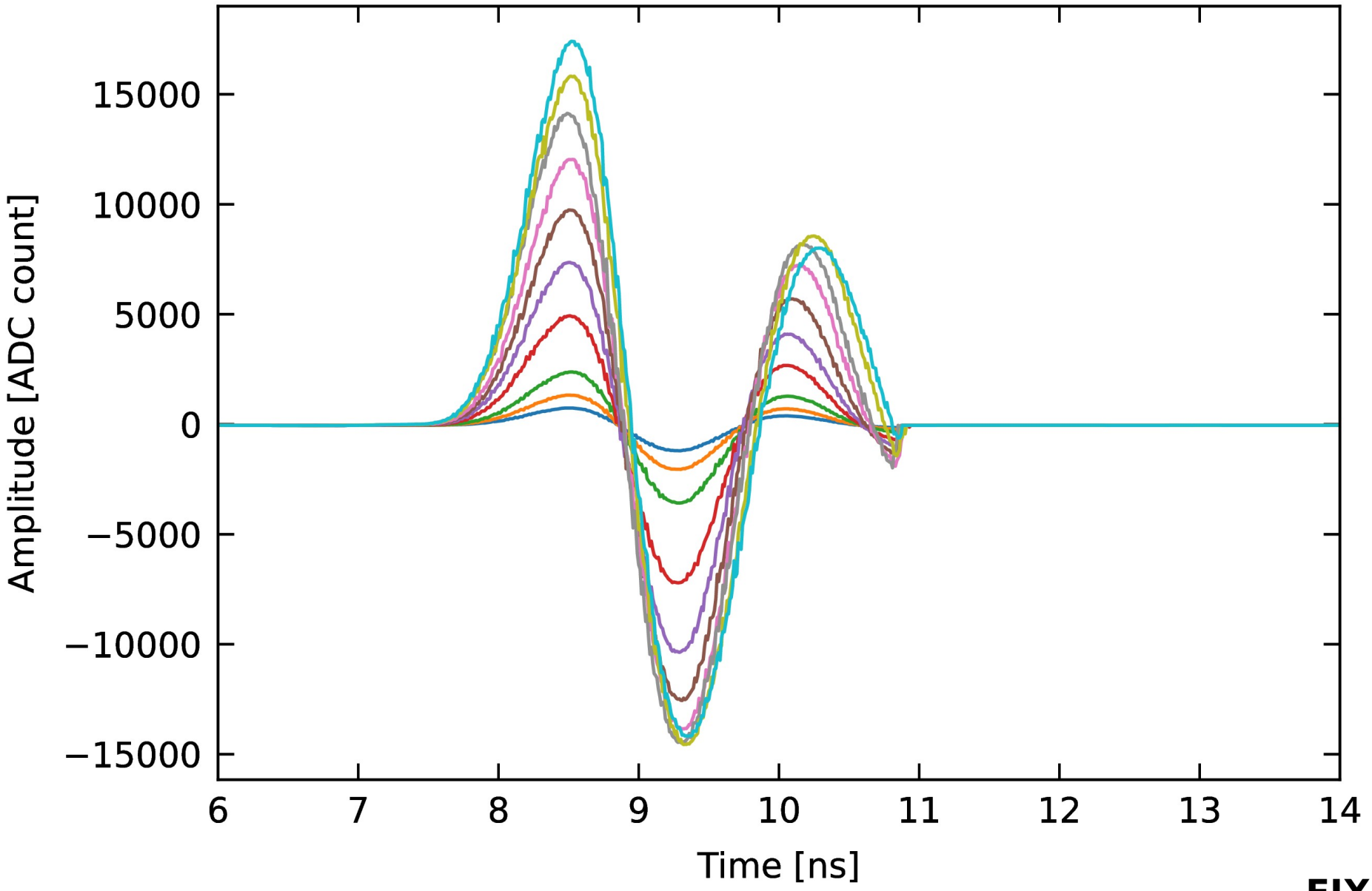
bot out



FIXED GAIN

Waveforms

top out



FIXED GAIN

Waveforms data

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FIXED GAIN

Additional materials