DMEM rise time improvements and coldbox results

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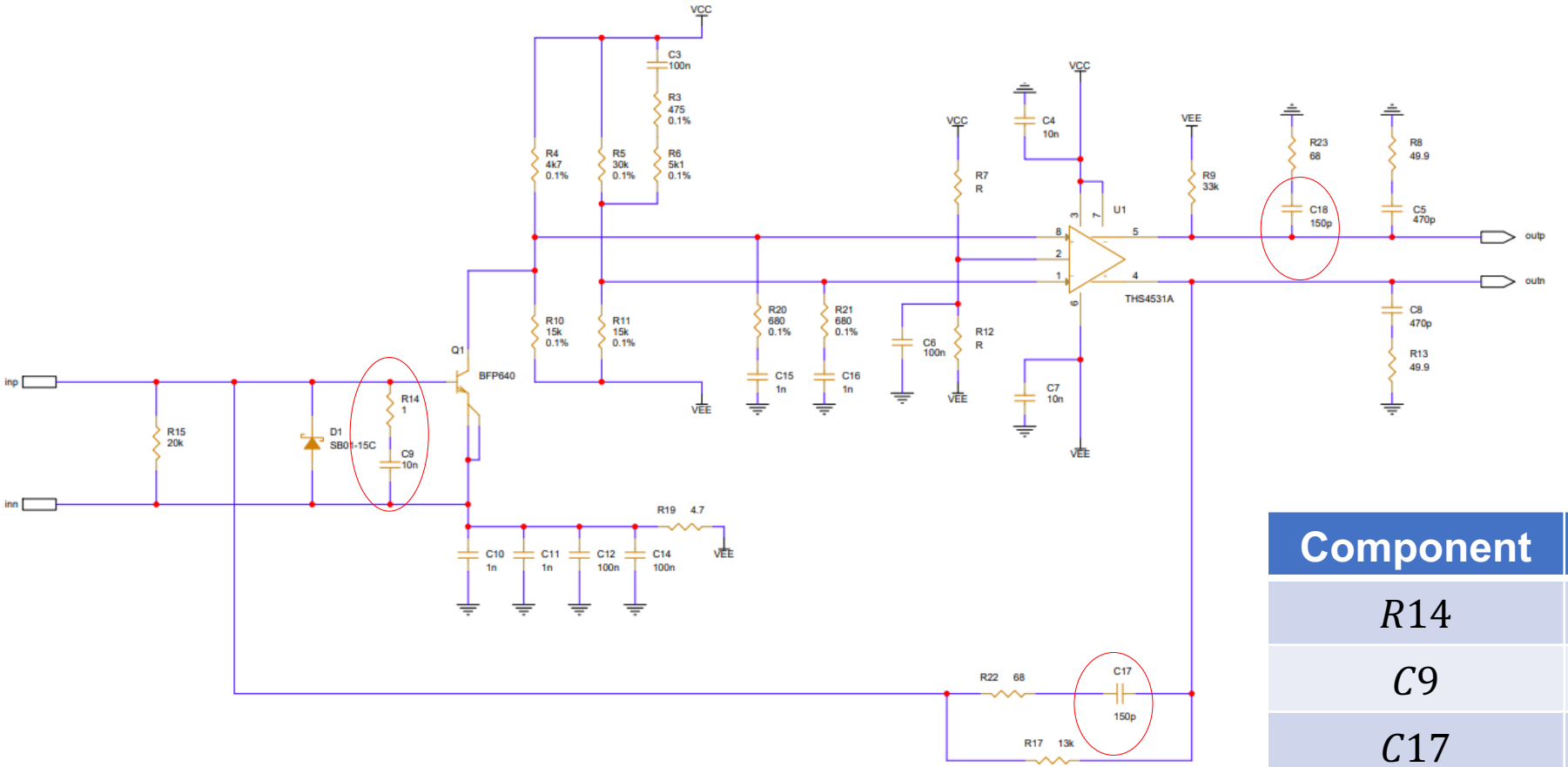
Overview

- Comparison of the electronic response and performance of the DMEM board (HD-membrane) equipped with the original amplifier and a new one
- Analysis of data taken in Bicocca laboratories (LN2)
- And at the VD Coldbox (LAr)

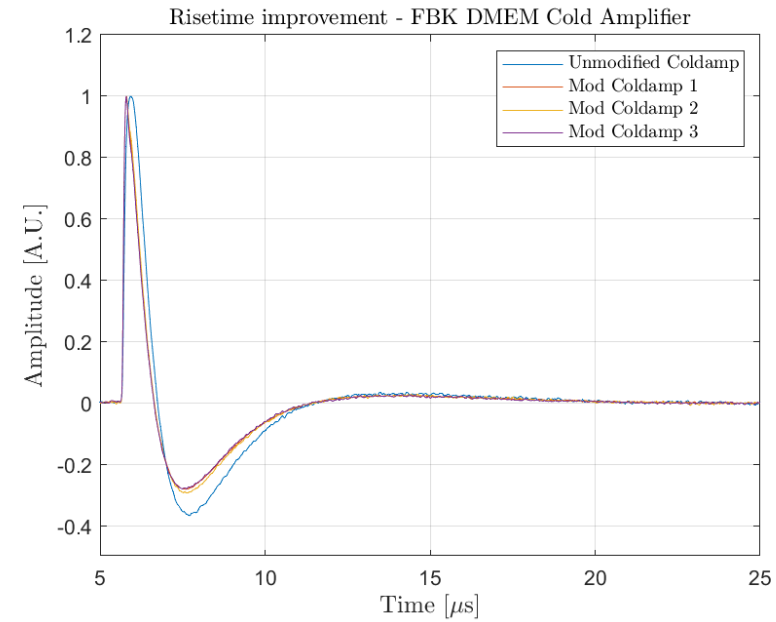
Previous works (April Coldbox) here:
https://indico.fnal.gov/event/64355/ and https://indico.fnal.gov/event/64586/ (Federico'spresentations)

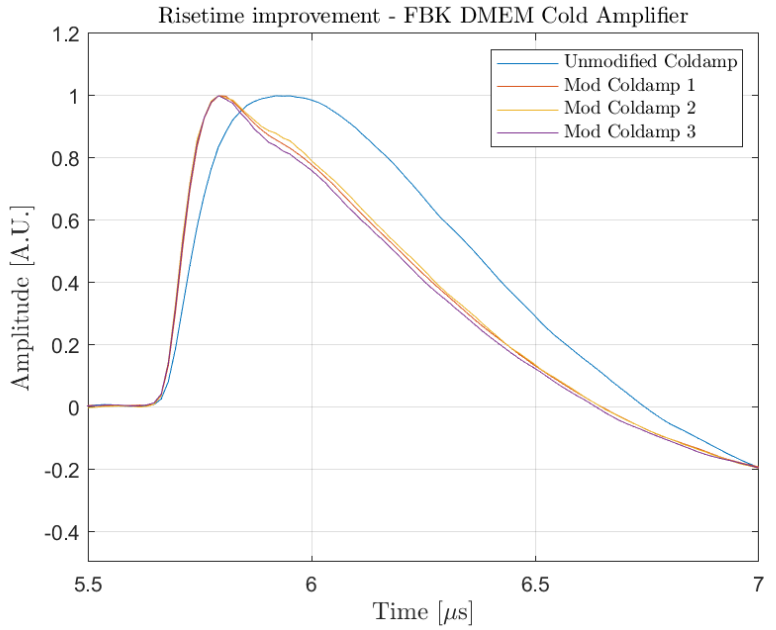
Modifications



Component	Original	Modified
$R14$	1Ω	3Ω
$C9$	$10nF$	$3nF$
$C17$	$150pF$	$68pF$
$C18$	$150pF$	$68pF$

Rise time


Risetime improvement - FBK DMEM Cold Amplifier
Unmodified Coldamp
Mod Coldamp 1
Mod Coldamp 2
Mod Coldamp 3
Amplitude [A.U.]
Time [μs]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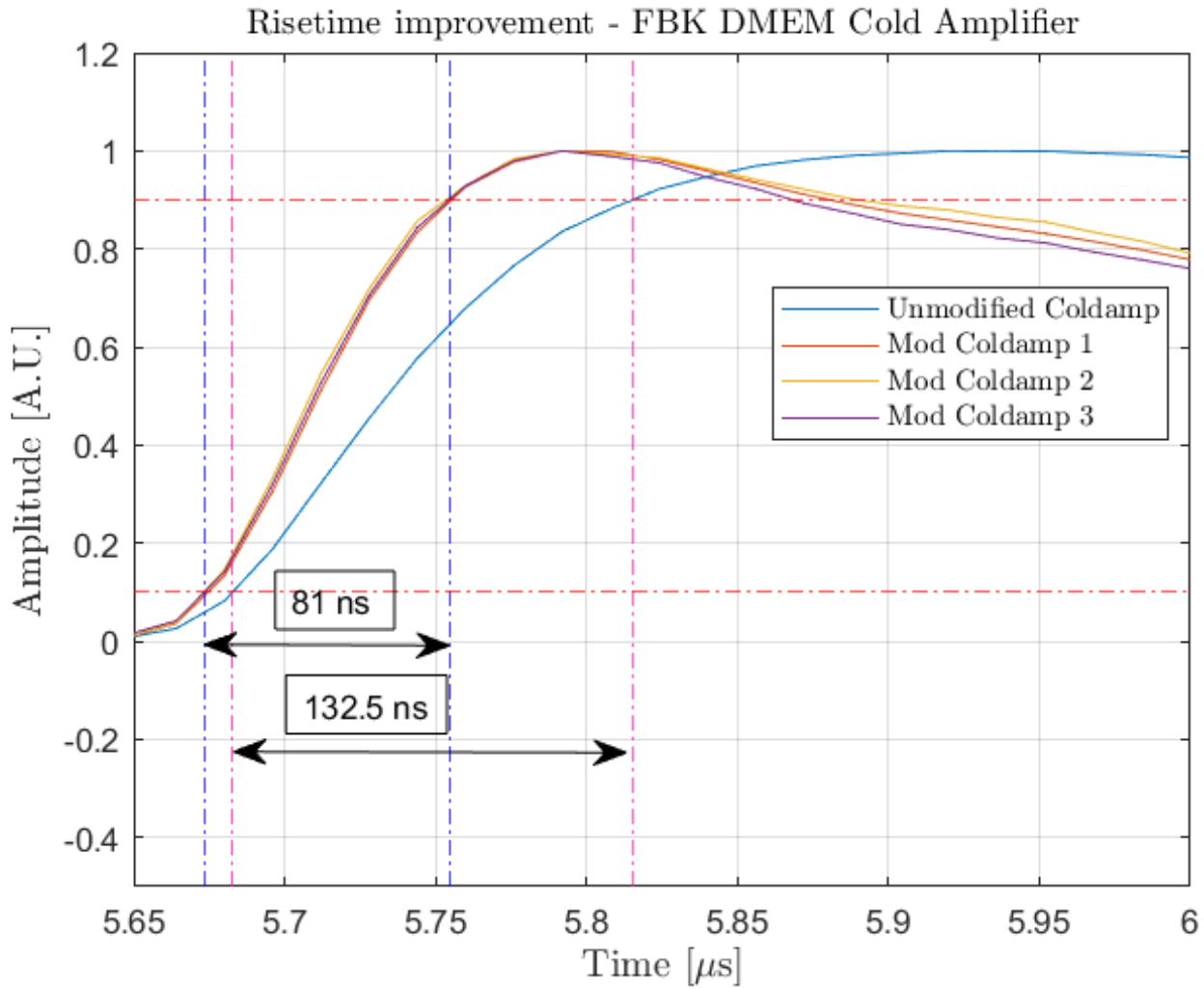
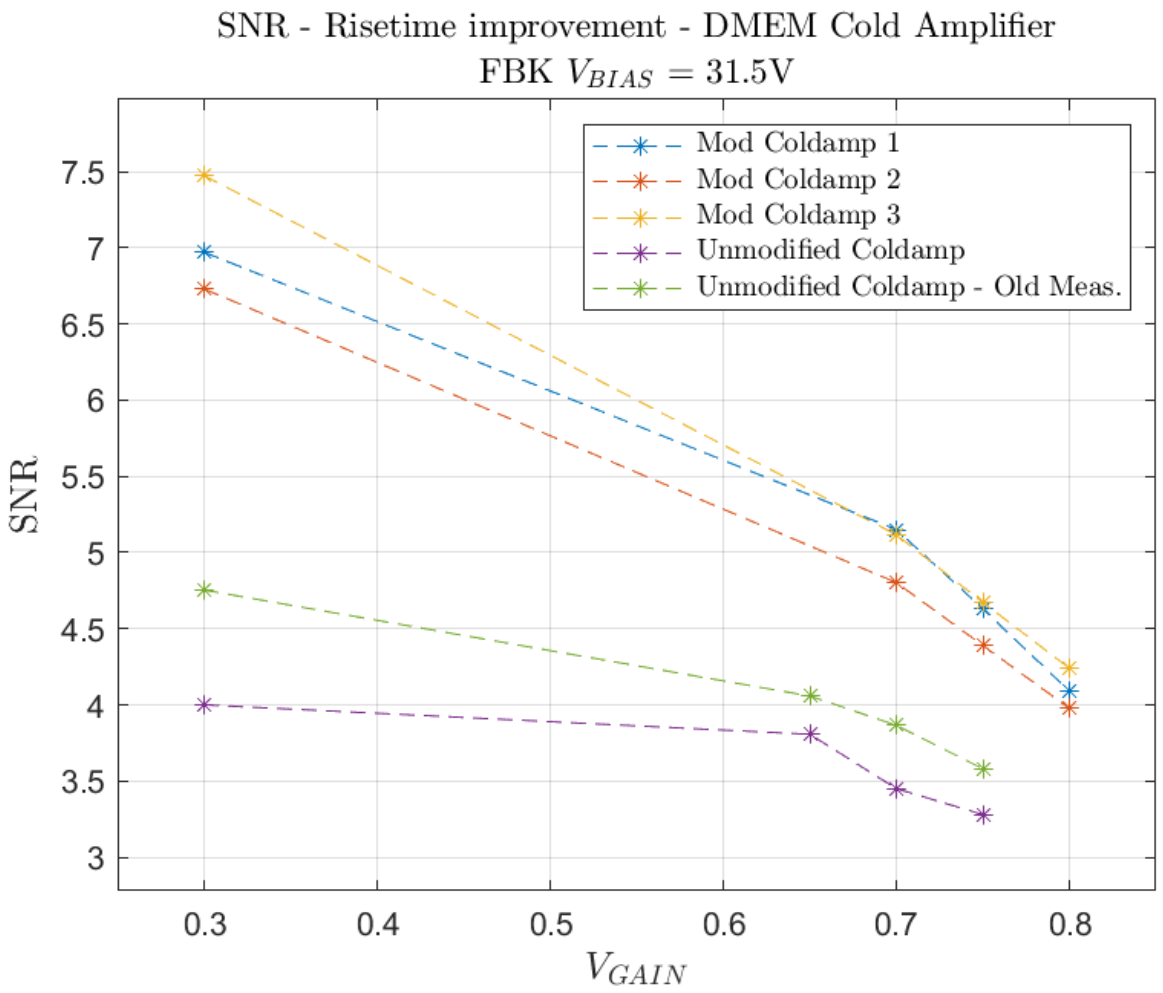
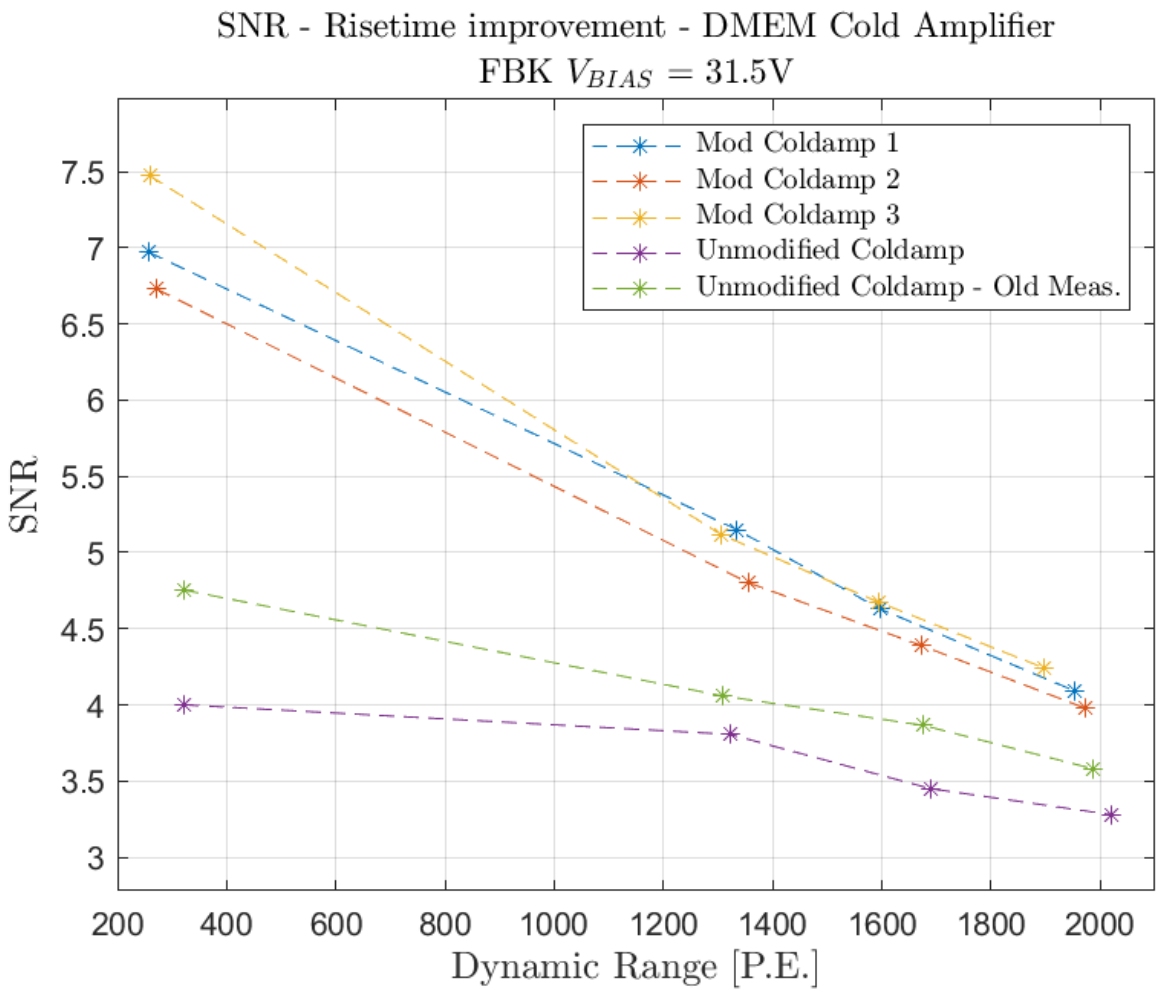

Risetime improvement - FBK DMEM Cold Amplifier
Unmodified Coldamp
Mod Coldamp 1
Mod Coldamp 2
Mod Coldamp 3
81 ns
132.5 ns
Amplitude [A.U.]
Time [μs]

SNR - $V_{BIAS} = 31.5V$





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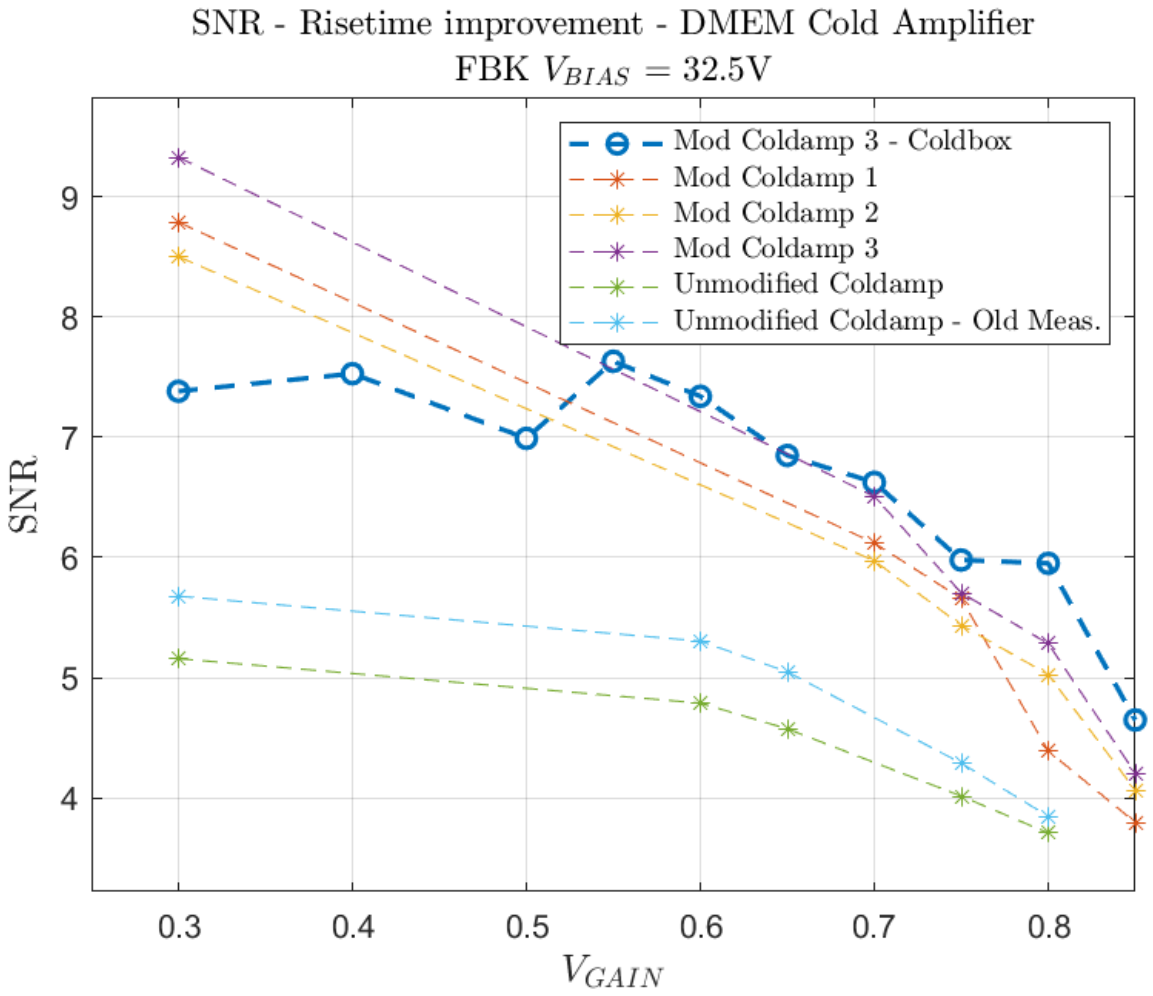
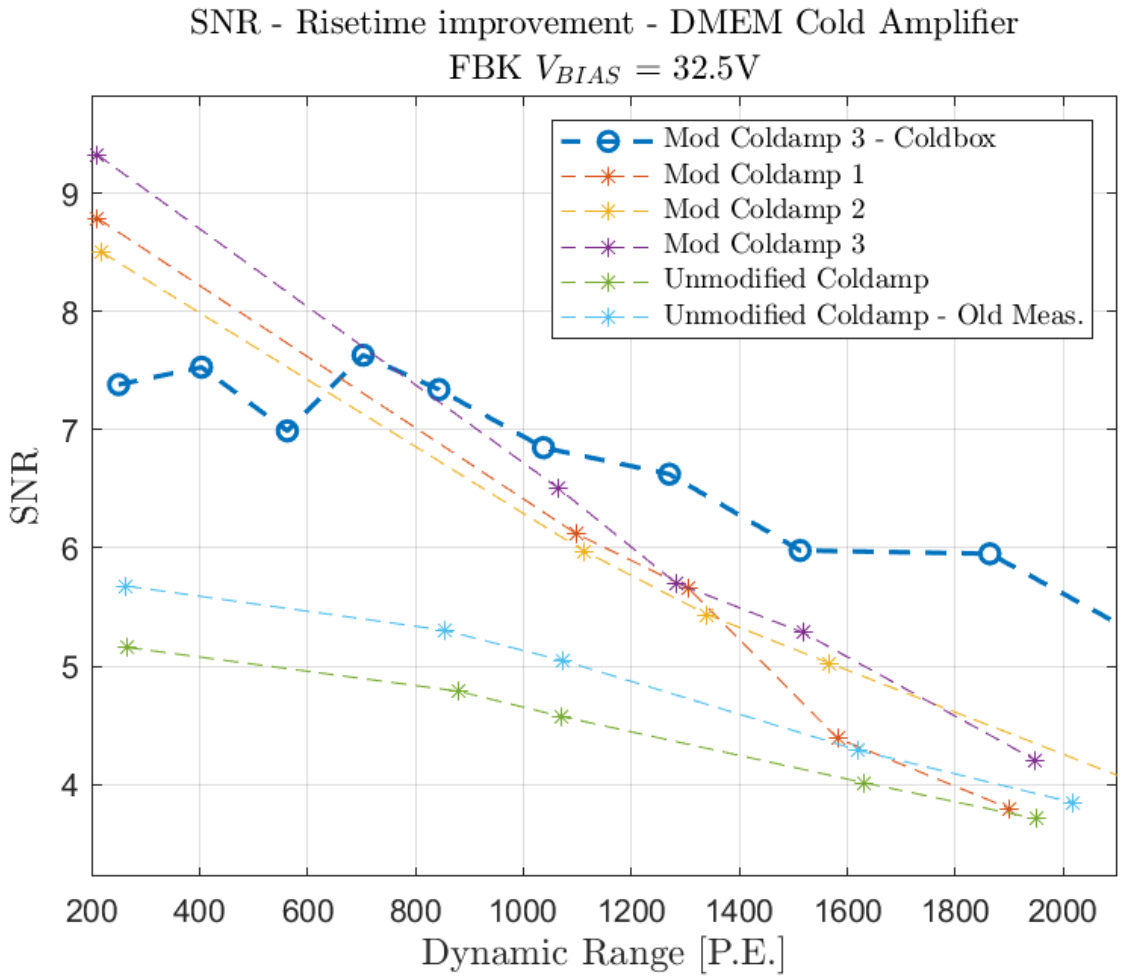
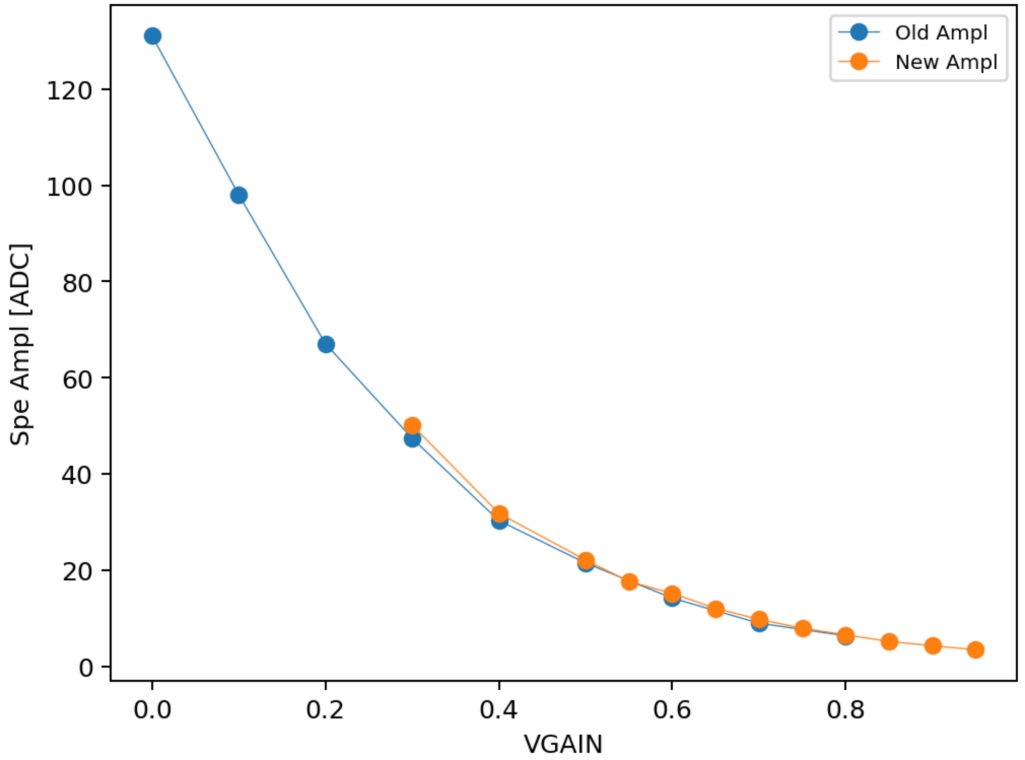


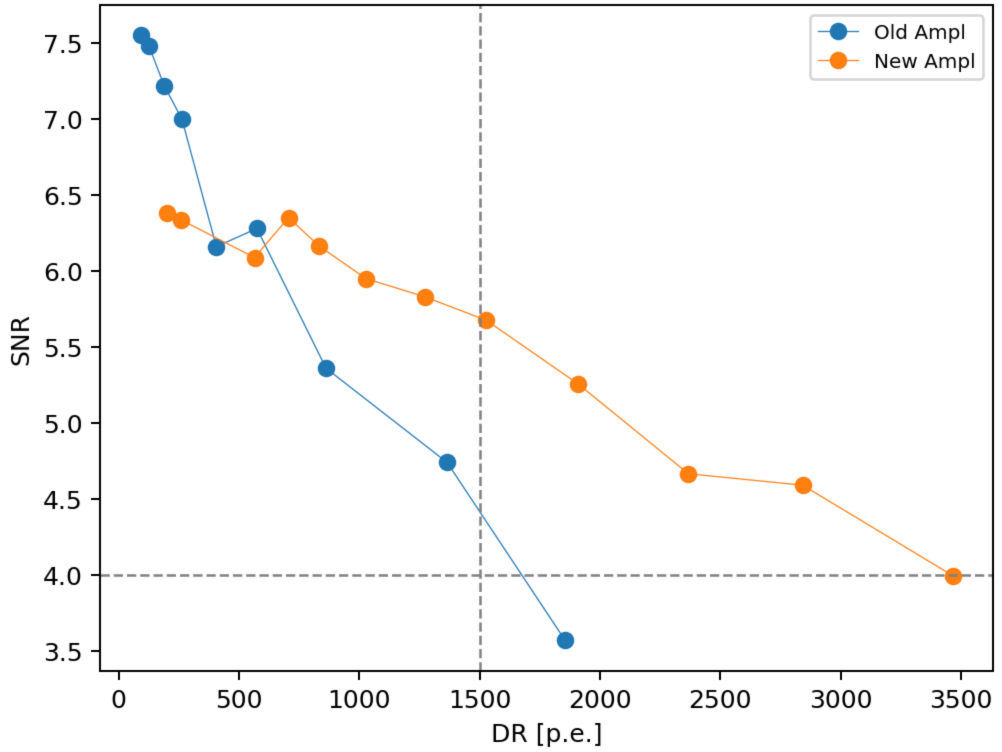


Original vs Modifier Amplifier comparison @ Coldbox

"Old ampl" = Original amplifier @ April Coldbox
"New ampl" = Modified amplifier @ June Coldbox

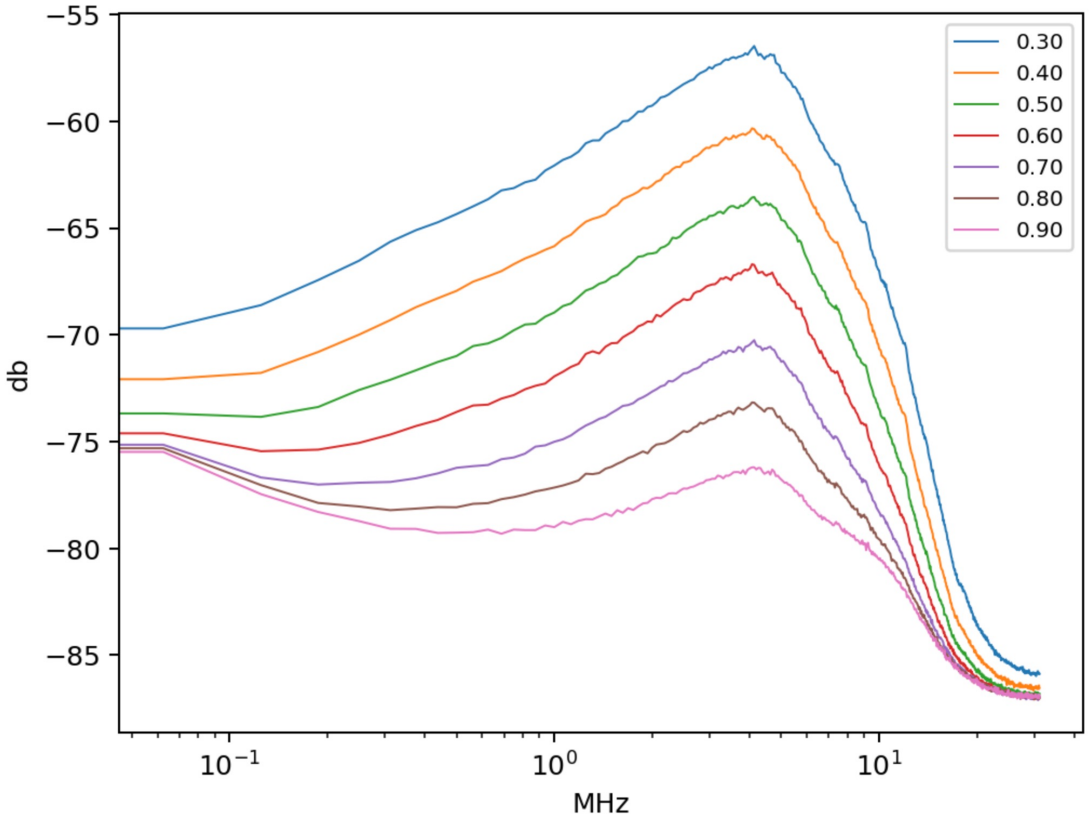
52 tick integration window for "Old ampl"
21 tick integration window for "New ampl"
Cannot use the same for the different rise/fall times





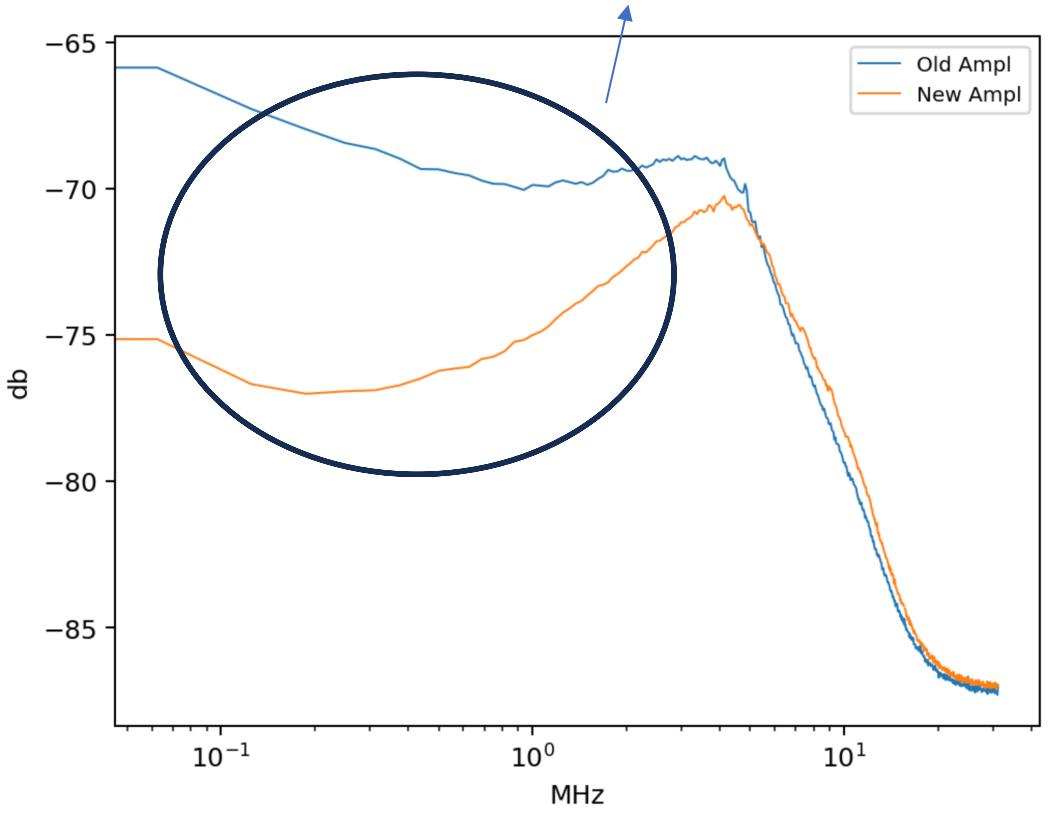
Original vs Modifier Amplifier comparison @ Coldbox

Noise FFT of the modified amplifier for different VGAIN in Daphne



Comparison @ 0.7 VGAIN

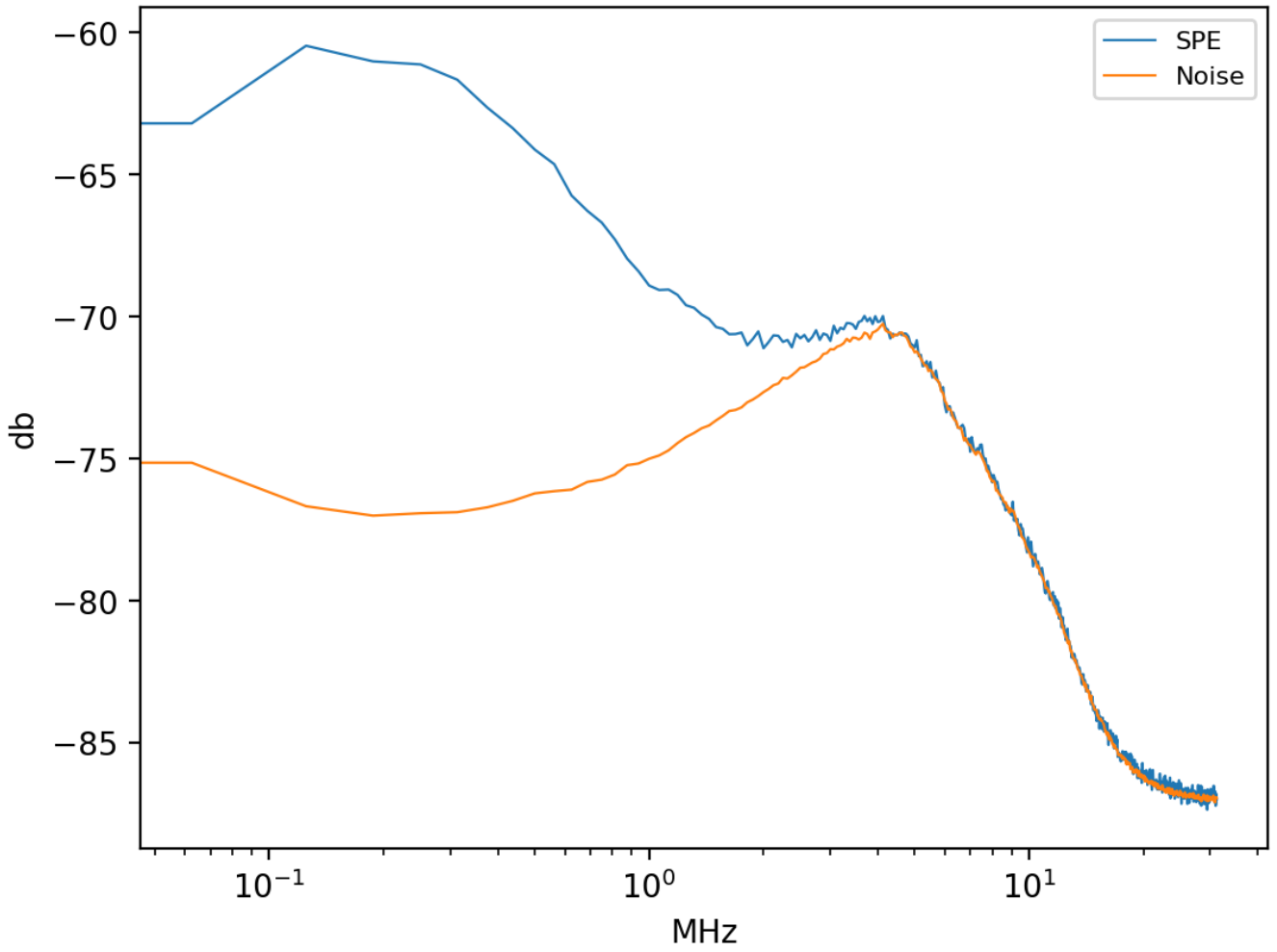
Where we gain in terms of RMS and SNR



Original vs Modifier Amplifier comparison @ Coldbox

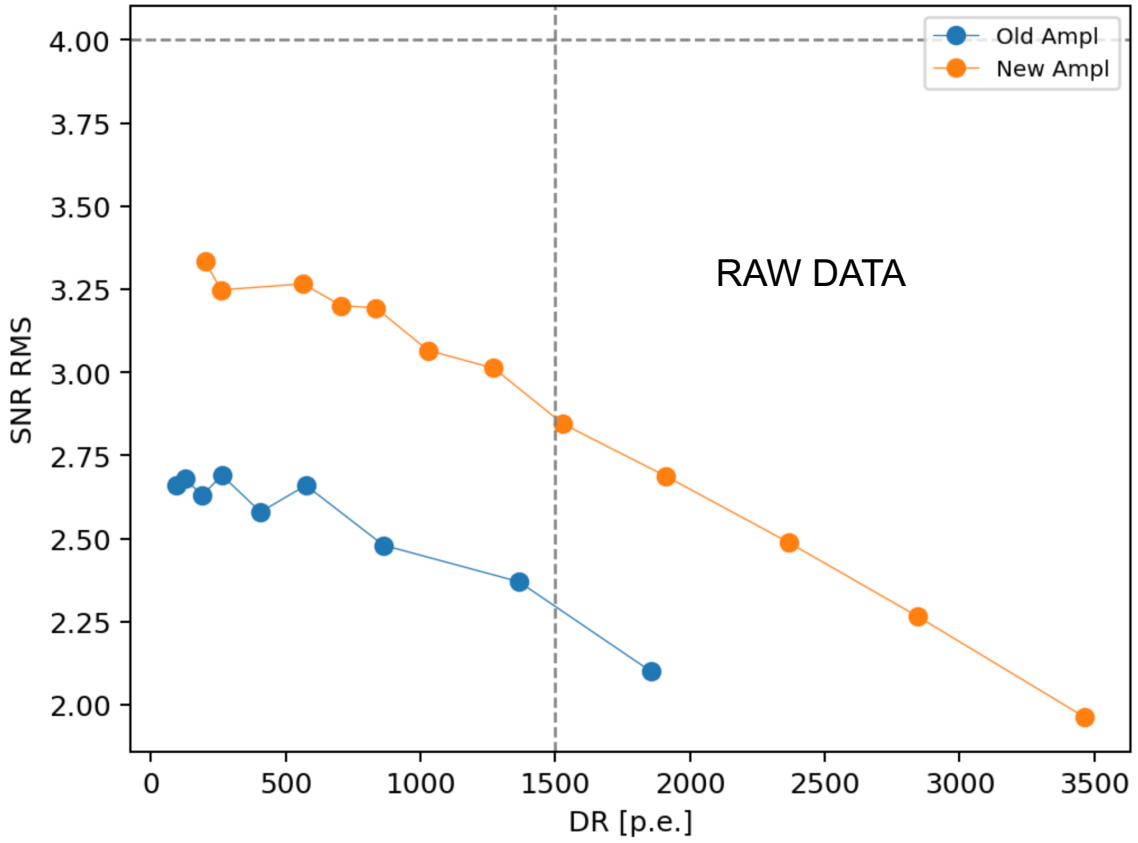
SPE and Noise FFTs
The signal dominates < 2 MHz

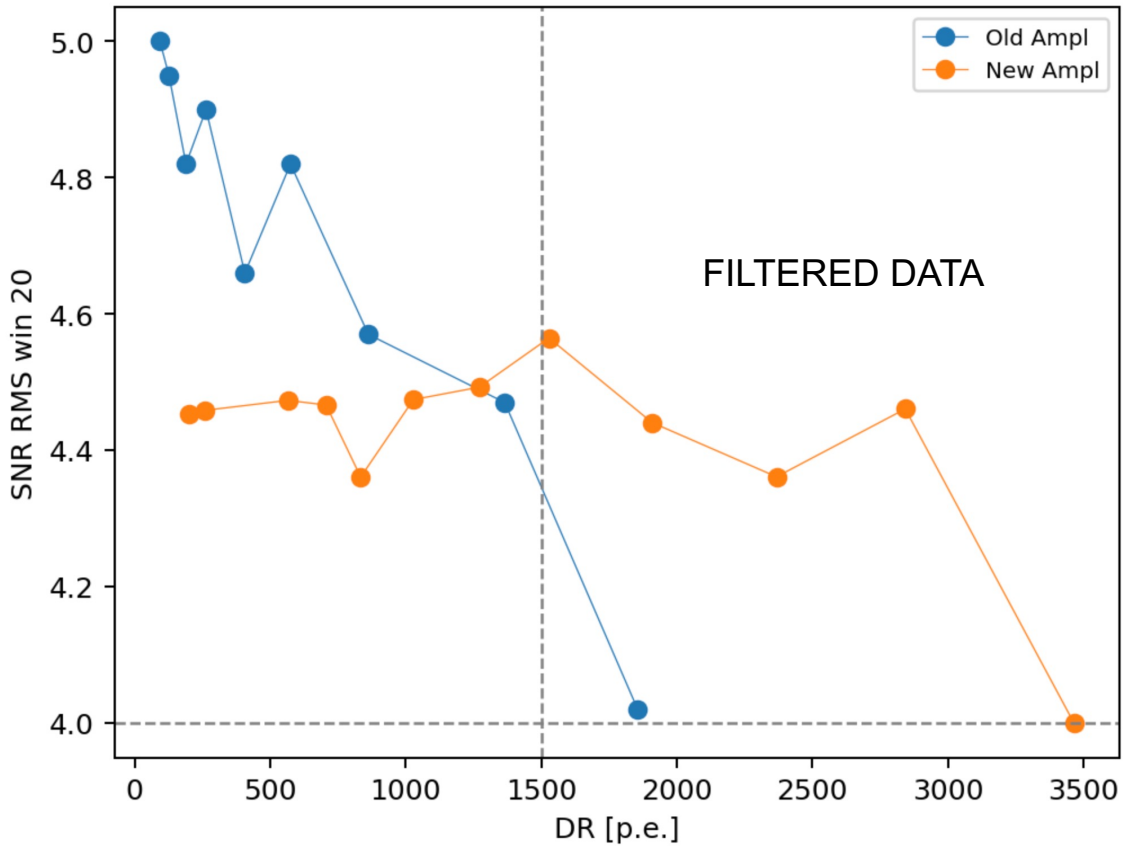
More datails later…



Original vs Modifier Amplifier comparison @ Coldbox

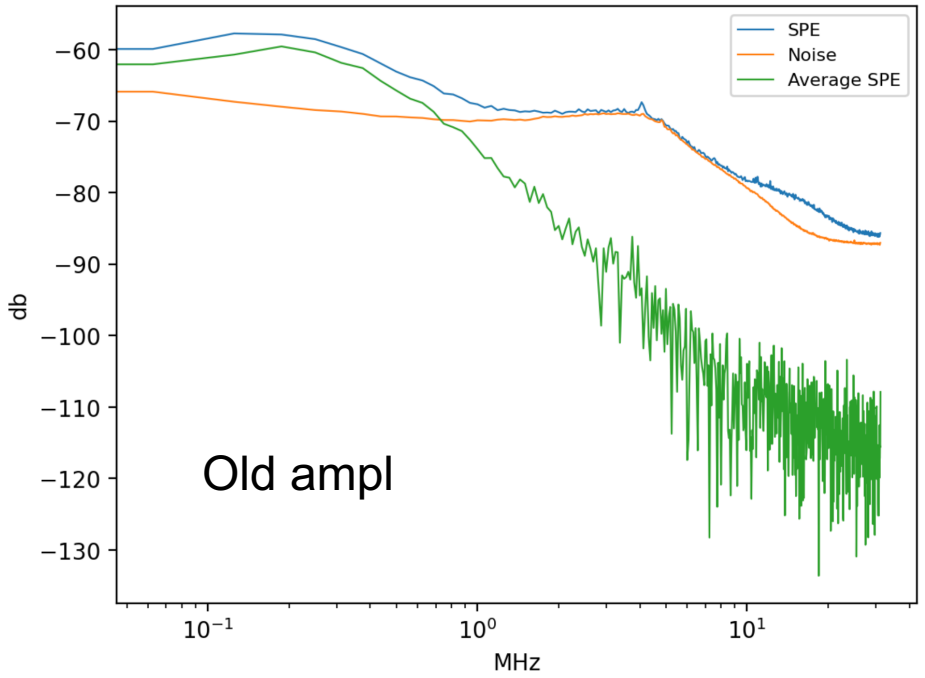
Win 20 = applying a 20 tick moving window
This decreases a lot the amplitude of a fast signal → The old-amplifier signal had more benefits from this filter

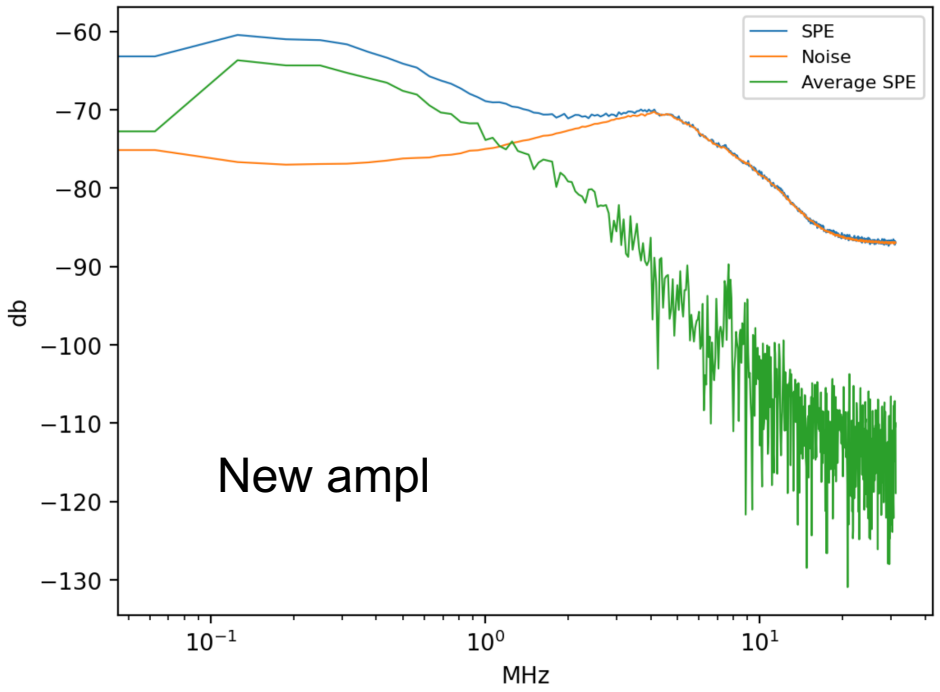


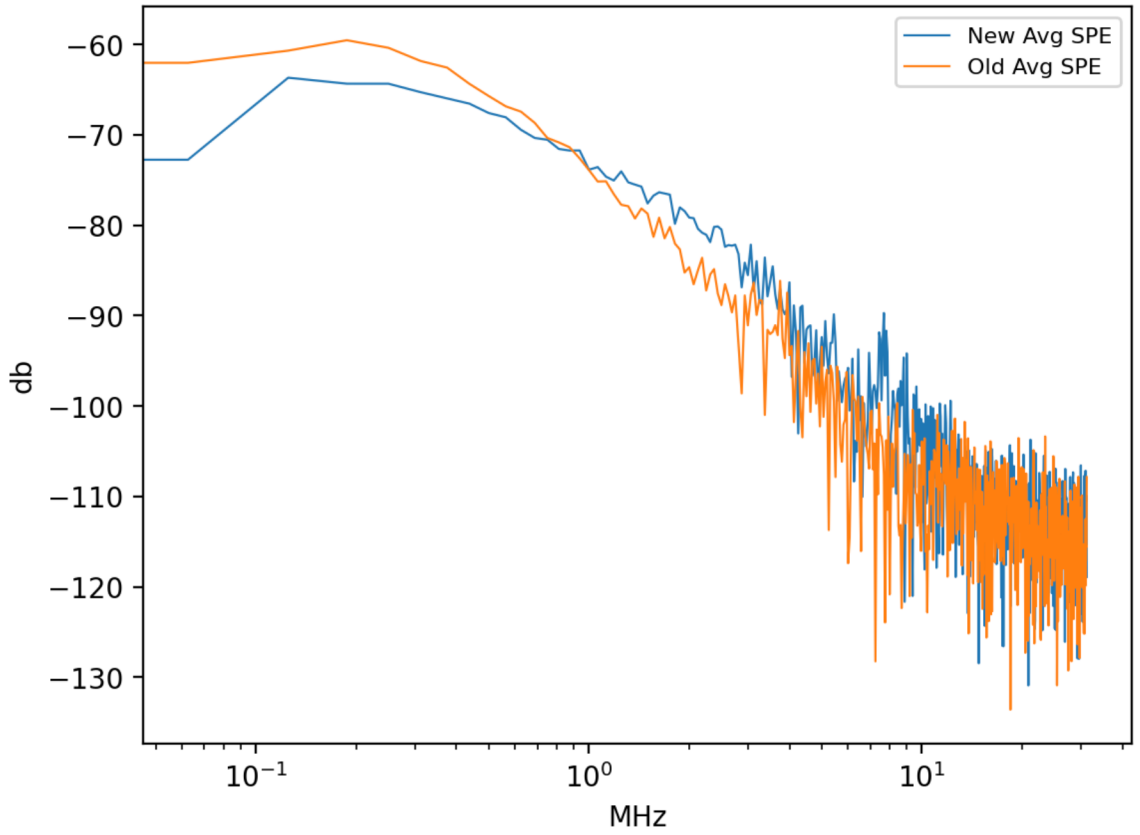


FFT headache :)

SPE: average FFT of SPE-waveform candidates
Average SPE: FFT of the average SPE-waveform







Conclusions

- The modifications lead to a faster rise time ($133 \rightarrow 81$ ns)
- The SNR improved in the range of interest (around 1500 p.e.)
- A faster signal is less afffected by the attenuation (VGAIN) in Daphne
- The FFTs explain where the improvements come from

Backup

Backup

Persistence plots

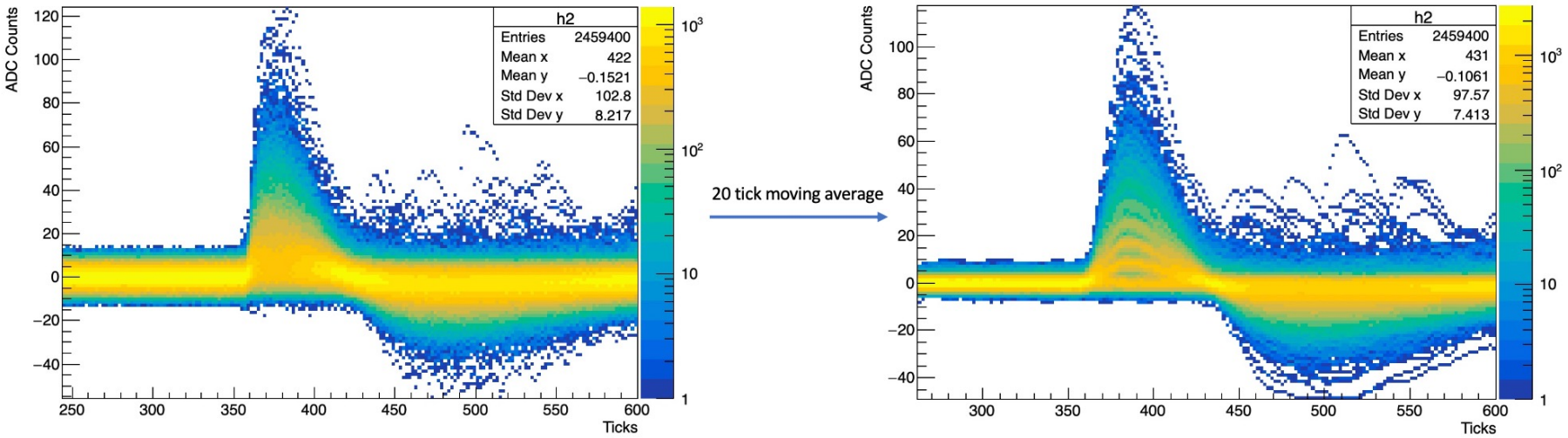
Raw and filtered waveforms

Slide from April coldbox analysis

For all the analyses I requred that all the ticks in the pretrigger fall in the [-1.5 spe ampl;+ 1.5 spe ampl] range

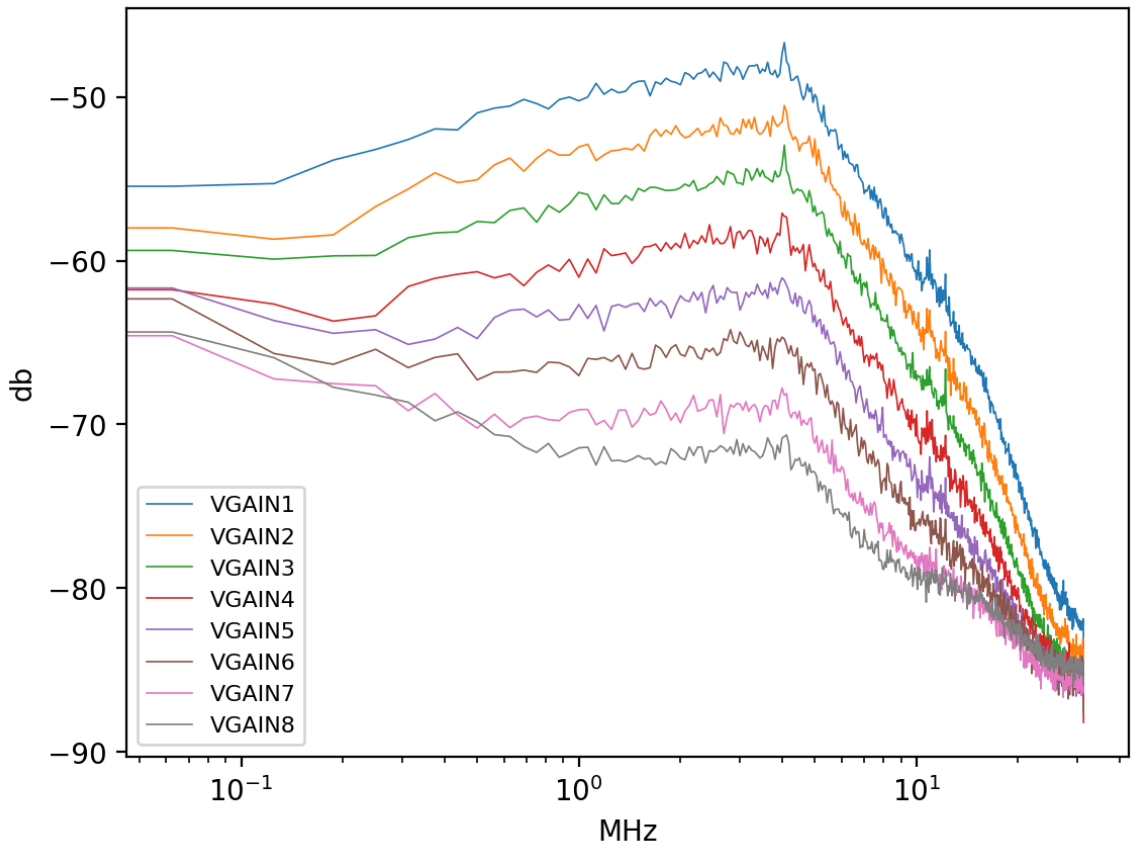
An example from MiB data with VGAIN 0.7:

- DR 1’400 p.e. - SPE ampl 8.9 ADC – SPE undershoot 3 ADC
- SNR: integral = 4.7 – RMS = 2.3 – RMS moving average = 4.6



Backup

Original amplifier @ April CB
FFTs affected by poor statistics



Modified amplifier @ June CB