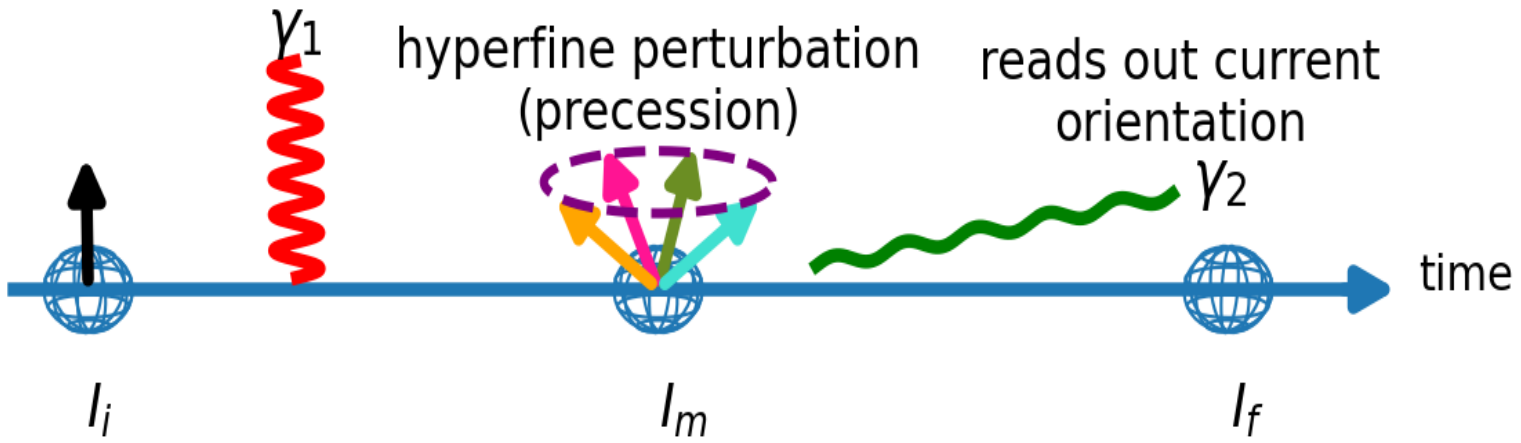
MULTIPAC and PACBIT-
Third Generation TDPAC



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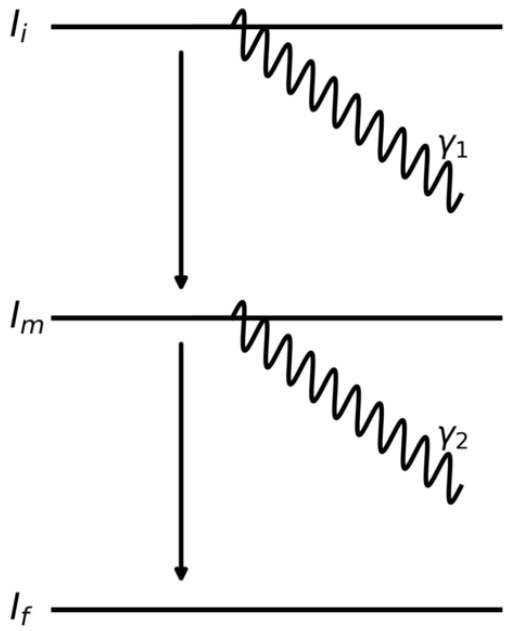
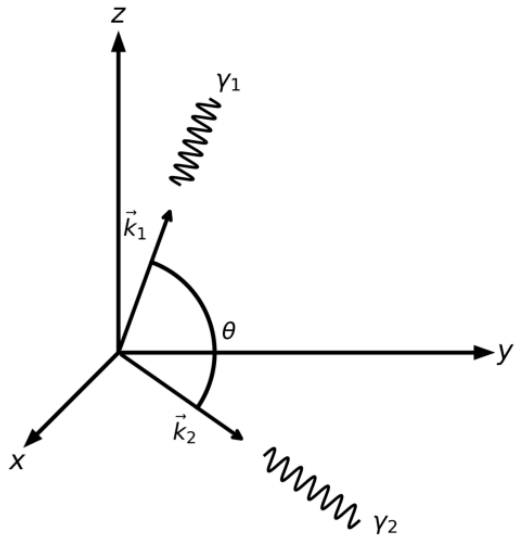
MULTIPAC and PACBit

MULTIPAC
- Combines VSM and TDPAC
- Up to 7.5 T
- 3K to 375K
- Moved to SSP lab in 508 in 2026

PACBit
Main goal a real-time R(t)
- Data acquisition software
- Post processing
- Coincidence search
- R(t) fitting

TDPAC Theory (Basics)

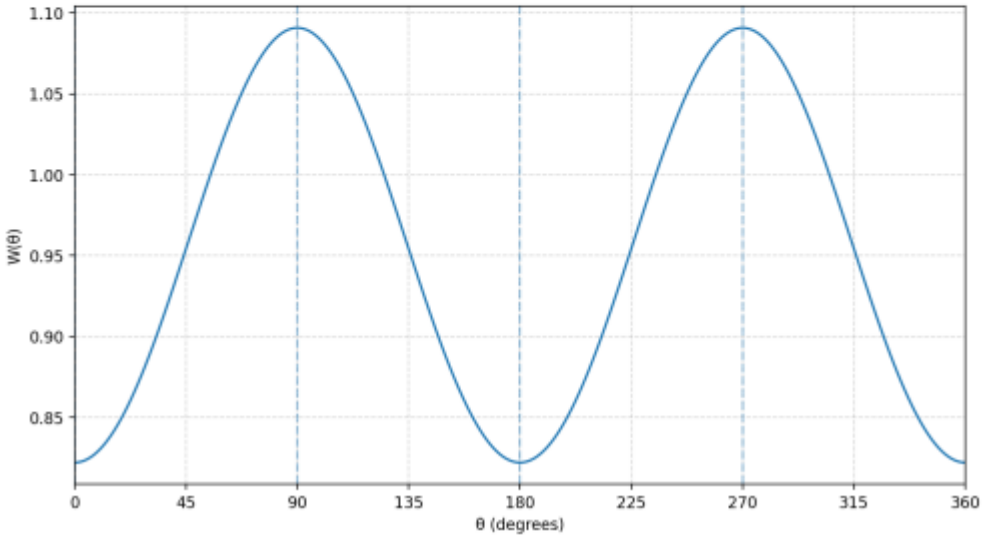


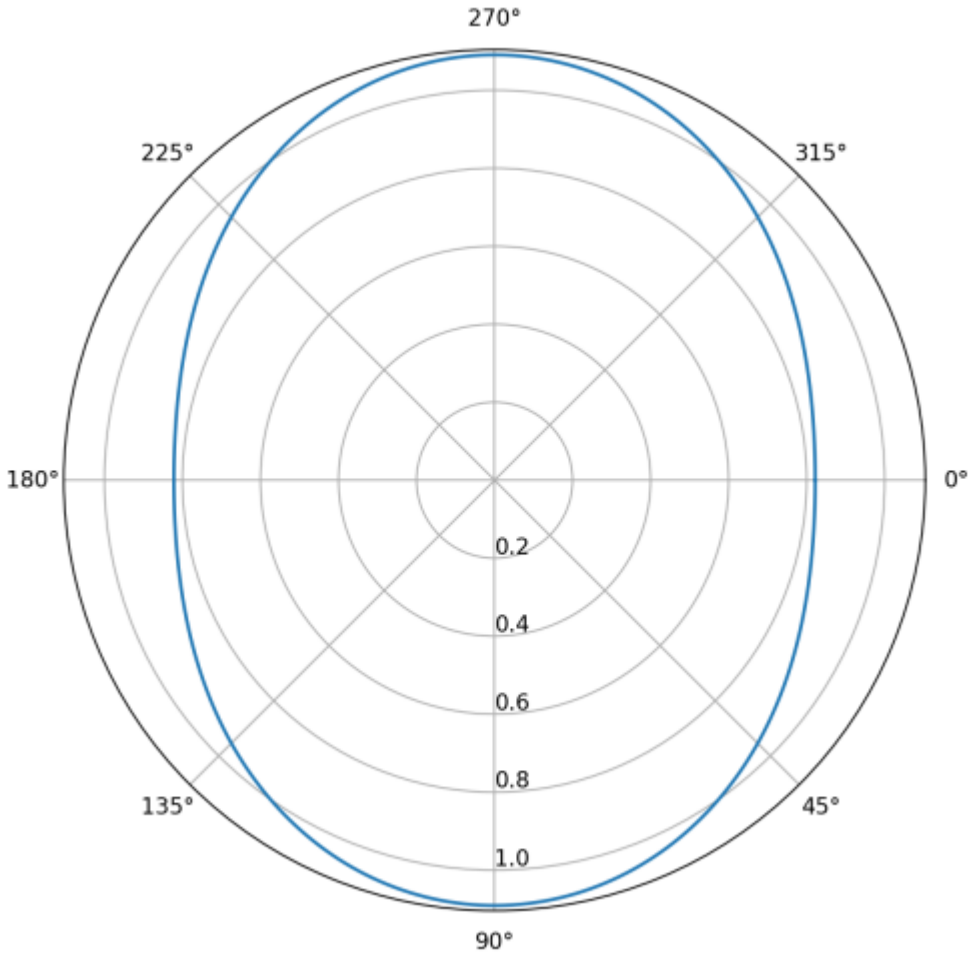


TDPAC Theory (Polycrystal only)

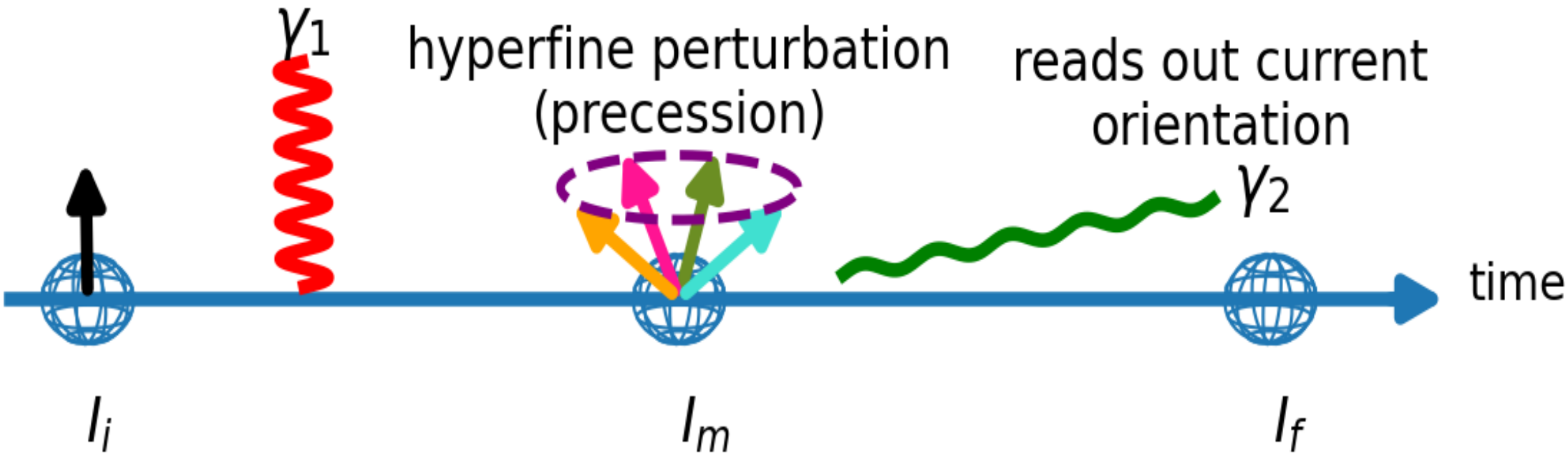
For ^{111m}Cd, the intermediate state a spin of 5/2
Angular Correlation function without perturbation:

$$W(\theta) = 1 + A_{22}P_2(\cos\theta) + A_{44}P_4(\cos\theta)$$





TDPAC Theory (Polycrystal only)



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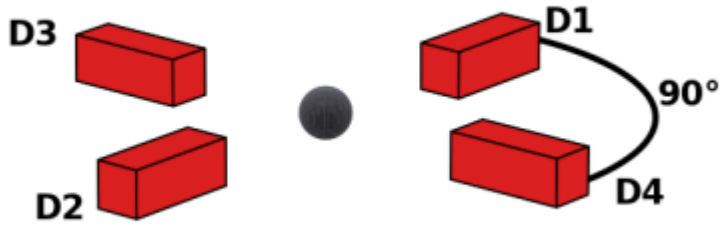
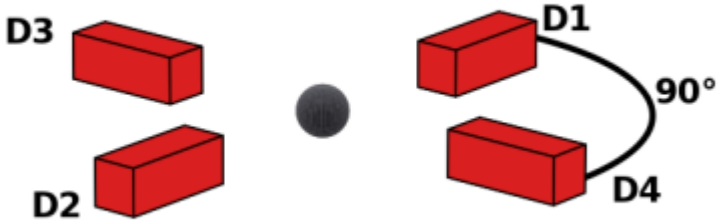


$$R(t) = 2\,\frac{W(180°,t) - W(90°,t)}{W(180°,t) + 2W(90°,t)}$$

Relative Variation

Mean Value

TDPAC Theory (Polycrystal only)



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Relative Variation

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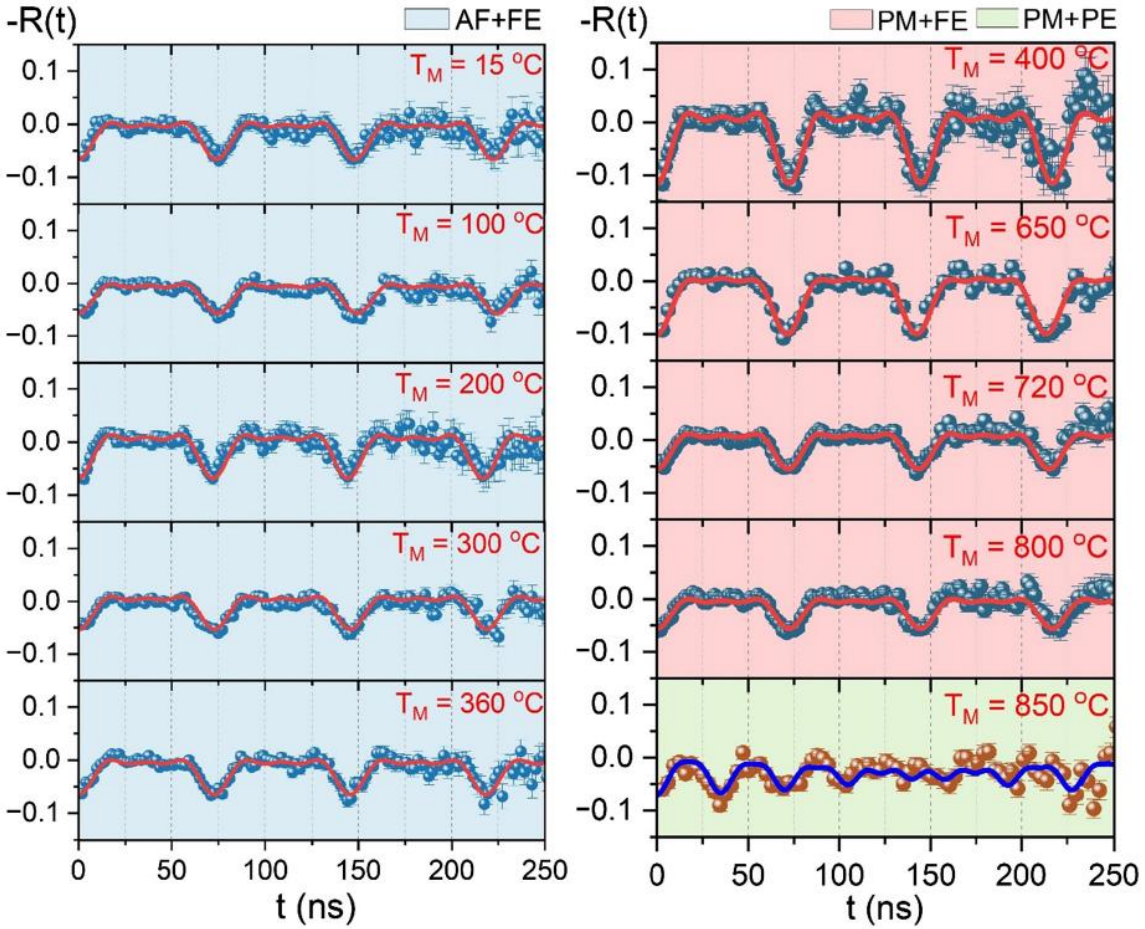
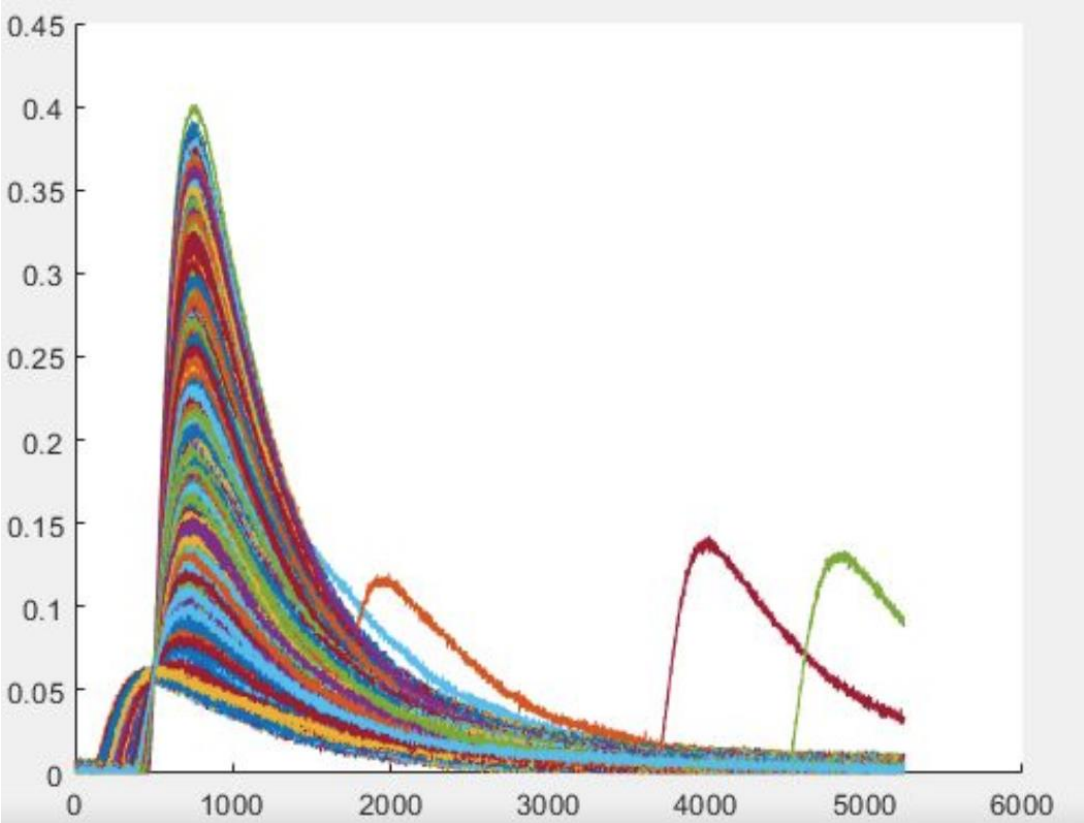


DOI: 10.1103/PhysRevLett.134.216702

Post Processing

Steps:

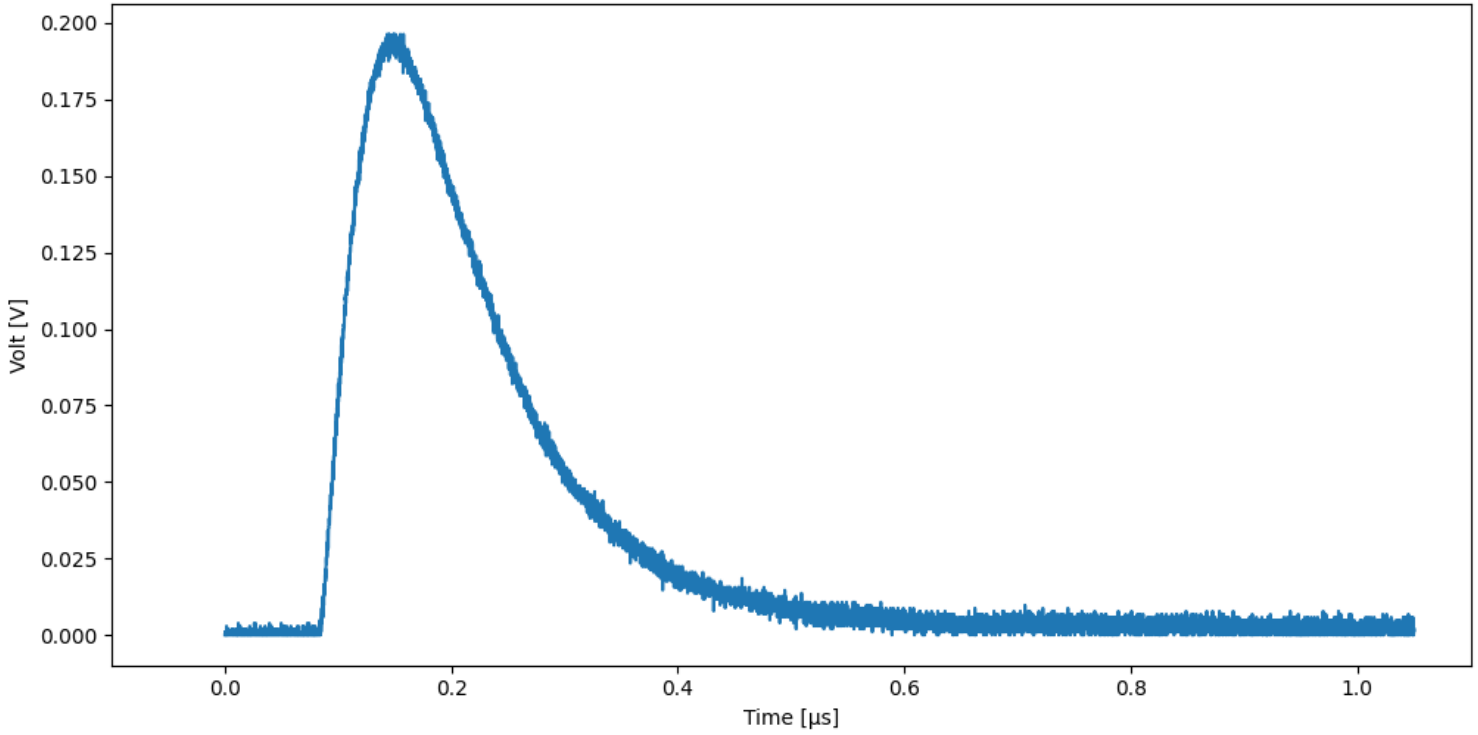
- Smoothing
- Filtering
- Integration
- Rise time determination



U5310A Digitizer

U5310A Digitizer
- 10 Bit resolution
- 10 GS/s sampling rate (0.1 ns)
- 1 Volt range

➔ 0.001 V quantisation step



U5310A Digitizer

U5310A Digitizer
- 10 Bit resolution
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- 1 Volt range

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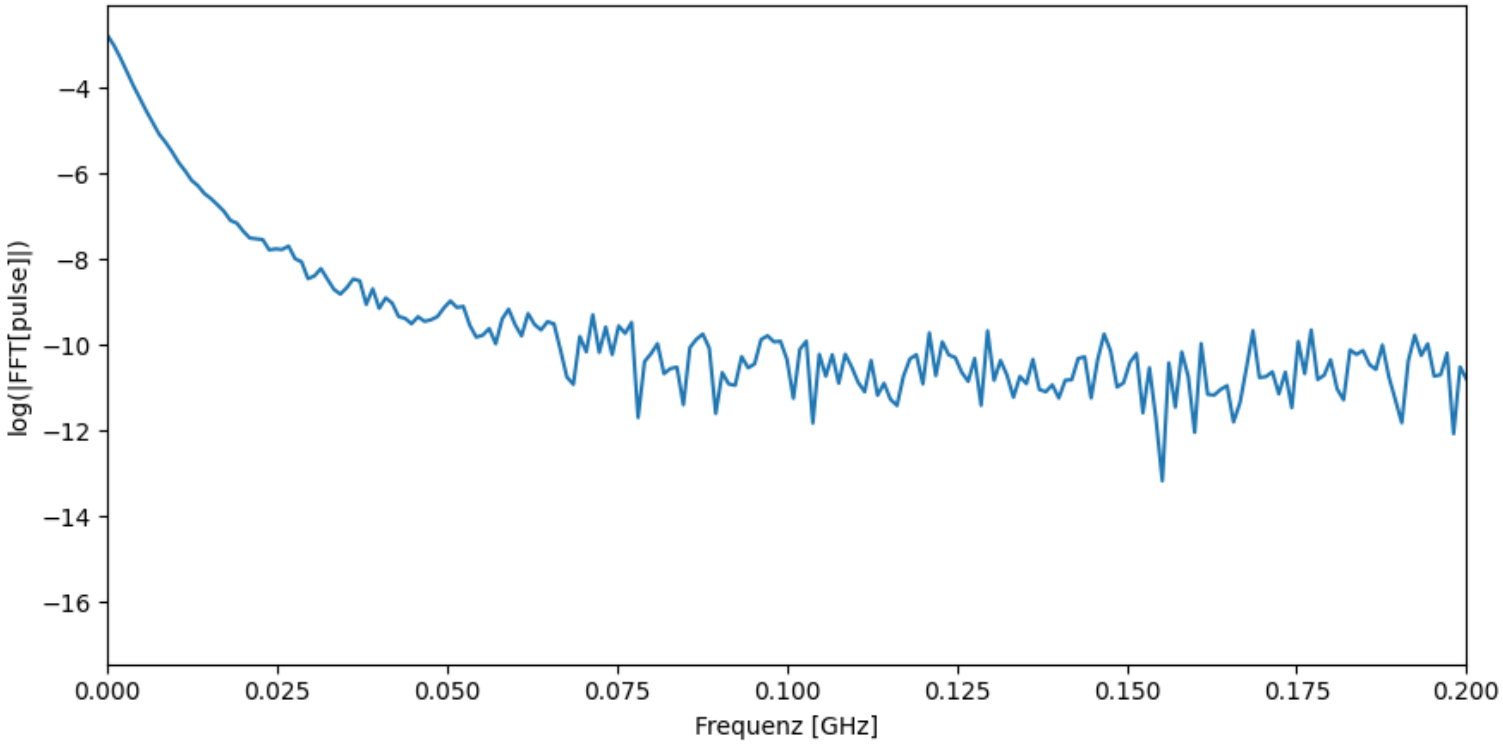
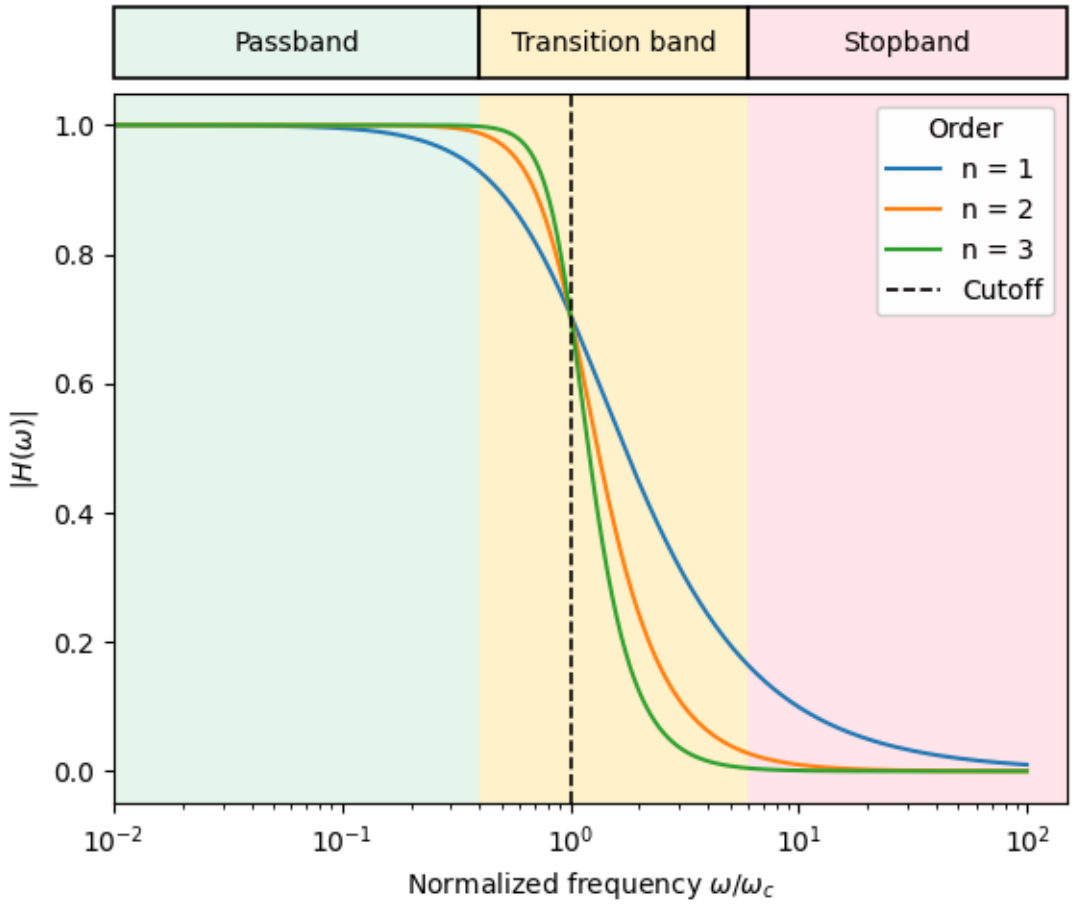
Fourier transformation of pulse
- Meaningfull frequencies up to 0.1GHz



Post Processing (Smoothing)

Butterworth smoother (digital low-pass filter)

- Noise reduction
- Equal weighting of all frequencies
- Cutoff frequency set to 0.1GHz



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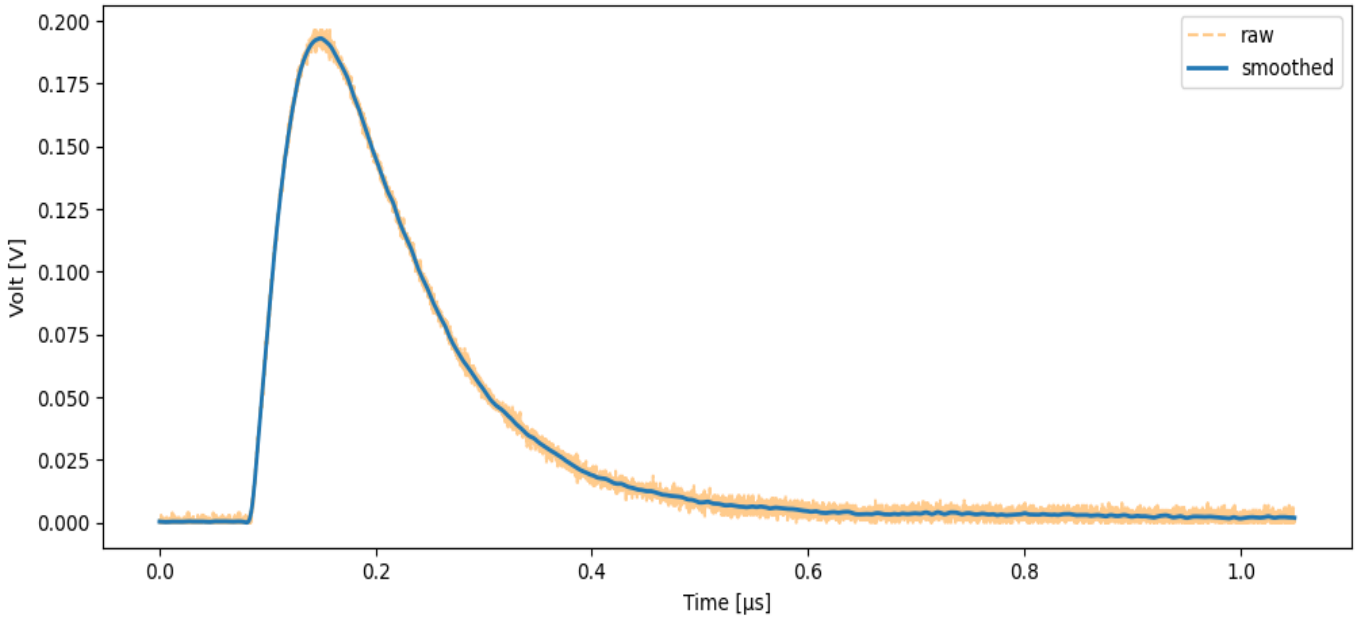
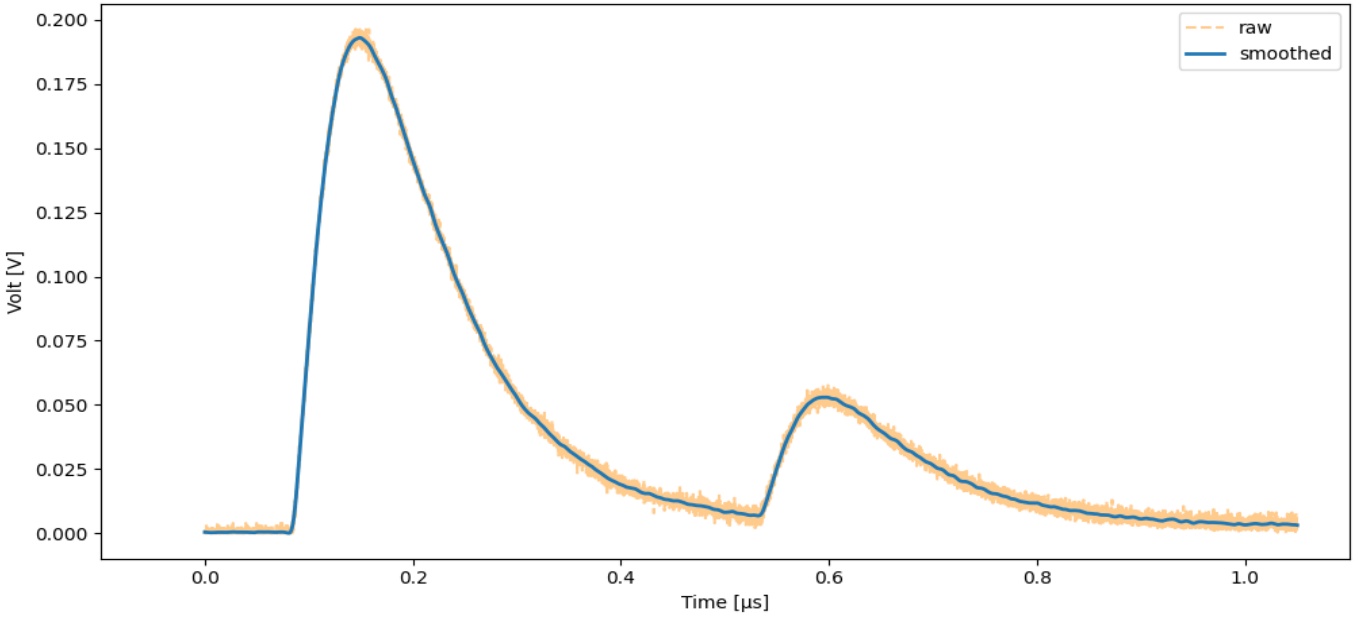


Post Processing (After Pulse Detection and Elimination)

Measure time is a fixed window (after trigger):
Two gamma rays in the same time window.

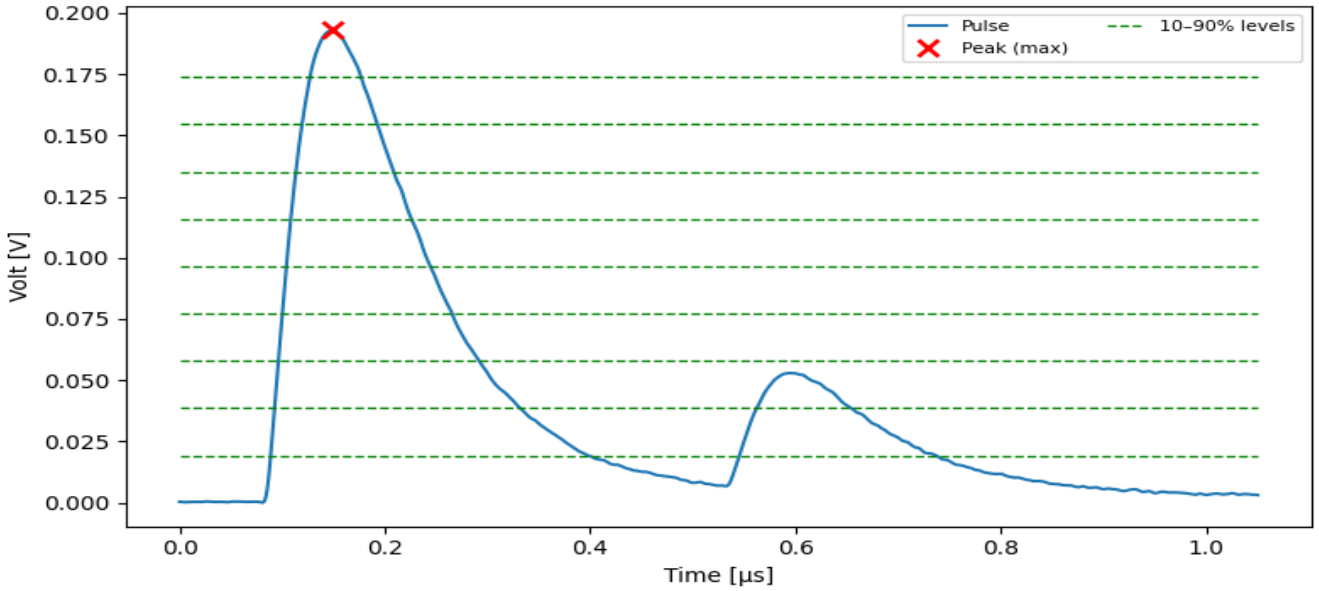
Afterpulses are a problem!



Post Processing (After Pulse Detection and Elimination)

How can secondary pulses be found?
Horizontal intersection lines
(depending on the peak value).

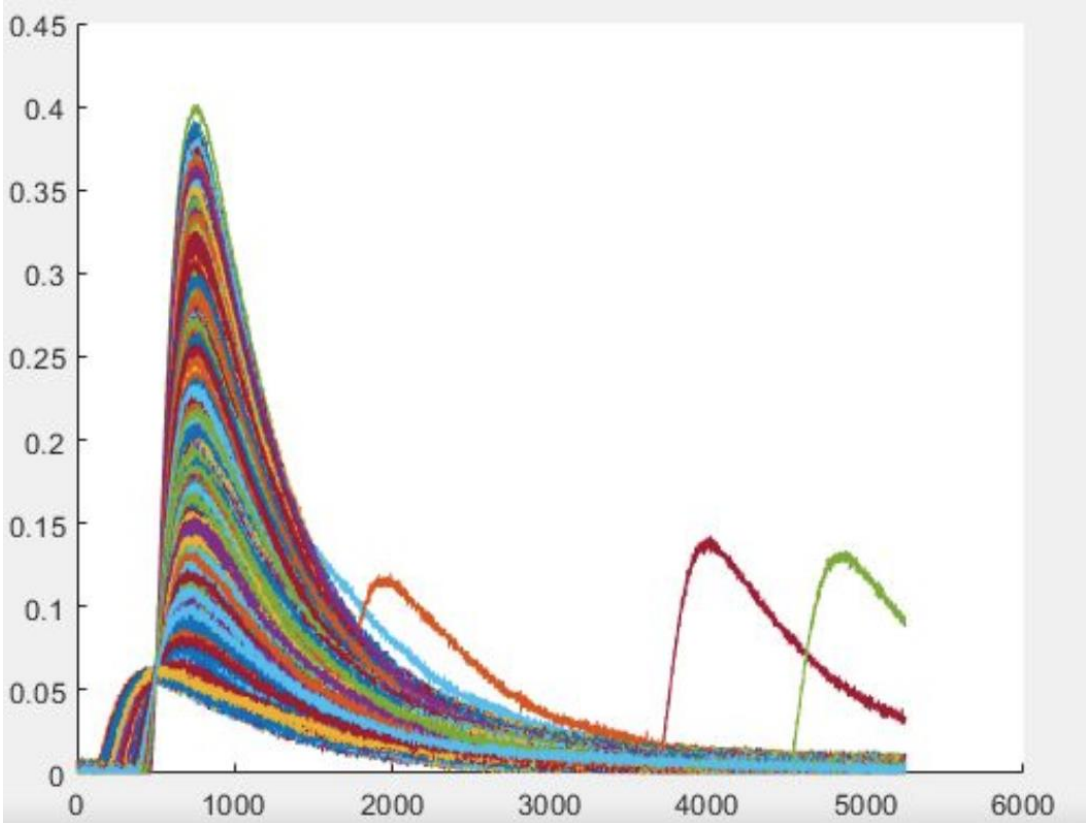
Intersection > 2 for any line:
→ discarded



Post Processing (Exact Rise Time determination)

Exact rise time determination (detection time):
Must be amplitude independent
Different amplitudes = different slopes
= different rise times

Instead of CFD, use a normalized LED

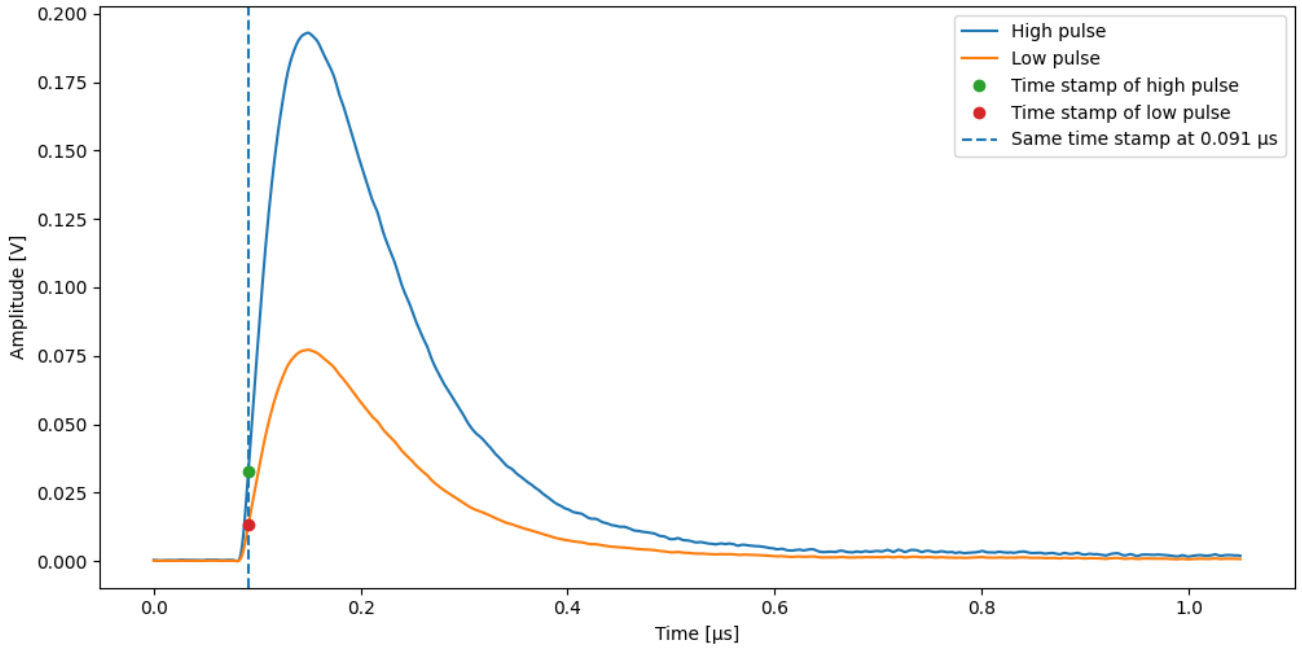


Post Processing (Exact Rise Time determination)

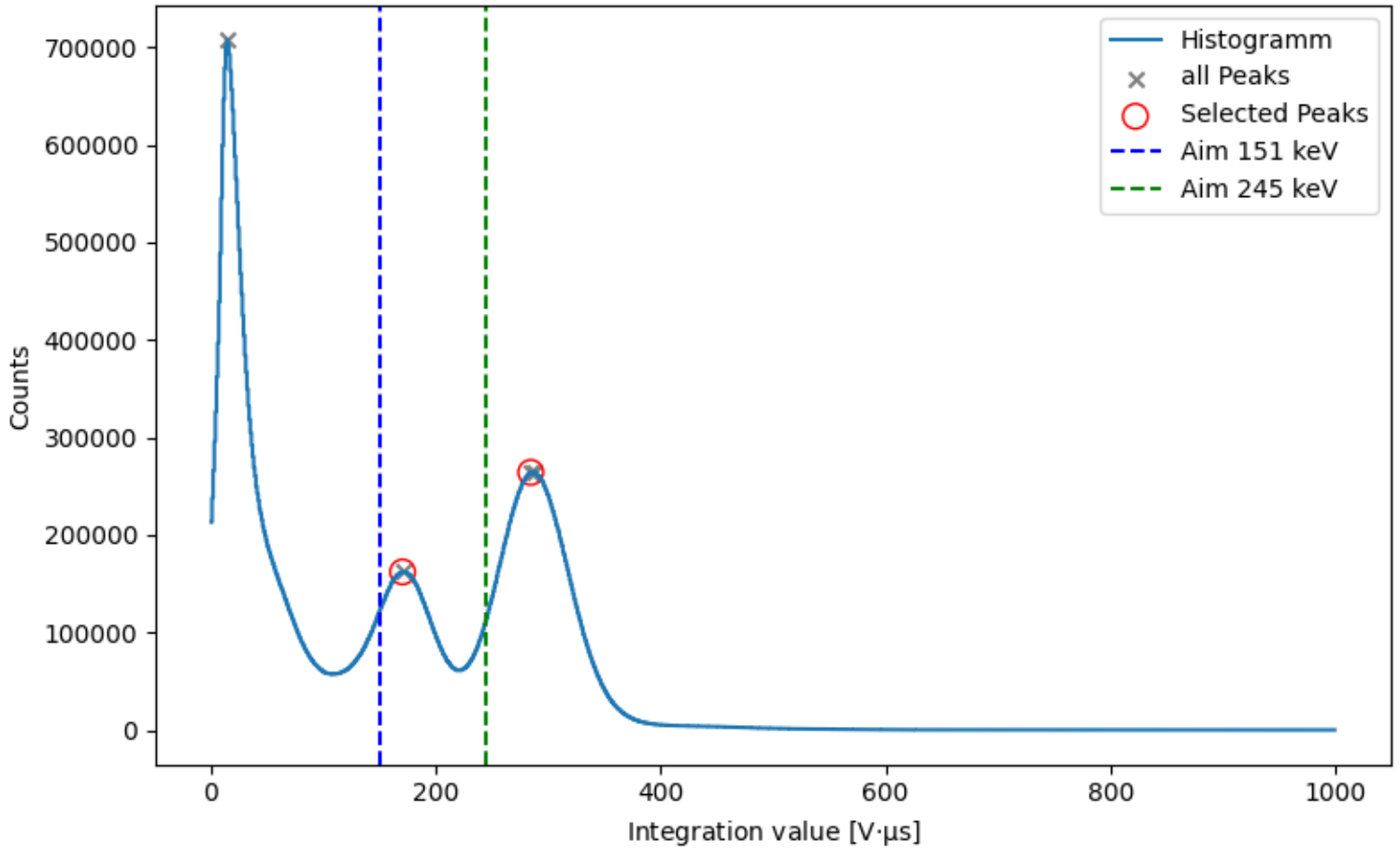
Exact rise time determination (detection time):
Must be amplitude independent
Different amplitudes = different slopes
= different rise times

Instead of CFD, use a normalized LED

- Divide the integration value by the constant
- Check when the pulse reaches this value.



Coincidence Search



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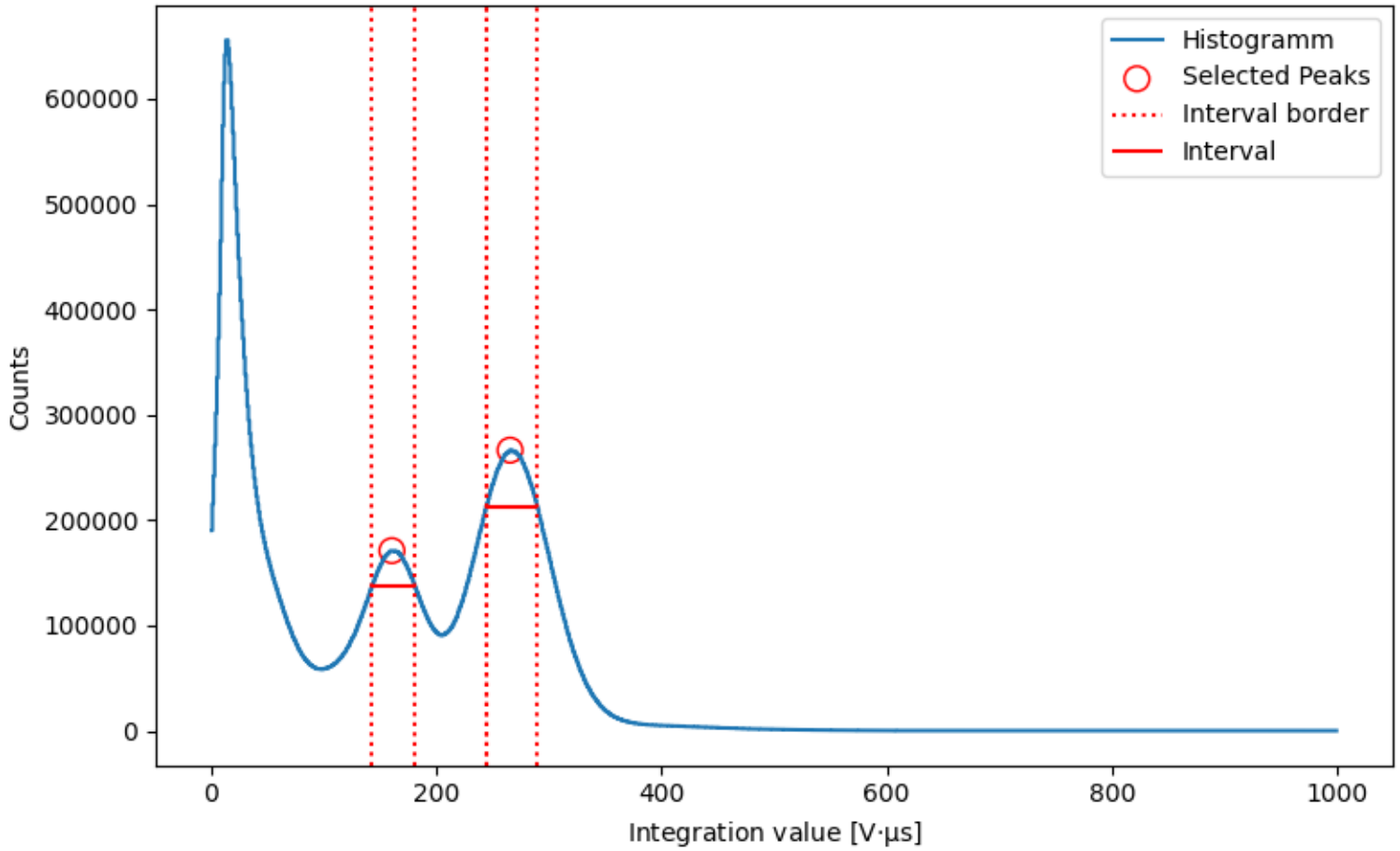
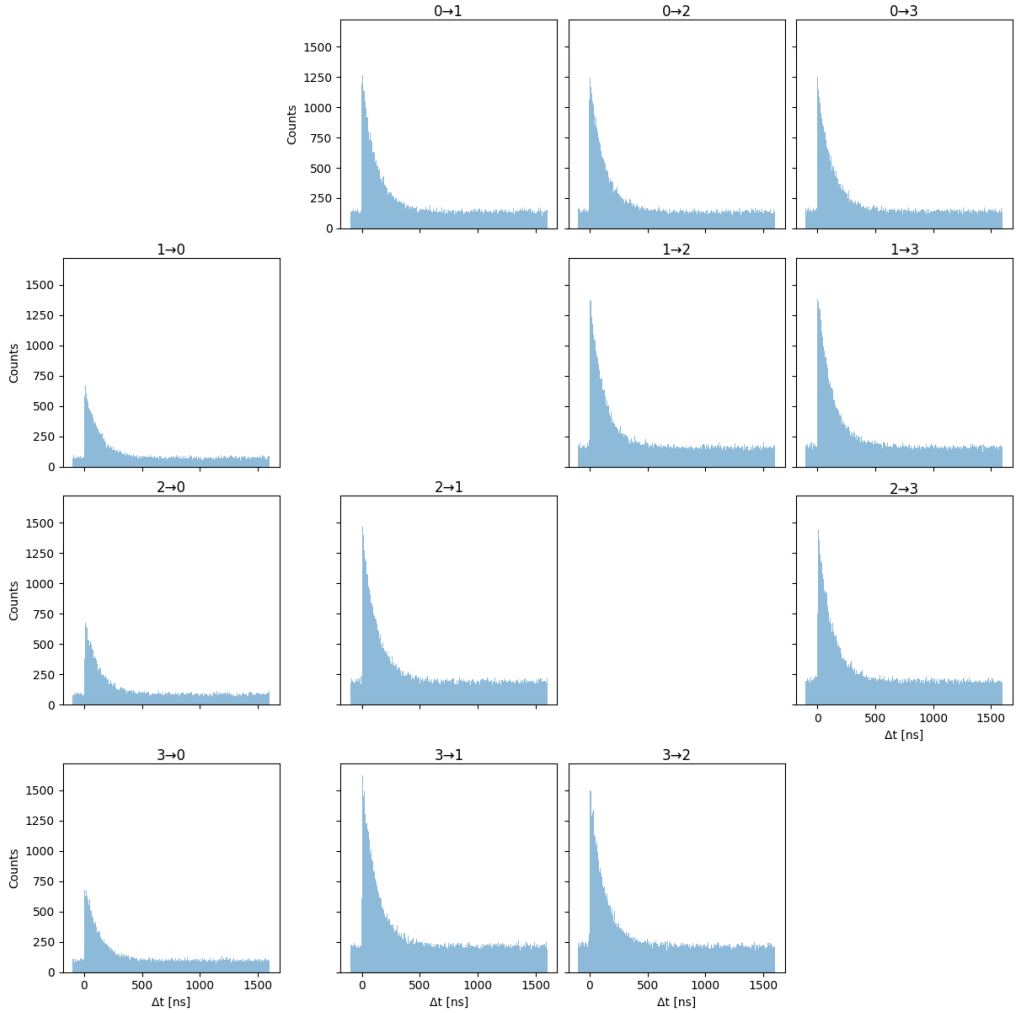


Coincidence Search



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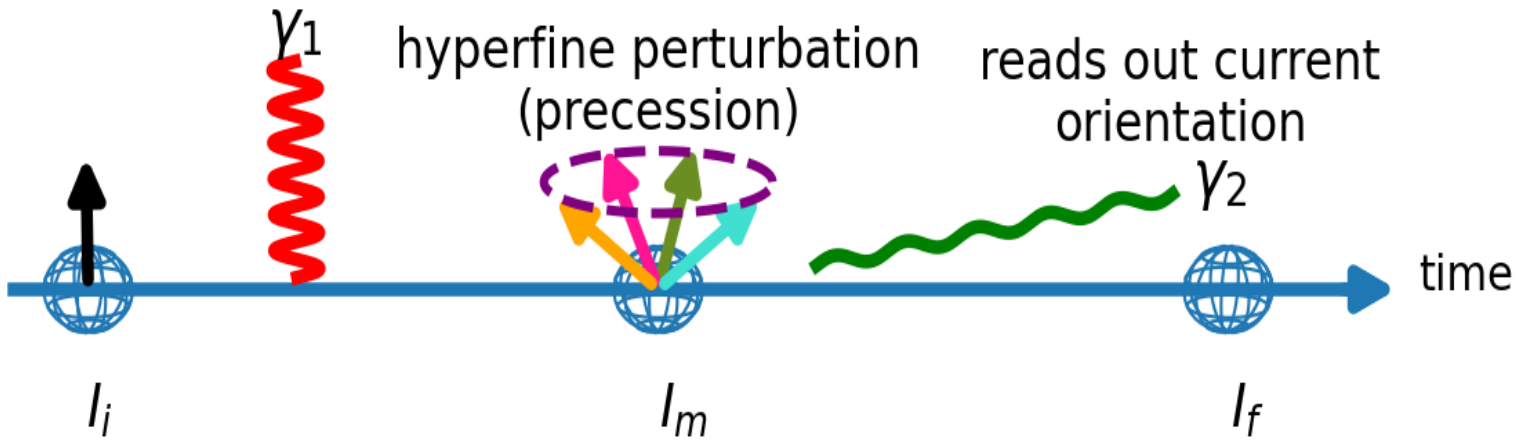

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