

Update on JUNO Waveform Reconstruction

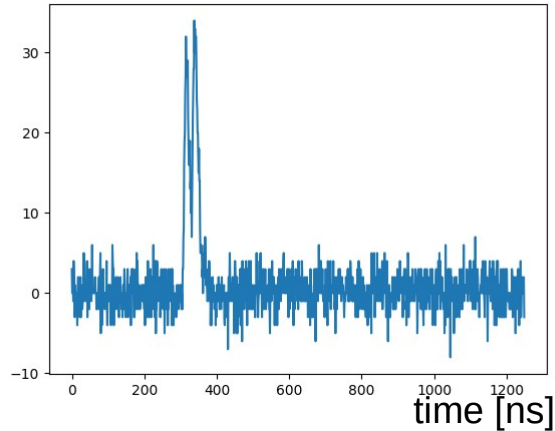
Michaela Schever

25th October 2022, EU-AM Collaboration Meeting

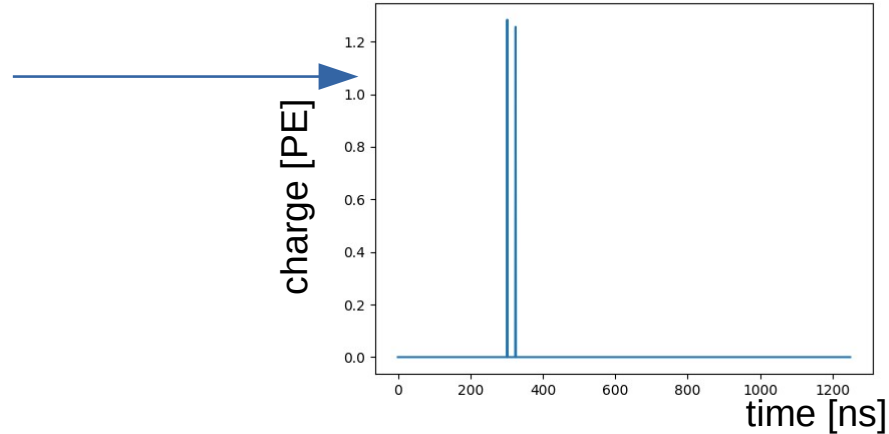
Outline

- Influence of different types of noise on the unfolding method

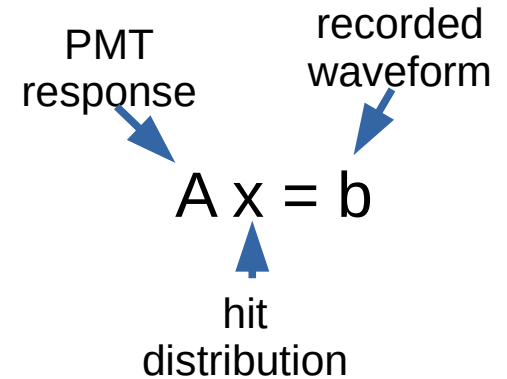
Principle of Unfolding



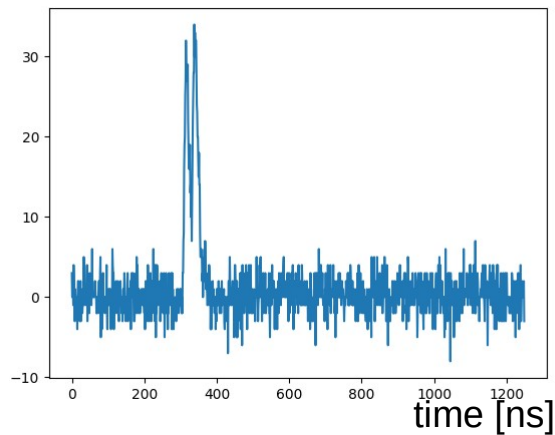
Simulated waveform



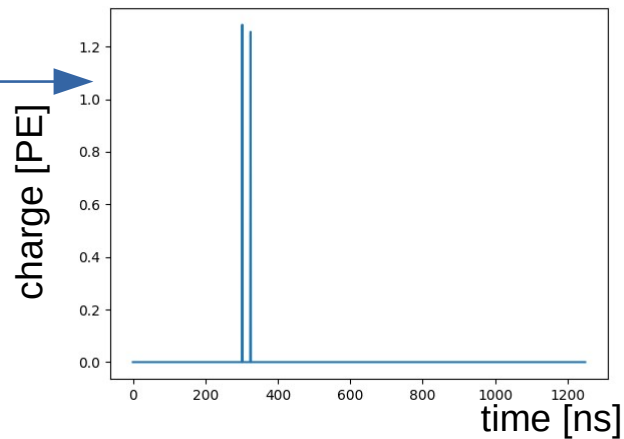
PE hit distribution



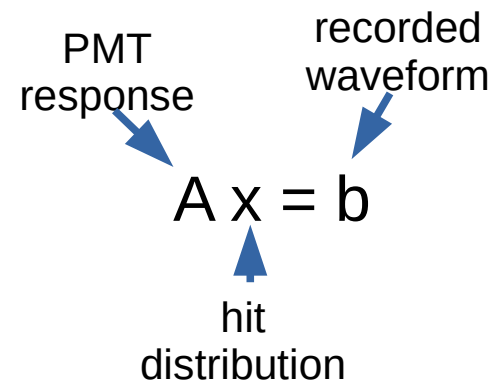
Principle of Unfolding



Simulated waveform



PE hit distribution



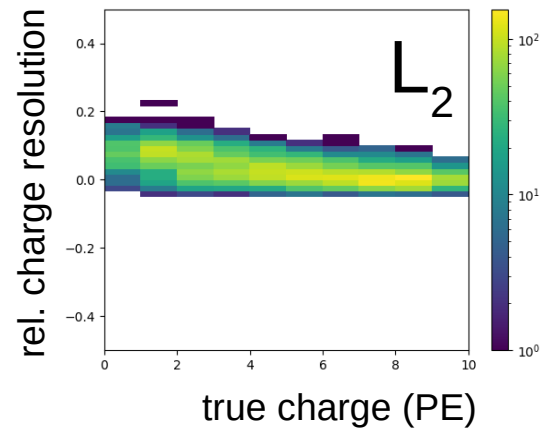
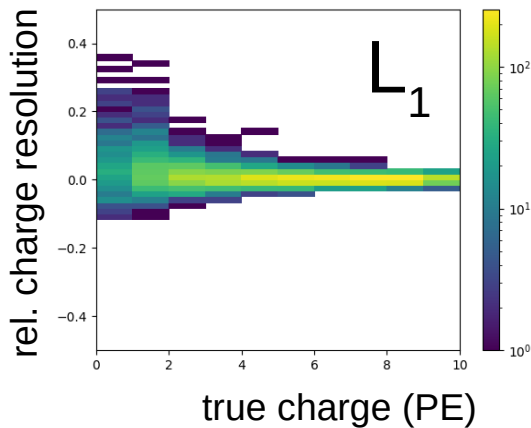
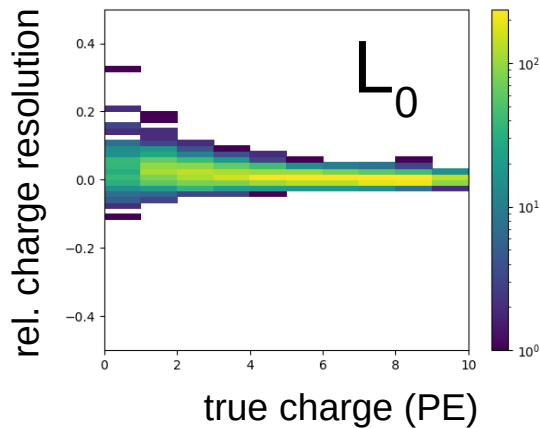
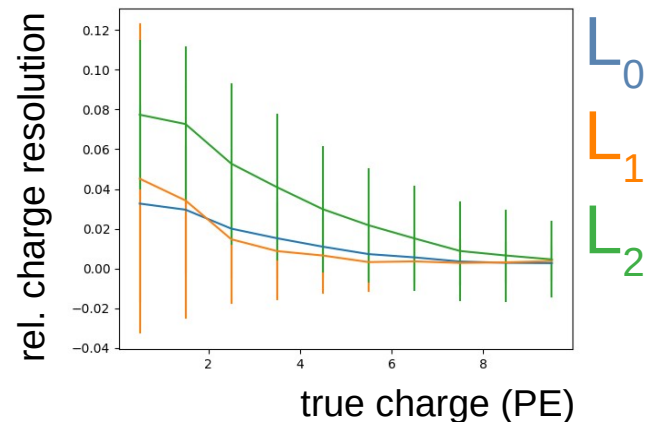
A diagram illustrating the relationship between different components and the cost function for unfolding. 'PMT response' and 'recorded waveform' have arrows pointing to the equation $(Ax - b)^T (Ax - b) + \tau (Cx)^T (Cx) = \min.$. A 'hit distribution' has an arrow pointing to the variable x . 'regularization parameter' has an arrow pointing to τ , and 'smoothing matrix' has an arrow pointing to C . A bracket labeled 'regularization' spans the second term of the equation.

$$(Ax - b)^T (Ax - b) + \tau (Cx)^T (Cx) = \min.$$

Charge reconstruction performance

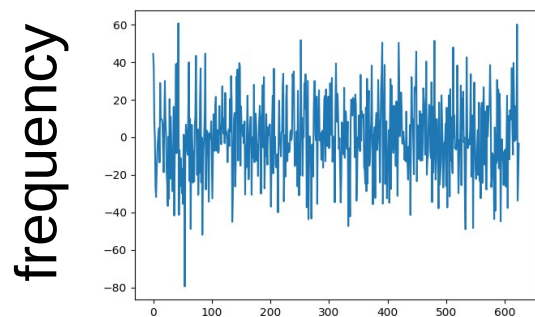
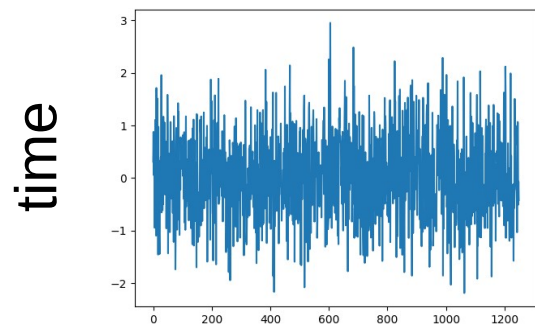
REMINDER

- Equivalent to deconvolution
- Use of unfolding for filter design
- Choices for regularization matrices:
 - L_0 : unity matrix
 - L_1 : minimize first derivative
 - L_2 : minimize second derivative

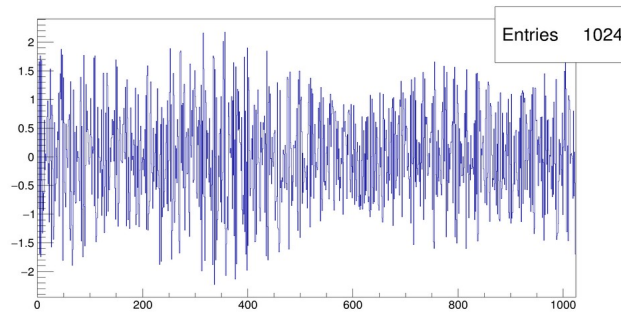


Different types of noise

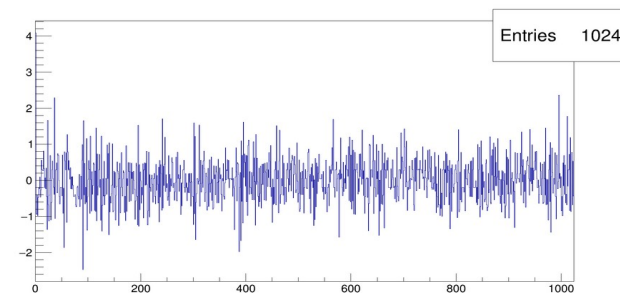
- Different waveform reconstruction methods have been studied in anticipation of varying performances depending on the composition and strength of the noise



Simulated white noise



Noise of specific frequencies

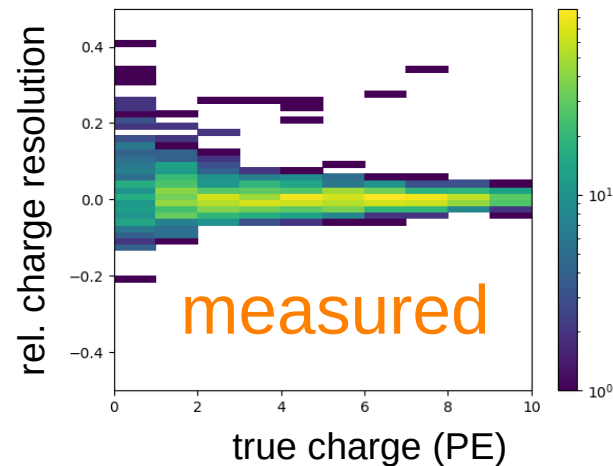
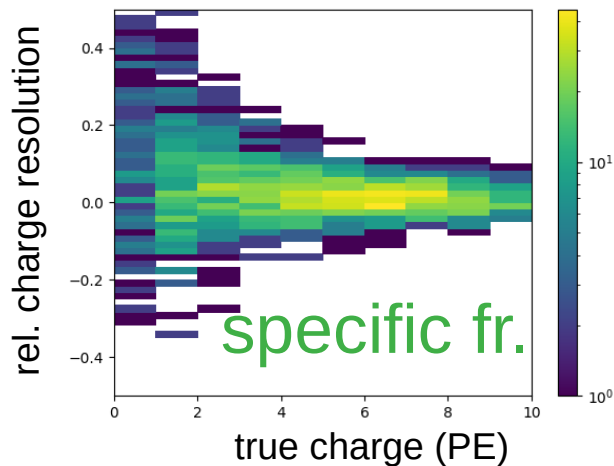
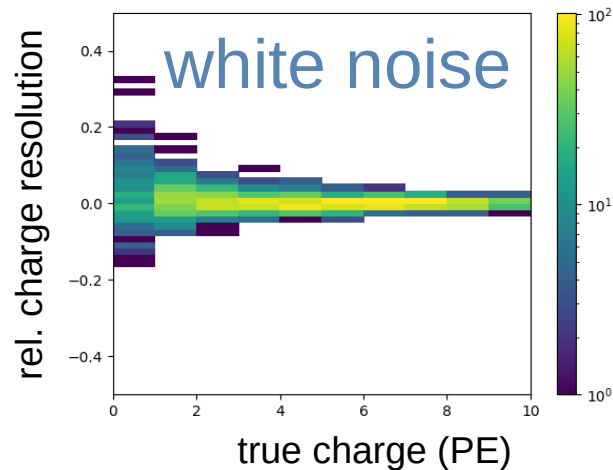
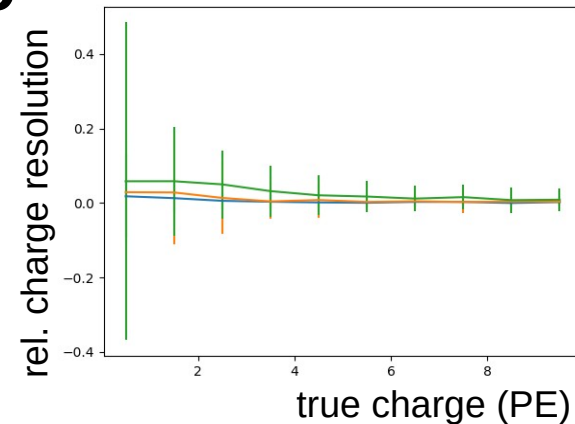


Noise measured at PMT testing site

Charge reconstruction performance for different types of noise

- Smoothing matrix: L_0 unity matrix
- Purely simulated white noise has best charge resolution
- Noise from PMT testing site only slightly worsens the charge resolution

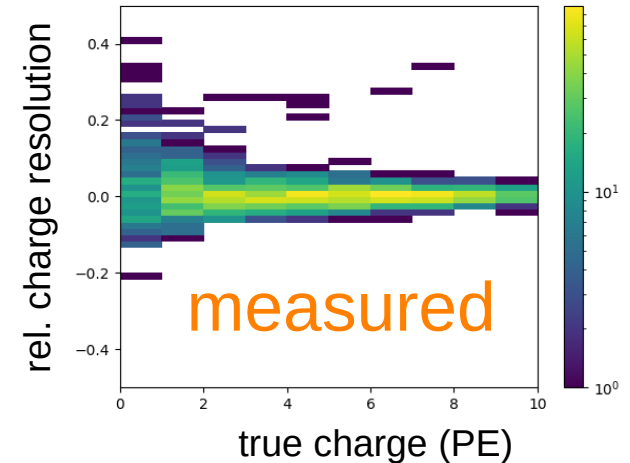
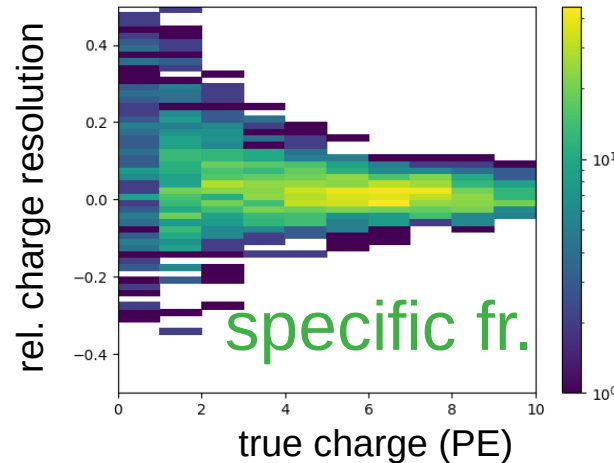
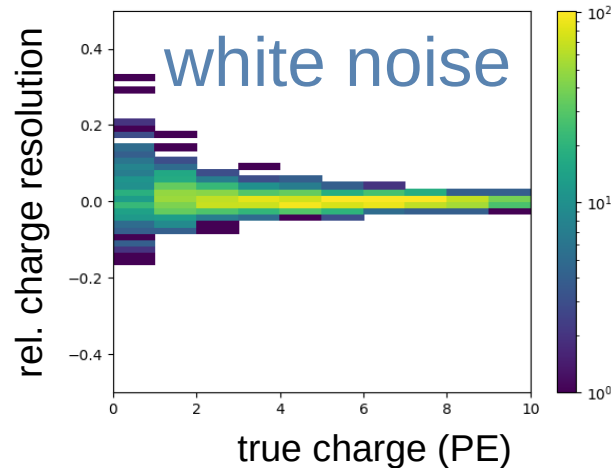
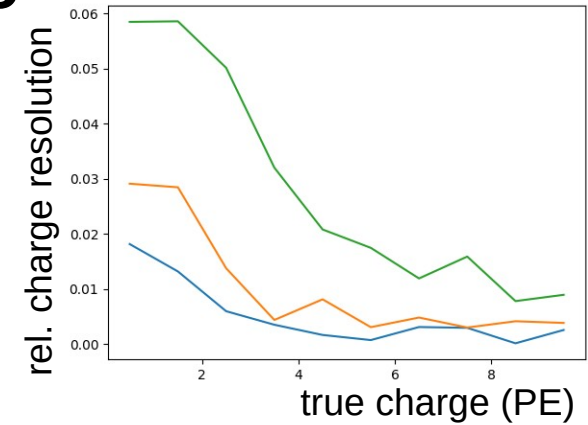
white noise
measured
specific fr.



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white noise
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Conclusion

- Influence of different types of noise on charge reconstruction performance has been studied for Unfolding method
- Influence mostly for small NPE
- Noise measured at PMT testing site only slightly worsens charge reconstruction performance compared to simulated white noise
- Other waveform reconstruction methods need to be tested with different types of noise, too