Xenon doping analysis in pDUNE

Niccolò Gallice, Henrique Souza

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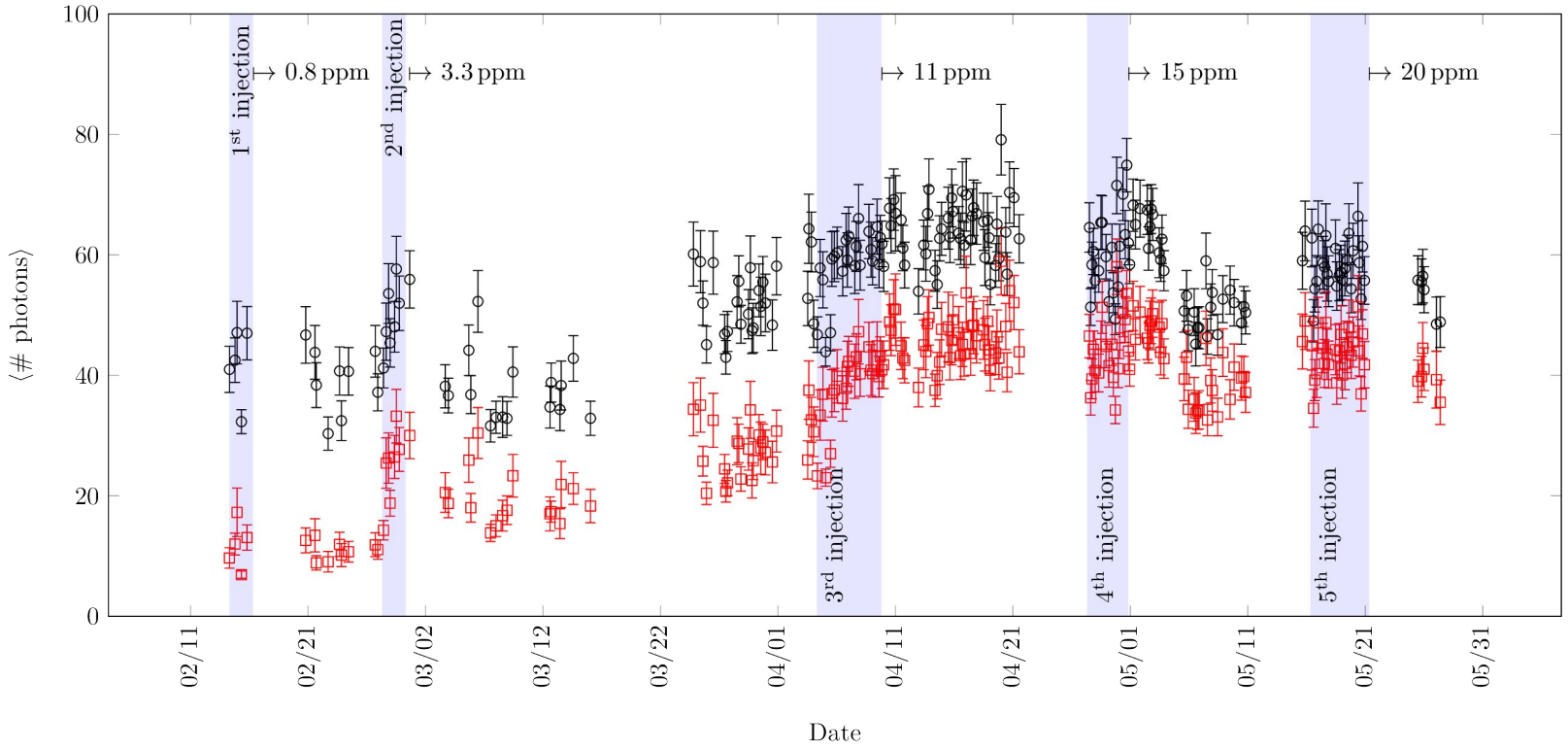
Data-sets

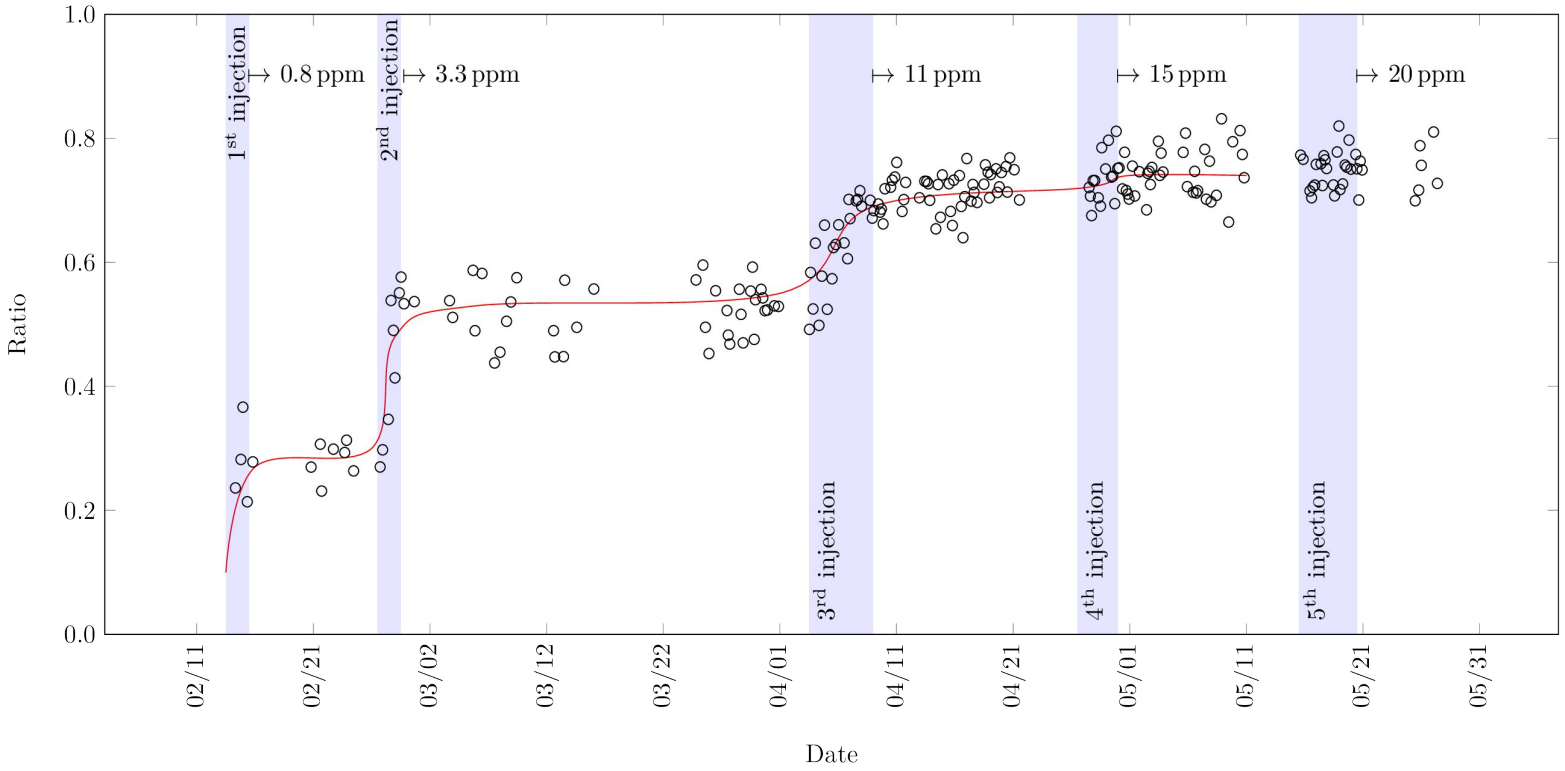
- Data collected with standalone SSP
- External trigger
- Time period: 12/02 to 27/05
- 5 doping steps:
  - 1 ppm
  - 3.3 ppm
  - 11 ppm
  - 15 ppm
  - 20 ppm

Collected light



Average number of photons detected by the Non-Quartz and Quartz Arapuca.

Light ratio



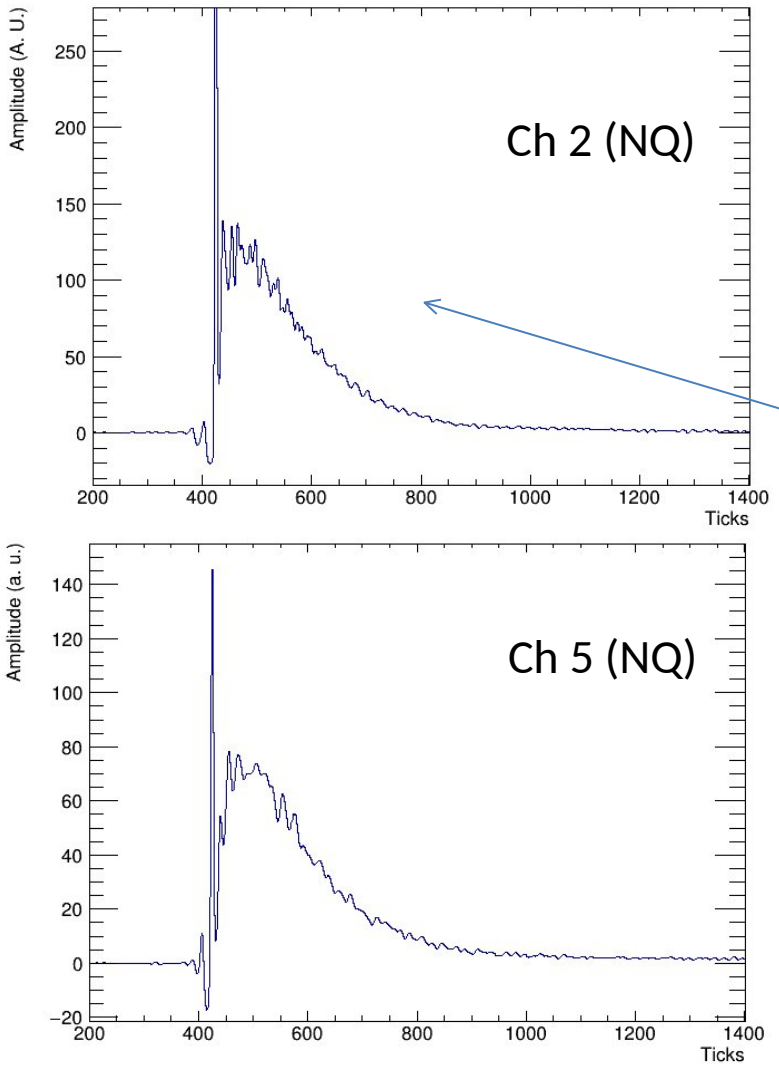
Data
Qualitative trend

$$\text{Ratio} = \frac{\text{Xe light}}{(\text{Ar} + \text{Xe})\ \text{light}}$$

(Ar + Xe) light
↓
ARAPUCA is sensitive to both wavelengths

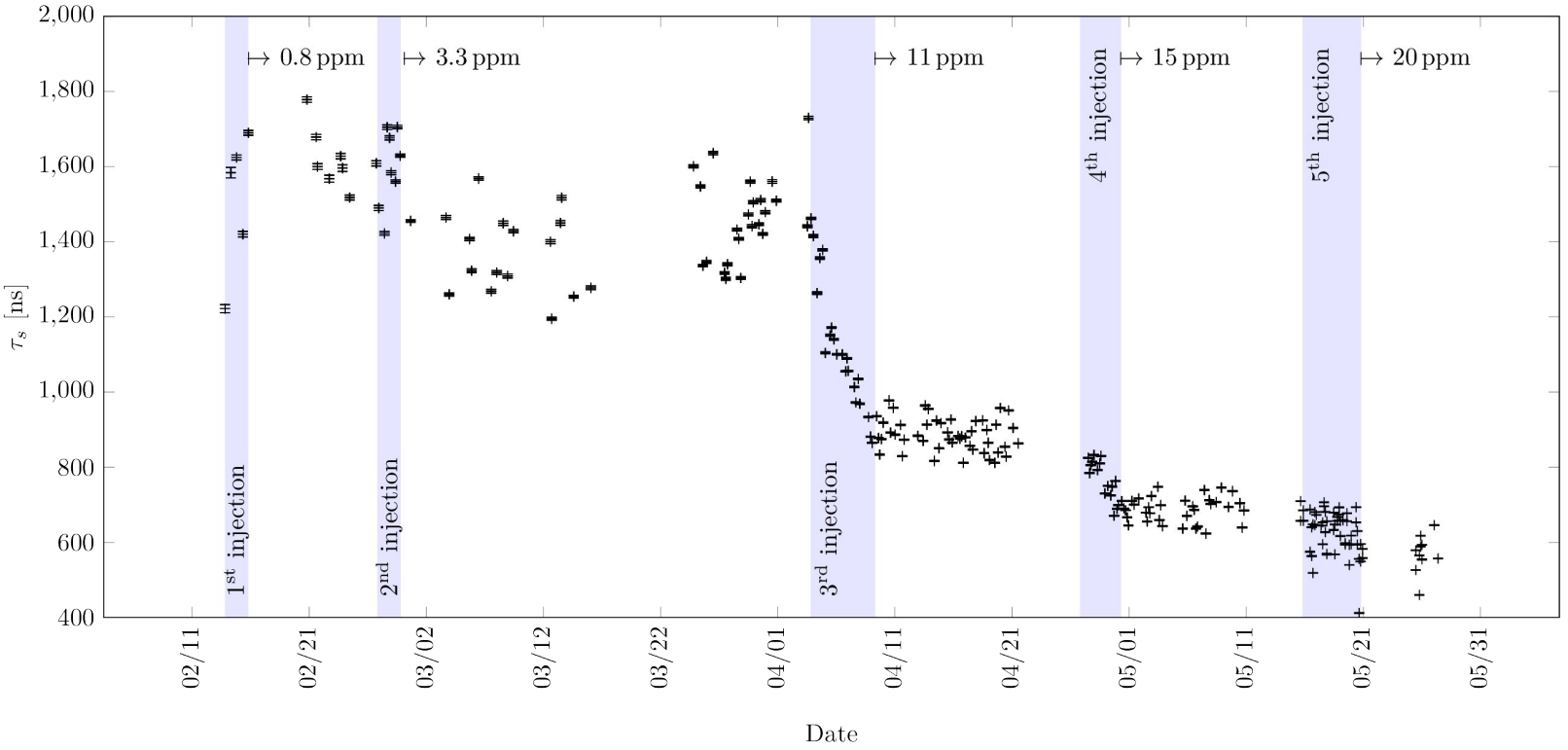
Xe light
↓
ARAPUCA with a quartz window transparent to Xe light (174 nm) and opaque to Ar light (128 nm)

Deconvolution



- Usin the fitted function to deconvolute
- Using Gold algorithm do perform deconvolution
- Fit from 500 to 1400 with $Ae^{-at} + B$ to get slow time constant of distribution (Ar + Xe)

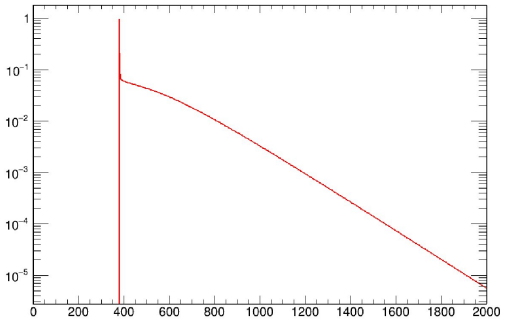
Slow time constant - Ar + Xe

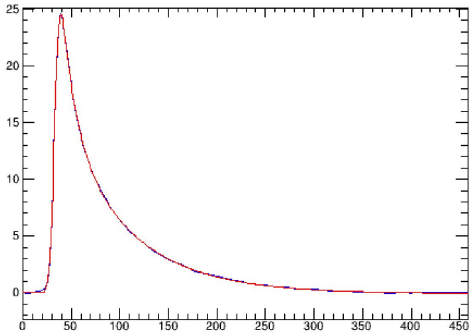


τ_s is the slow time constant of Ar + Xe distribution.

Convolution Fit

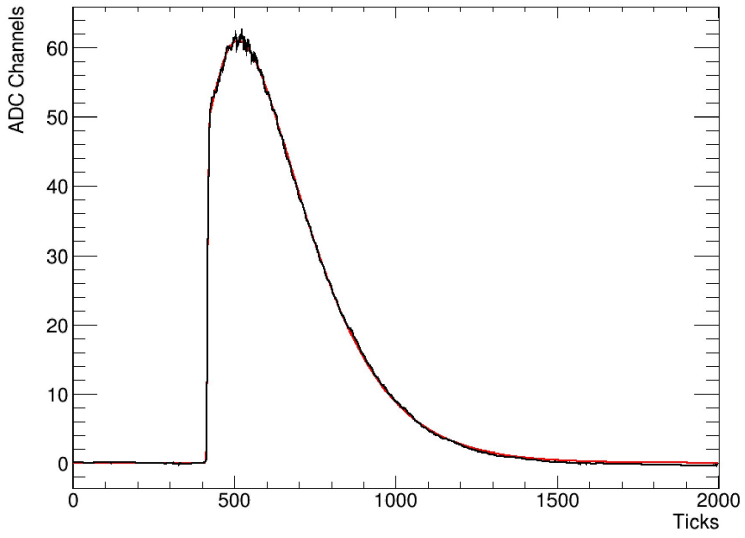
- The average waveform is fitted convoluting the SPE response with the expected distribution for Ar + Xe light





Pure LAr + Xe:

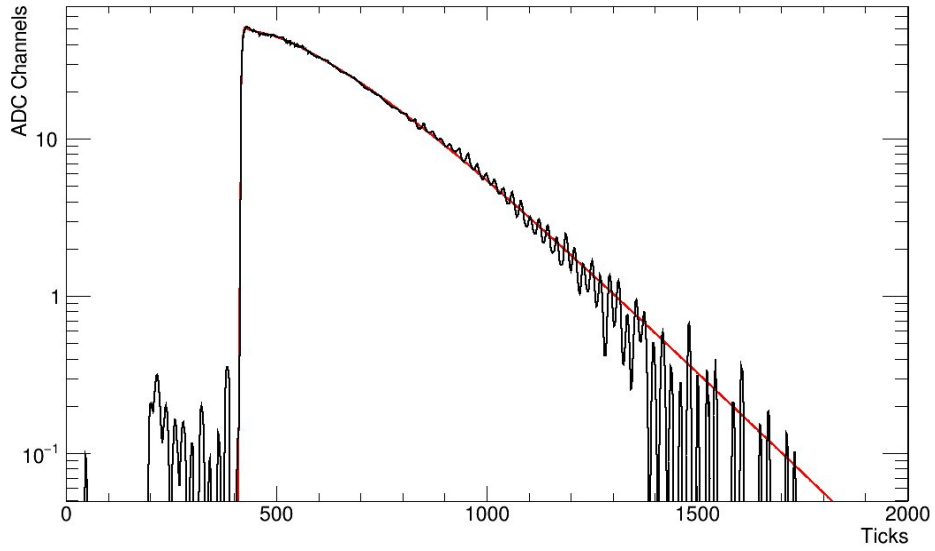
$$A\, e^{-t/\tau_f} + B\, e^{-t/\tau_s} - C\, e^{-t/\tau_d}$$

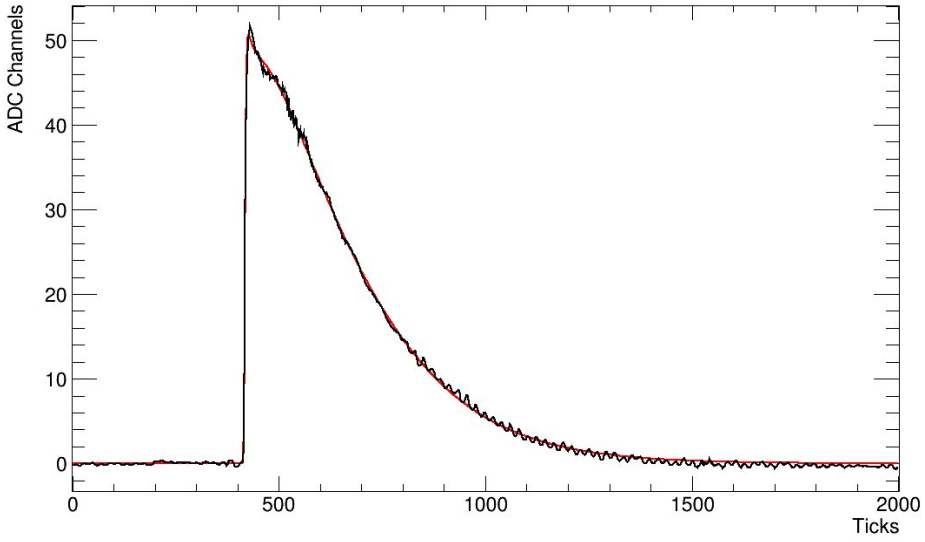


- τ_f fast Ar component
- τ_s slow component (Ar + Xe)
- τ_d intermediate component (de-excitation time of ArXe*)

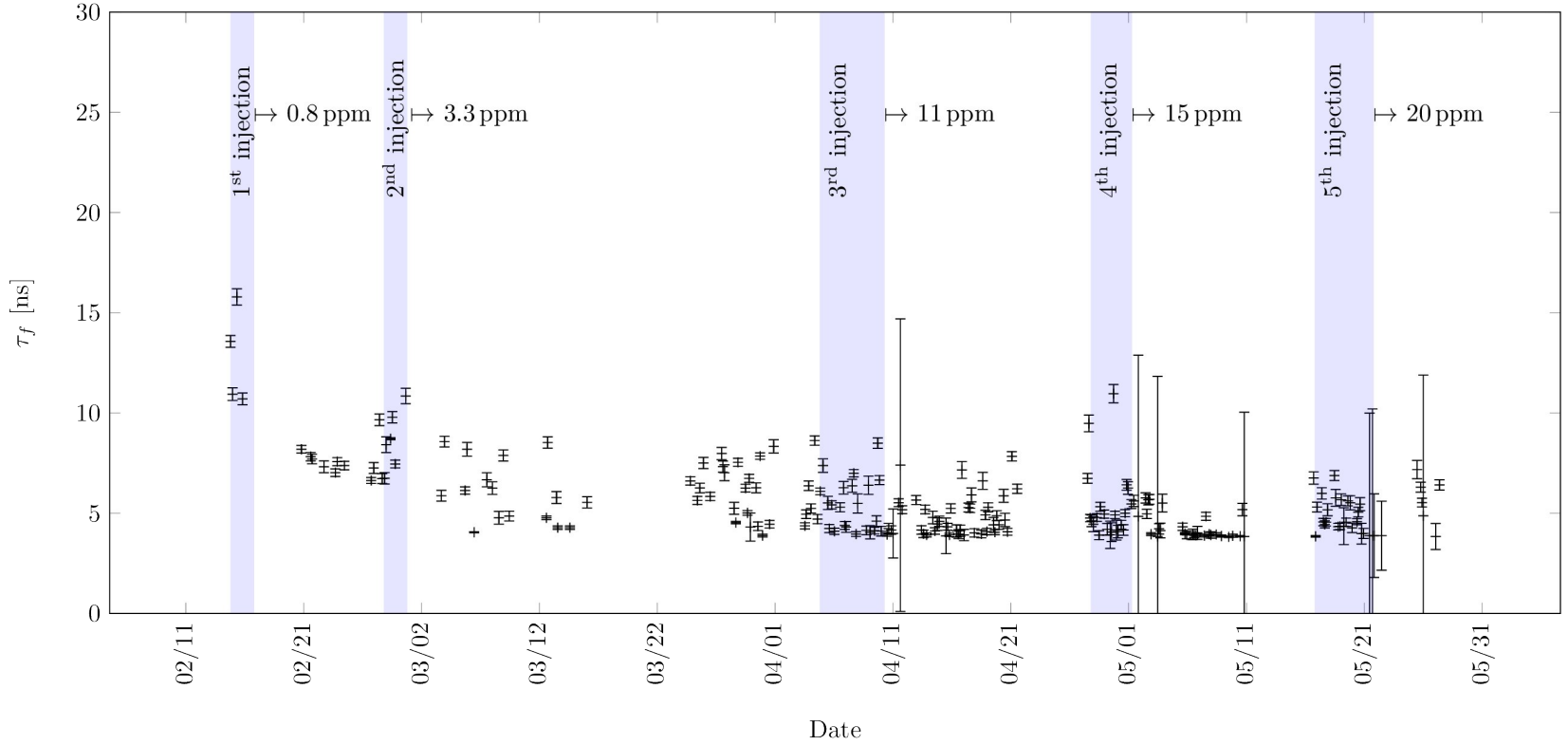
Convolution Fit

- The average waveform is fitted convoluting the SPE response with the expected distribution for Ar + Xe light
- It is possible to extract from the fit the three time constants:
  - τ_f fast Ar component
  - τ_s slow component (Ar + Xe)
  - τ_d intermediate component (de-excitation time of ArXe*)





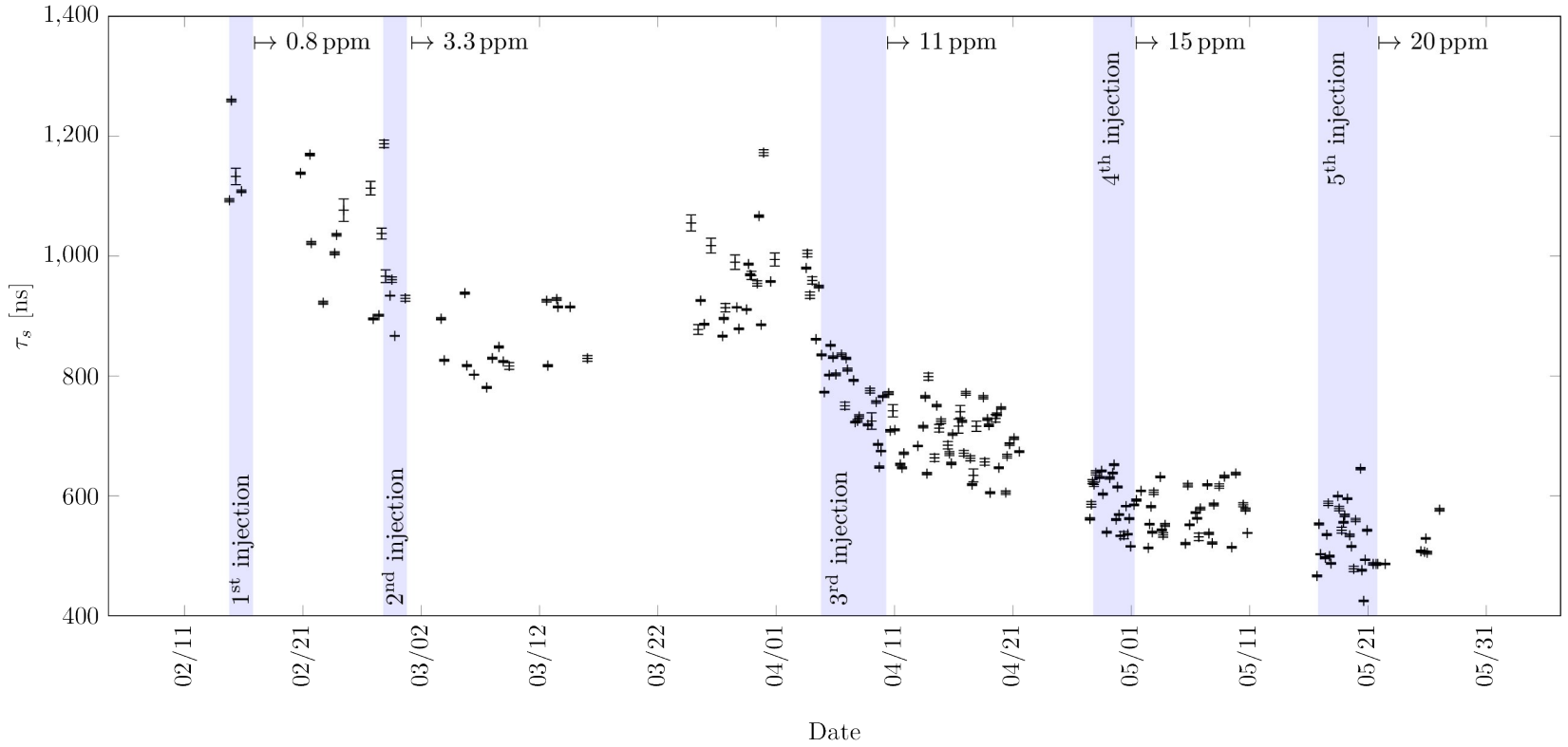
Convolution Fit - τ_f



τ_f is the fast time constant of Ar + Xe distribution.

Preliminary

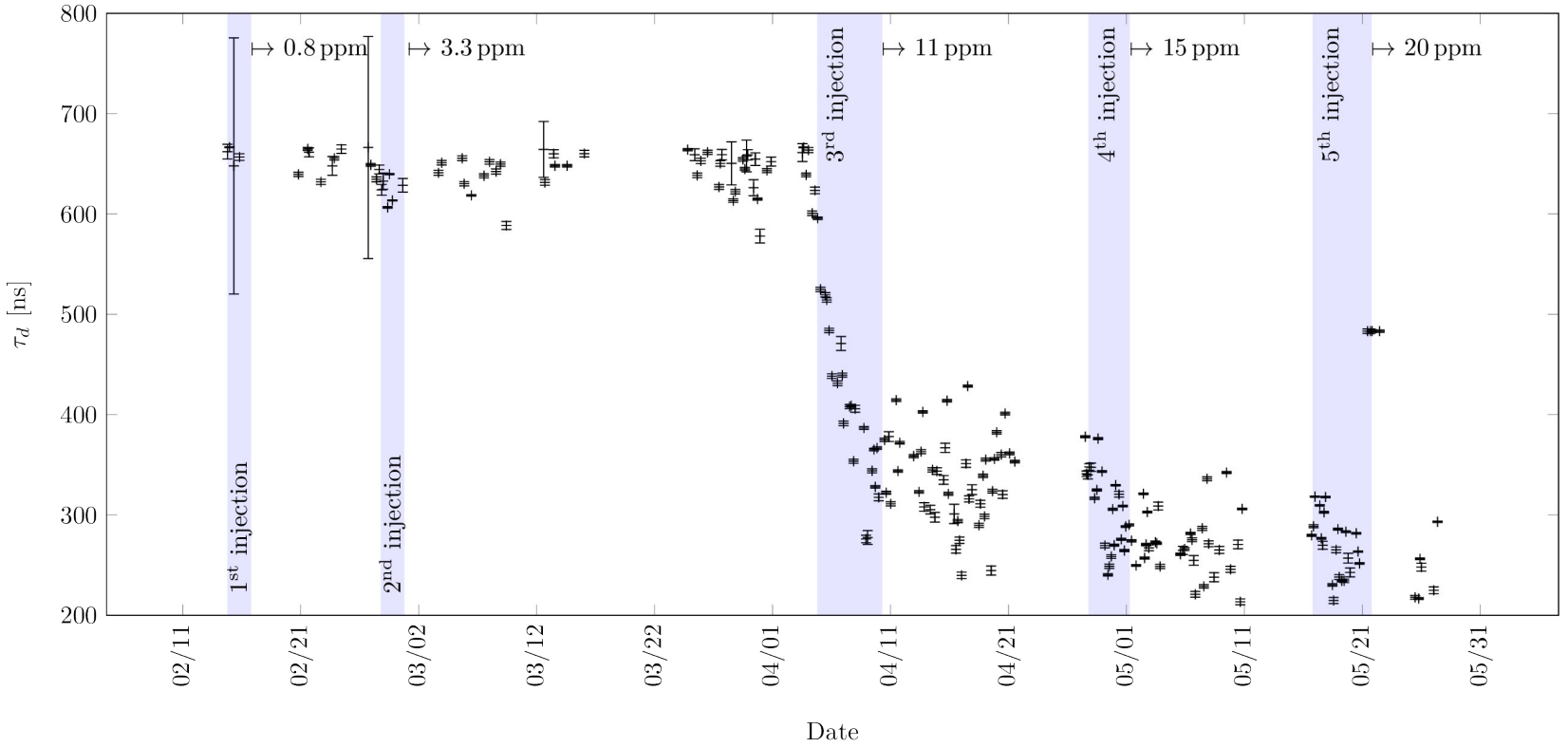
Convolution Fit - τ_s



τ_s is the slow time constant of Ar + Xe distribution.

Preliminary

Convolution Fit - τ_d



+Data

τ_d is the intermediate time constant of Ar + Xe distribution.
It is the average de-excitation time of $ArXe^*$

Preliminary