BGO test beam data

04/07/25

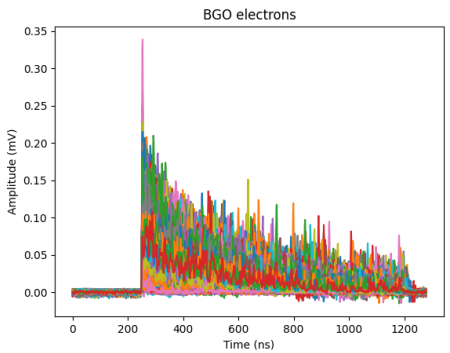
Reminder : data sets

Type	Wavecatcher conf.	Location
Electron source	NOK	IJCLab lab
Proton	OK	ALTO
Proton with attenuator	OK	ALTO

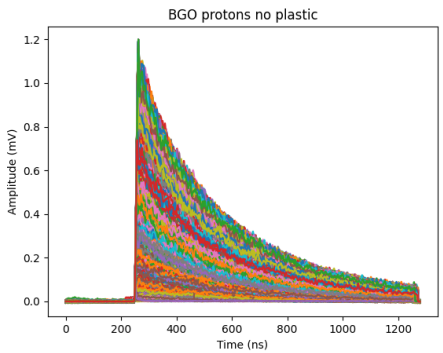
Data is pre-processed :

- Pedestals, Re-timing, cuts on min and max amplitude and integral

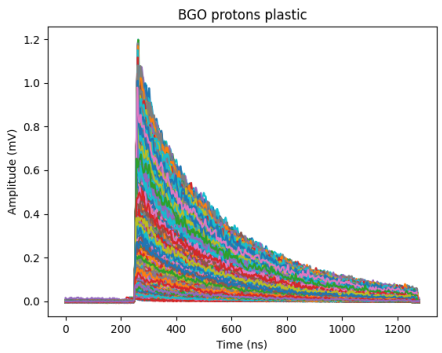
Electon



Proton

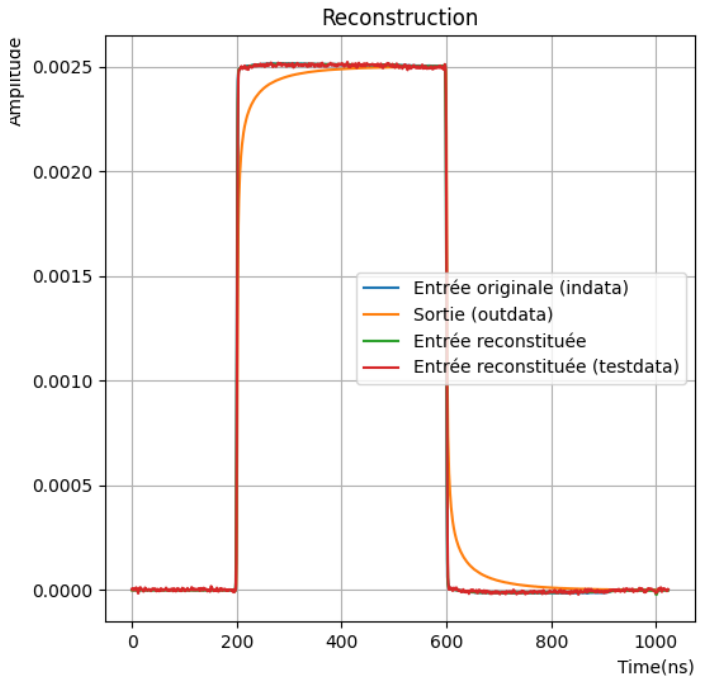


Proton with attenuator



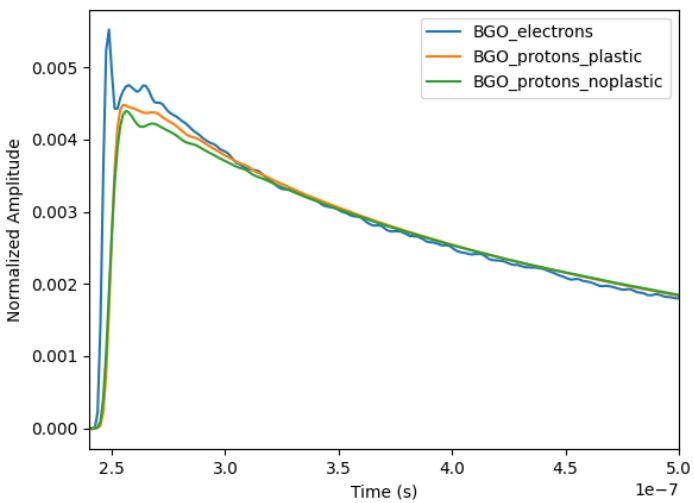
First step : Correcting for ALTO cable/amplifier

- Got two acquisition of a square wave: Wavecatcher measurement at ICJLab lab (direct connection) and ALTO (cable+amplifier)
- Rising edge $\approx$ 5 ns (can not correct for higher frequencies)
- Deconvolution method:
  - Transfer function h is estimated using least squares
  - Measurement is de-convoluted using Tikhonov regularisation

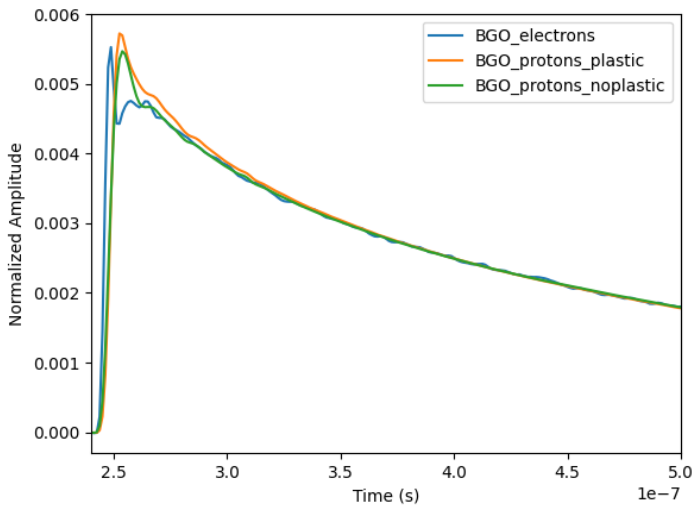


Second step: Apply to Proton data

- Use the same deconvolution procedure as for the square signal (same estimated h)
- Normalisation : $y / \int y$



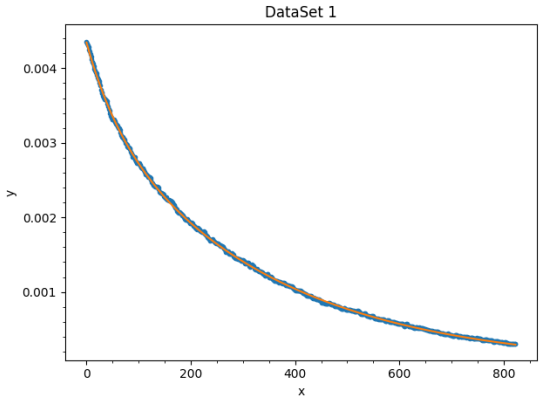
Before applying the deconvolution



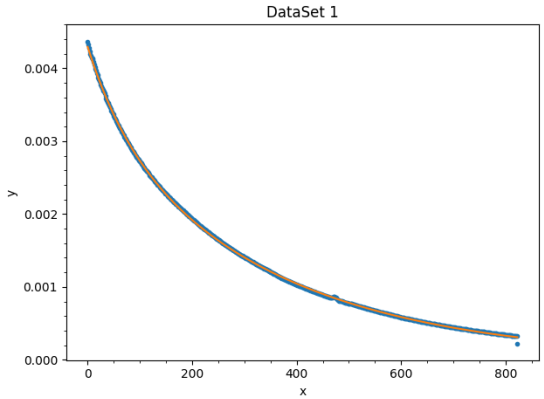
After applying the deconvolution

Fitting the data

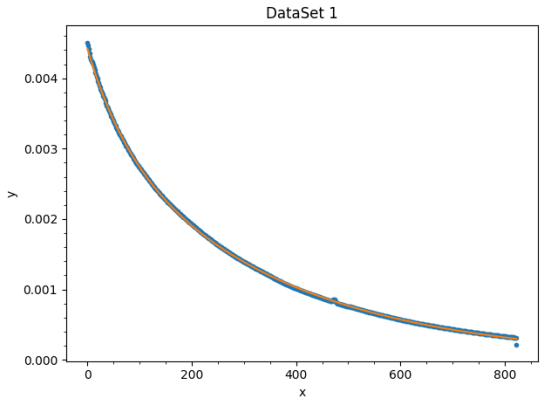
Electron



Proton



Proton (attenuator)



- Double exponential decay fit
- Results :

Dataset	τ_1 (ns)	%	τ_2 (ns)	%	χ^2
Electron	59.9	4.5	333	95.5	1.01
Proton without attenuator	75.5	6.3	348	93.6	0.99
Proton with attenuator	71.4	6.6	342	93.3	0.91

- Simultaneous fit : $\tau_1 = 341$ ns $\tau_2 = 69$ ns ($\chi^2 = 1.05$)

Dataset	τ_1 %	τ_2 %
Electron	5.6	94.4
Proton without attenuator	5.3	94.6
Proton with attenuator	6.4	93.4

Reminder : Literature

- S Gundacker et al, Phys. Med. Biol. 65 (2020) 025001 (20pp)

Source	τ_1 (ns)	%	τ_2 (ns)	%
511kEv Annihilation γ	45.8	8.2	365	92

link

- W. Wolszczak, et al "Temperature Properties of Scintillators for PET Detectors: a Comparative Study" 2014

Source	τ_1 (ns)	%	τ_2 (ns)	%
Cs137	85	6.5	370	93.5

link

- "TIMING PROPERTIES OF BGO SCINTILLATOR" Nuclear Instruments and Methods 188 (1981) 403 409

Source	τ_1 (ns)	%	τ_2 (ns)	%
Co60	60	10	300	90

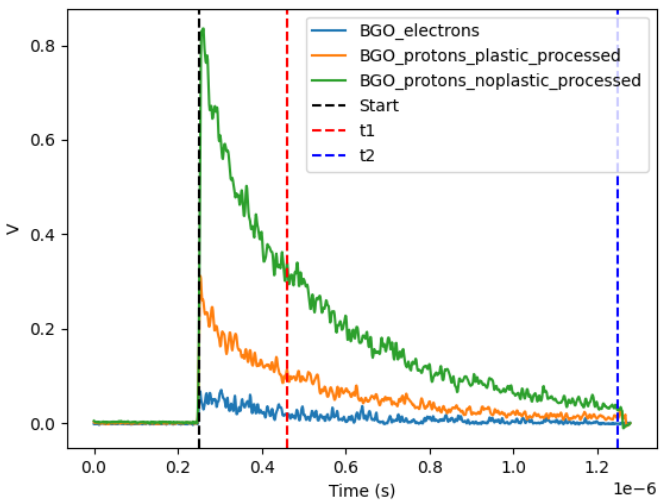
link

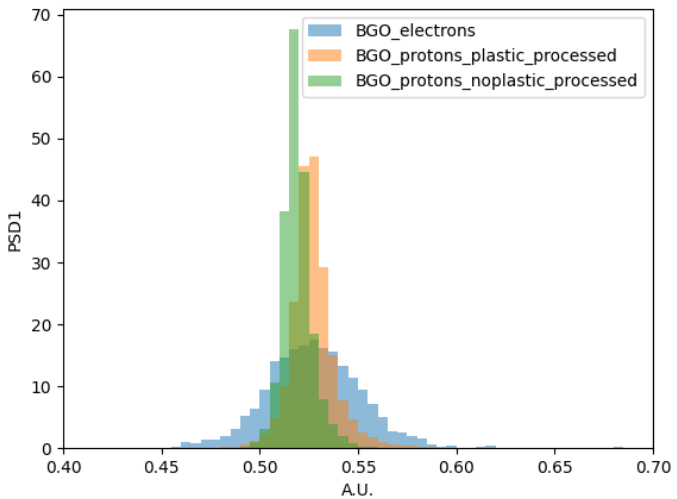
- Yetta Porter-Chapman et al, "Bi3+ luminescence in ABiO2Cl (A=Sr, Ba) and BaBiO2Br"

Source	τ_1 (ns)	%	τ_2 (ns)	%	τ_3 (ns)	%
18 keV x-Rays	100	12	300	79	1000	4

link

PSD





- Computed $a_1 = \int^{210ns}$ and $a_2 = \int^{1000ns}$, $PSD = fraca1a2$
- Electron is more spread : less PE and bad measurements ?