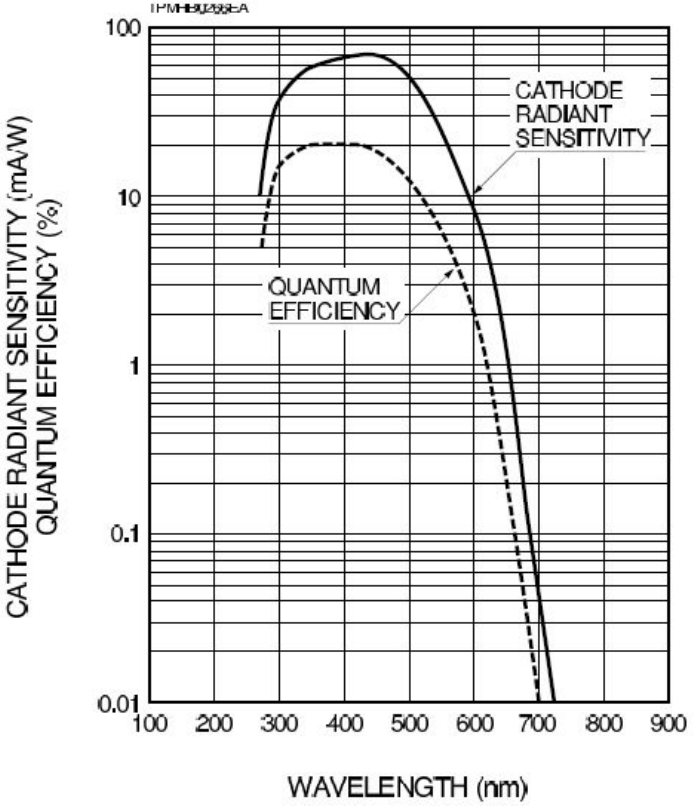
TB data analysis

16/10/2024

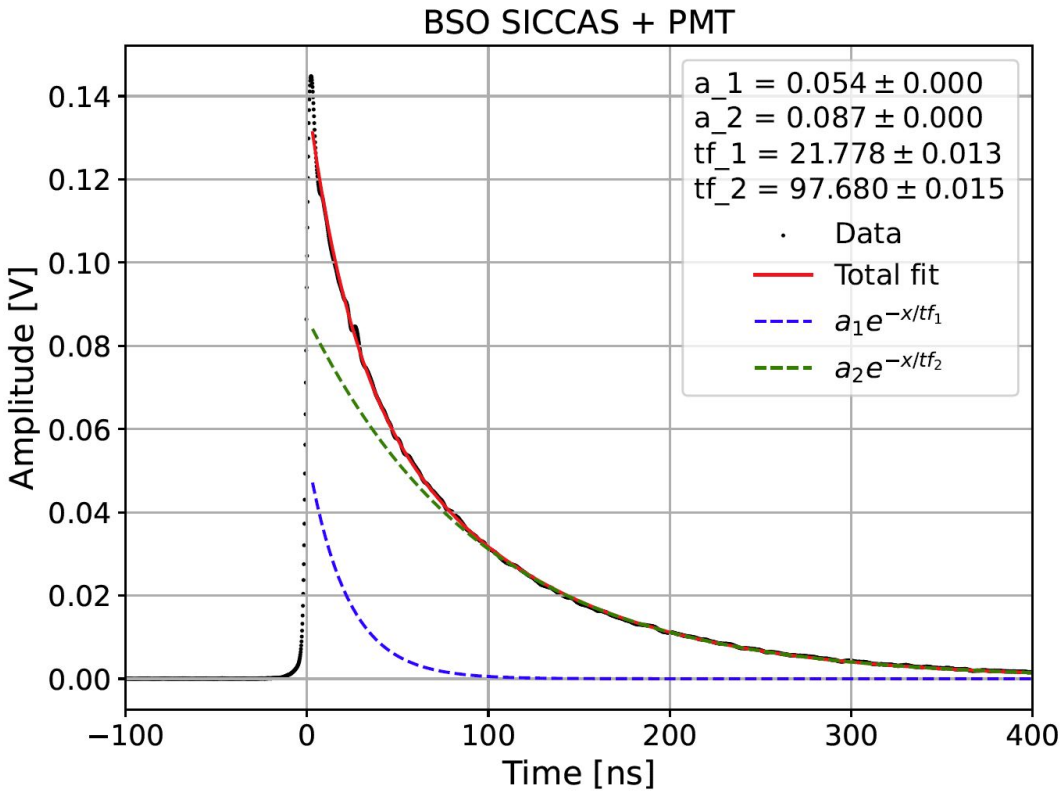
M.C.

Crystal decay times

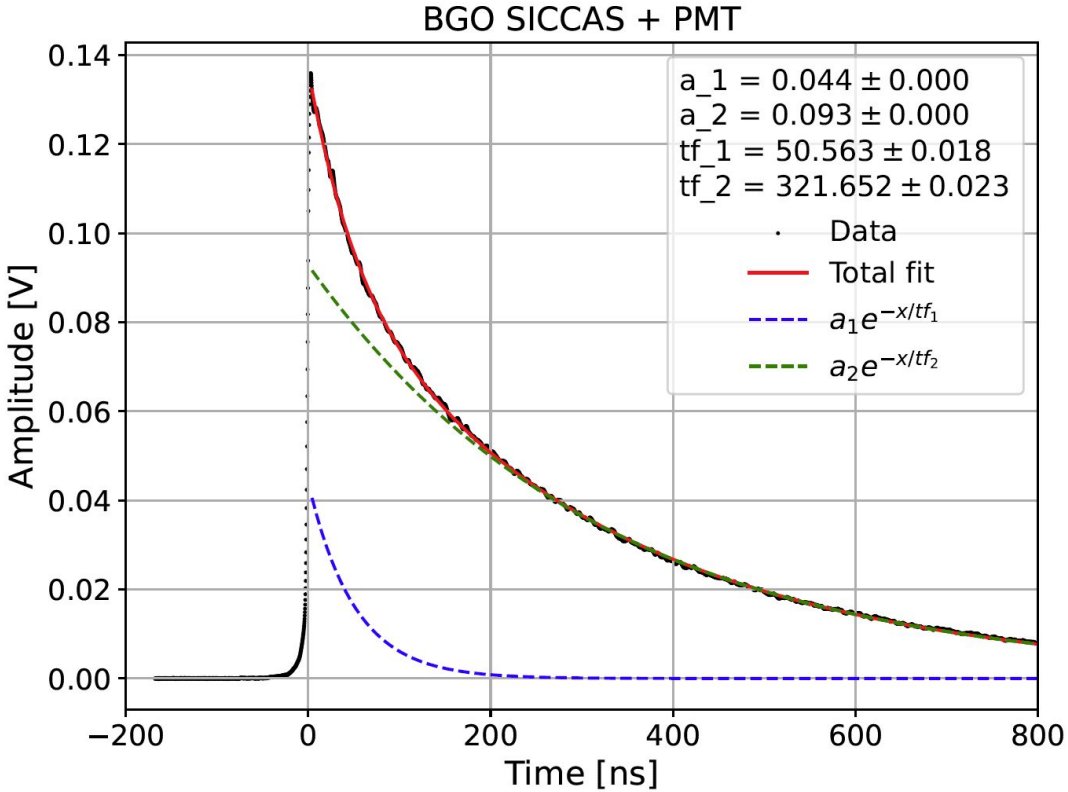
Decay times measured with a Hamamatsu R5900 PMT using cosmics



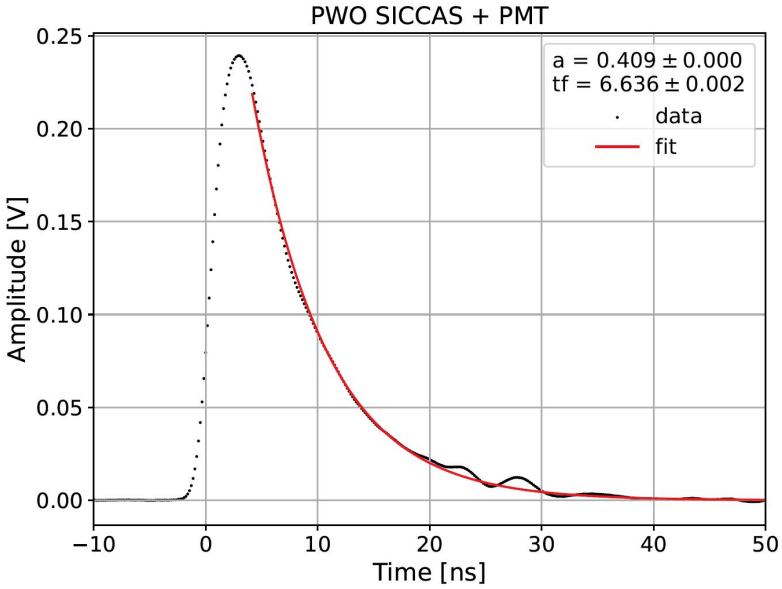
BSO

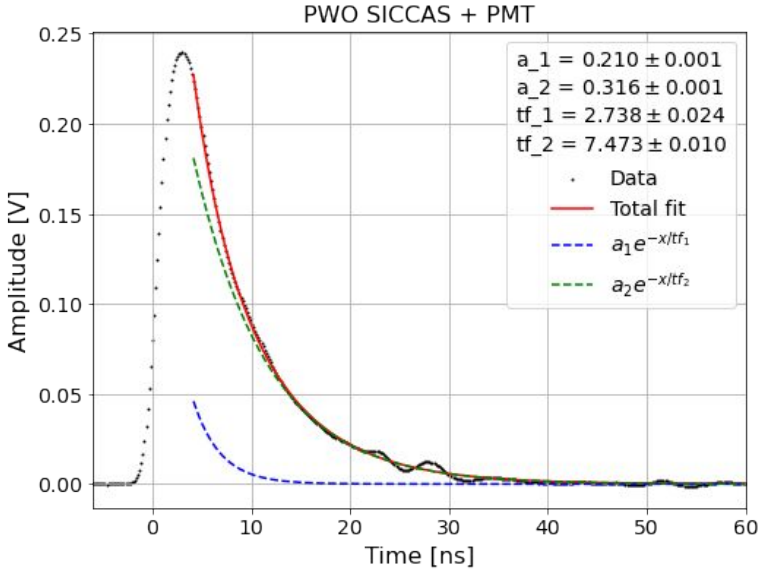

BSO SICCAS + PMT
a_1 = 0.054 ± 0.000
a_2 = 0.087 ± 0.000
tf_1 = 21.778 ± 0.013
tf_2 = 97.680 ± 0.015
Data
Total fit
$a_1 e^{-x/tf_1}$
$a_2 e^{-x/tf_2}$
Amplitude [V]
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
−100
0
100
200
300
400
Time [ns]

BGO


BGO SICCAS + PMT
a_1 = 0.044 ± 0.000
a_2 = 0.093 ± 0.000
tf_1 = 50.563 ± 0.018
tf_2 = 321.652 ± 0.023
Data
Total fit
$a_1 e^{-x/tf_1}$
$a_2 e^{-x/tf_2}$
Amplitude [V]
Time [ns]
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
−200
0
200
400
600
800

PWO


PWO SICCAS + PMT
a = 0.409 ± 0.000
tf = 6.636 ± 0.002
data
fit
Amplitude [V]
Time [ns]
0.25
0.20
0.15
0.10
0.05
0.00
−10
0
10
20
30
40
50


PWO SICCAS + PMT
a_1 = 0.210 ± 0.001
a_2 = 0.316 ± 0.001
tf_1 = 2.738 ± 0.024
tf_2 = 7.473 ± 0.010
Data
Total fit
$a_1 e^{-x/tf_1}$
$a_2 e^{-x/tf_2}$
Amplitude [V]
Time [ns]
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
60

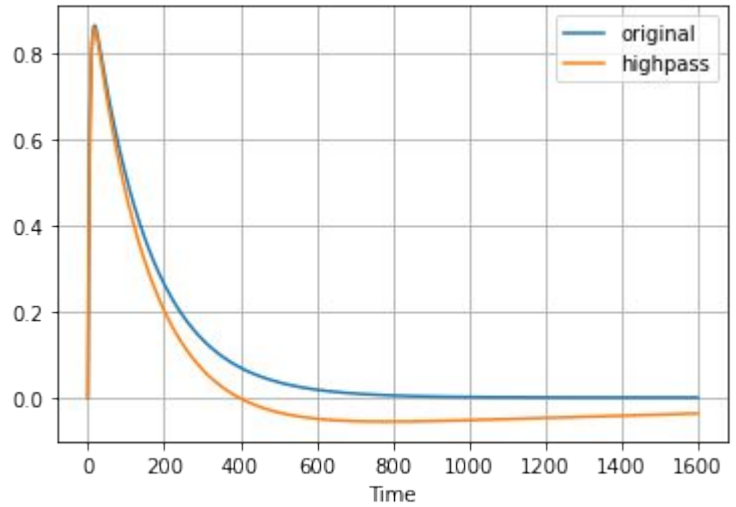
SiPM response

SiPM signal response modelled using high intensity LED pulse (run 376)

peak+tail modelled as:

```
def func(x, a, tf, tr, x0, c, fc):
    y = a*np.exp((-x+x0)/tf)*(1-np.exp((-x+x0)/tr))*(x>x0)+c
    y = highpass(y, dt, fc)
    return y
```

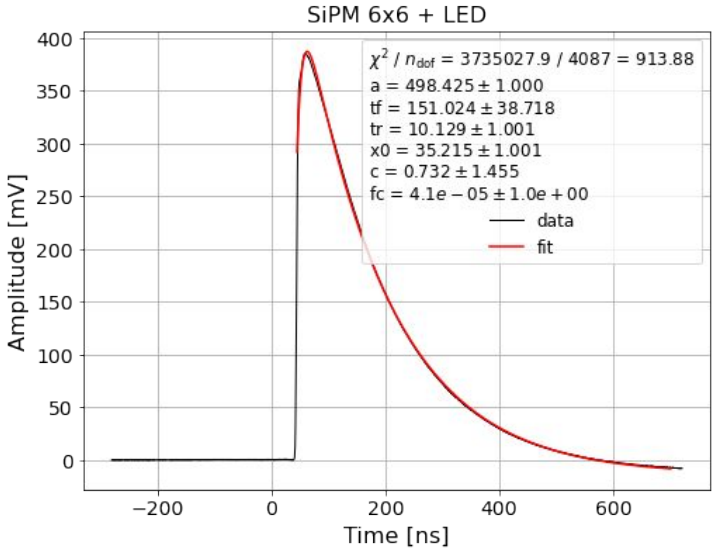
```
def highpass(x, dt, fc):
    RC=1/(2*np.pi*fc)
    n = len(x)
    y = np.zeros(n)
    alpha = RC / (RC + dt)
    y[0] = x[0]
    for i in range(1, n):
        y[i] = alpha * (y[i - 1] + x[i] - x[i - 1])
    return y
```



SiPM response

SiPM signal response modelled using high intensity LED pulse (run 376)

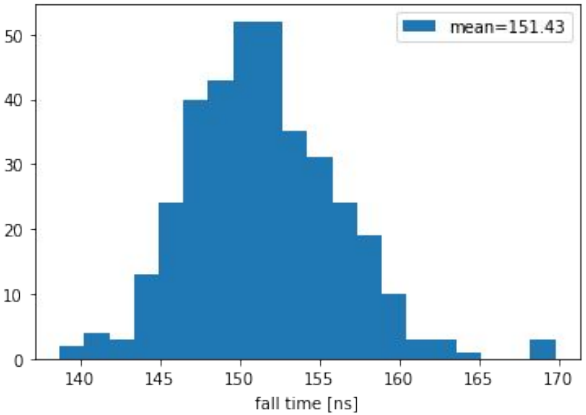
peak+tail modelled as:

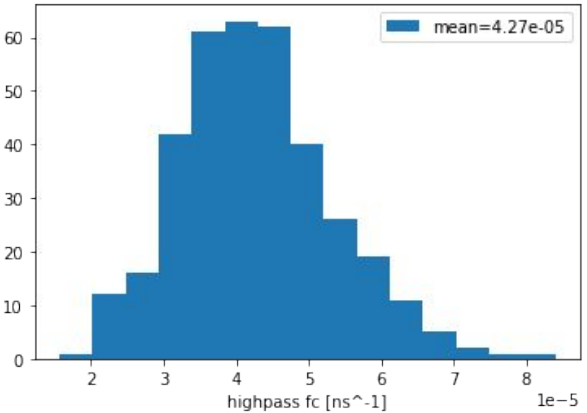


SiPM response

SiPM signal response modelled using high intensity LED pulse (run 376)

peak+tail modelled as:





SiPM response and fit templates

Cherenkov: It is prompt -> it has the same SiPM single photon shape (double exp + hipass);

Scintillation: it is the convolution of single photon shape (double exp + hi-pass) with exponential with characteristic crystal time.

- rise time related to SiPM single photon discharge time
- fall time related to crystal decay time

Will check with simulation (or with no-filter data) if it can be still modelled as a double exponential + hipass

Or can use a numeric function. All time constants are determined and could be fixed in the fit