

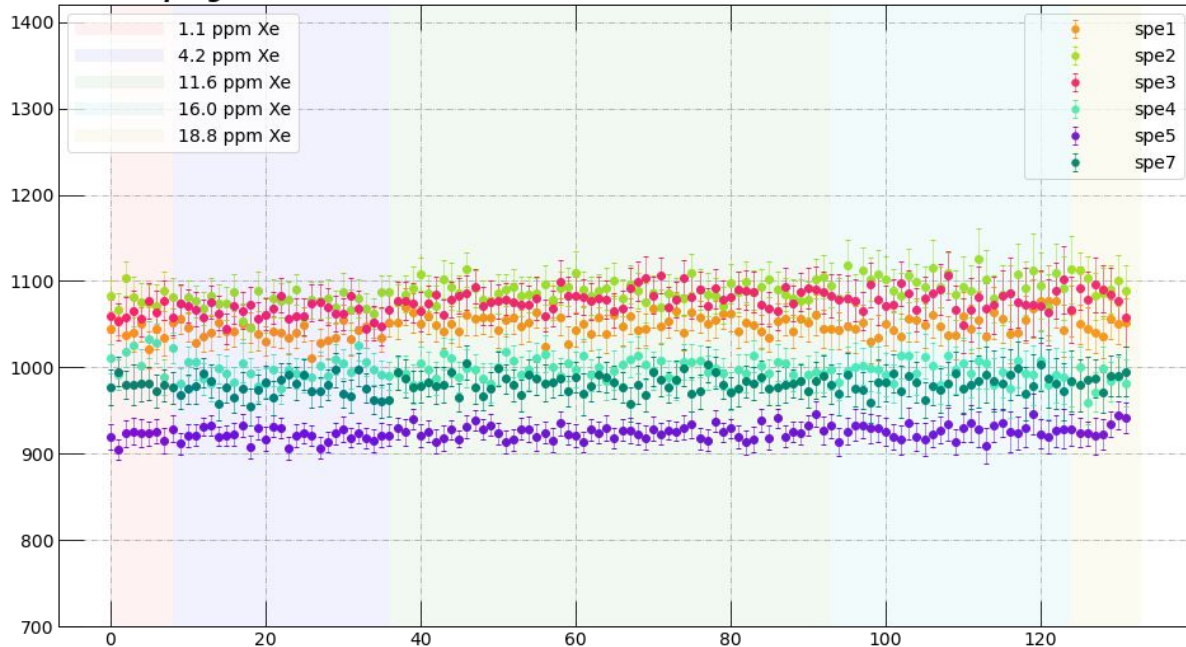


F. BORAN
F. DOLEK

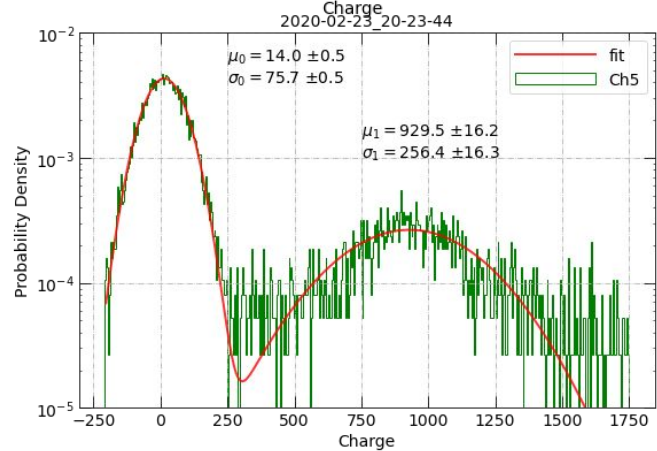
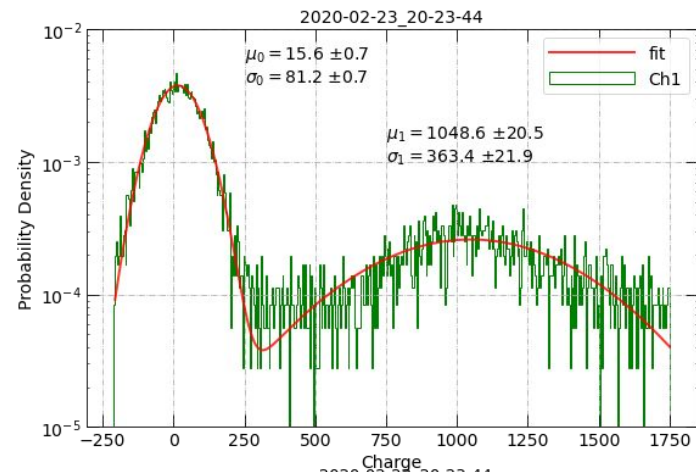
Standalone Arapuca Analysis

Work in progress

SPE

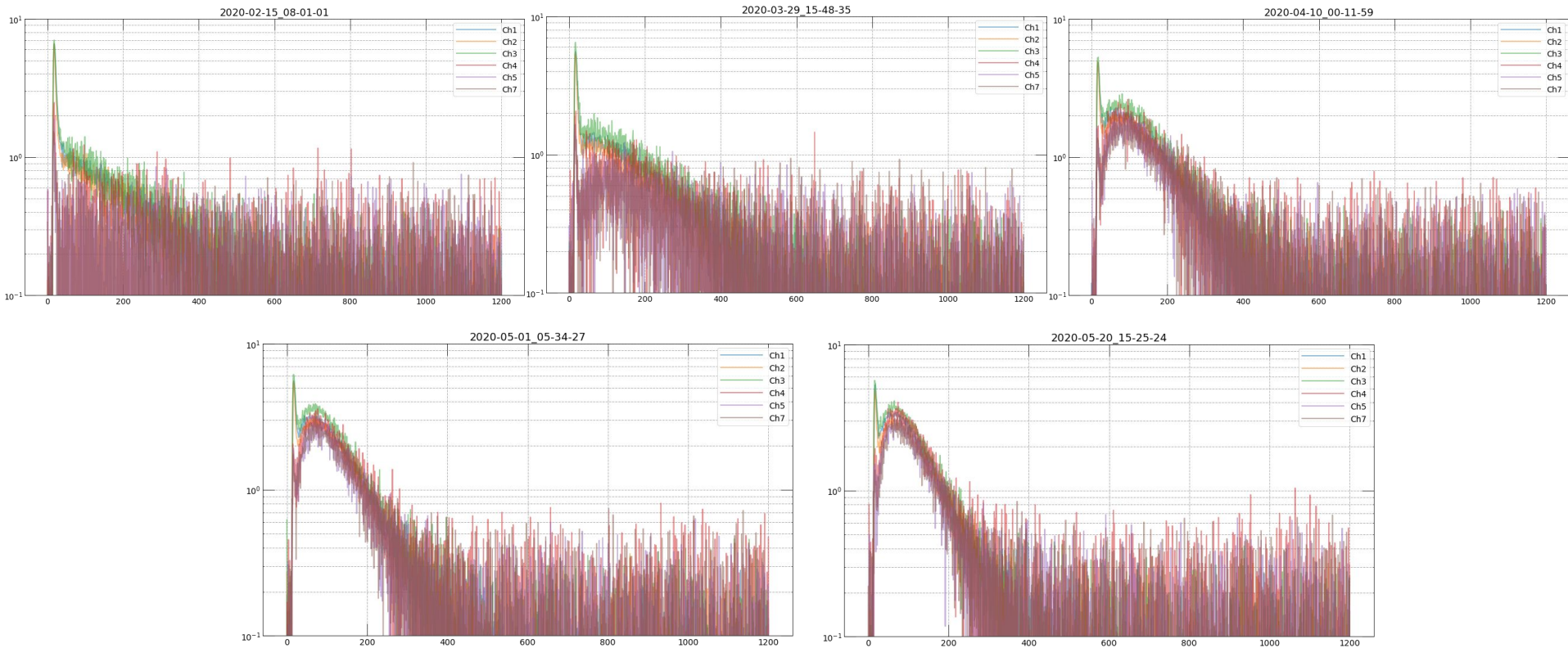


SPE

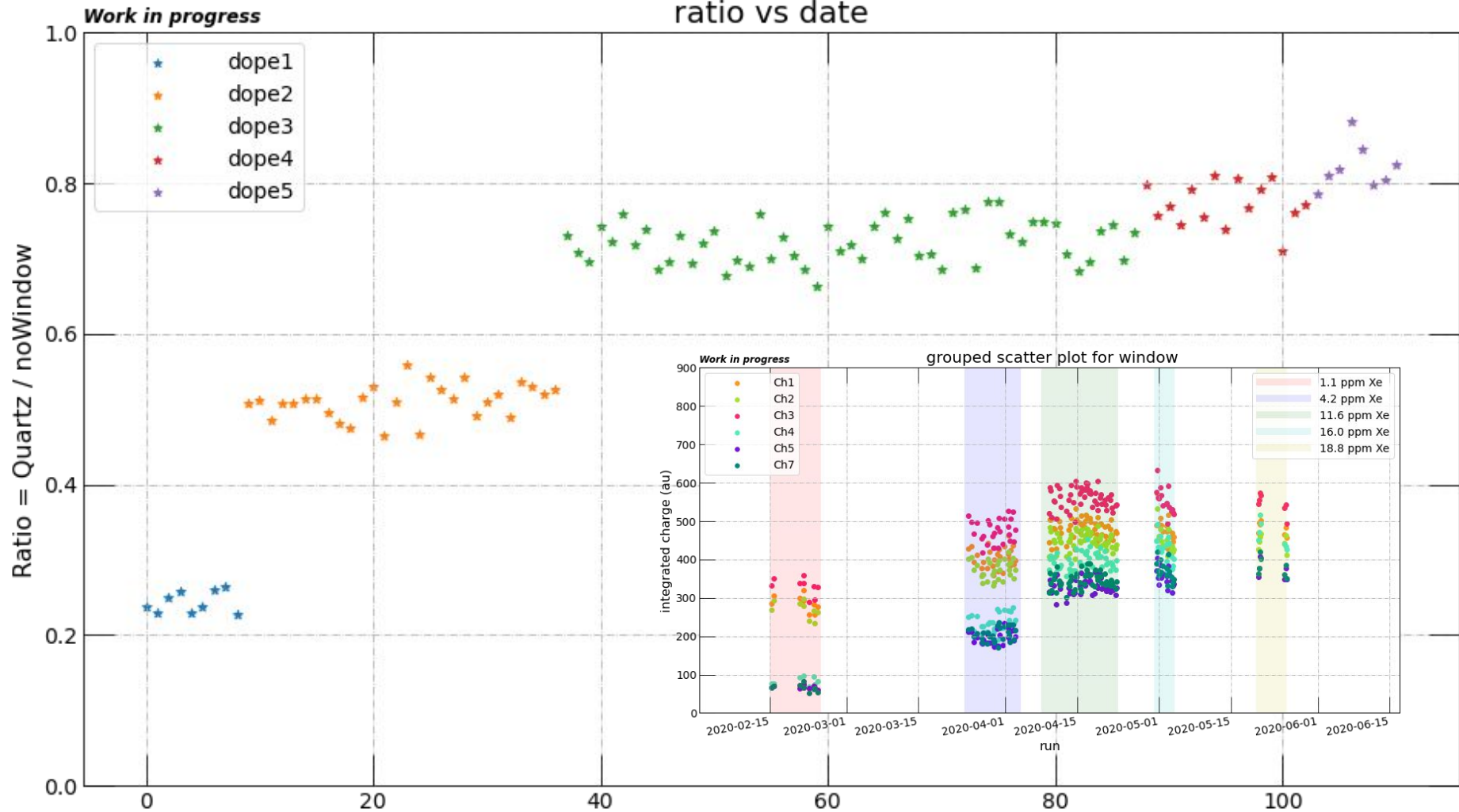


ch1: 1048.4 +/- 11.6 (SYS 2.4)
ch2: 1087.8 +/- 13.6 (SYS 2.5)
ch3: 1075.8 +/- 12.9 (SYS 3.1)
ch4: 997.41 +/- 12.0 (SYS 2.3)
ch5: 924.99 +/- 8.0 (SYS 0.16)
ch7: 980.68 +/- 10.3 (SYS 1.6)

Run examples for each injection and channels



ratio vs date



Reminder

$$\frac{dAA}{dt}(\text{scint}@128\text{nm}) = K \frac{\tau_{TA}}{\tau_{128}} \frac{e^{-t/\tau_{TA}}}{\tau_{TA}}$$

$$\frac{dAX}{dt}(\text{scint}@150\text{nm}) = K \frac{\tau_{TA}}{\tau_{150}} \frac{\tau_{TX}}{\tau_{AX}} \frac{(e^{-t/\tau_{TA}} - e^{-t/\tau_{TX}})}{(\tau_{TA} - \tau_{TX})}$$

$$\frac{dXX}{dt}(\text{scint}@175\text{nm}) = K \frac{\tau_{TA}}{\tau_{XX}} \frac{\tau_{TX}}{\tau_{AX}} \frac{(e^{-t/\tau_{TA}} - e^{-t/\tau_{TX}})}{(\tau_{TA} - \tau_{TX})}$$

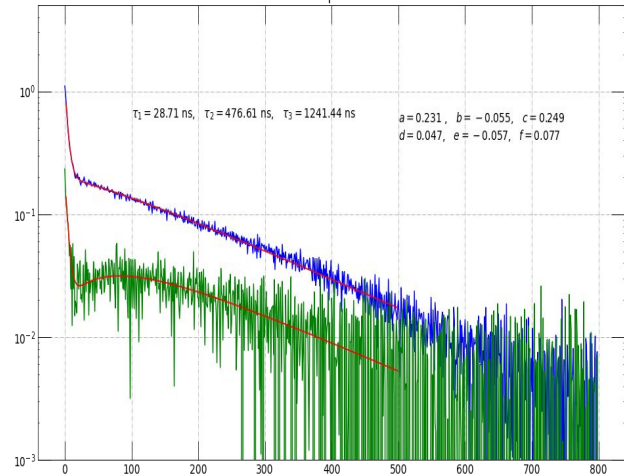
and

$$\frac{d(AX + XX)}{dt}(\text{scint}@150\text{nm} + 178\text{nm}) = K \frac{\tau_{TA}}{\tau_{AX}} \frac{(e^{-t/\tau_{TA}} - e^{-t/\tau_{TX}})}{(\tau_{TA} - \tau_{TX})}$$

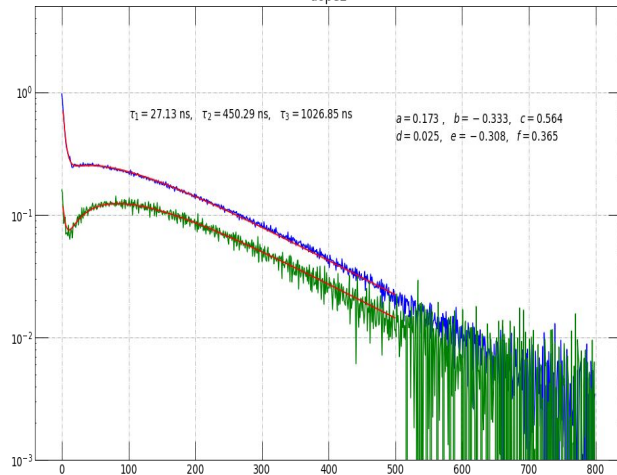
```
def mod1(t,a,b,c,d,e,f,t1,t2,t3): # not all pa
    return (a*(np.exp(-(t - t0)/t1)) +
            b*(np.exp(-(t - t0)/t2)) +
            c*(np.exp(-(t - t0)/t3)))

def mod2(t,a,b,c,d,e,f,t1,t2,t3): # not all pa
    return (d*(np.exp(-(t - t0)/t1)) +
            e*(np.exp(-(t - t0)/t2)) +
            f*(np.exp(-(t - t0)/t3)))
```

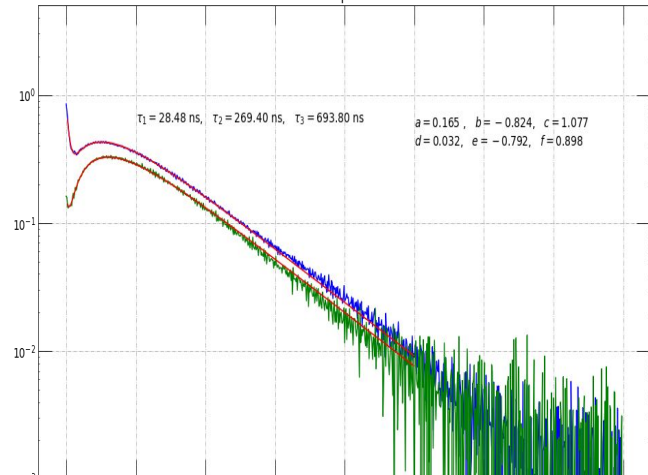
dope1



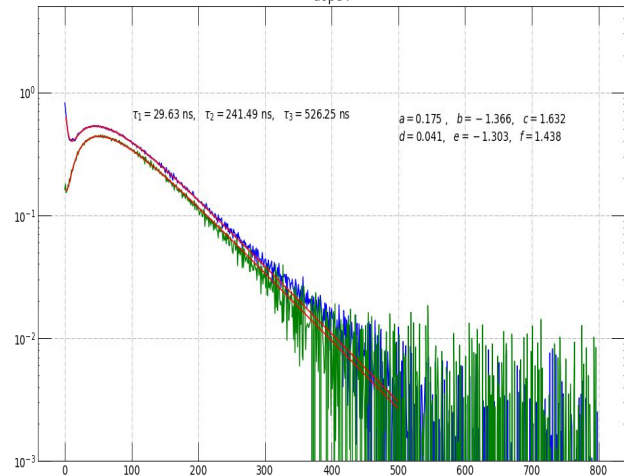
dope2



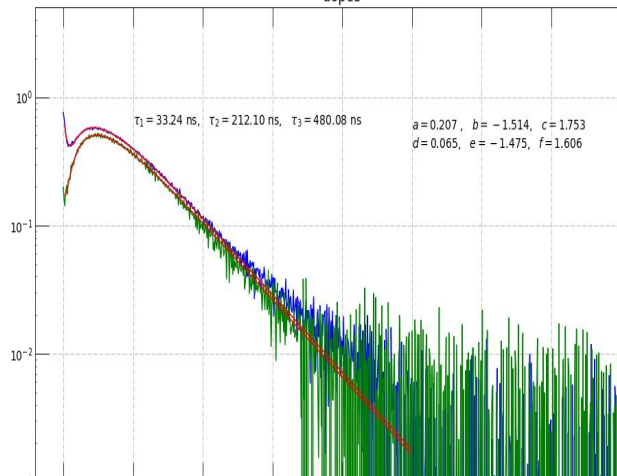
dope3

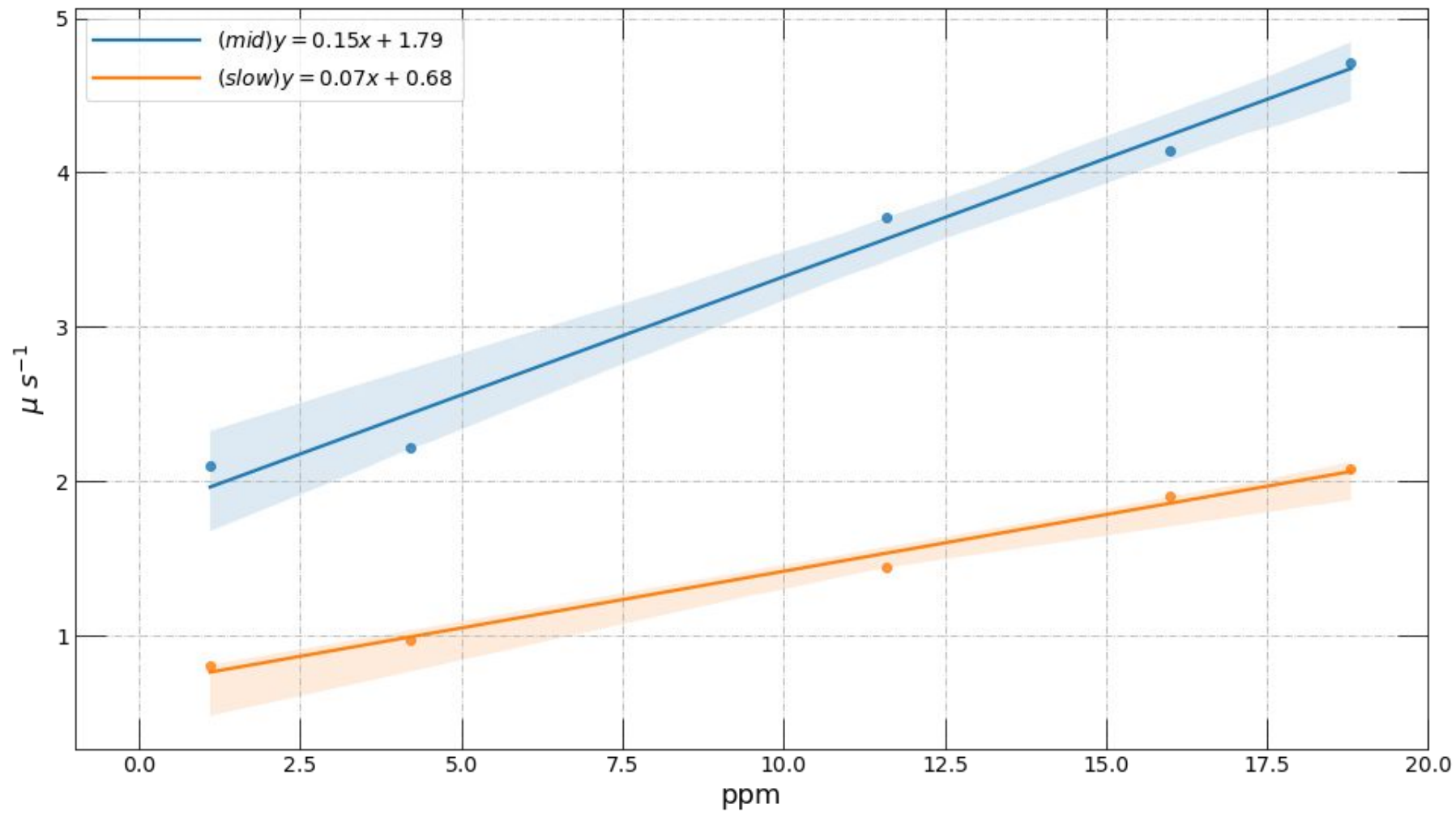


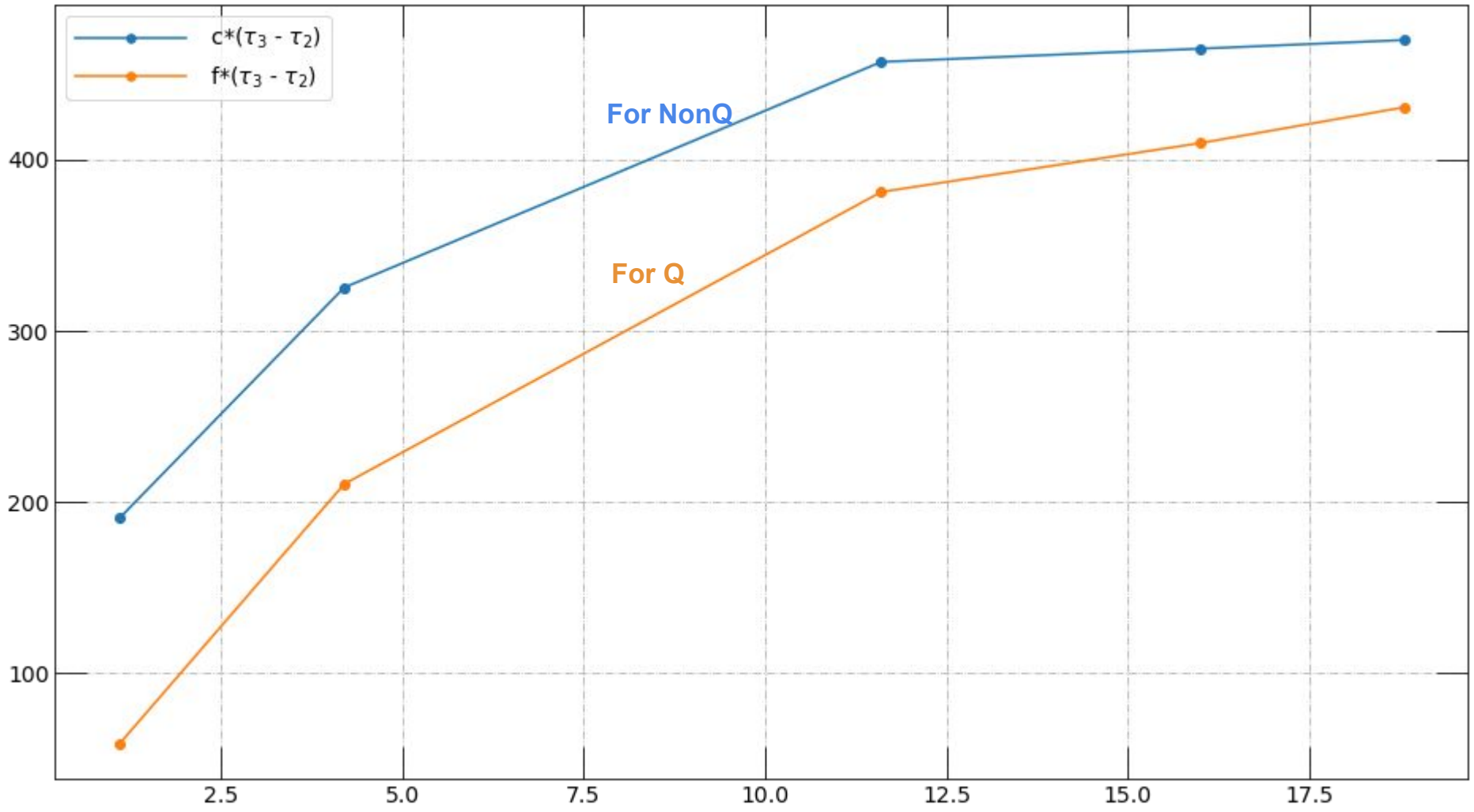
dope4

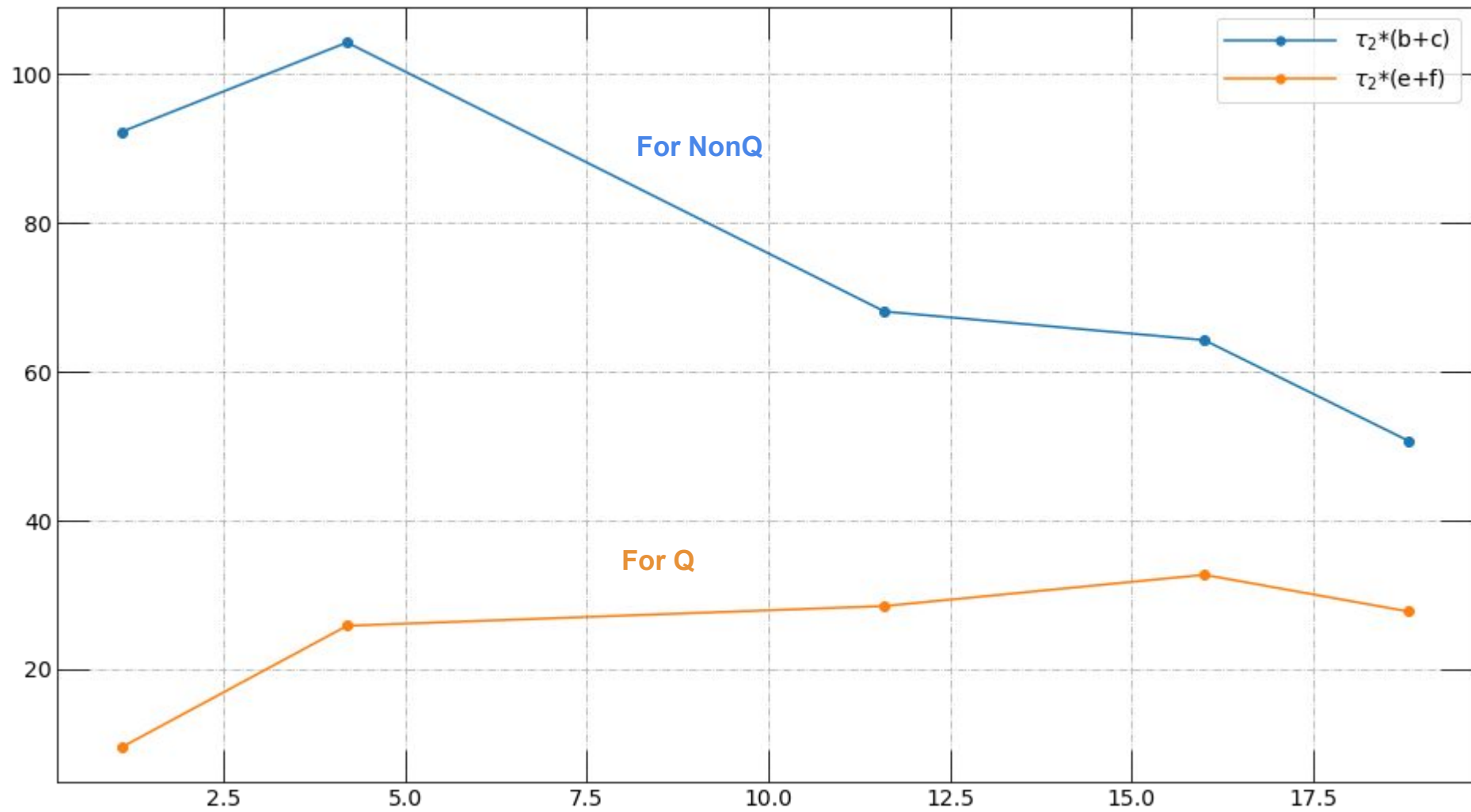


dope5



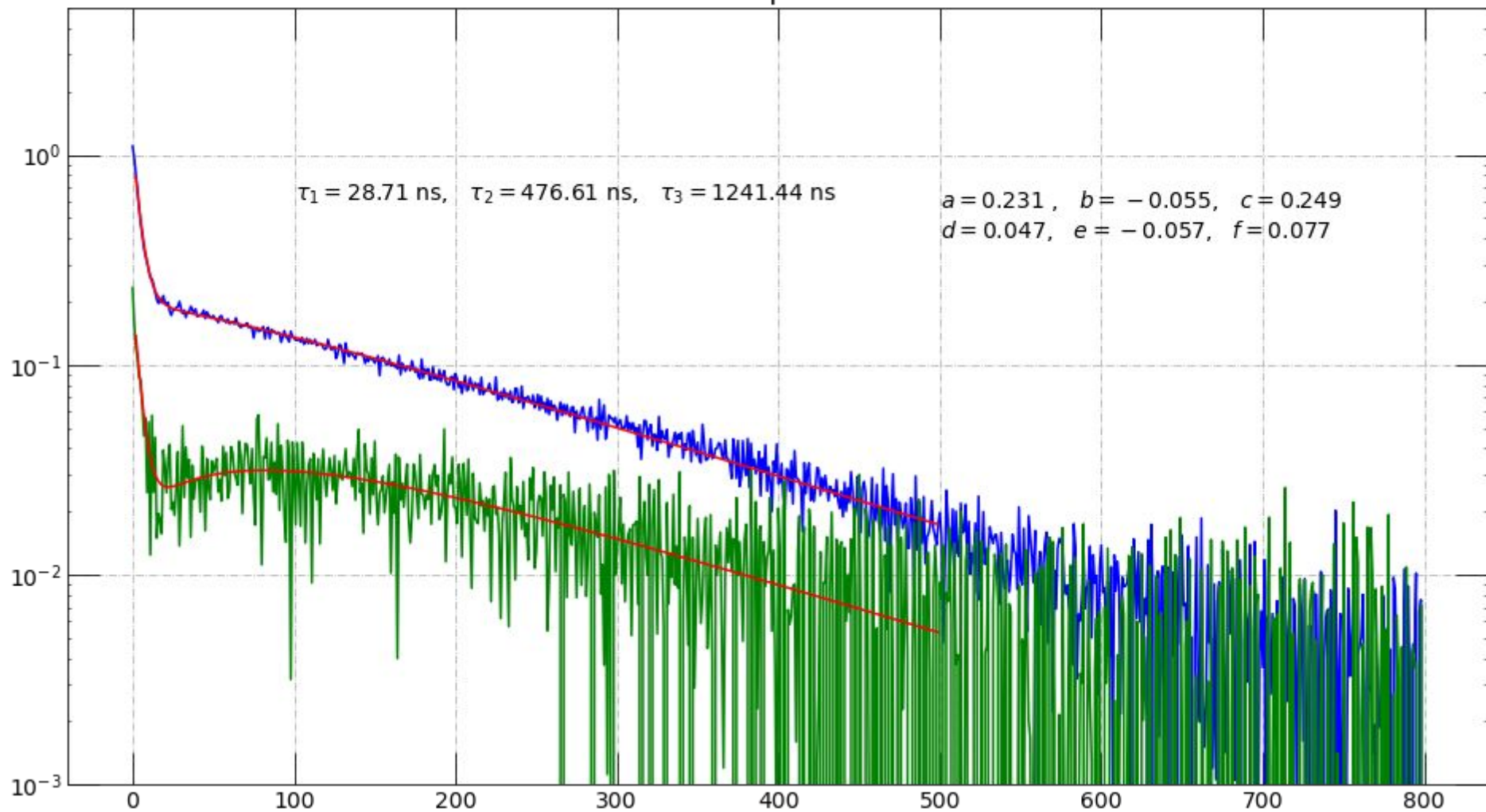




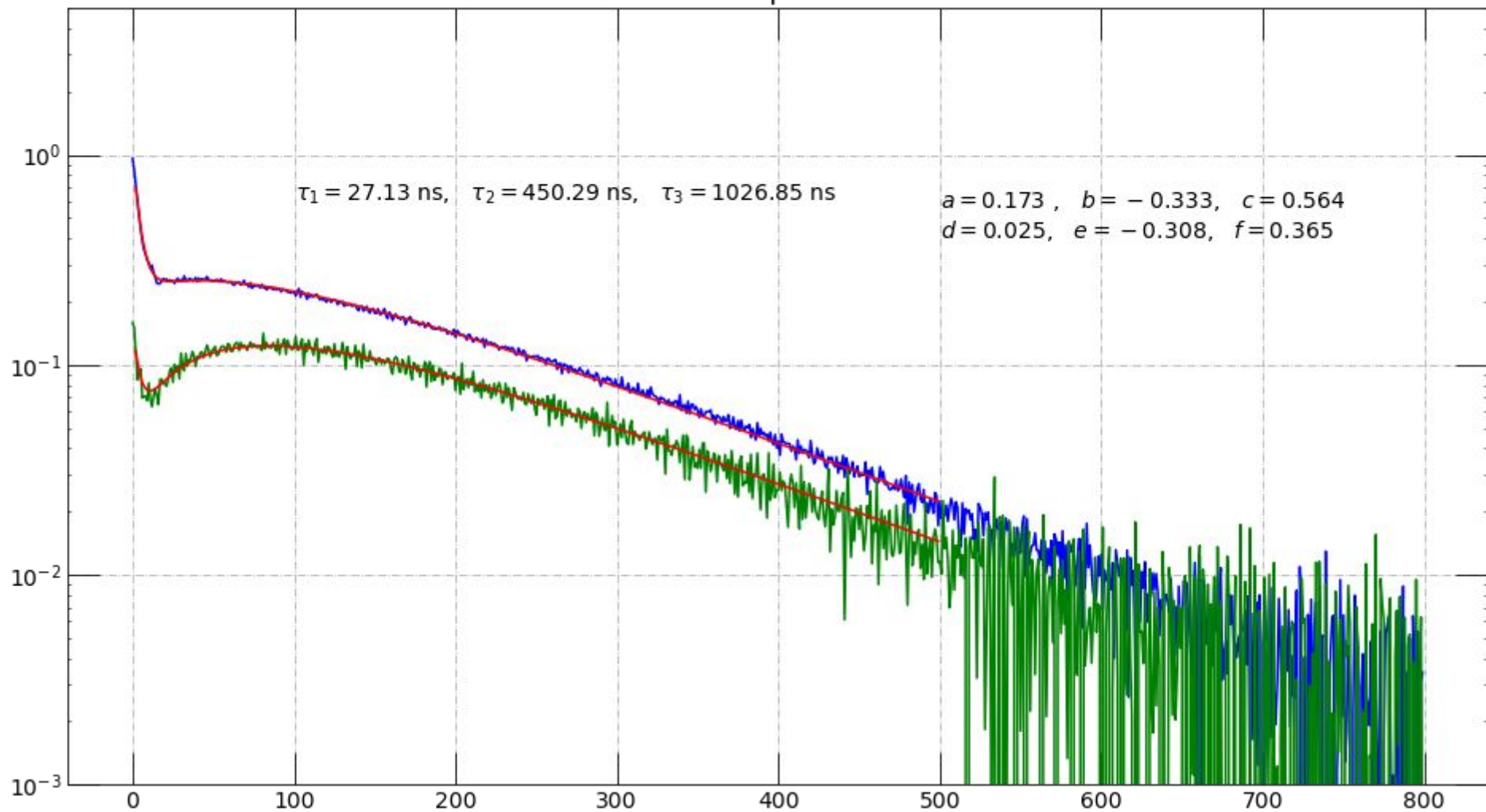


backup

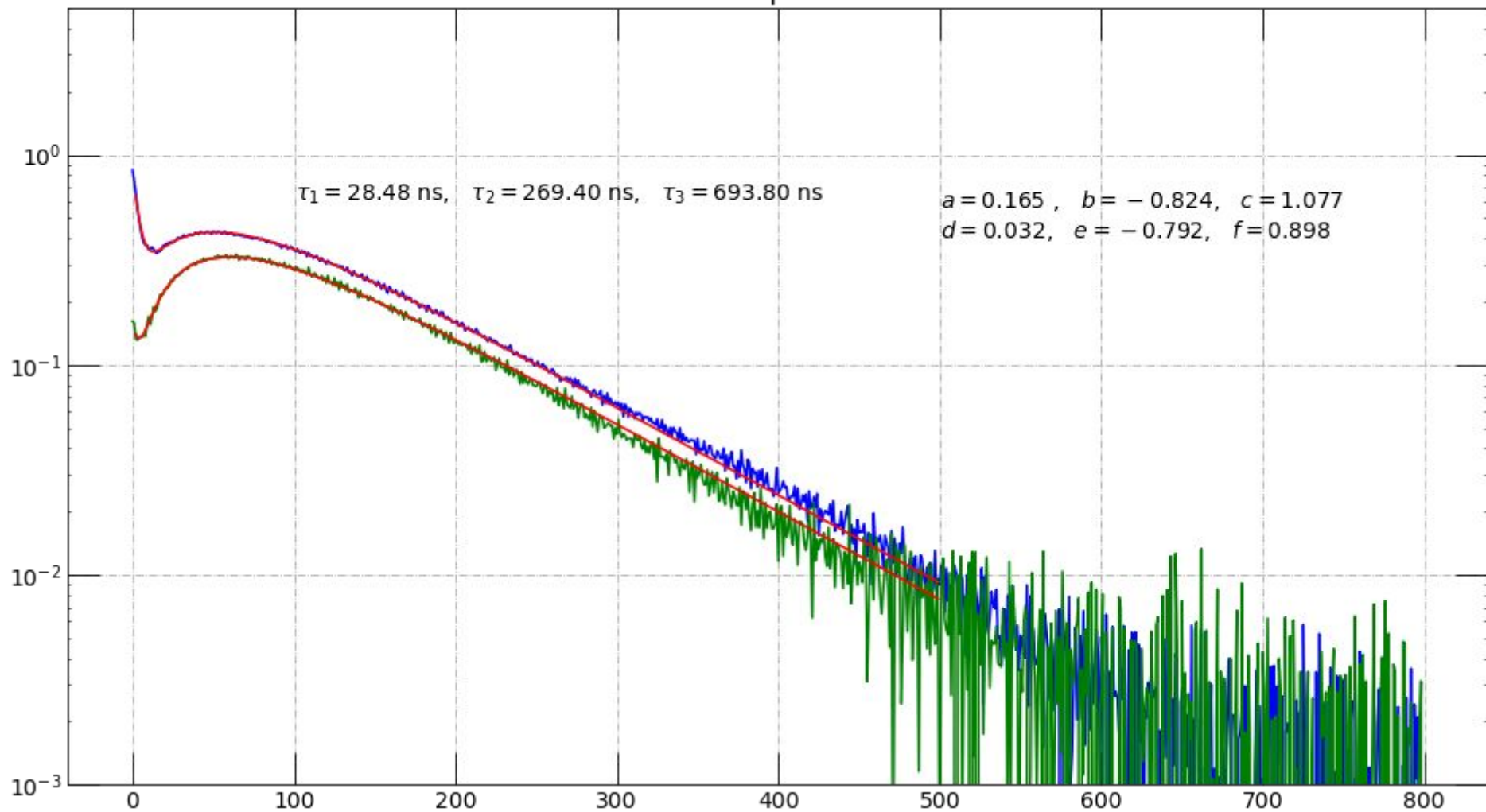
dope1



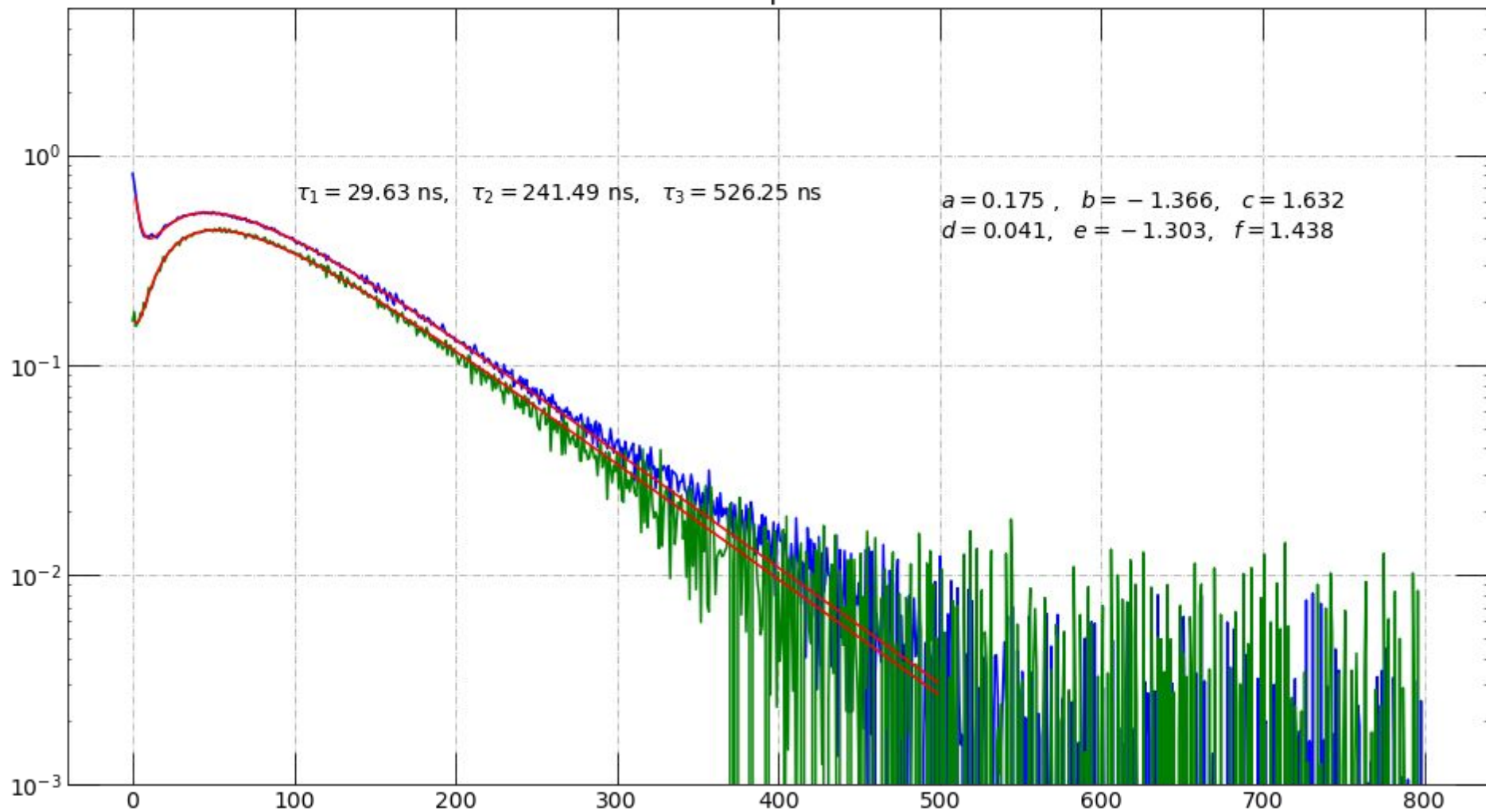
dope2



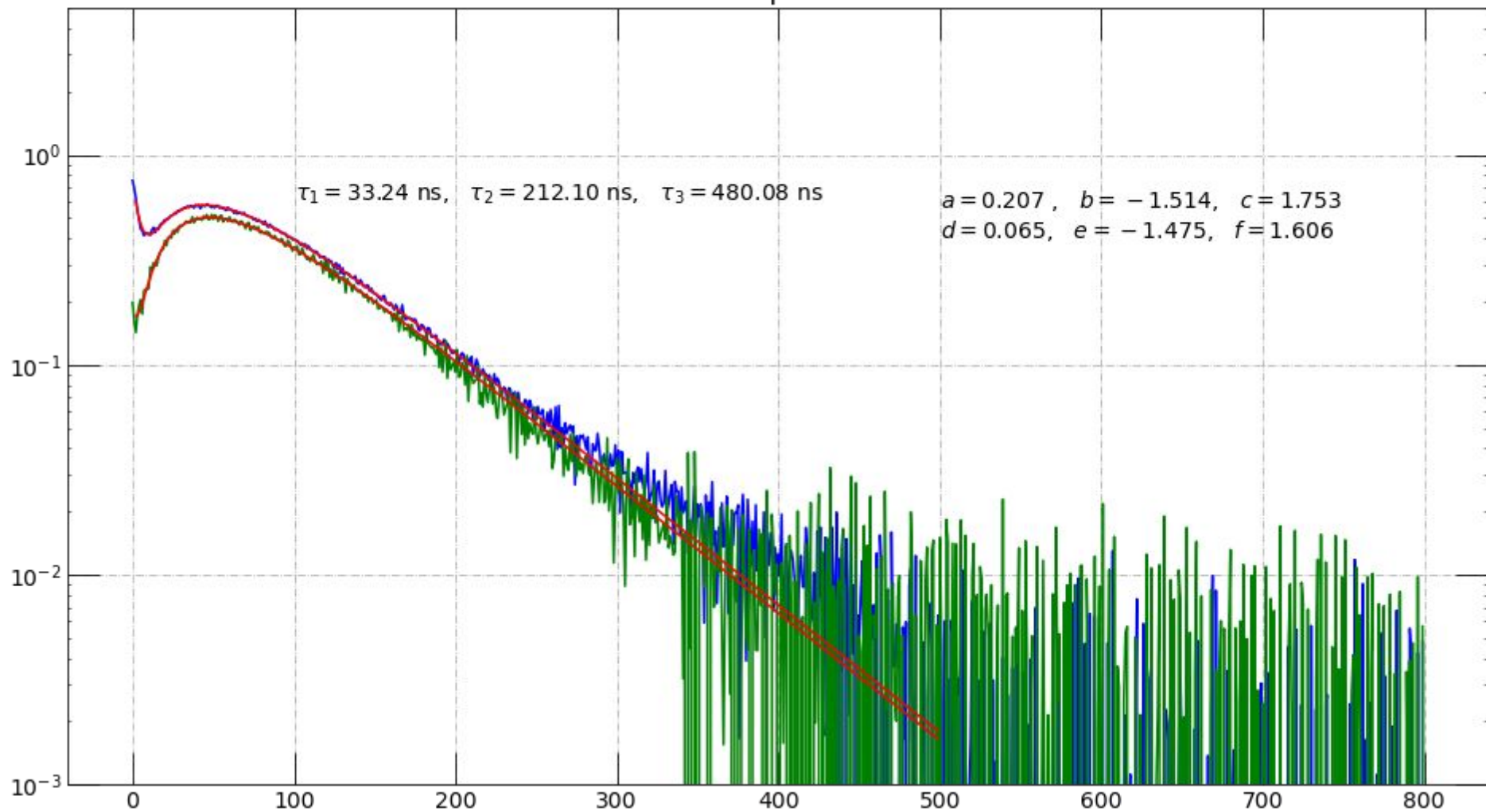
dope3



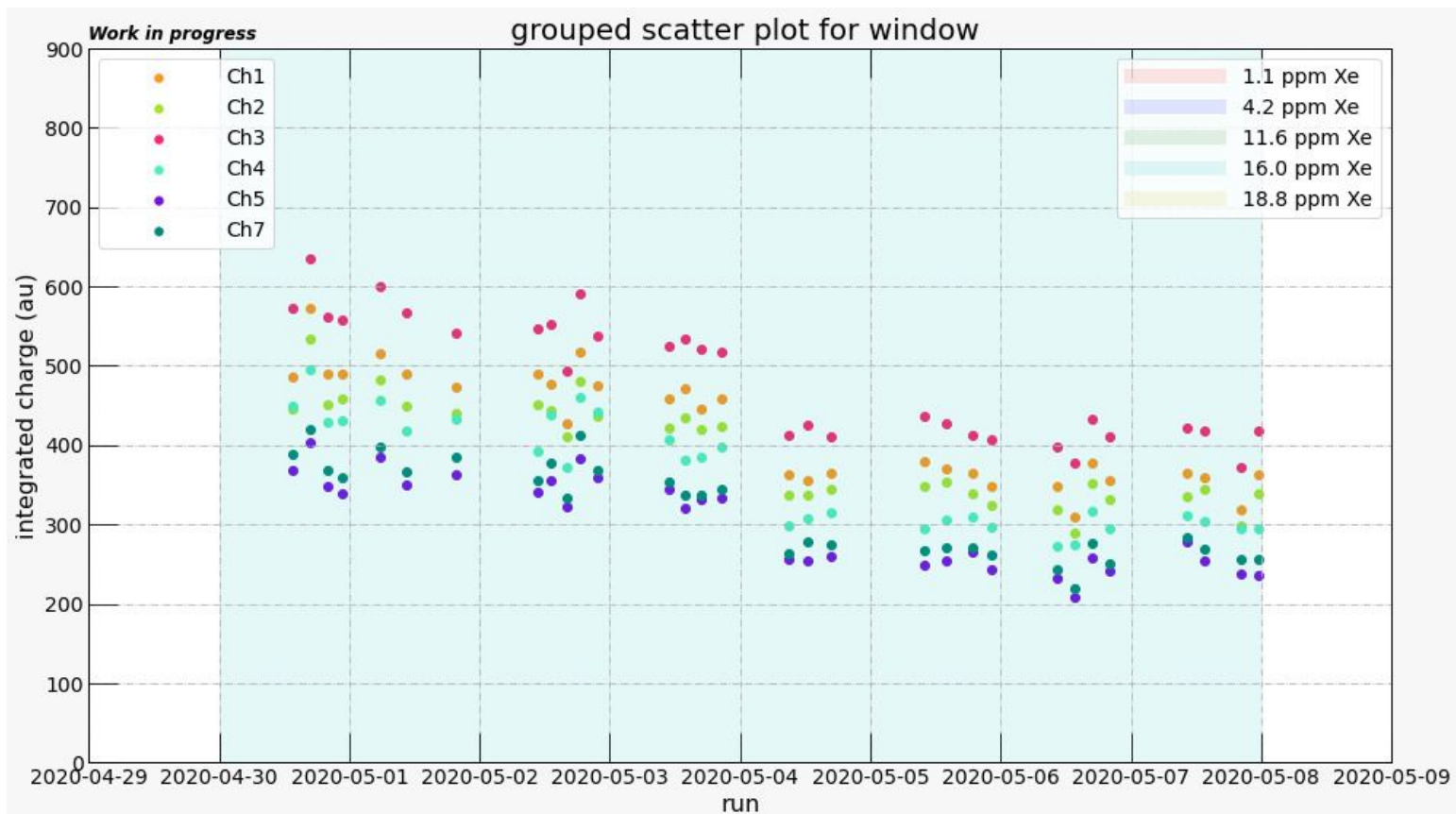
dope4



dope5



Dope4 after 2020-05-04(E180)



The X-Arapuca without Quartz window (XN) will see the sum of the three spectra, with the assumption that the three wavelengths are shifted with similar quantum efficiency.

$$\frac{dXN}{dt}(\text{scint}@128\text{nm} + 150\text{nm} + 178\text{nm})$$

$$= K \left(\frac{\tau_{TA}}{\tau_{128}} \frac{e^{-t/\tau_{TA}}}{\tau_{TA}} + \frac{\tau_{TA}}{\tau_{AX}} \frac{(e^{-t/\tau_{TA}} - e^{-t/\tau_{TX}})}{(\tau_{TA} - \tau_{TX})} \right)$$

The X-Arapuca with the Quartz window (XQ) will only be sensitive to the third spectrum (the one from XeXe*)

$$\frac{dXQ}{dt}(\text{scint}@178\text{nm}) = (1 - \varepsilon) K \frac{\tau_{150}}{\tau_{XX} + \tau_{150}} \frac{\tau_{TA}}{\tau_{AX}} \frac{(e^{-t/\tau_{TA}} - e^{-t/\tau_{TX}})}{(\tau_{TA} - \tau_{TX})}$$

The XN and XQ spectra at the different Xe concentrations can be fitted 'simultaneously' with the $\frac{d^{XN}}{dt}$ and $\frac{d^{XQ}}{dt}$ functions to extract the common value of τ_{TA} and τ_{TX} .

A linear fit of $\frac{1}{\tau_{TA}}$ and $\frac{1}{\tau_{TX}}$ as a function of the Xenon concentration could allow to estimate estimate of τ_{AX} and τ_{XX} :

$$\frac{1}{\tau_{TA}} = \frac{1}{\tau_{128}} + \frac{1}{\tau_{N2}} + \frac{1}{\tau_{AX}} = (a + b \text{ Xe}[ppm]) \mu s^{-1}$$

$$\frac{1}{\tau_{128}} + \frac{1}{\tau_{N2}} = a \mu s^{-1}$$

$$\frac{1}{\tau_{N2}} = (a - \frac{1}{1.6}) \mu s^{-1}$$

$$\tau_{N2} = 1 / (a - \frac{1}{1.6}) \mu s$$

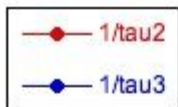
$$\frac{1}{\tau_{AX}} = b \text{ Xe}[ppm] \mu s^{-1}$$

$$\tau_{AX} = \frac{1/b}{\text{Xe}[ppm]} \mu s$$

$$\frac{1}{\tau_{TX}} = \frac{1}{\tau_{150}} + \frac{1}{\tau_{XX}} = c + d \text{ Xe}[ppm] \mu s^{-1}$$

$$\tau_{150} = \frac{1}{c} \mu s$$

$$\tau_{XX} = \frac{\frac{1}{d}}{\text{Xe}[ppm]} \mu s$$



Red line equation: $y = 1.5317 + 0.18691x$ $R = 0.99108$

Blue line equation: $y = 0.68279 + 0.073093x$ $R = 0.99344$

