

Study of PSD for ReD TPC scan in t_{prompt}

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Scan in t_{prompt}

A series of runs were reconstructed during this week with varying t_{prompt} parameter, from 200 - 900 ns with a 50 ns step. (15 root files in total)

$$f_{prompt} = \frac{\int_{t_{start}}^{t_{prompt}} w f(t)}{\int_{t_{start}}^{t_{end}} w f(t)}$$

The purpose was to systematically study PSD capabilities of PSD parameter f_{prompt} for ReD TPC by varying t_{prompt} parameter. The root files are available both on Roma3 and on darksidews03 in Napoli.

FoM - Figure of merit

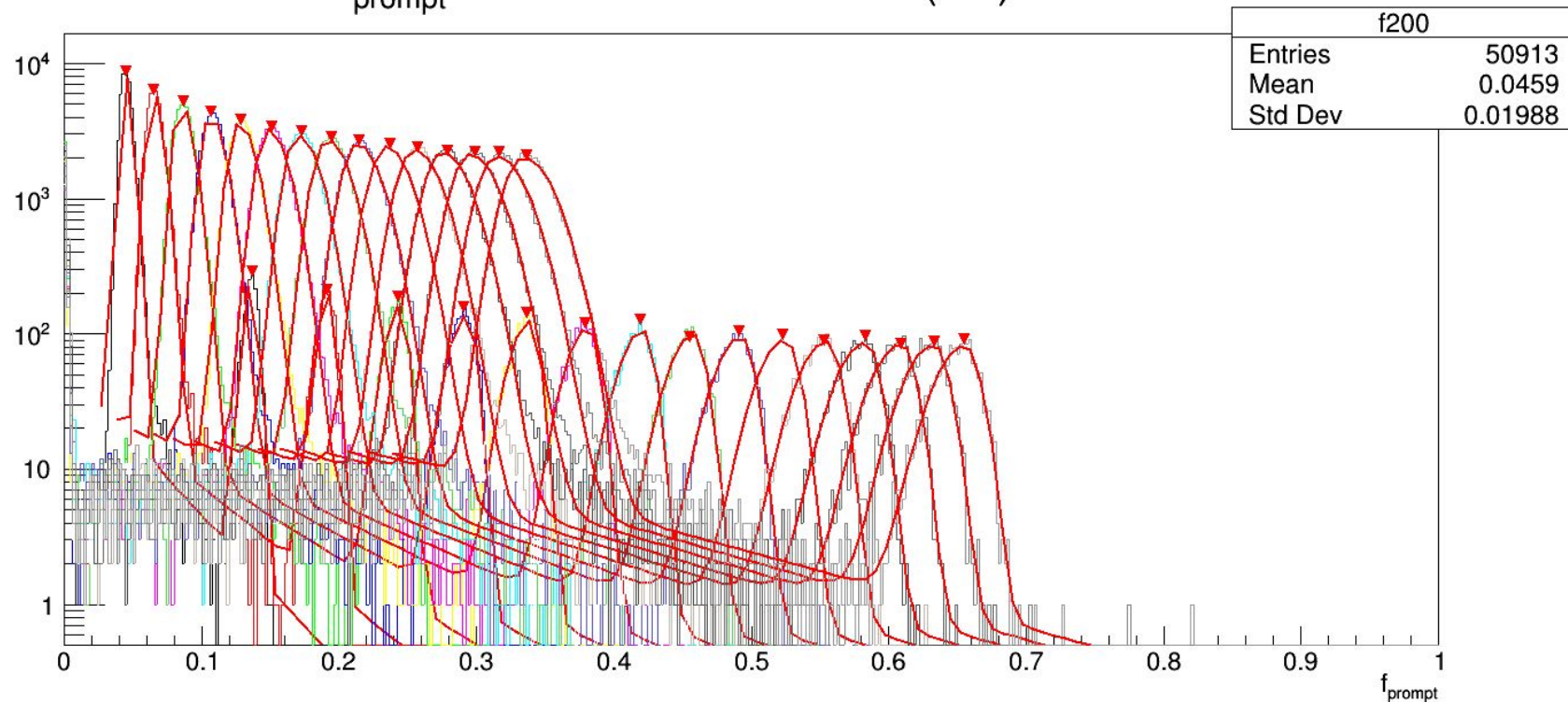
The parameter used to evaluate goodness of a certain t_{prompt} value is a FoM between NR and ER distributions in parameter f_{prompt} and defined as follows:

$$FoM = \frac{\mu_{NR} - \mu_{ER}}{\sqrt{\sigma_{ER}^2 + \sigma_{NR}^2}}$$

Where μ 's and σ 's are parameters for the gaussian fit of peaks for NR and ER population in f_{prompt} distributions. Actually, as this fit function has been revisited to be defined by the sum of 2 asymmetric gaussian + 1 exponential, the σ 's in the equation refer to *internal* σ , standing for right σ of left gaussian for ER and left σ of right gaussian for NR.

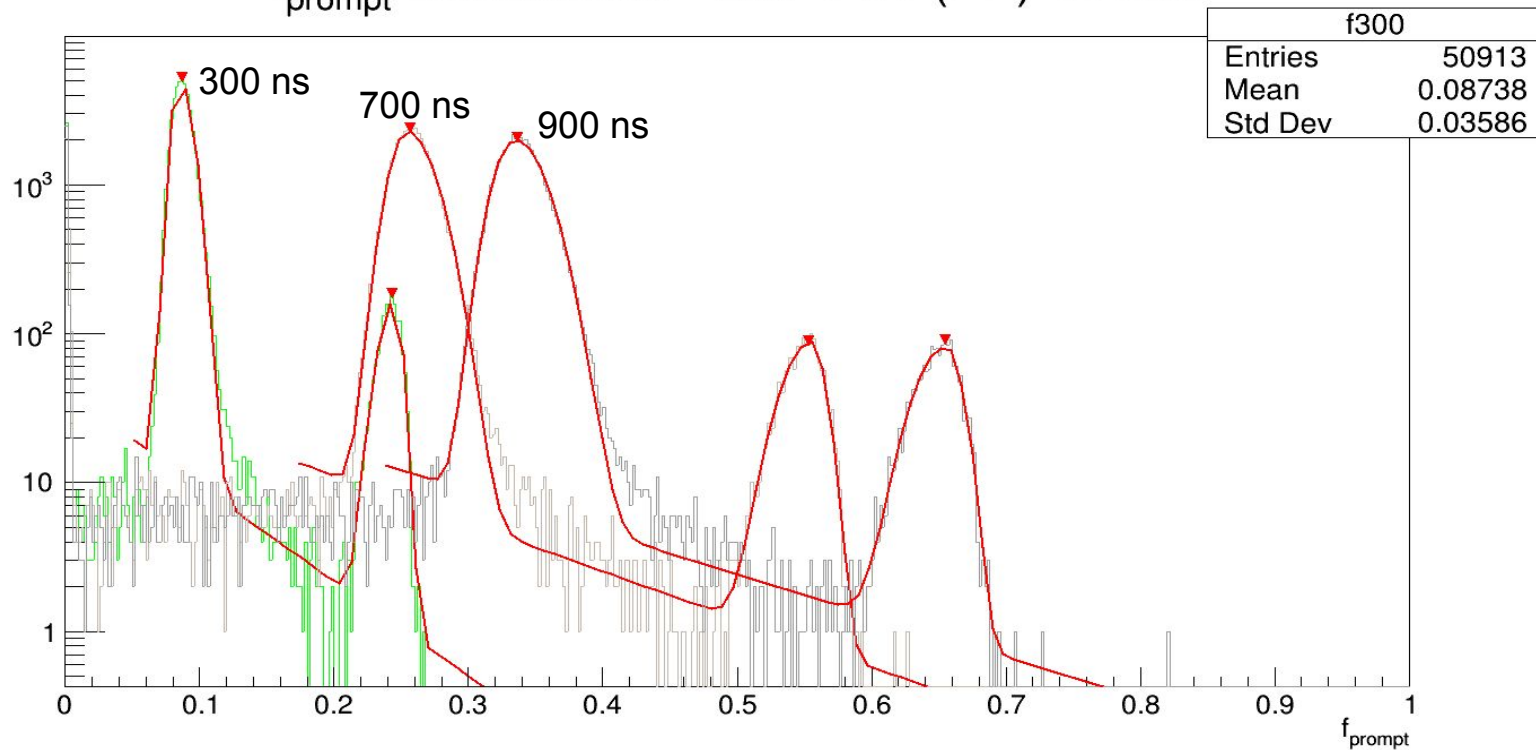
Macro fitting all runs - Very messy!

f_{prompt} distribution - $500 < S1 \text{ (PE)} < 2500$



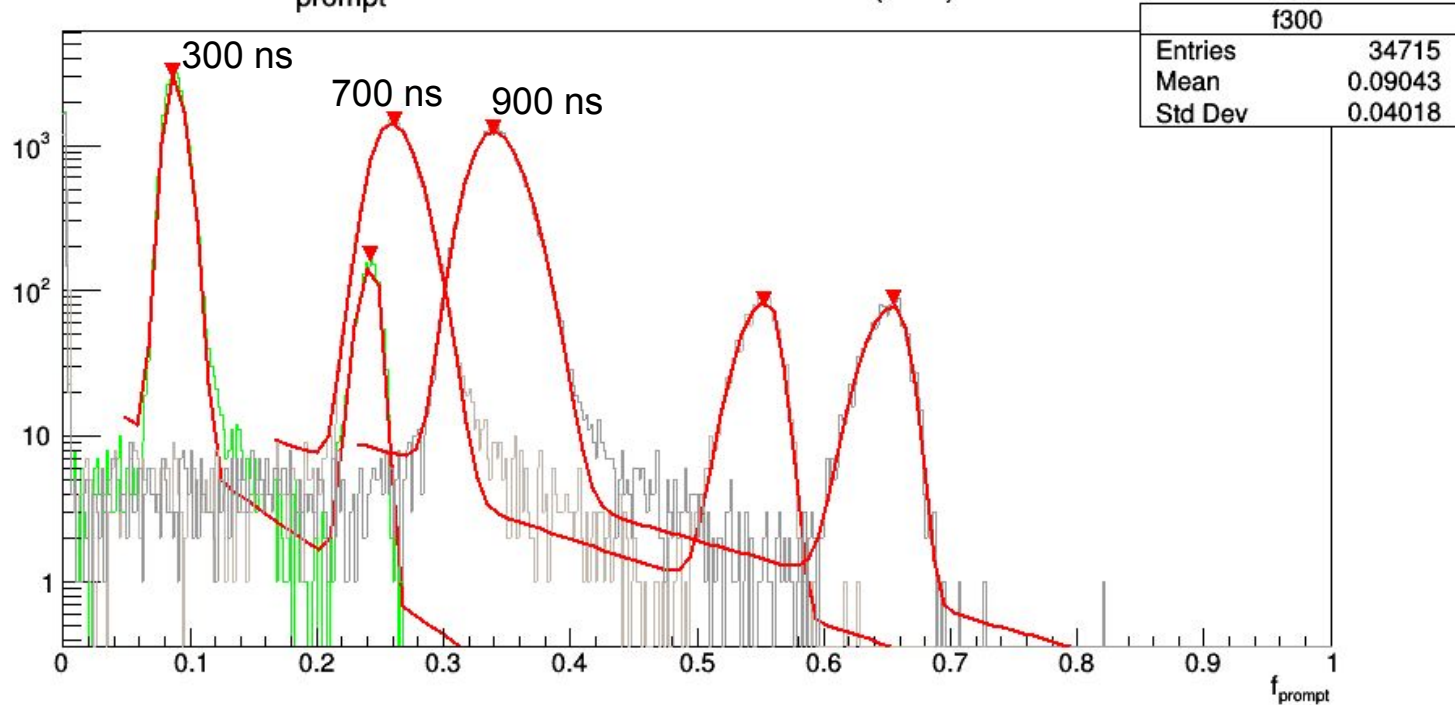
Showing only $t_{\text{prompt}} = 300, 700, 900$ ns

f_{prompt} distribution - $500 < S1 \text{ (PE)} < 2500$

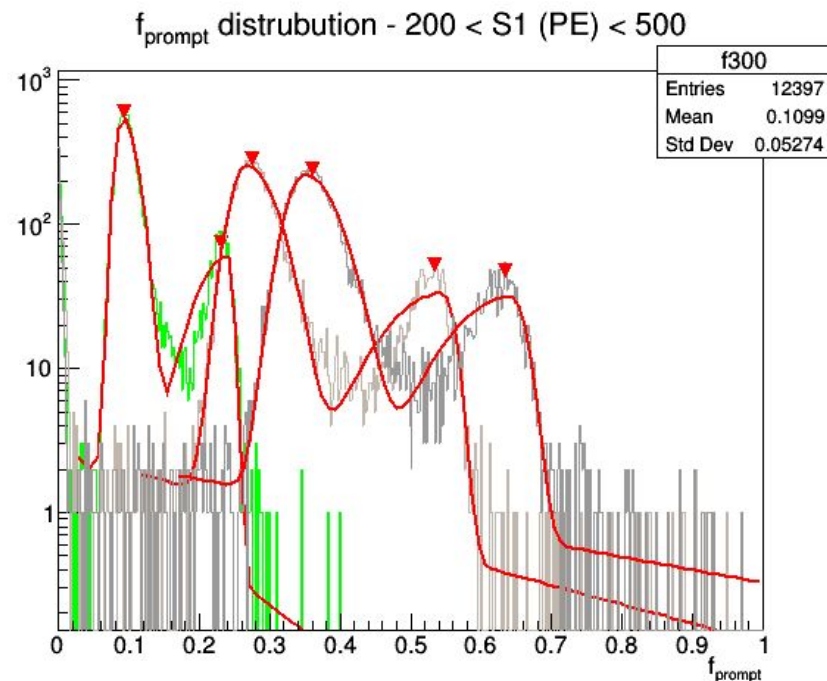
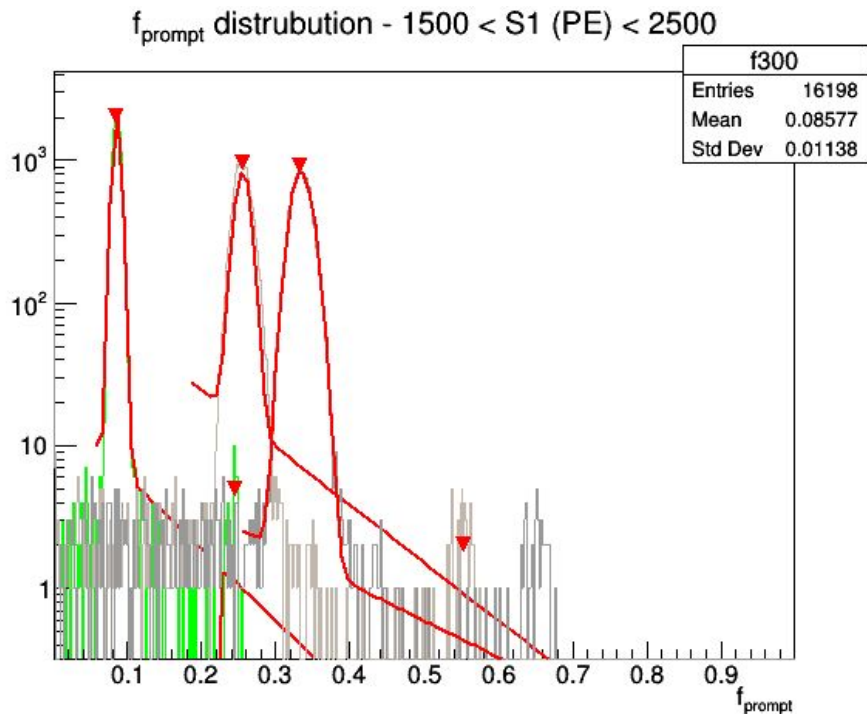


Slice of energies between 500 and 1500 PE

f_{prompt} distribution - $500 < S1 \text{ (PE)} < 1500$

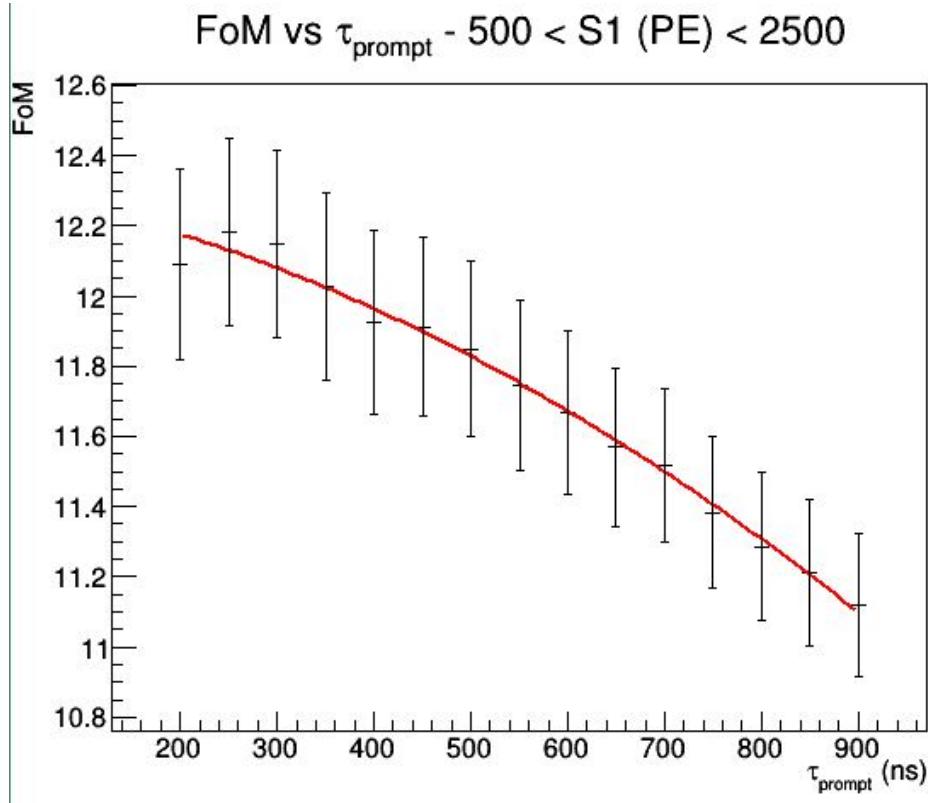


Outside region... the macro doesn't work



It needs to be done by hand... Simone Castellano did!

FoM vs t_{prompt}



Energy window between 500 and 2500 PE

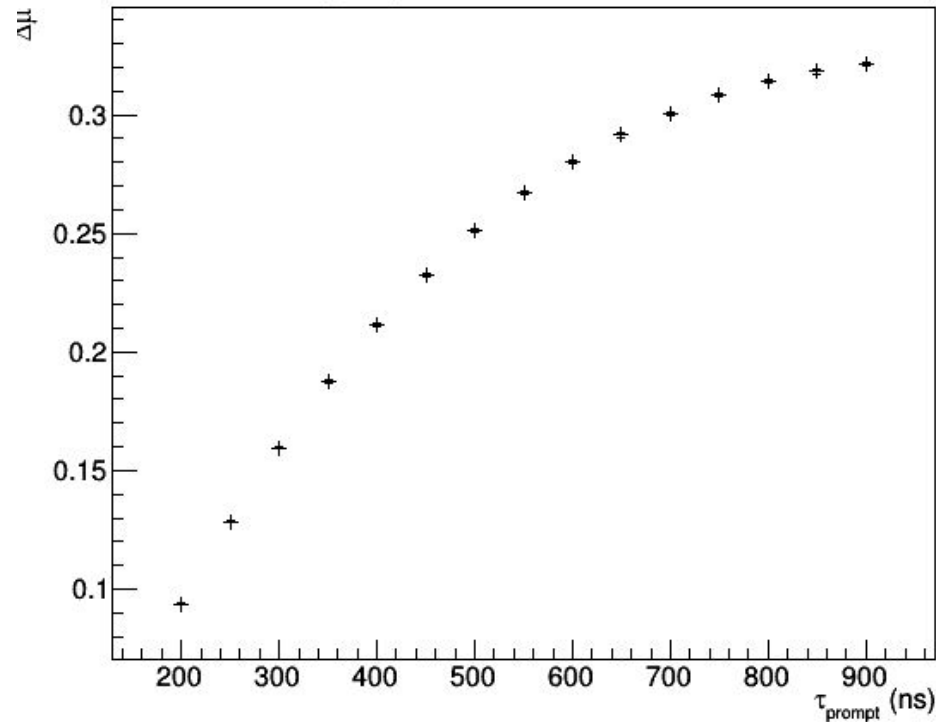
Variation of about 10% in this range of t_{prompt}

Maximum seems located between 200 and 300 ns.

This does not account S2 - S1 identification using t_{prompt} . Only NR/ER.

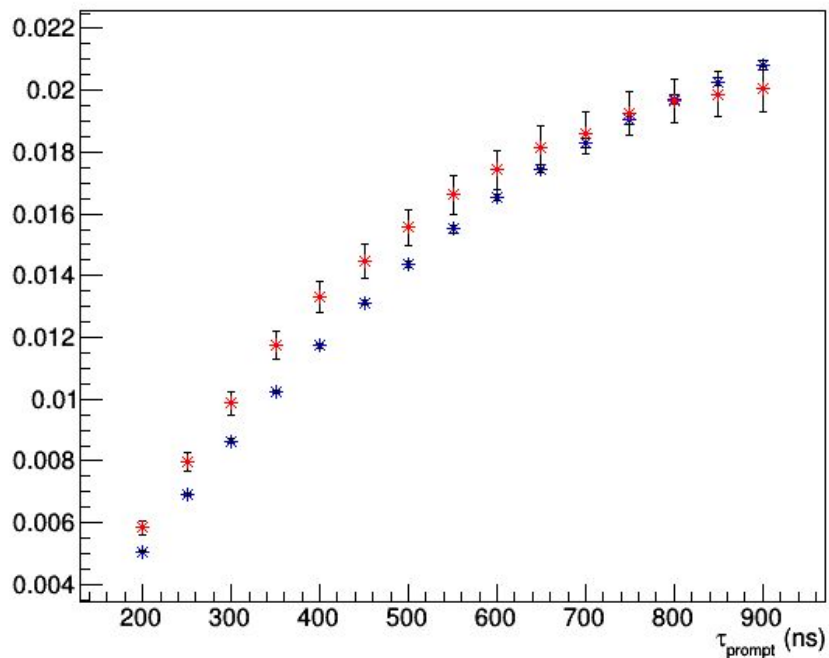
Other interesting plots... (1/2)

$\Delta\mu$ vs τ_{prompt} - $500 < S1 \text{ (PE)} < 2500$

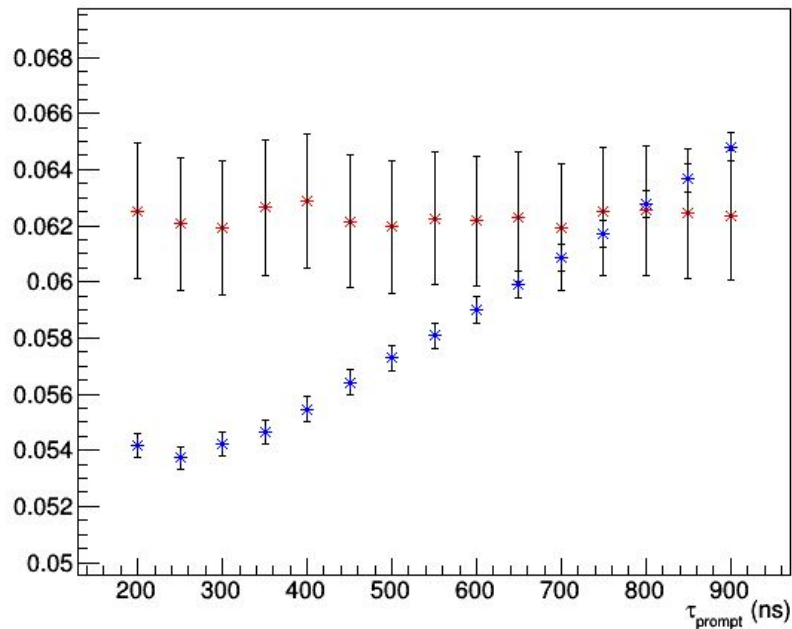


Other interesting plots... (2/2)

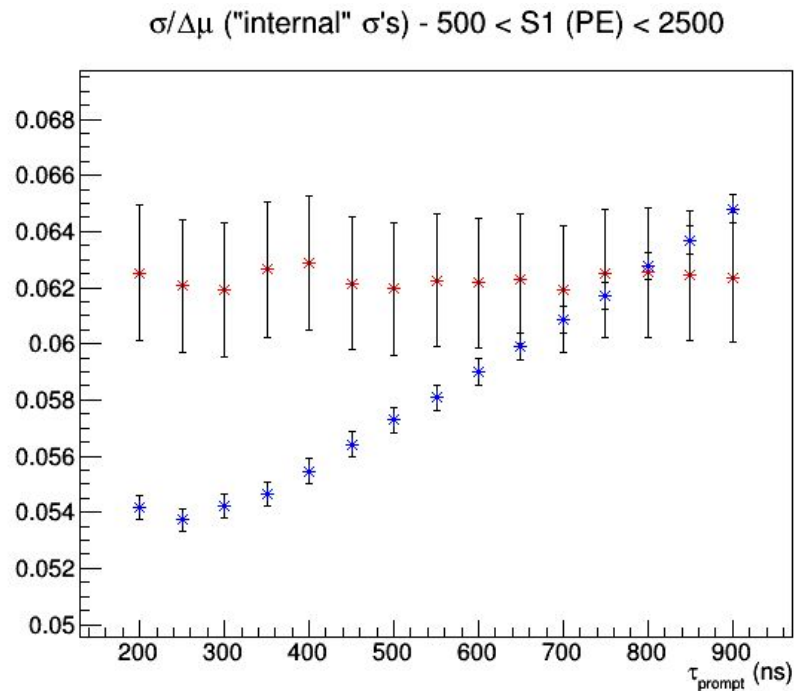
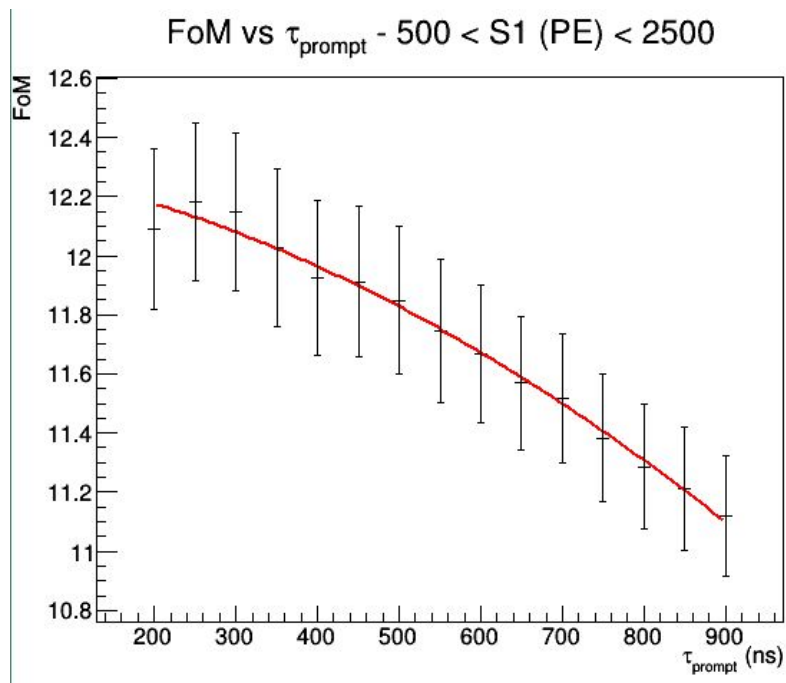
σ ("internal" σ 's) - $500 < S1$ (PE) < 2500



$\sigma/\Delta\mu$ ("internal" σ 's) - $500 < S1$ (PE) < 2500



Quick study of FoM trend



Discussion topics and conclusions

The value $t_{\text{prompt}} = 700$ ns seems to be not the very best choice for ER/NR discrimination. Would it be worth to reduce t_{prompt} to increase PSD power?

Pros:	Cons:
Better discrimination	Only 10% increase in FoM All older runs would have different t_{prompt} Would a lower t_{prompt} be able to separate S1 and S2 distributions?

Idea: we could introduce “two” t_{prompt} parameters, one for NR/ER discrimination and one for S2/S1 discrimination. This possibility will be discussed after more analysis is done, maybe scanning a double phase runs in t_{prompt} .