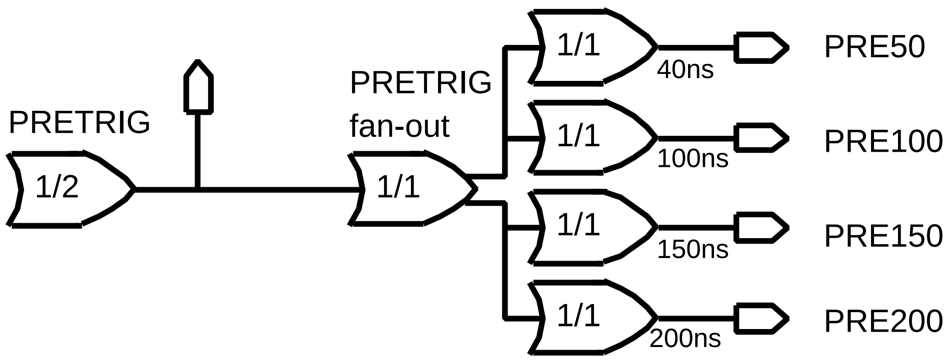
How we measure electronic dead time



- Probability that an event arrives a time $t > \tau$ after 1st event:

$$P(t > \tau) = e^{-R\tau} \approx 1 - R\tau$$

- Measure electronic dead time by varying gate width τ

- Calculation in ENGINE

$$\begin{aligned}
N_{true} &= N_{measured} + (N_{PRE100} - N_{PRE200})\frac{\tau_{pre}}{100\ ns} \\
\frac{N_{measured}}{N_{true}} &= 1.0 - \left(\frac{N_{PRE100} - N_{PRE200}}{N_{true}}\right)\frac{\tau_{pre}}{100\ ns} \\
E.DT. &\approx \left(\frac{N_{PRE100} - N_{PRE200}}{N_{PRE100}}\right)\frac{\tau_{pre}}{100 ns}
\end{aligned}$$

- Note that we assume the PRETRIG gate is the limiting gate width: $\tau_{pre} = 60$ ns

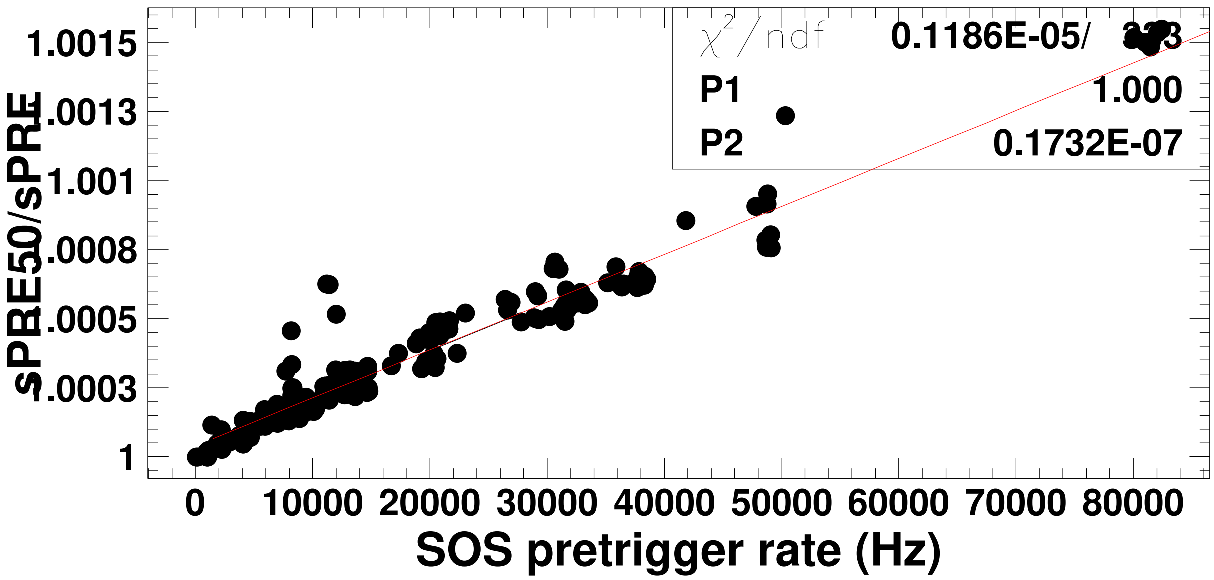
PRE50 Problem

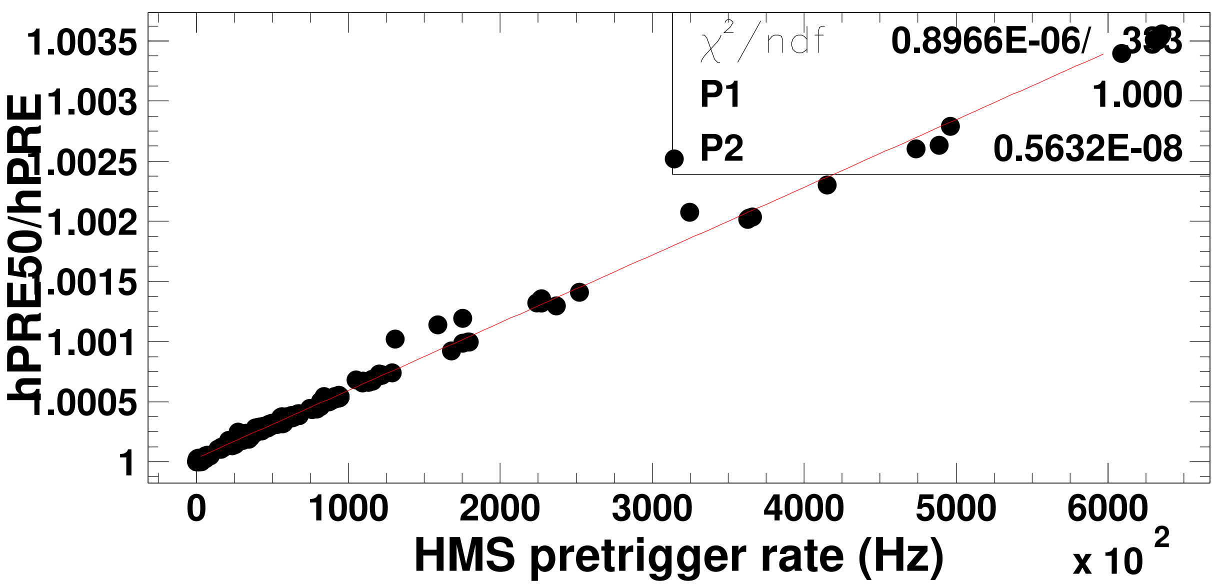
- The PRE50 scaler always has more counts than the PRETRIG scaler
  - $\rightarrow$ Cross talk? - changed cable lengths
  - $\rightarrow$ Problem with NIM-ECL converter? - checked with signal generator: in = out
  - $\rightarrow$ Problem with Fan-out? - tried passive fan–out
  - $\rightarrow$ "Cosmic" tests changing PRE gate width - see some correlation, but hard to tell since effect is small at low cosmic rate

- In principle not a big problem, but makes it difficult to diagnose "limiting gate width" problems a la Rick Mohring.

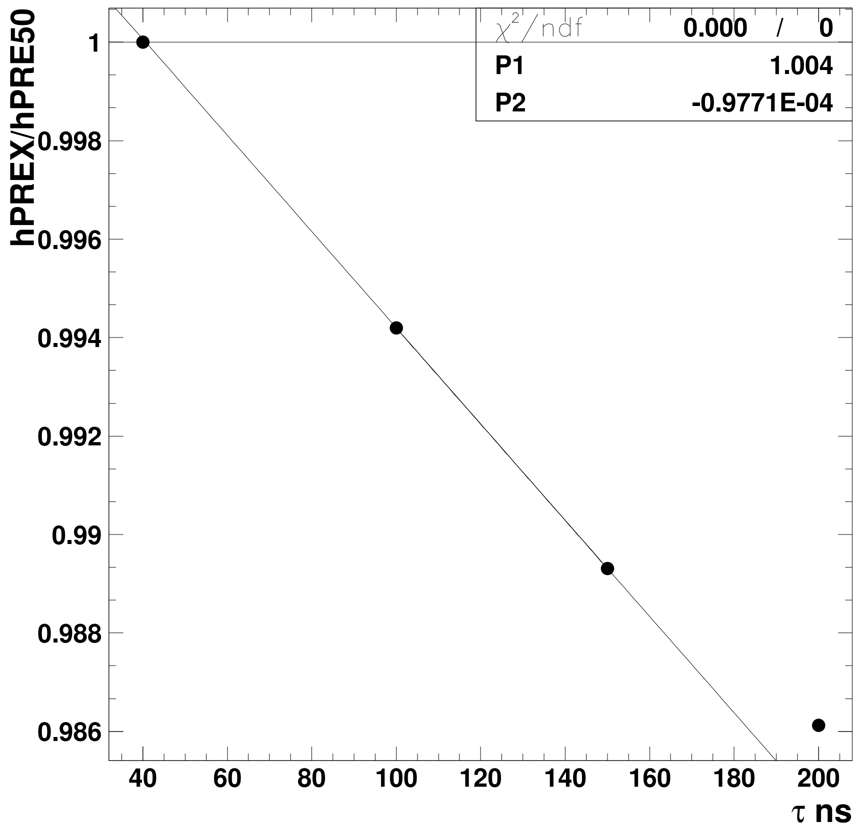
- The effect is rate dependent

PRE50/PRETRIG





Usual weirdness with hPRE200 (the scaler formerly known as EL120)

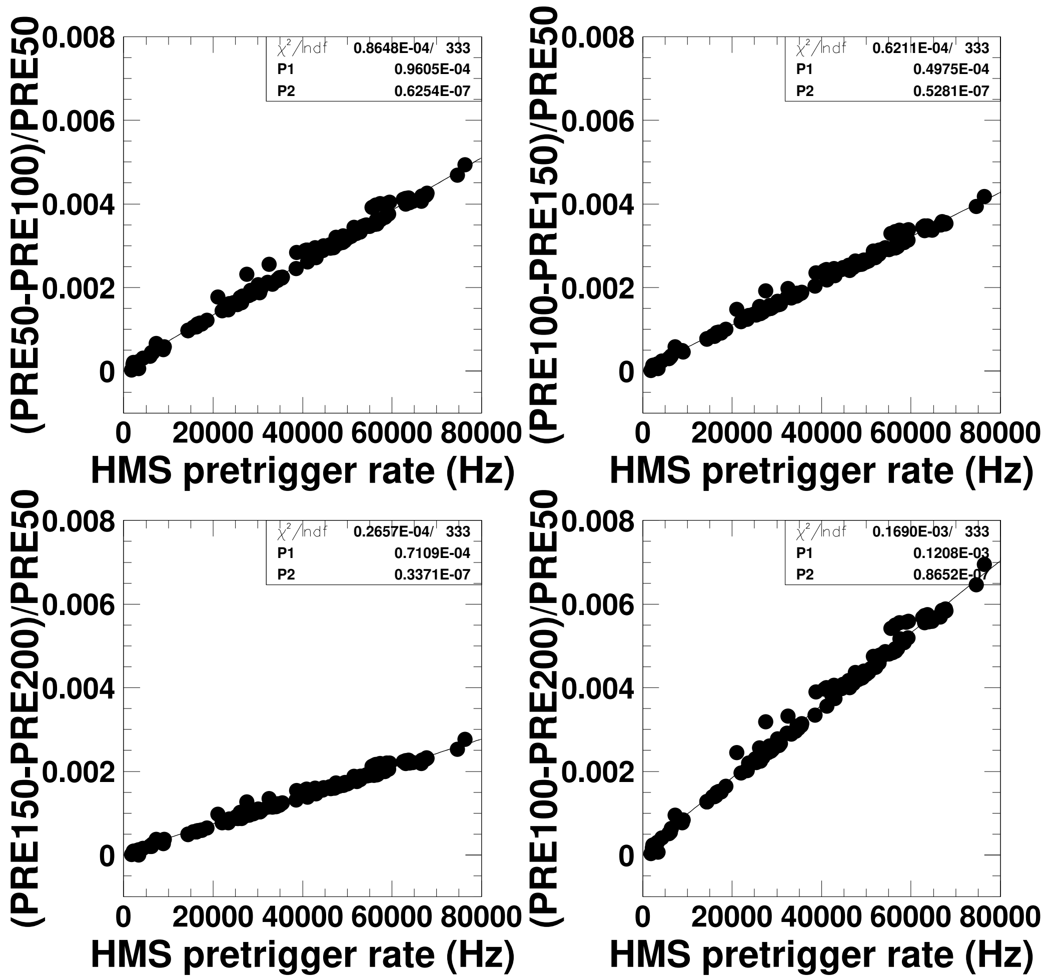


- Early experiments found it was necessary to assume a different τ for EL120 (PRE200) make E.DT. make sense

- Problem was assumed to be a mis–set gate width

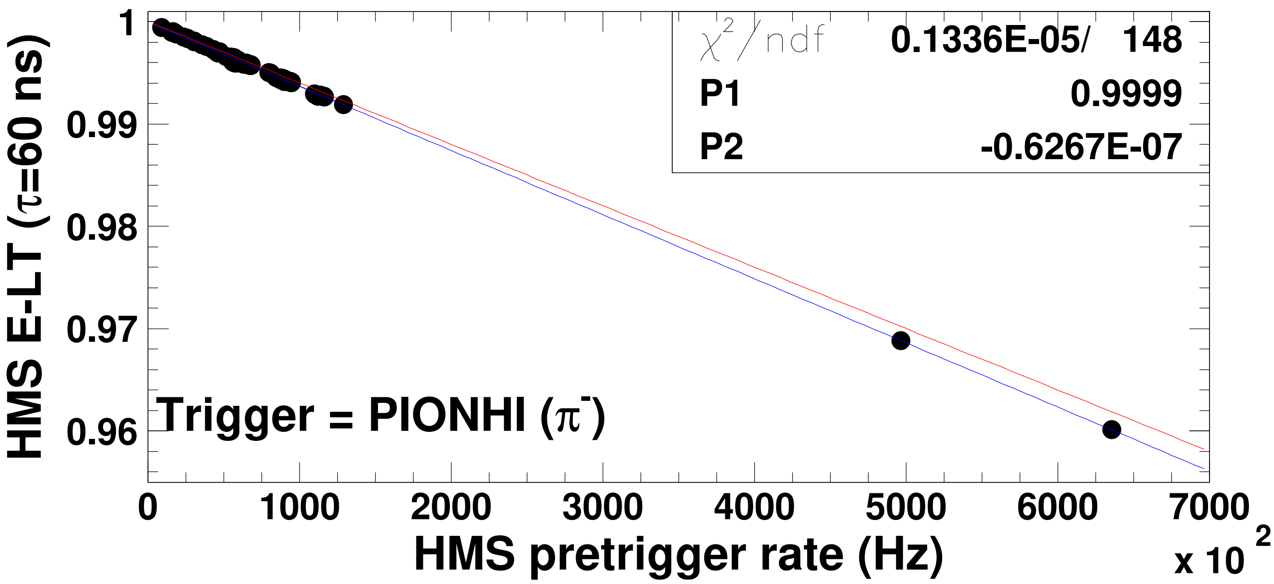
- Problem appears again for Spring03 running – checked widths: all are as advertised

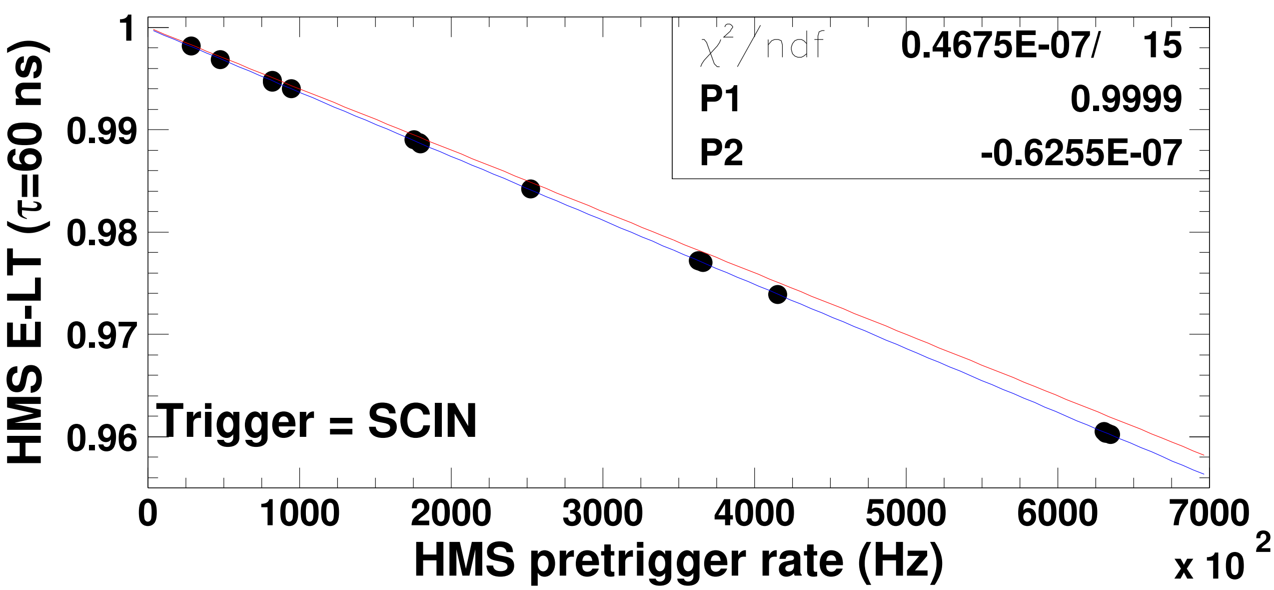
Relative Gate Widths in HMS



- $\Delta\tau$ should be 40 ns for PRE50-PRE100
- $\Delta\tau$ should be 50 ns for PRE100-PRE150 and PRE200-PRE150
- $\Delta\tau$ should be 100 ns for PRE100-PRE200
- Conclusion: use hPRE100 and hPRE150 to calculate dead time

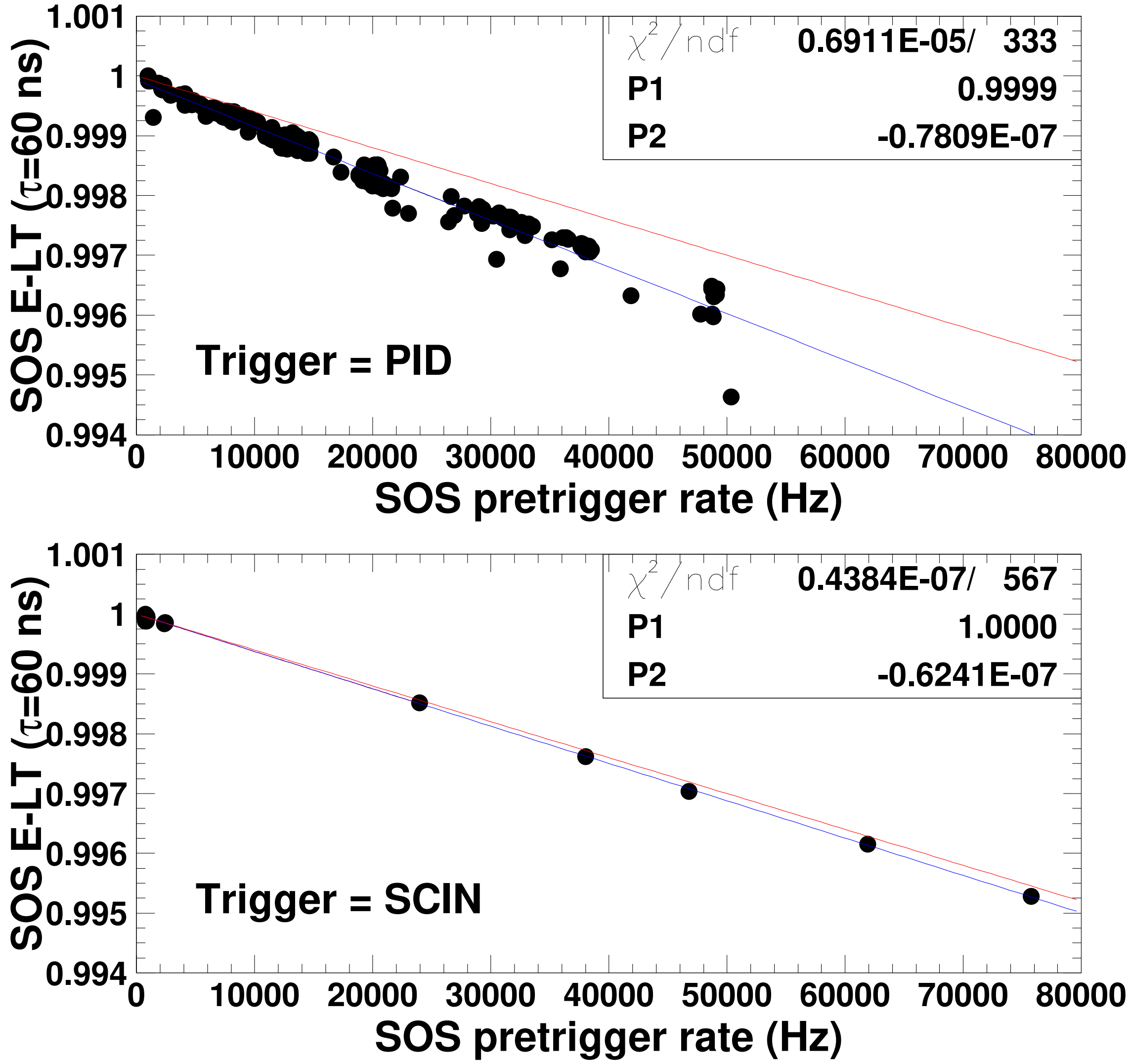
Electronic Dead Time vs. Rate in HMS





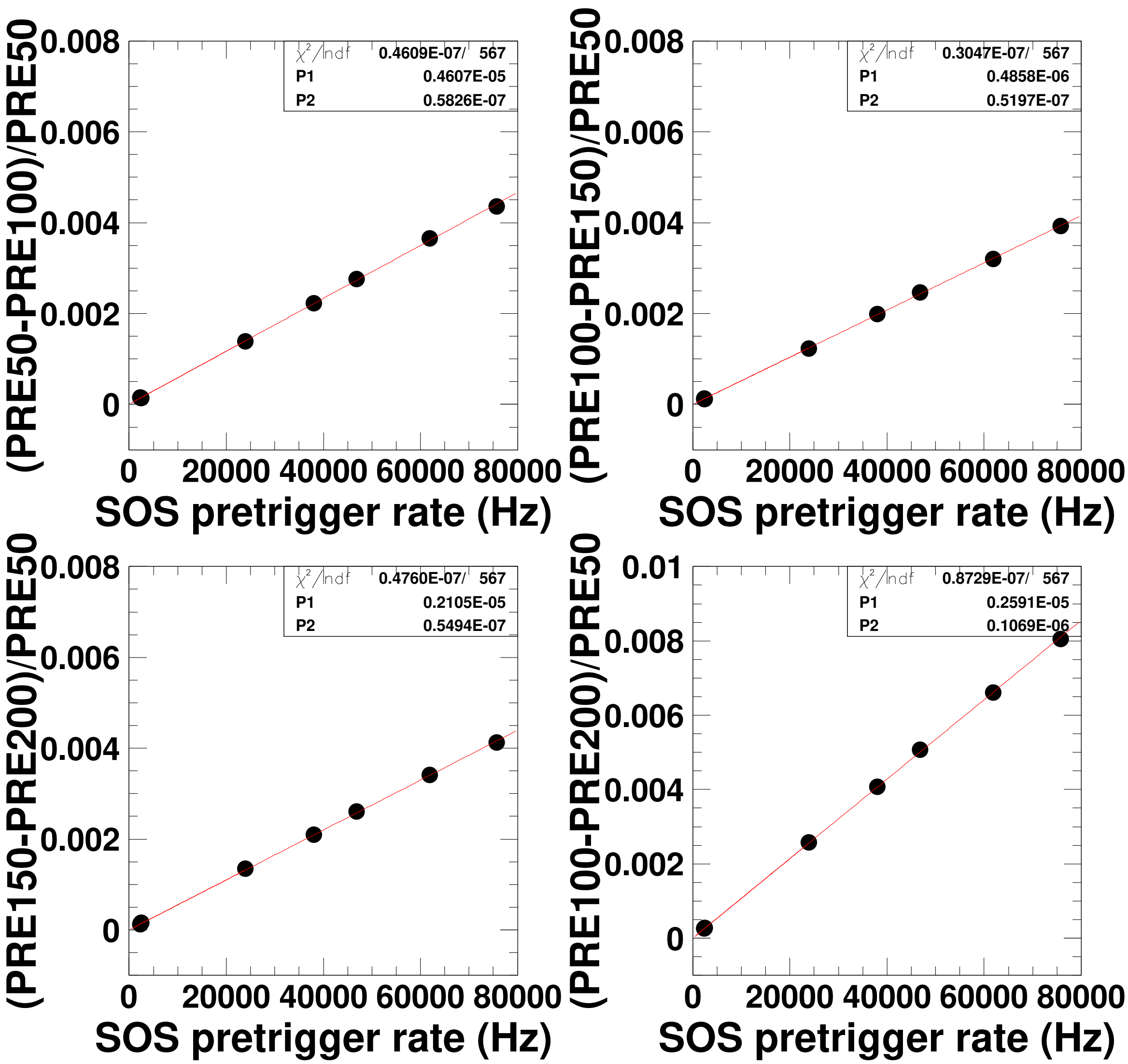
- Addition of gas Cerenkov veto has no apparent effect on dead time
- Fitted τ consistent with pretrigger gate width (60 ns)

Electronic Dead Time vs. Rate in SOS

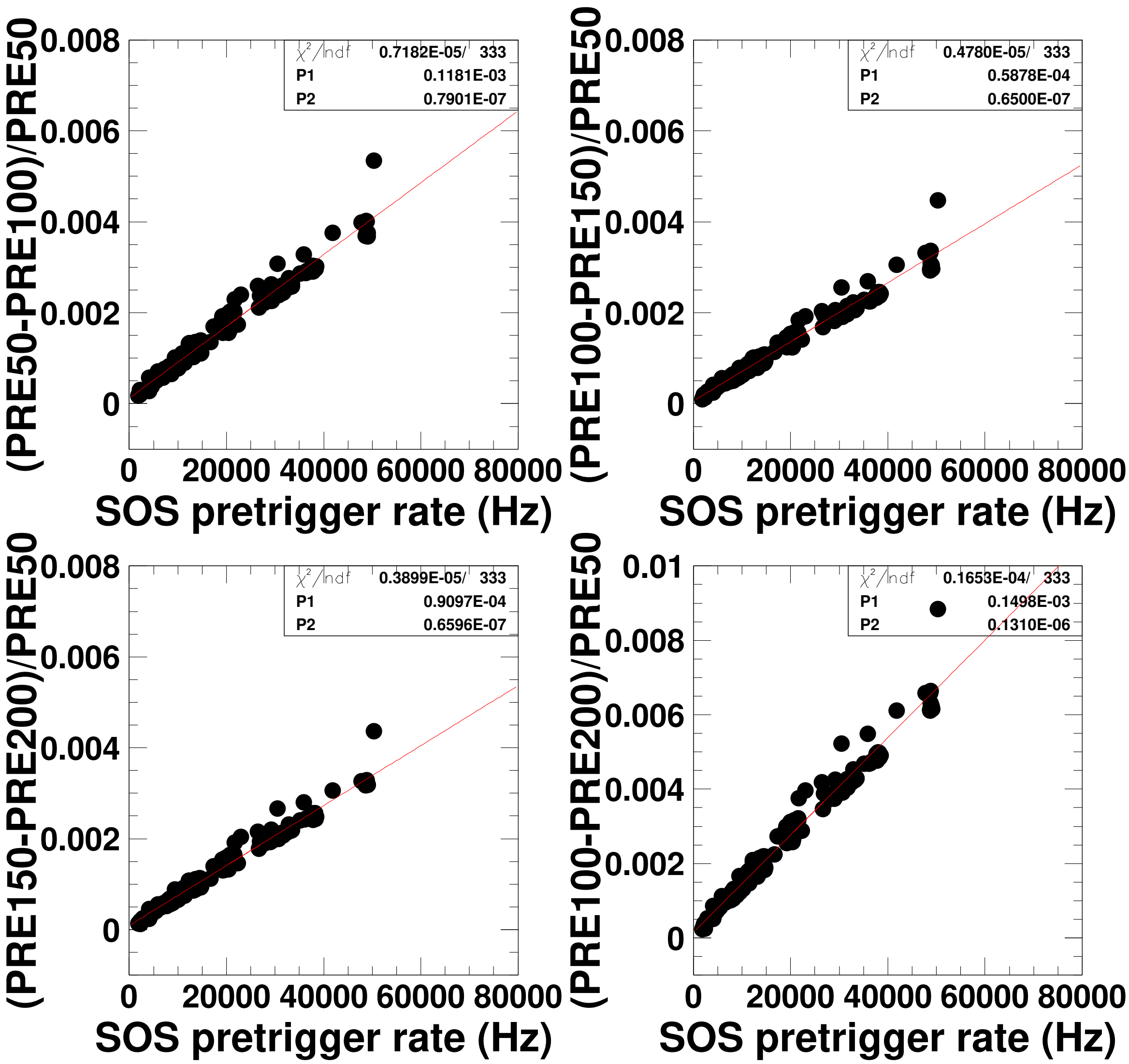


- PID trigger yields fitted τ inconsistent with pretrigger gate width
- "Iterative" approach (use $\tau = 80$ ns in dead time calculation) does not help - fitted τ always ≈ 20 ns larger.
- Conclusion: pretrigger rate is not necessarily the correct degree of freedom in this case for calculating deadtime - likely some complicated function of other rates too

Relative Gate Widths in SOS: 3/4



Relative Gate Widths in SOS: ELREAL



Conclusions

- HMS electronic dead time seems to make sense (for the most part). Fitted τ is consistent with the pretrigger gate width.
- SOS electronic dead time makes sense for 3/4 trigger.
- Unclear how to handle SOS EDT with ELREAL trigger. Are we using the correct gate width but comparing to the wrong rate?
- More open issues

  $\rightarrow$ What's causing the extra counts in the PRE50 scalers?

  $\rightarrow$ Does the PIPRE circuit of the trigger impact the dead time (larger instantaneous rates)?