TOF PMT Hit Times

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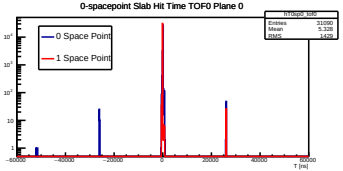
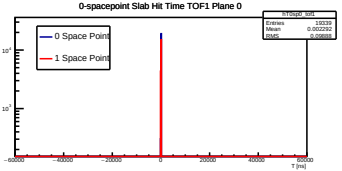
University of Sheffield

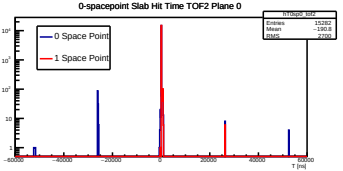
MAUS mtg., Feb 7, 2018

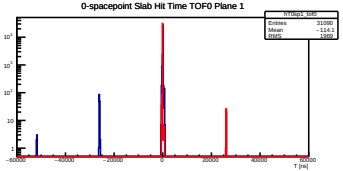
TOF Slab Hit Raw Times

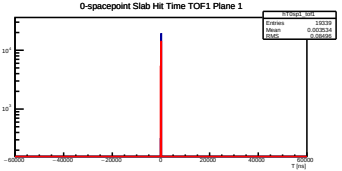
Issue

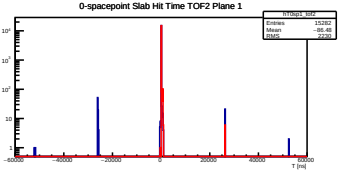












- Show unexpected peaks at around ± 26 μs and ± 52 μs

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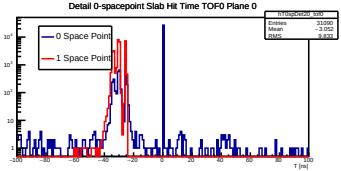
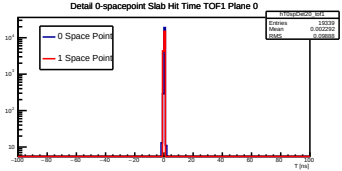
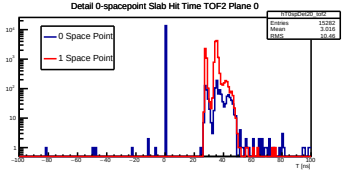
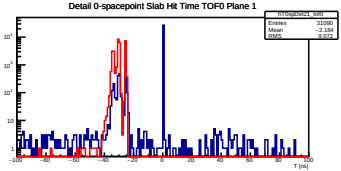
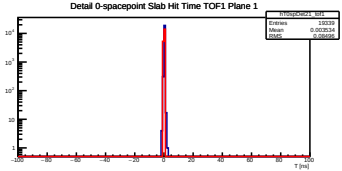
What we are interested in

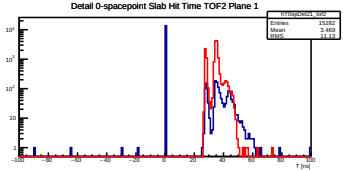












- Slab hits are expected to align within about 100 nss around 0

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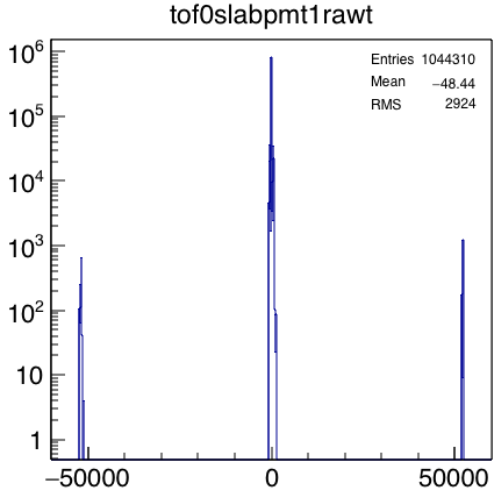
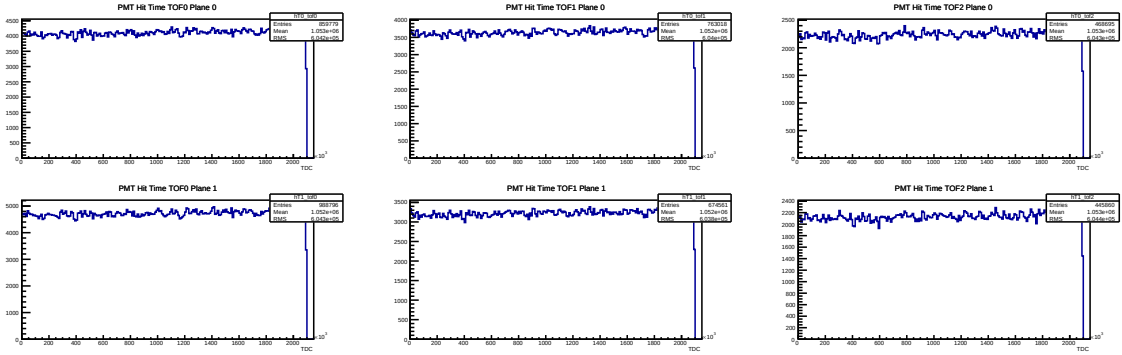


- PMT hits have peaks at around ± 52 μs
- Slab hit time is an average of 2 PMT hits times $\rightarrow$ ± 26 μsif only one PMT has time in the odd peak

TOF PMT TDC Digits



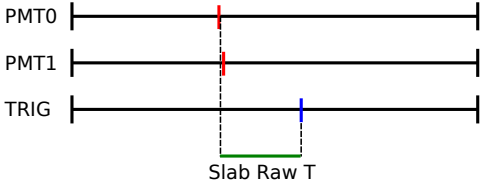
- TDC increments continuously
- Wraps around back to 0 when it reaches the end of its range
- Range seems to be $\sim 2.097 \times 10^6 \rightarrow$ must be 20-bit TDC with range: $0..(2^{21} - 1) = (0..2097151)$
- How do we get *PMT raw time*?

MapCppTOFSlabHits.cc

```
184   int xTimeDigit0 = xDigit0.GetLeadingTime();
185   int xTriggerReqDigit0 = xDigit0.GetTriggerRequestLeadingTime();
186
187   int xTimeDigit1 = xDigit1.GetLeadingTime();
188   int xTriggerReqDigit1 = xDigit1.GetTriggerRequestLeadingTime();
189
190   // Calculate the measured value of the time in nanoseconds.
191   double time_digit0 =
192   _tdcV1290_conversion_factor*(static_cast<double>(xTimeDigit0 - xTriggerReqDigit0));
193   double time_digit1 =
194   _tdcV1290_conversion_factor*(static_cast<double>(xTimeDigit1 - xTriggerReqDigit1));
195
196   double xRawTime = (time_digit0 + time_digit1)/2.;
197   slHit.SetRawTime(xRawTime);
```

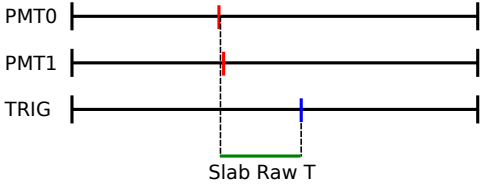
- TDC of actual hit is relative to TDC of received trigger signal
- It is then converted to ns
  - conversion factor = 0.025 (ns/TDC)
- This relative and converted number is stored as *PMT raw time*
- Last line shows the average of 2 PMTs being *slab raw time*

Possible Scenarios



- Regular event
- *Slab raw T* is an average of PMT hit times relative to trigger time

Possible Scenarios



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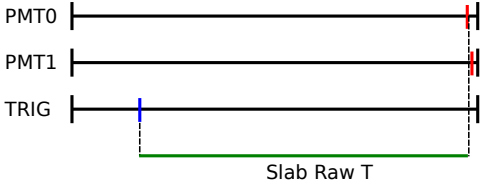
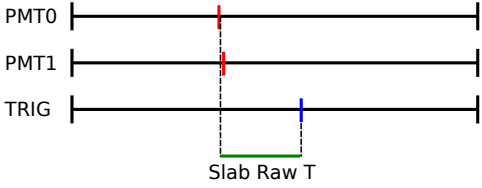


- Extreme event happening by the end of range of TDC
- Trigger signal arrived after TDC started over from 0
- *Slab raw T* is nearly as large as the TDC range *rightarrow*
  $2097151 \times 0.025\text{ns} = 52.429\mu\text{s}$

Possible Scenarios



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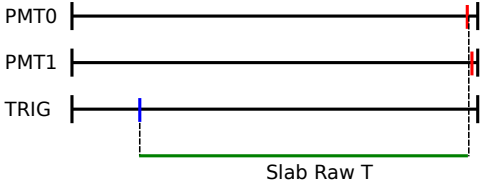

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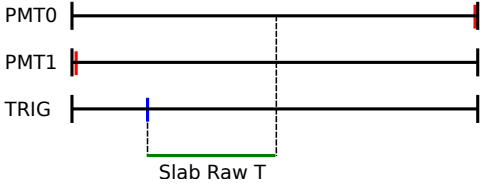

- I can imagine also this scenario where 1 PMT hit arrives before TDC zeroed itself and one PMT after
- *rightarrow* $52.429\mu\text{s}/2 = 26.2\mu\text{s}$