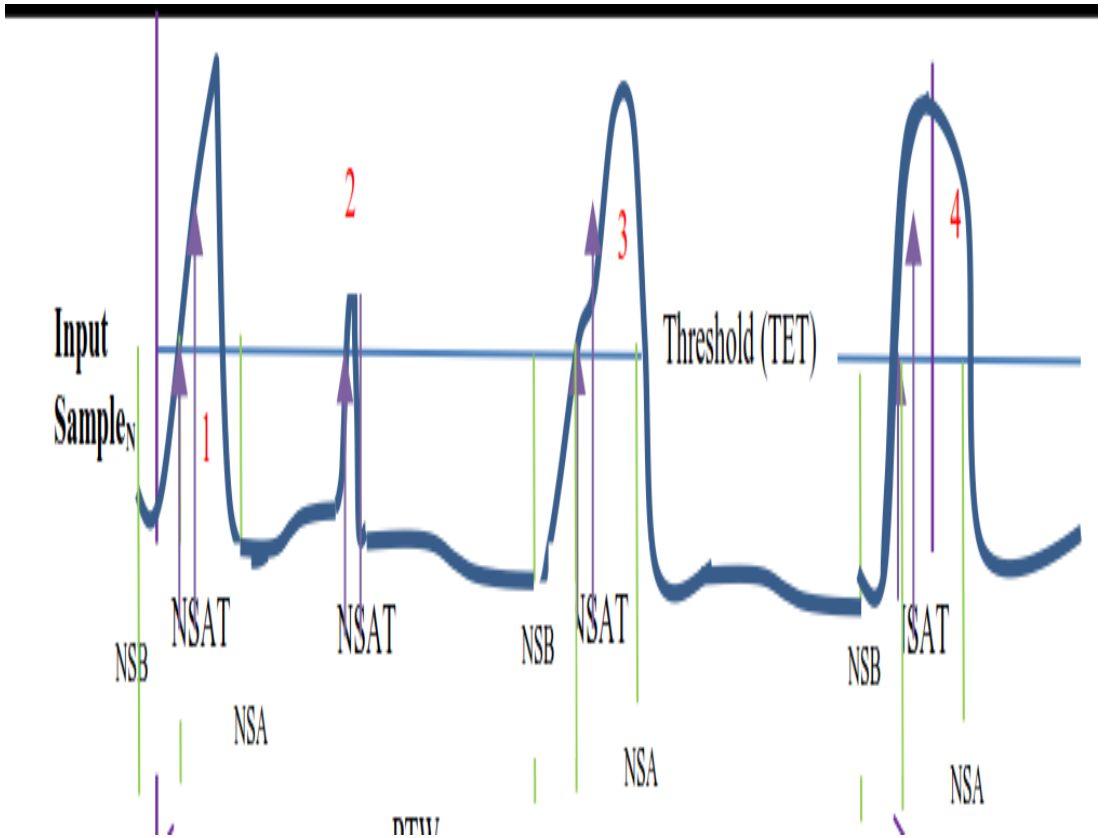
Effects of FADC Deadtime

1. How pulses defined in the FADC.
2. FADC Deadtime in FADC reference time
3. FADC Deadtime in the SHMS HG
4. FADC deadtime effect in the HMS HG
5. For detectors (except Hodoscope)
    1. Cannot eliminate the effect in the data
    2. Can only determine rate dependent correction.
6. How the FADC deadtime is avoided in the Hodoscope class?
    1. TDC-ADC reference time difference measured in hodoscope
7. Cuts that can be placed on data variables to remove the bad reference time events.

FADC pulse identification

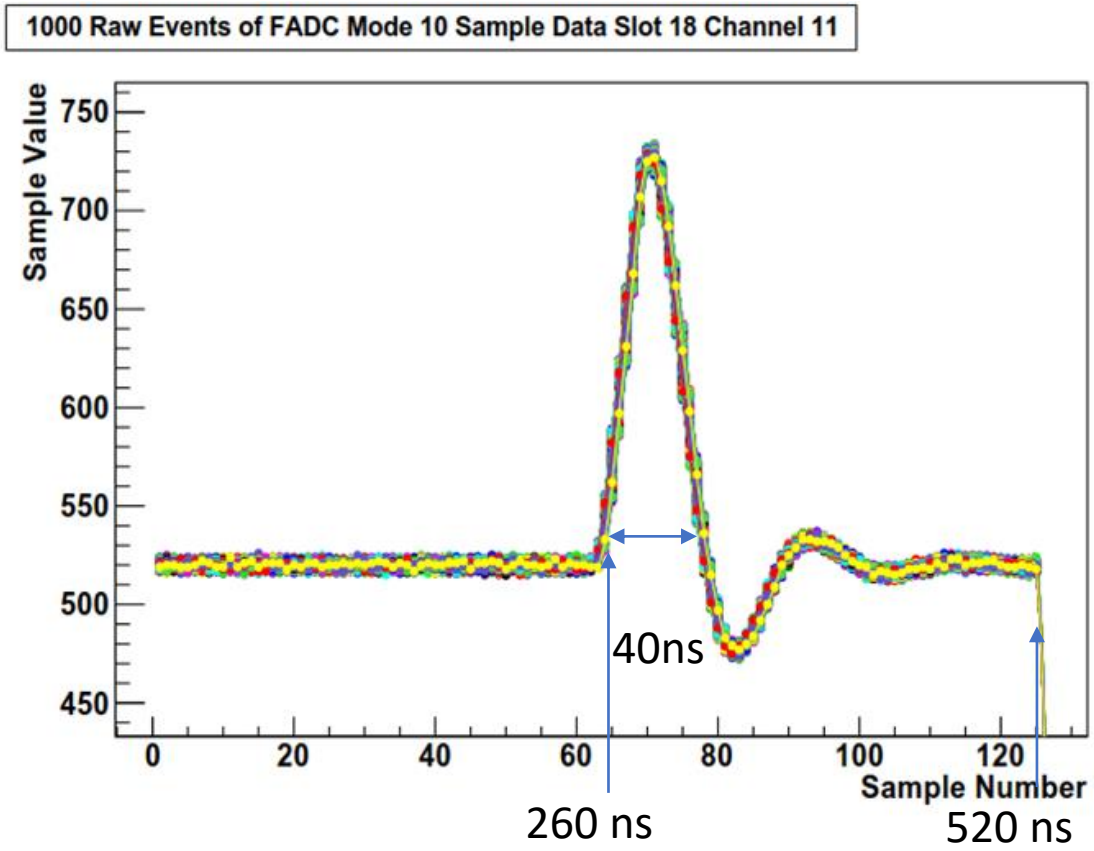
- Looks for sample that crosses the TET (Threshold) and if it finds NSAT=1 (Number of Samples After Threshold) above threshold then has a pulse.
- Need to have at least one sample below the threshold to identify the next pulse.
- Set the integration window (NSB+NSA) to 100ns
- With normal pulse widths and low threshold, it is hard to imagine that one could separate two pulses within the 100ns integration window.
- Creates an effective 100ns deadtime.

Diagram illustrates how FADC identifies pulses

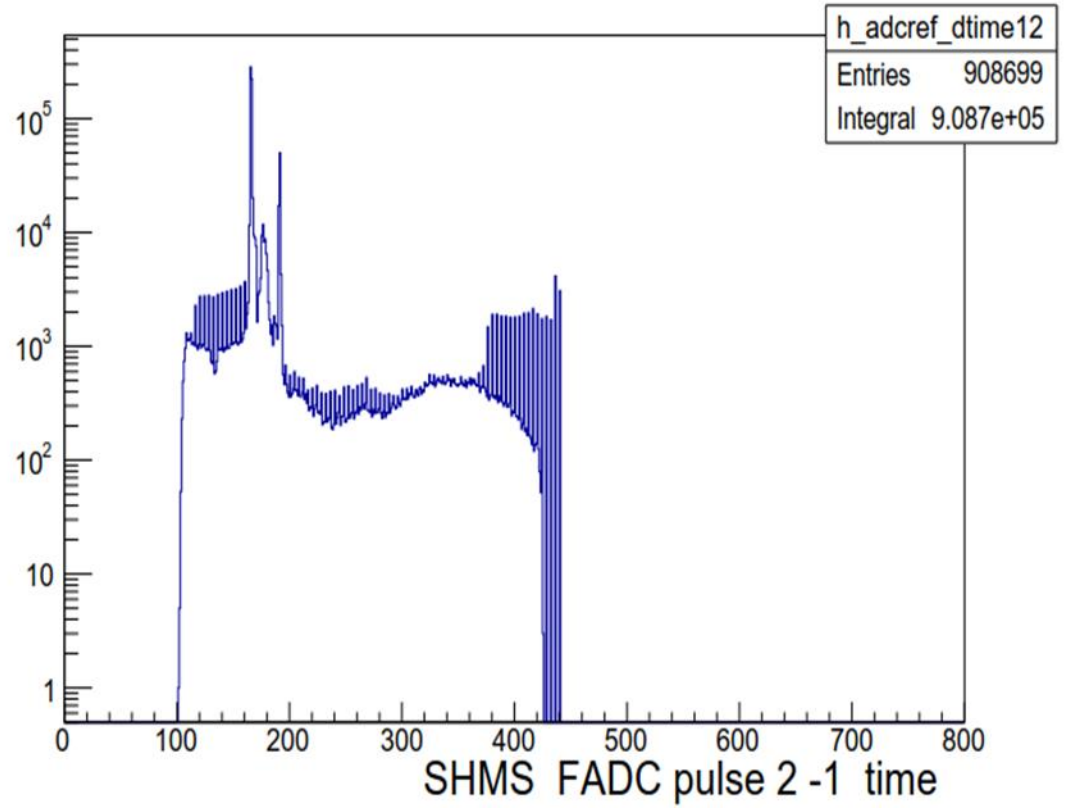


FADC deadtime in reference time signal

Example of the FADC reference time pulse shape



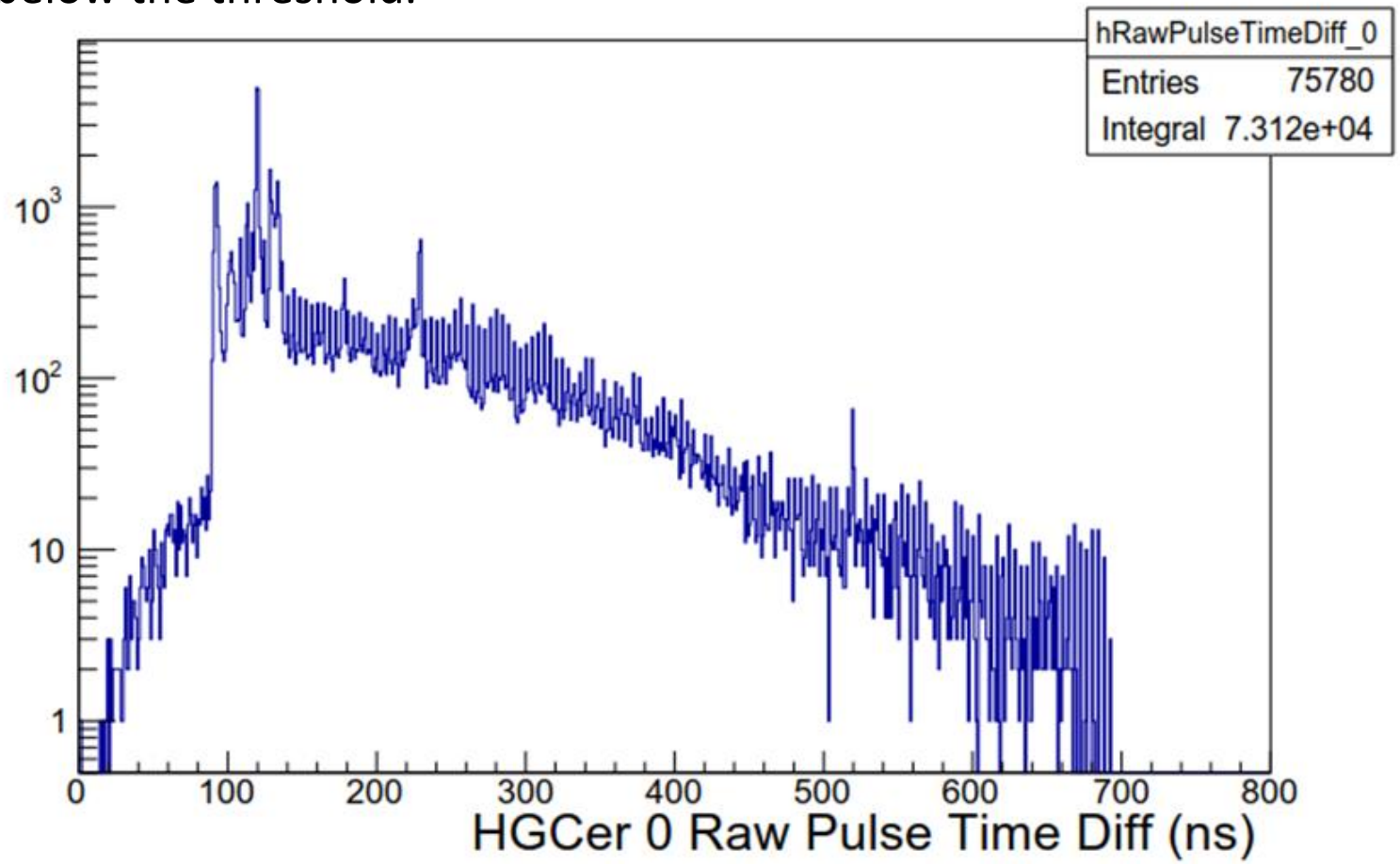
- Histogram below is the time difference between SHMS FADC reference time when at least two pulses found in one event.
- Given the time widths of the pulses do not find two pulses within 100ns.



Example FADC deadtime in SHMS HG cerenkov

- Histogram below is the time difference between SHMS HGCER pulses in PMT0 when two pulses found in one event.
- Given the time widths of the pulses and low threshold, almost never happens that when two pulse with 100ns of each other that a sample within the integration window drops below the threshold.

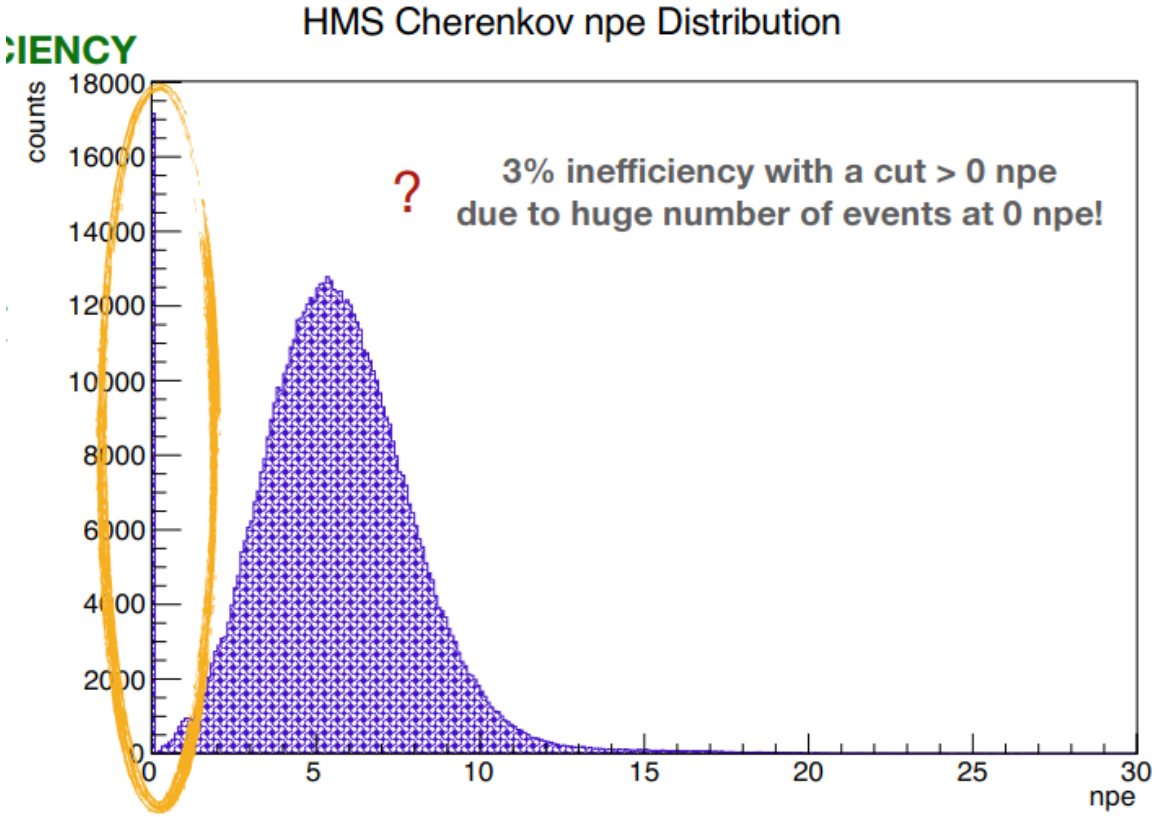
- "Deadtime" might not be the right word, since one gets a pulse.
- But the timing will be wrong and the pulse integral will be wrong.
- Effect on data will vary with size of ADCTDCDiff time window cut.



Example with the HMS Cerenkov

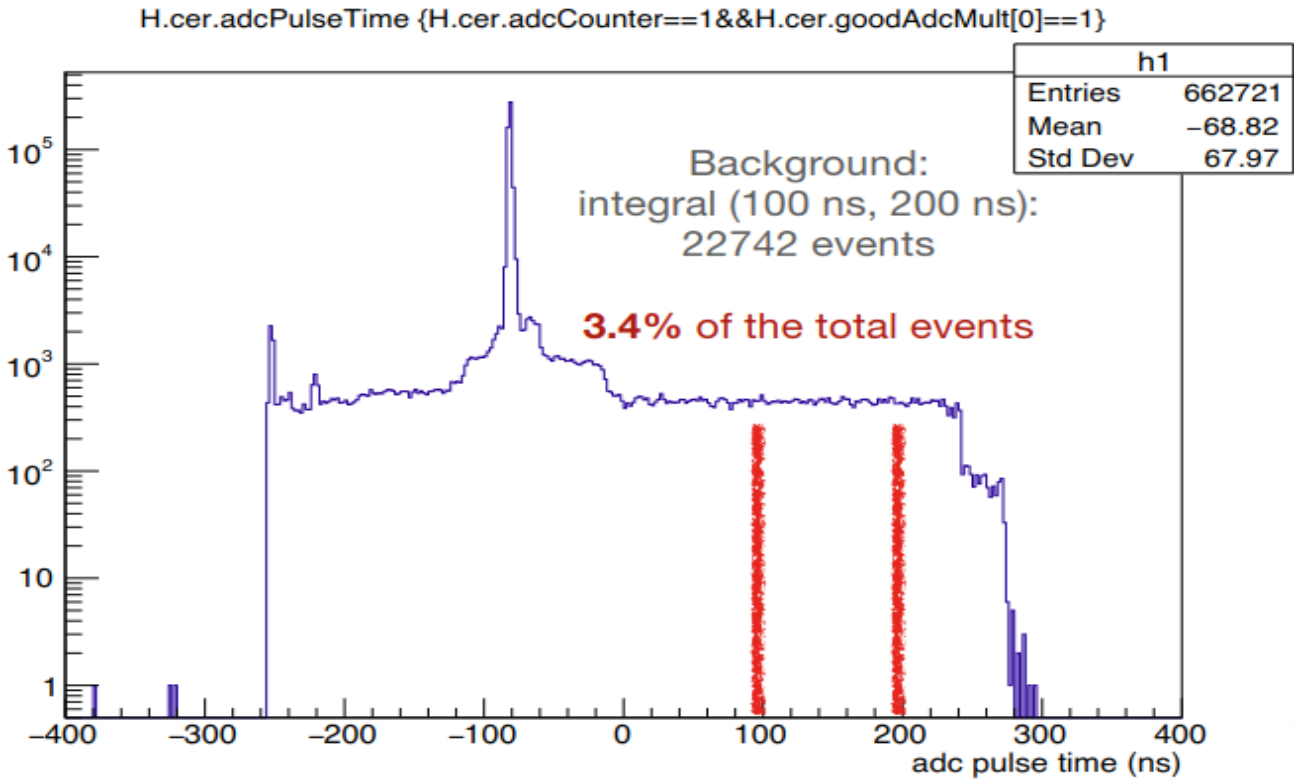
Burcu Duran found reduced HMS Cerenkov efficiency for J/Psi experiment.

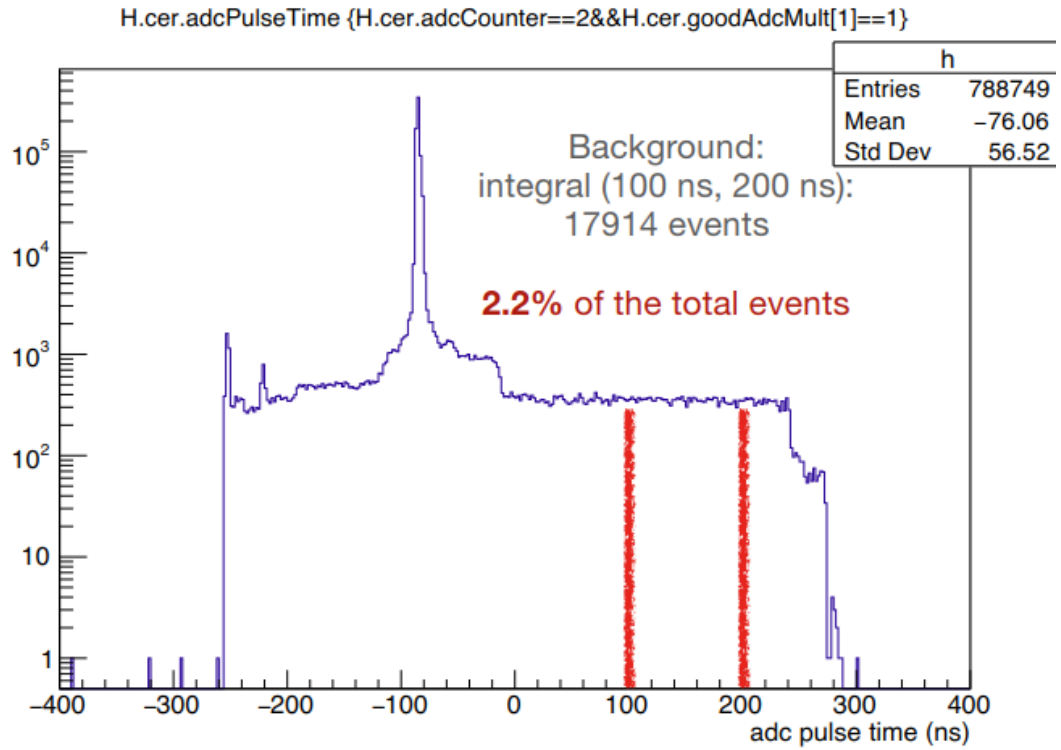
HMS Cherenkov	Efficiency	Pion Rejection Factor	Target Cuts	Cherenkov Cut position (npe)
HMS 2368 DIS data	97%	70	abs(y tar) < 4. -10 < delta < 10 -0.1 < xp tar < 0.08	Npe > 0.5



Look at possible FADC deadtime effect

- Light leak in HMS Cerenkov causes high rate (~300 kHz) even without beam
- Histograms below of the HMS Cerenkov pulse time (no starttime correction).
  - Flat random background used to estimate fraction which would block the good signal.
  - Use a 100ns window to select good hit.
- Results consistent with the 3% loss in efficiency as a baseline. Would be rate dependent.
- For SHMS , need to estimate the rate on HGCER or NGCER Cerenkov to determine the loss.





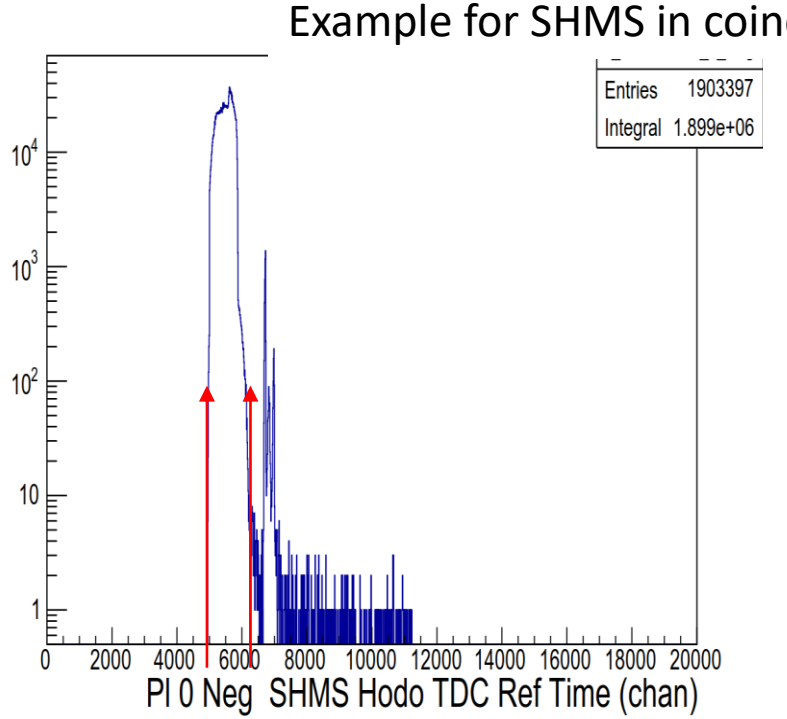
How does the hodoscope deal with FADC issue?

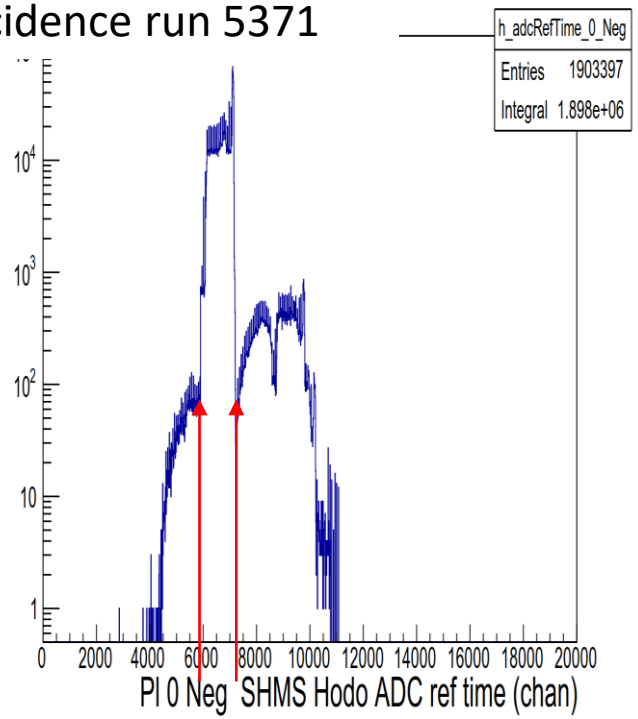
- Changed hodoscope code in ProcessHits so that it effectively does not use the ADCTDCDiff time window cut.
  - The ADC hit that is closest in time to the TDC hit is used.
  - ADC is only used for Time Walk Correction.
  - Assumption is that most particles give large enough pulse that the time walk correction is small.
- Add calculation of the difference between the average difference between raw ADC times and TDC times for paddles with “good” hits at both ends.
  - Tree variable P(H).hod.adctdcoffset
  - Created hodoscope method GetOffSetTime that is used by other detectors in determining the ADCTDCDiffTime in addition to the StartTime

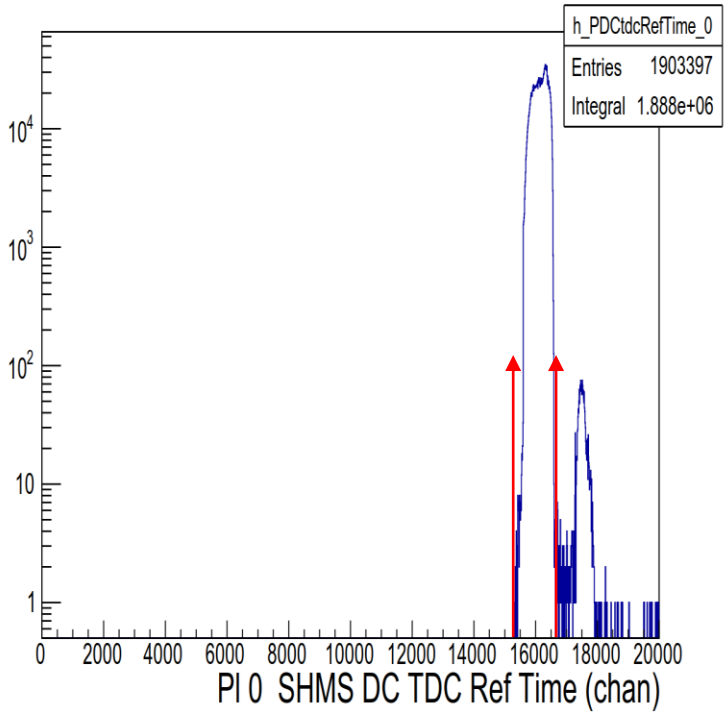
New tree variables of the Reference time used by the detector

- For HGCER and Aerogel P.hgcer.RefTime, P.aero.RefTime
- For each HODO plane, P.hod.1x.AdcRefTime or P.hod.1x.TdcRefTime
- For each DC plane , P.hod.u1.RefTime
- The ADC reference time spectra should be the same for all detectors.
- Can put cut on the SHMS/HMS hodoscope to skip events with bad reference time.
  - Keep track of fraction of bad reference time events. Use to correct yield.

Example for SHMS in coincidence run 5371

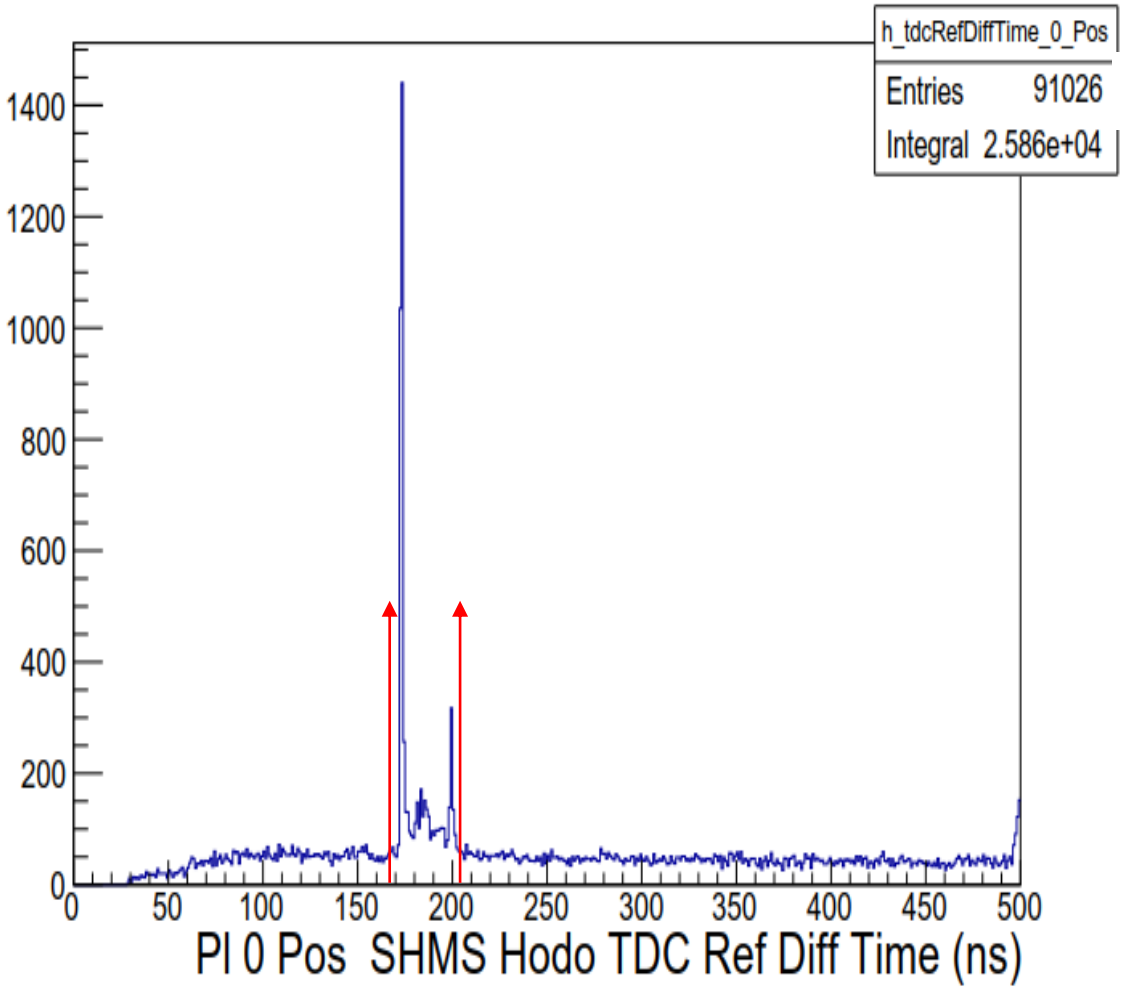






New tree variables of time difference between good Reference Time pulse and previous for hodoscope

- The good reference time in the coincidence region should only have a random pulse previous to it.
- If time difference is between 170 to 200ns then the previous pulse was actually the El_REAL associated with the random HODO 3of4 that was earlier.
- Can reject events in the 170 to 200ns region.



Example for SHMS in coincidence run 5371