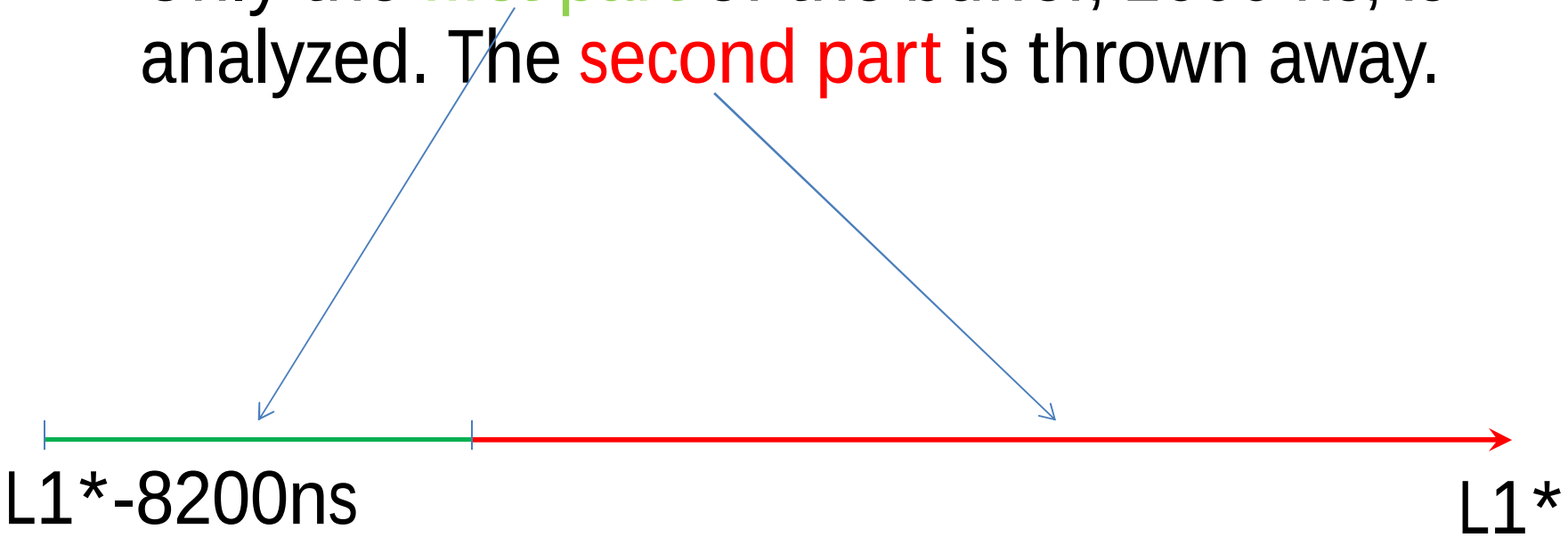
The ZDD data structure

- Each ZDD channel produces a positive “waveform”, one 8-bit sample every 2 ns
- This waveform is then splitted in “fragments”: a sequence of contiguous data samples, each one above a given threshold
- Each “cluster” gives a maximum (biggest sample, for calorimetric analysis to come) and a time for this maximum (used in this analysis)

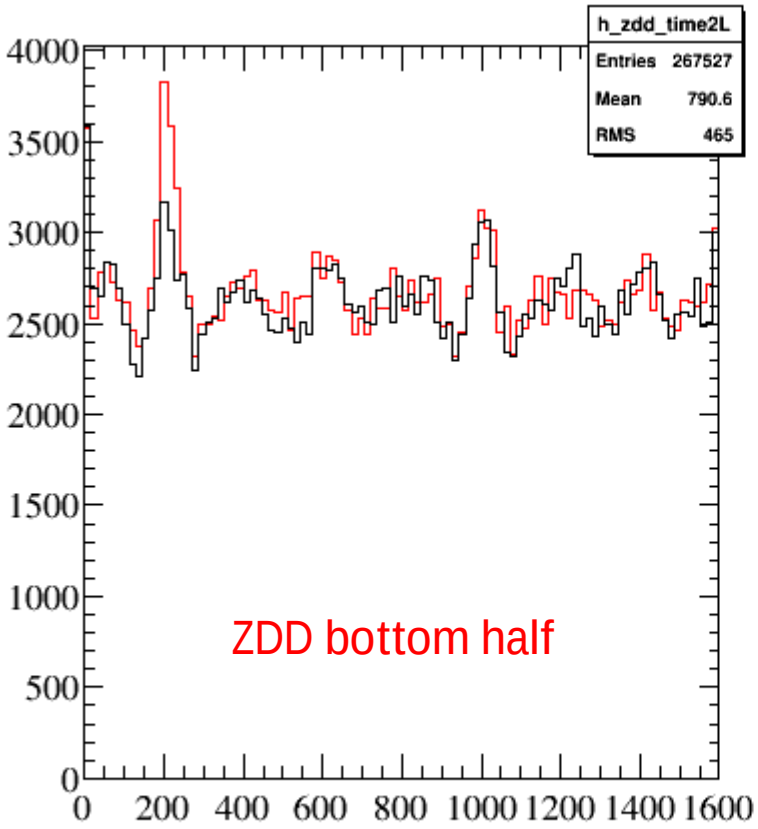
The ZDD data structure

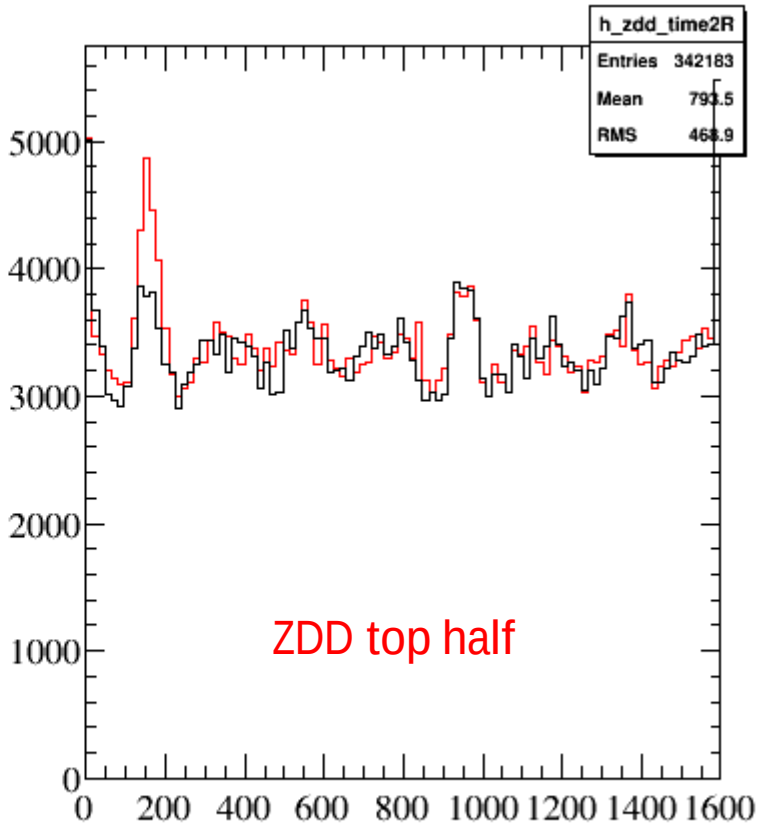
- This time is relative to the start of the ZDD data buffer, so (indirectly) to L1*, that closes the buffer
- Only the first part of the buffer, 1600 ns, is analyzed. The second part is thrown away.



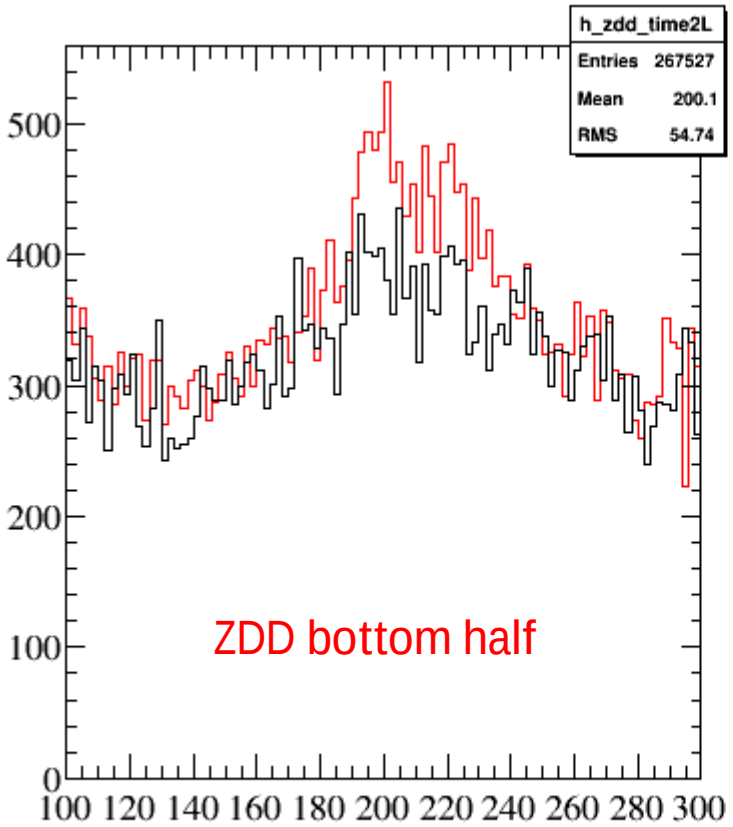
Finding the ZDD signal timing

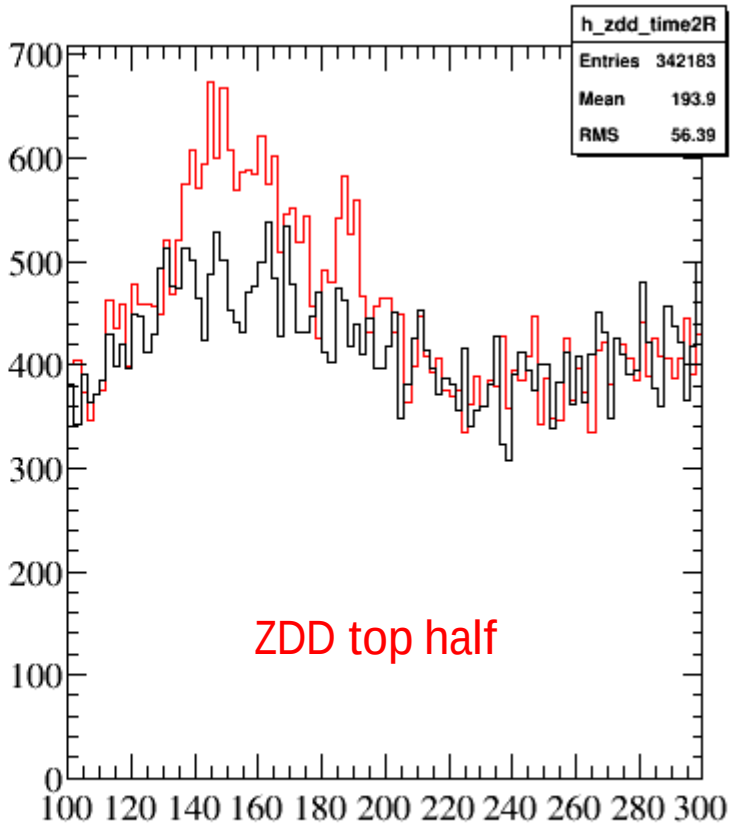
- The ZDD is sensitive to most of the BEPCII beam crossings. There is much background!
- We must maximize the probability of a hit in the ZDD
- In addition to the radiative Bhabha selection we require:
  - A “strong” missing photon: $E_{miss}>0.4$ GeV
  - A low emission angle: $|\cos(\theta_\gamma)| > 0.98$



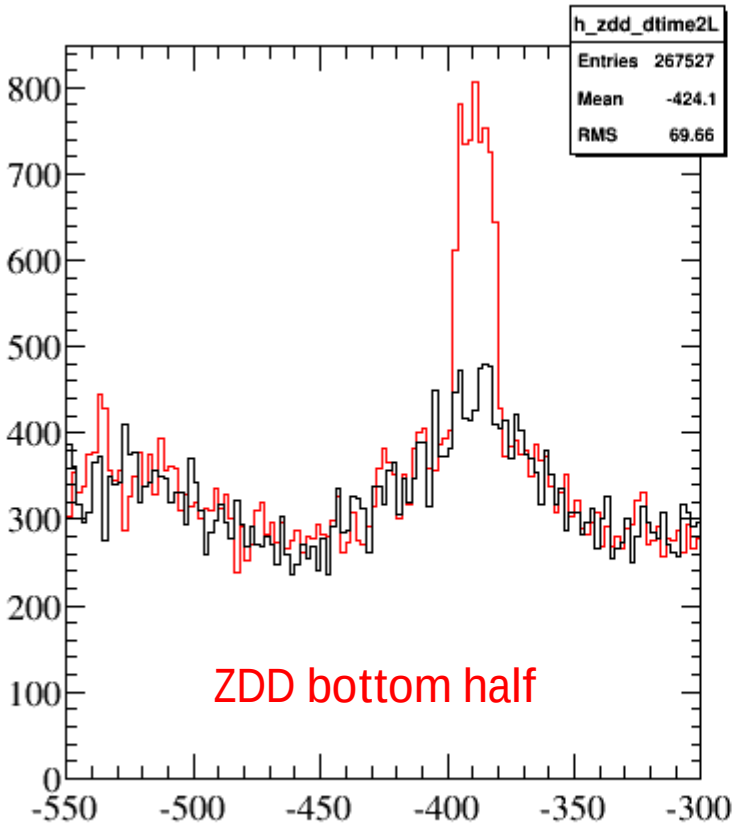


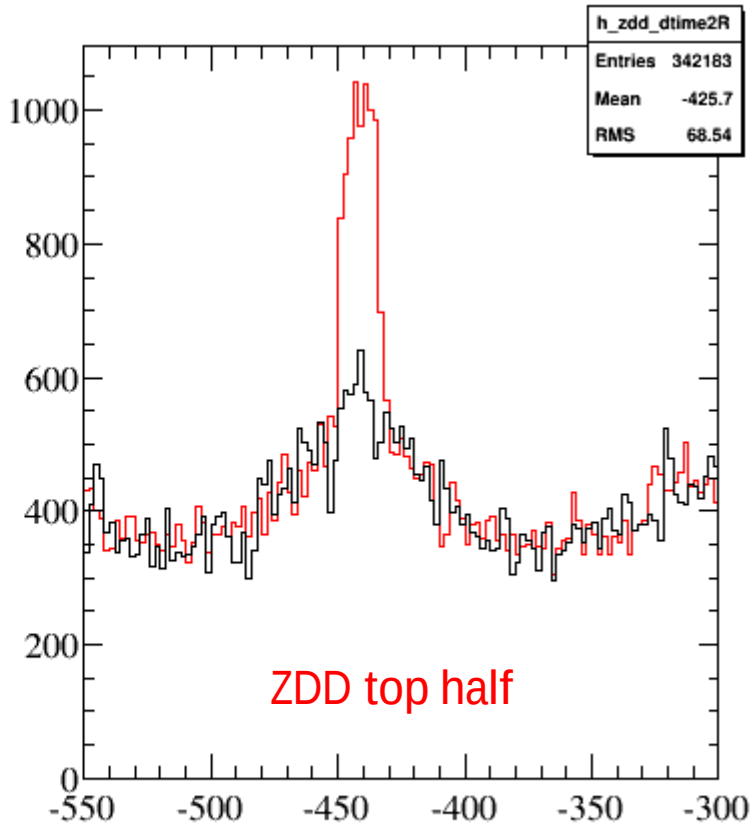
- The red histogram shows ZDD "fragment times" (16 ns/bin) when the missing photon points to the ZDD side ($\cos(\theta_\gamma) > 0.98$)
- The black histogram shows ZDD "fragment times" when the missing photon points to the other side ($\cos(\theta_\gamma) < -0.98$)
- There is a clear accumulation around +200 ns in both plots, FWHM ~40-50 ns wide





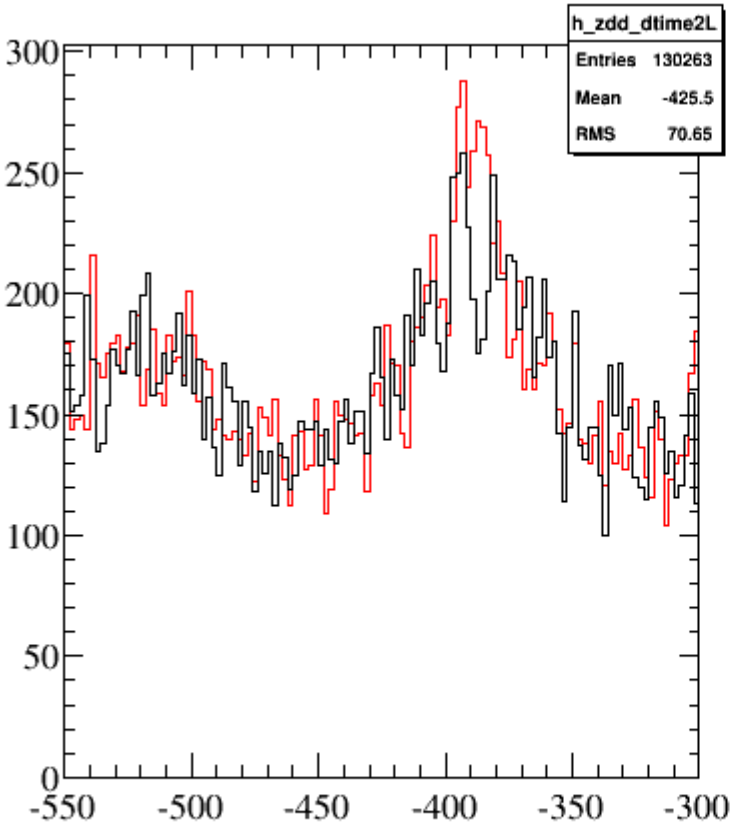
The same plot, zoomed (2ns/bin) on the interesting region.

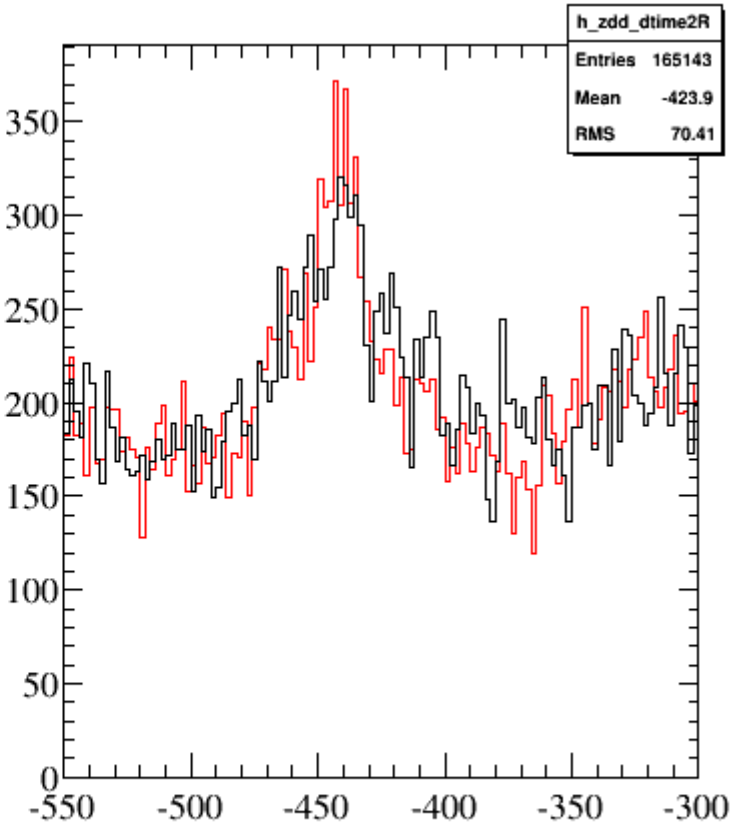




- Here we correct the timing by subtracting the BESIII “Event start time”, the time scale is again 2ns/bin
- The event-to-event variation of the L1* latency is removed
- Both peaks are much narrower, and the time shift is because the L1* trigger cable enters the ZDD “bottom” FADC first
- The widths (not gaussian, ~16ns) are due to the FADCs “trigger sensing” granularity

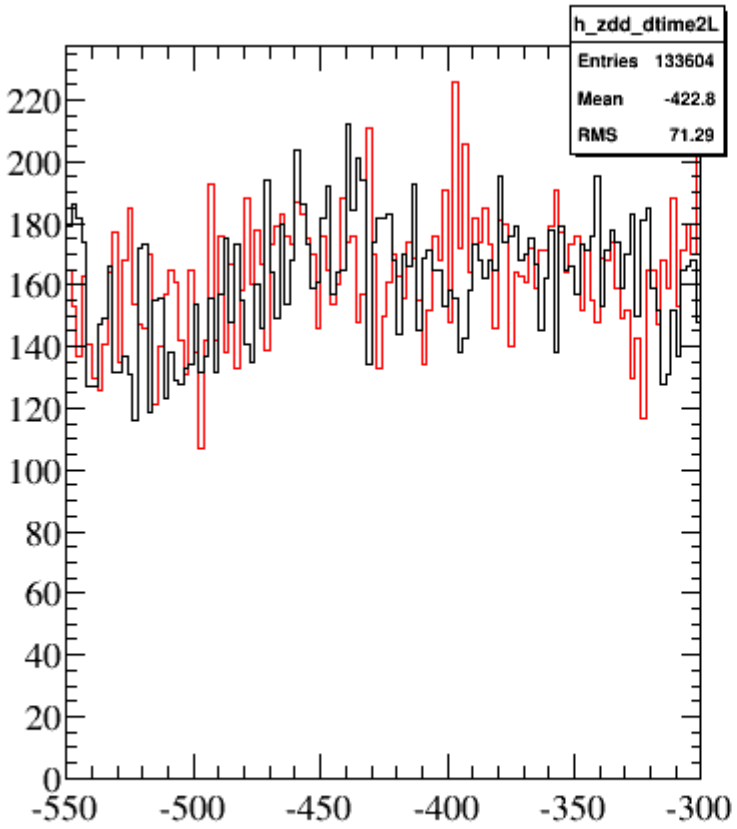
Countercheck 1

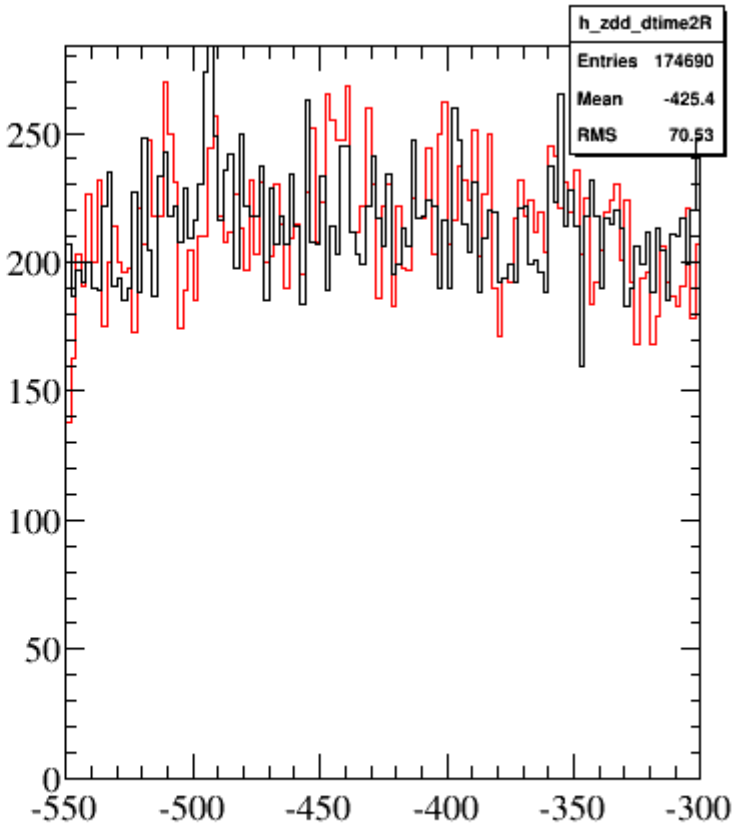




- The same plot, for the “bad” control sample $0.8 < |\cos(\theta_\gamma)| < 0.97$

Countercheck 2





- The same plot, for a “bad” FADC time window, starting at -7200ns before L1*

Conclusions

- We have demonstrated that accumulations of ZDD hits correlate strongly with 2 BESIII subsystems:
  - The MDC because the accumulation depends on the polar angle of the missing photon
  - The TOF because the timing is made more precise by using the event t_0
- Also, we have shown that if we shift the trigger window, the correlation vanishes

Outlook for the 2014-2015 run

- The ZDD start of the time window appears correct
- The time window will be shortened to 400 ns from 1600→much more tolerable for DAQ
- The ZDD signal will become part of the BESIII DQM, and will be monitored by ZDD people to make sure that it does not move