Compton Analysis Progress

for the d_2^n analysis meeting

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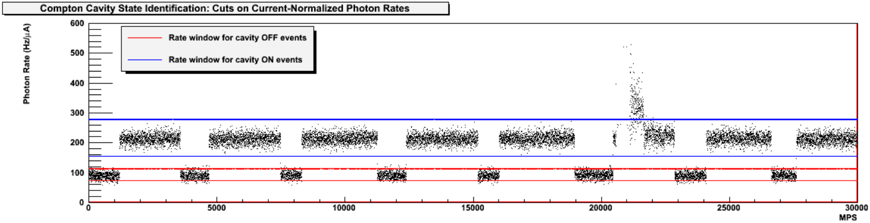
Compton Cavity State ID: Problems

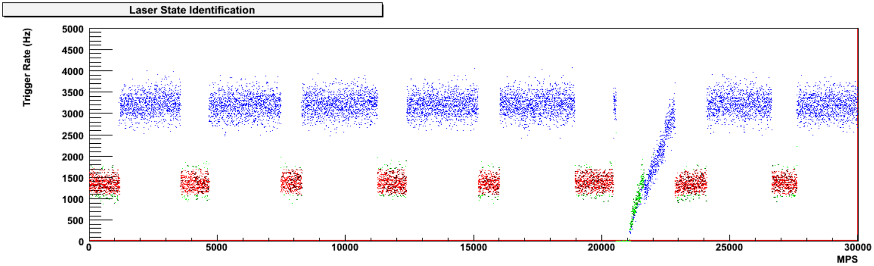
- As we discussed last time, Compton polarimetry requires accurate knowledge of whether the laser cavity is on or off
- Unbeknownst to us during running, this was more difficult than we thought:
  - Real-time logic signal is unreliable during cavity-off phase
  - EPICS cavity power variable lags changes by up to 1.5 seconds
- Luckily, there should be a clear separation of photon rates for the two modes.
- At Brad's suggestion, we tried applying cuts to the photon rate, normalized to the beam current...

Cuts on Current-Normalized Photon Rate



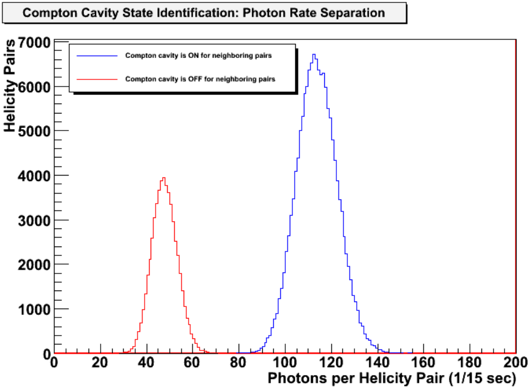
- Using the beam-current-normalized photon rates shields us from some effects of beam trips, etc
- To find the locations of the cut windows, we need to make a preliminary cavity-state ID:
  - Cavity ON: Preliminary ID made with EPICS data
  - Cavity OFF: Preliminary ID made with RT signal
- With the preliminary ID, we locate the approximate mean and RMS for each cavity state to determine the location and width of each cut window

Results: Identification of Compton Cavity States



- We include virtually all cavity-ON MPS pairs
- We exclude a small number of cavity-OFF MPS pairs with very low or very high rates
- Using photon rates normalized to beam current allows us to exclude temporary mis-tunes of the beam

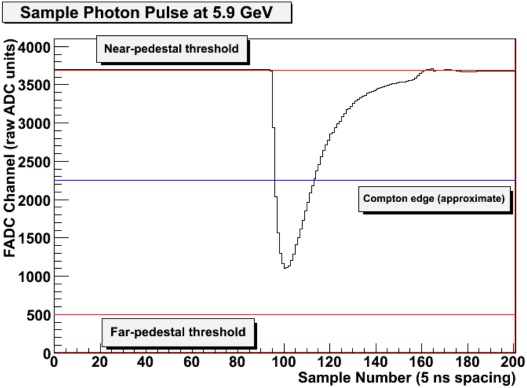
Results: Separation of Compton Cavity States



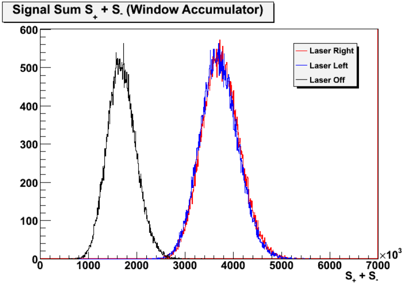
- We use the average photon rates over the course of a helicity pair (two consecutive MPSes, one + and one -)
- For each pair, we assign a cavity state based on the photon rates for the preceding and subsequent pairs

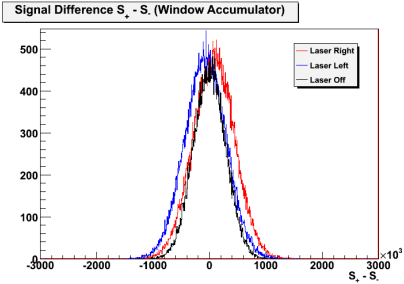
The Window Accumulator

- We compute an asymmetry in the energy-weighted photon signal, sampled every 5 ns and integrated over the course of an MPS
- Due to the low rates during d_2^n, pedestal noise dominates
- Best results are from the *window accumulator*, which includes samples within a pair of thresholds



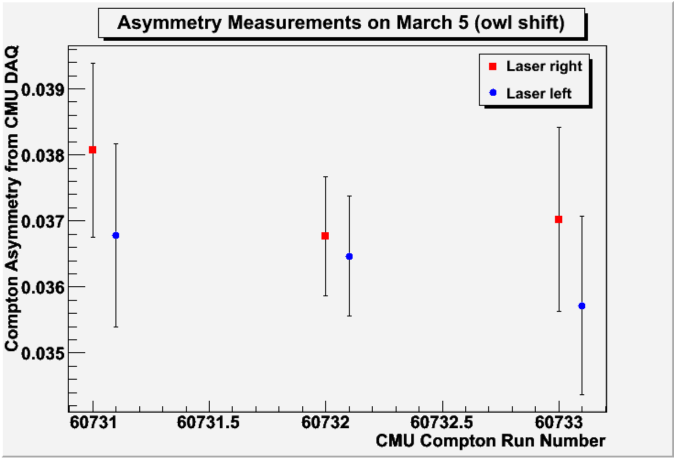
Constructing the Asymmetry





- Our goal is to compute the asymmetry $A_{Compton} = \frac{S_+ - S_-}{S_+ + S_-}$
- For each helicity pair, we compute the sum and difference of the signal for the two electron beam helicity states
- The overall asymmetry over a two-hour run is derived from
  - Mean and RMS of signal sum and difference, separated by photon polarization state
  - Corrections for mean and RMS of signal sum and difference for laser-off state

Early Results



Over nine hours of Compton-data taking on March 5, we see asymmetries that agree with each other, run-to-run as well as between left- and right-circular photon polarizations