# Compton Analysis Progress

## for the $d_2^n$ analysis meeting

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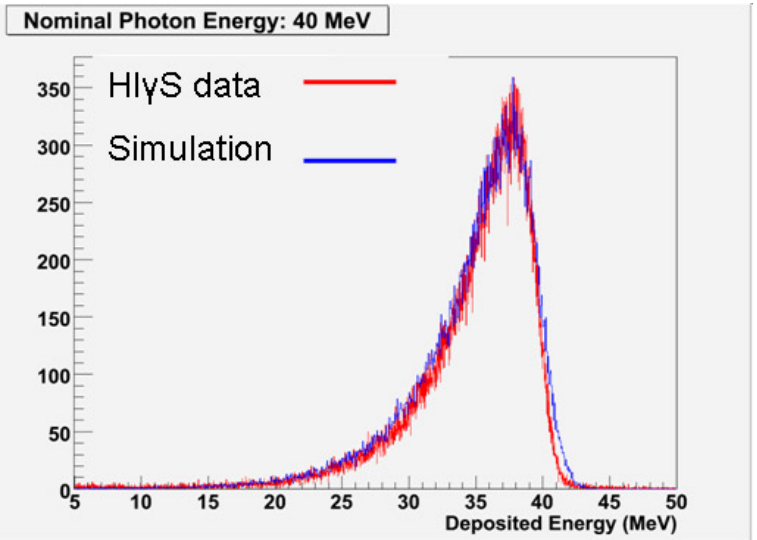
1. Compton Photon Detector Resolution
2. Left/Right Disagreement in $d_2^n$ Compton Data
3. What's Next?

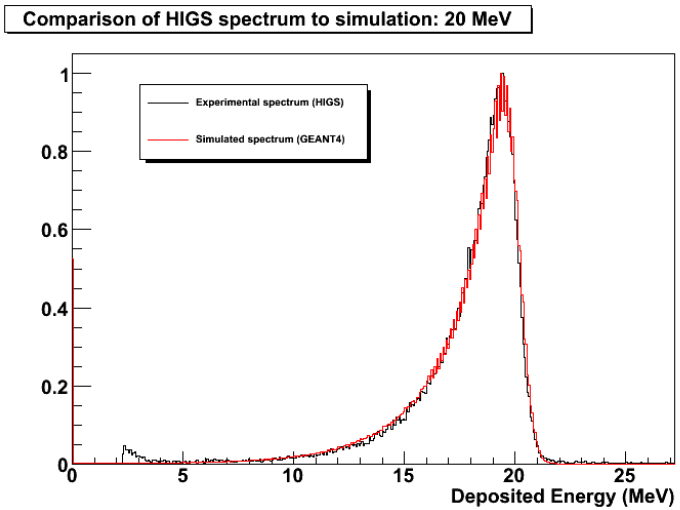
# Tests with "Monochromatic" Beam

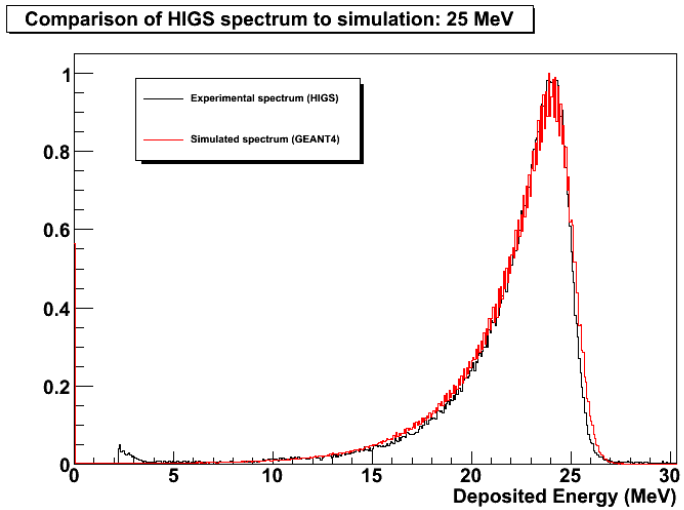
- As I showed last time, we've made great progress using GEANT4 simulations to help understand our data
- We went to HI$\gamma$S last October to test our photon detector with a "monochromatic" photon beam
- Agreement of our data with simulation seemed limited only by our knowledge of the HI$\gamma$S beam characteristics

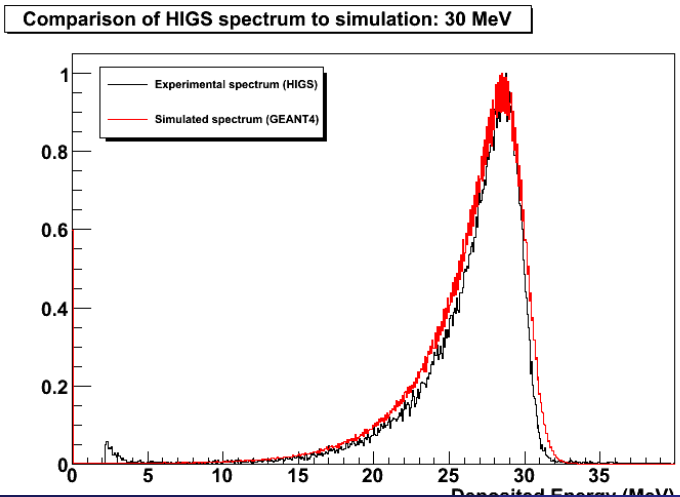


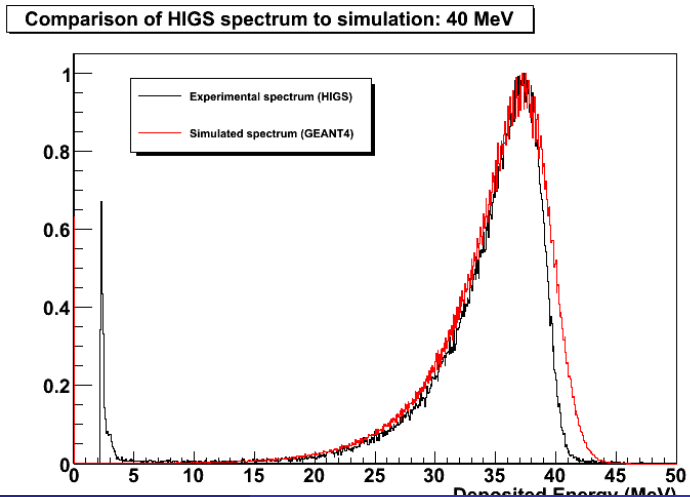
# New Simulations, with HI$\gamma$S Accelerator Data

In early August, HI$\gamma$S sent us the beam energy spreads computed by accelerator scientists. We updated our simulations.



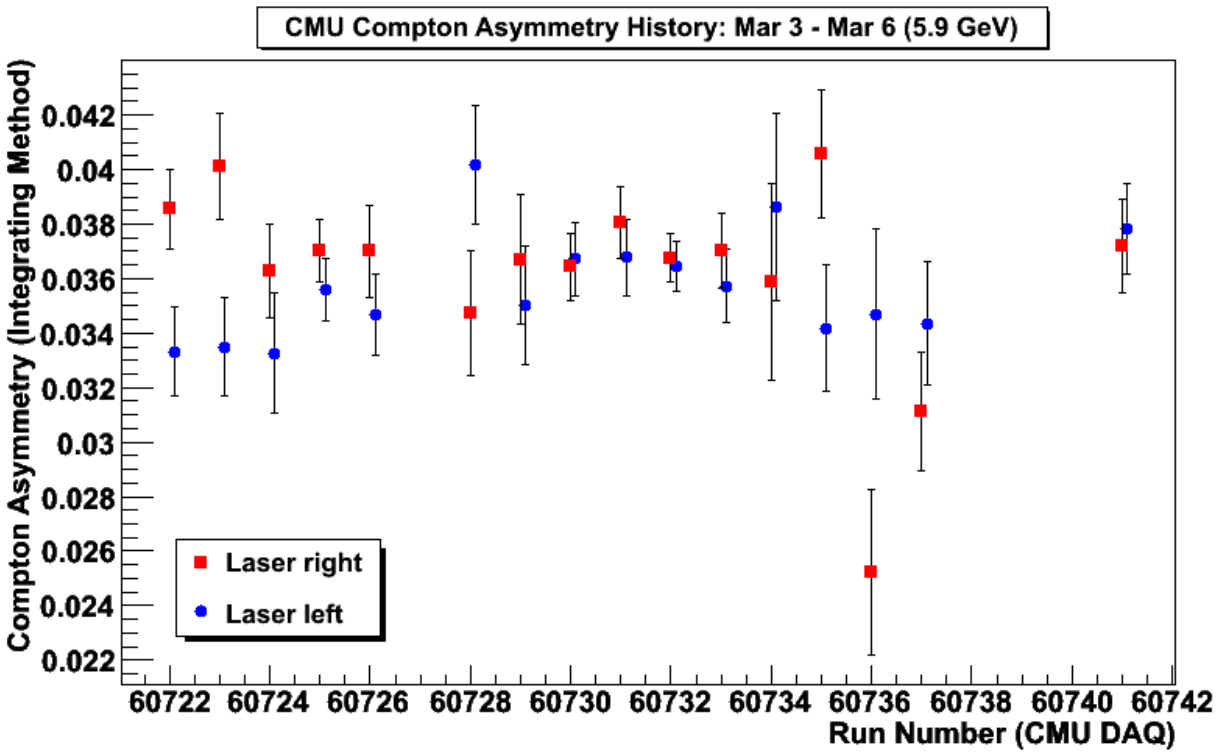
# Remaining Discrepancies

- The agreement looks great at low energies (20 MeV) – but gets steadily worse at higher energies
- We approximated energy spread as a Gaussian (good to first order)
  - Awaiting data from HI$\gamma$S as to true shape
  - Could Gaussian approximation get worse at higher energies?
- HI$\gamma$S scientists are taking a closer look

Bottom line: We've made progress toward understanding the detector resolution, but we aren't there yet!

# Disagreement between Left/Right Polarization States

- The Compton asymmetry should have the same magnitude whether it is measured with a left-circularly polarized laser or a right-circularly polarized laser
- However, when we examine the CMU Compton asymmetry history over the span of a few days, we find that they do not always agree



# Stretching the Accumulator Window (1)

- Our low-energy noise means we only want to accumulate signal in a **window** between two thresholds
- But our FADC firmware provides two window accumulators:
  - Ordinary window: takes signal falling between thresholds
  - Stretched window: includes more of the pulse (not just the "tip" of the iceberg)

**Window Accumulator**

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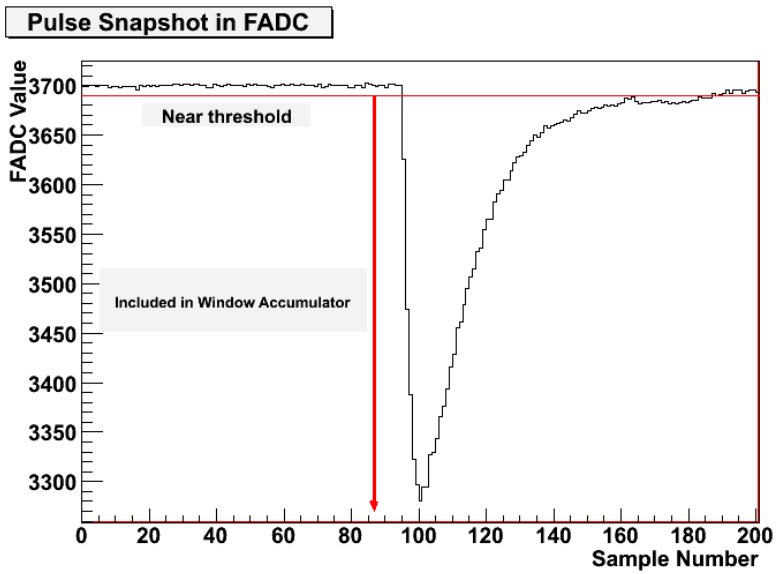


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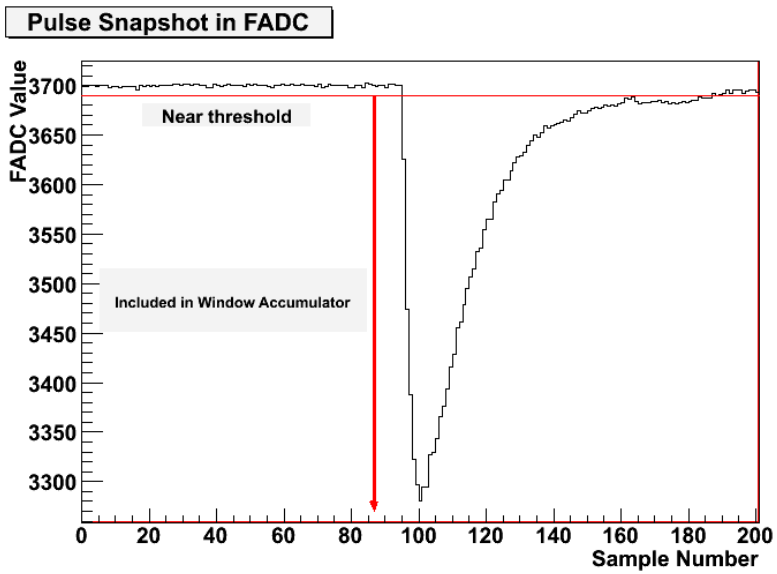


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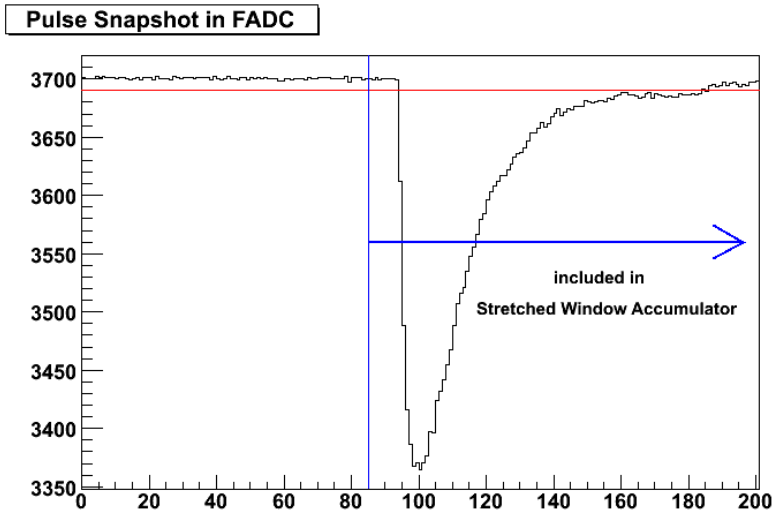
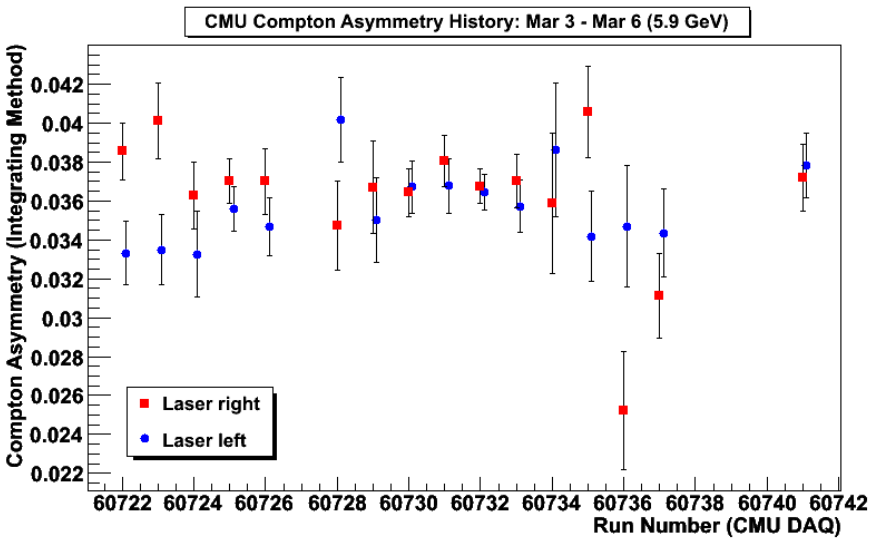


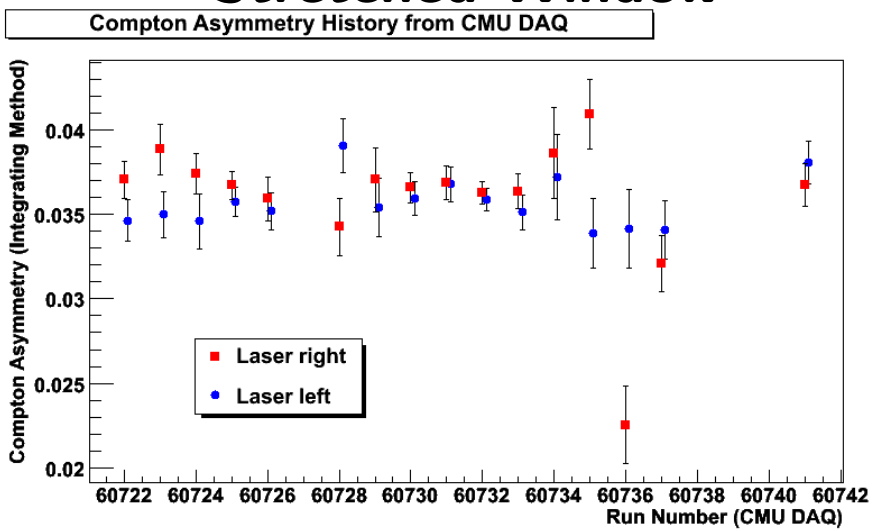
# Stretching the Accumulator Window(2)

- Using the stretched-window accumulator avoids some systematic error from excluding parts of the pulses
- It also partially addresses the left/right discrepancy problem:

**Ordinary Window**



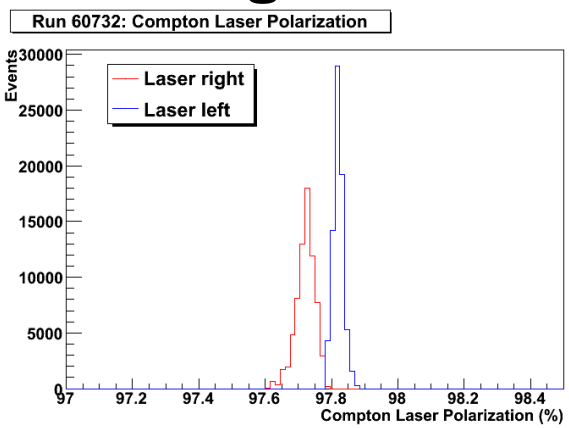

**Stretched Window**



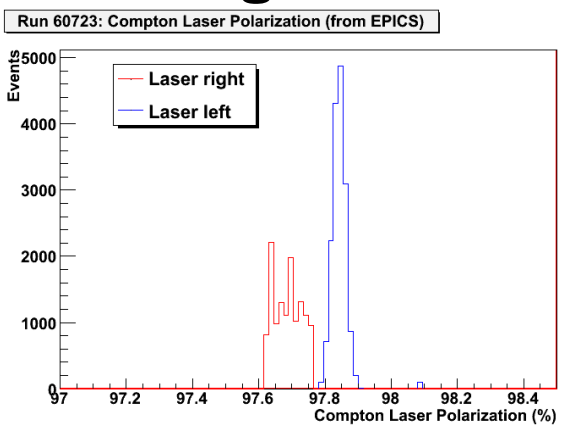
# Extent of Laser Polarization

- Why do we expect the Compton asymmetry to be the same for L/R laser states?
  - $A_{Compton} \propto P_e$ – and $P_e$ doesn't change
  - But the relationship is actually more complicated: $A_{Compton} \propto P_\gamma P_e$
- Does the extent of the laser polarization $P_\gamma$ change significantly between L/R?

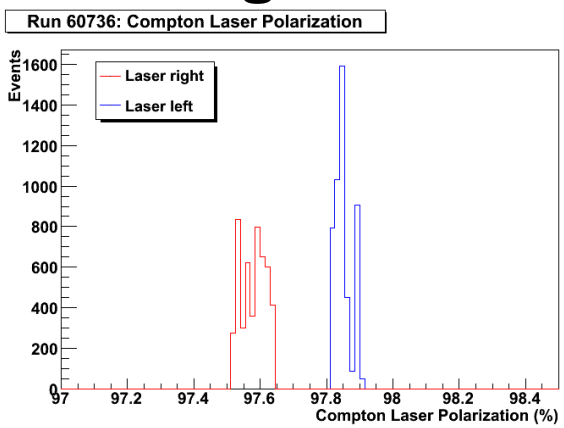
**Run 60732: No Disagreement**




**Run 60723: Mild Disagreement**




**Run 60736: Large Disagreement**



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- The behavior of the polarization is suggestive – but is it enough?
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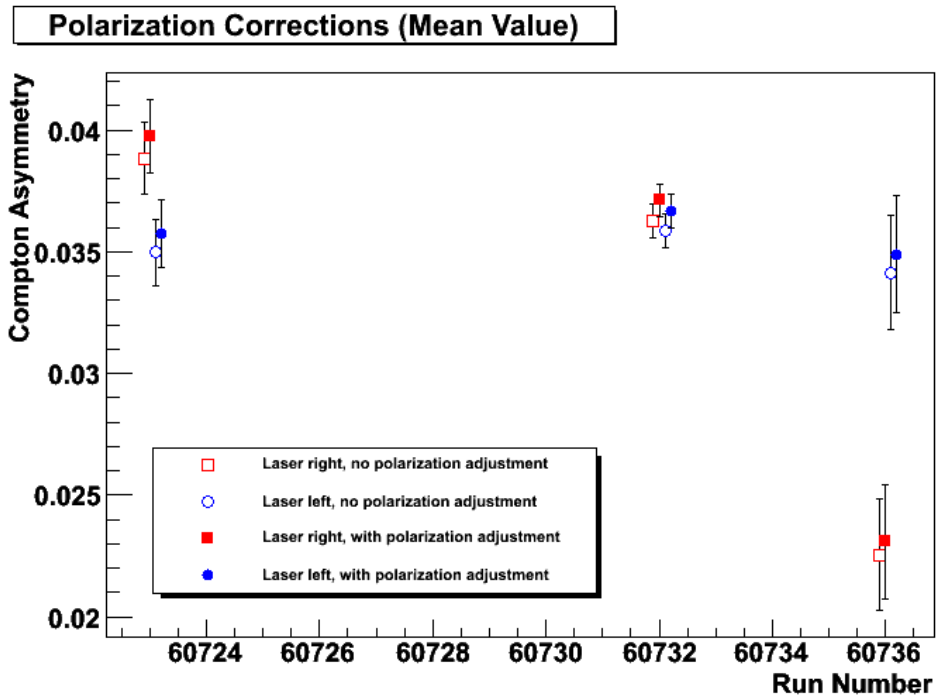


- Doesn't do much to improve agreement!
  - Is this adjustment algorithm incorrect?
    - Could apply correction every EPICS update ($\sim$ 1.5 seconds)
  - Is the polarization behavior a red herring?

# What's Next?

- HAPPEx-III Commissioning in Hall A
  - Requires high-precision Compton photon polarimetry to run
    - New and improved hardware and software
  - Was my priority for last $\sim 1.5$ weeks
  - Still a priority item now that I'm back in Pittsburgh
  - May be able to answer a few $d_2^n$ questions along the way:
    - Systematic errors that would also affect $d_2^n$ data
- BB optics