Analysis Progress

for the d_2^n analysis meeting

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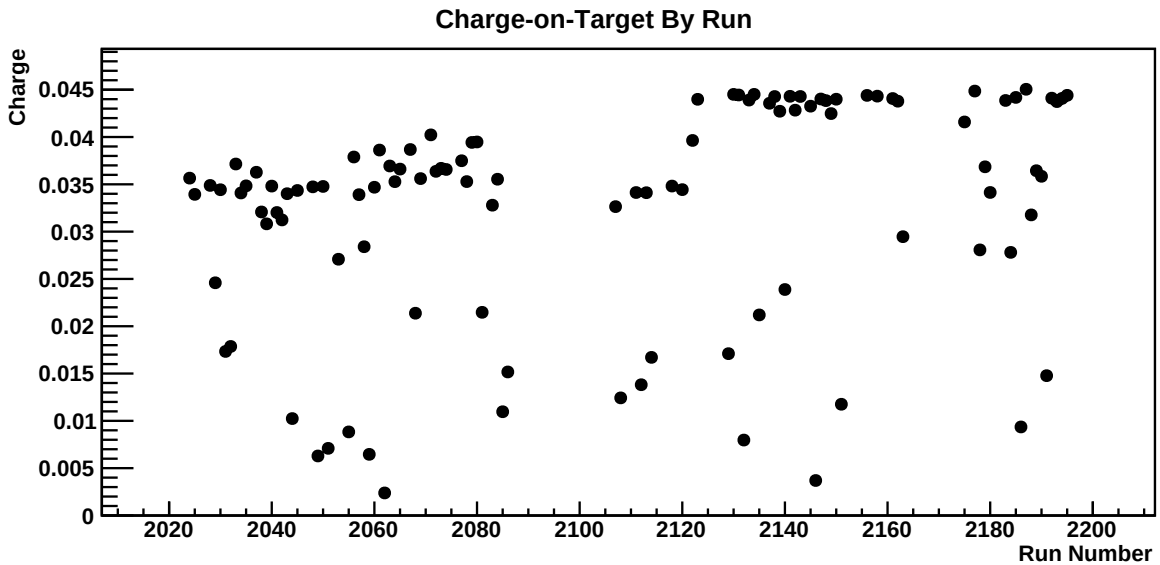
Beam Charge

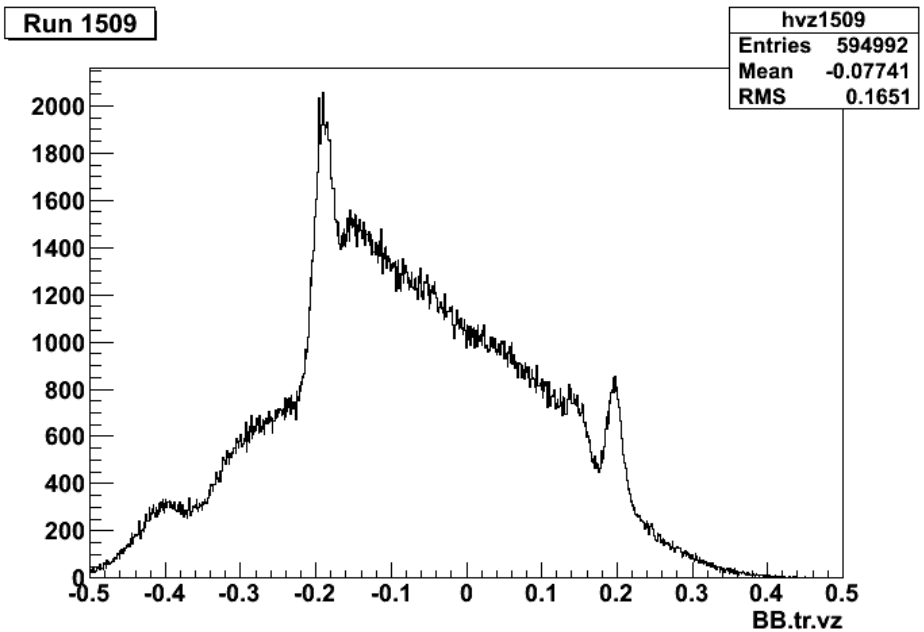
- We need the total charge-on-target per run for normalization purposes
  - *e.g.* finding the nitrogen dilution factor
- I've written code to calculate this for a run, excluding beam trips
- It makes a database matching charge to run number for all runs
- On d2n machine, it's at /home/dseymour/beamtrip/08Dec/BeamCharge.C



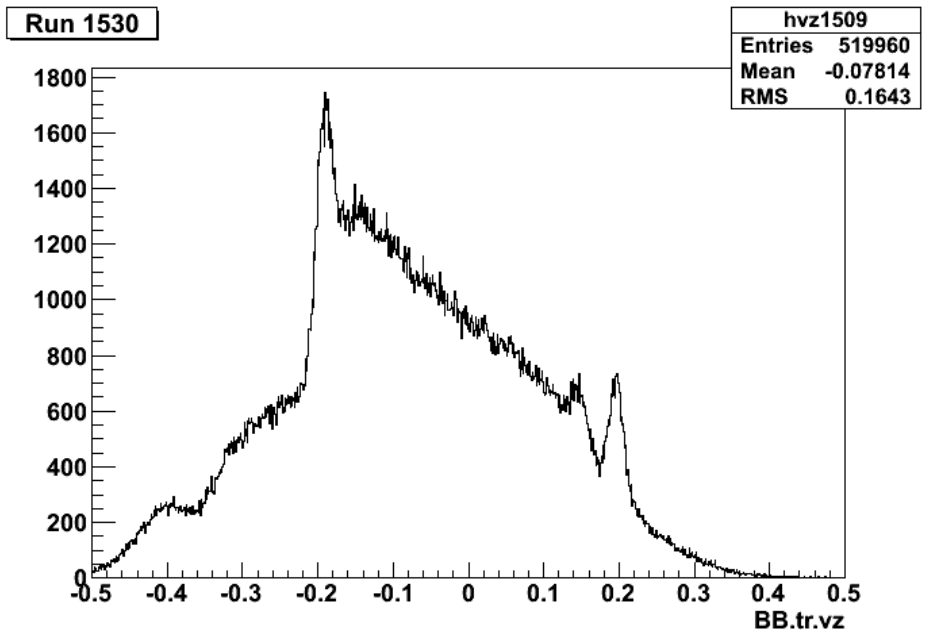
Vertex Distribution (i)

- I looked for accesses where target work was mentioned
- Could a collimator have been installed (or re-installed) during one of these times?
- First up: February 17

Before



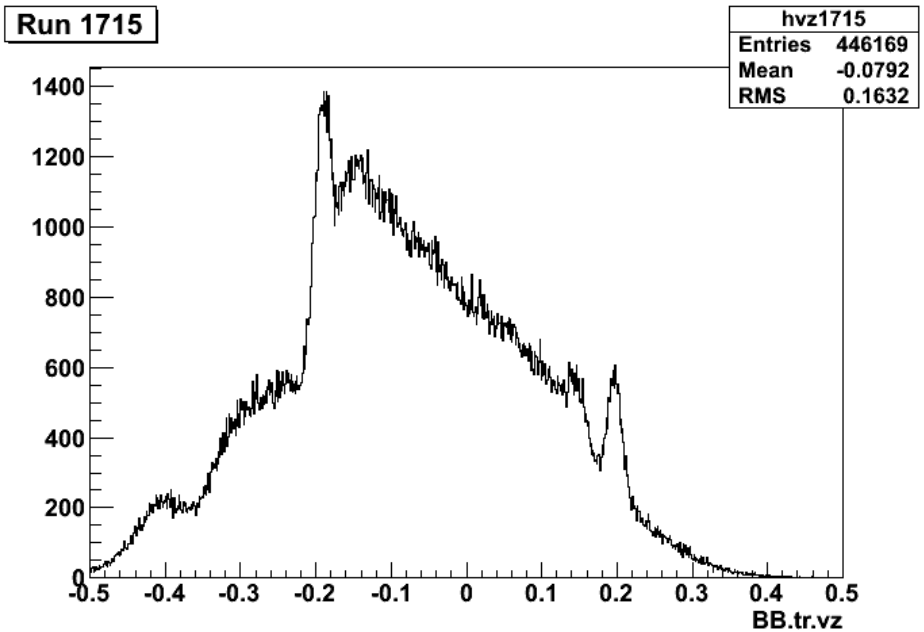
After



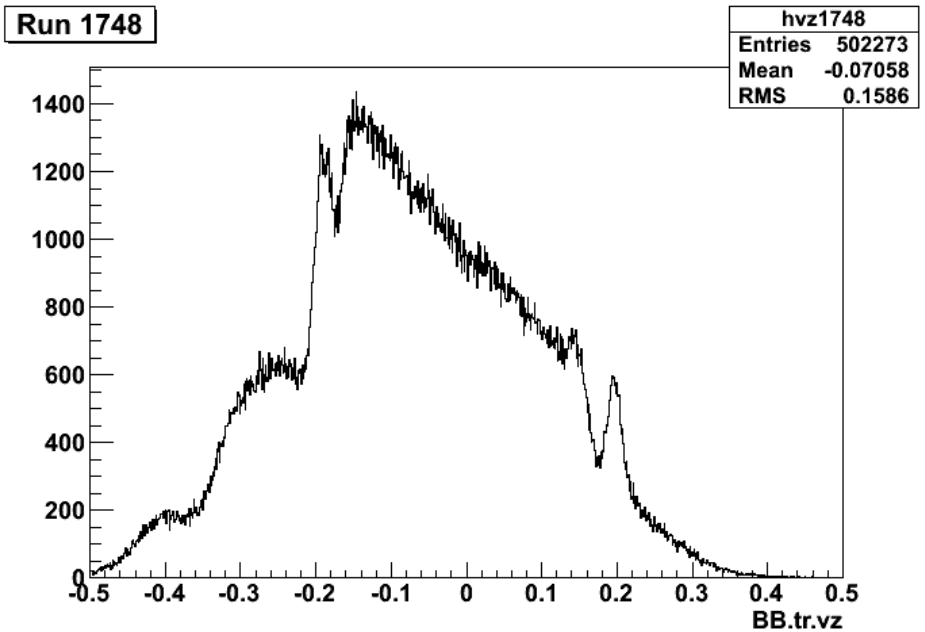
Vertex Distribution (ii)

- Next up: February 23

Before



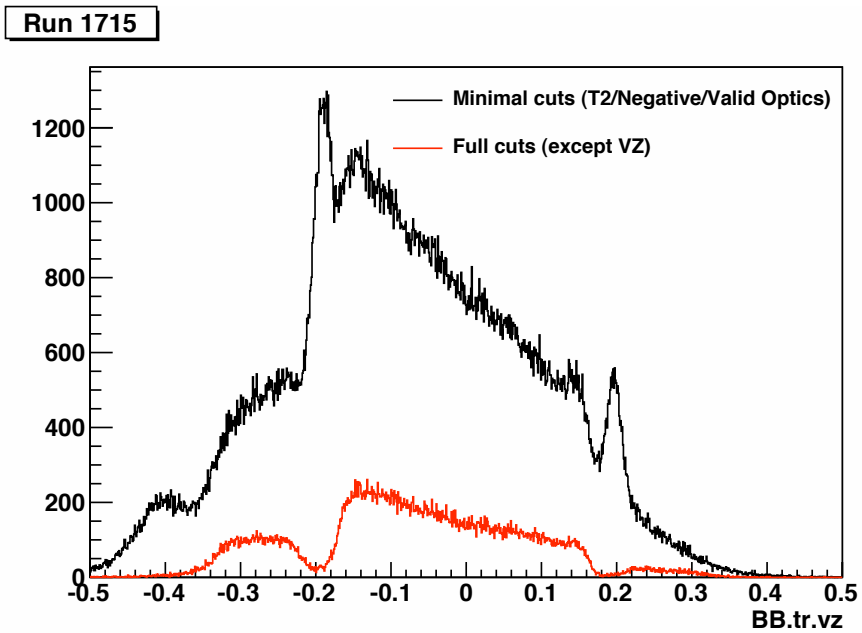
After



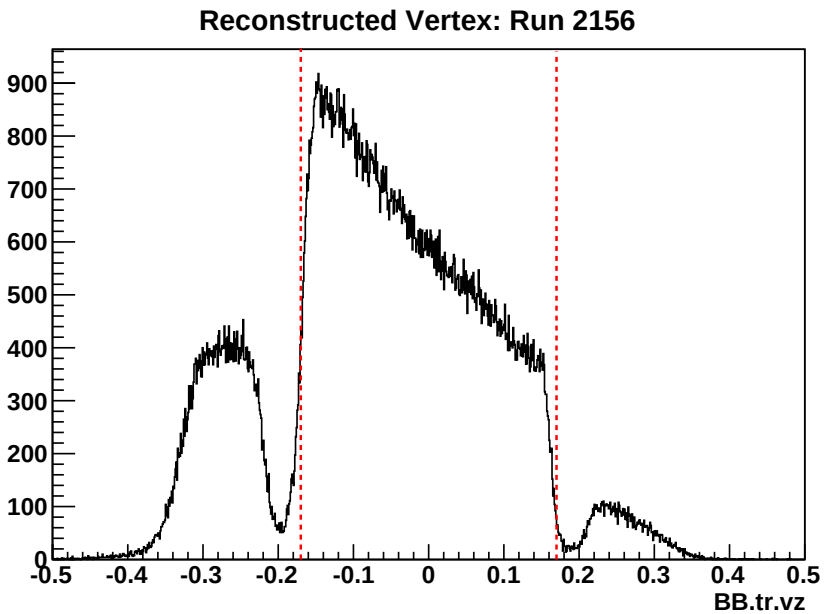
Vertex Distribution (iii)

- What happens if we apply our full set of cuts?

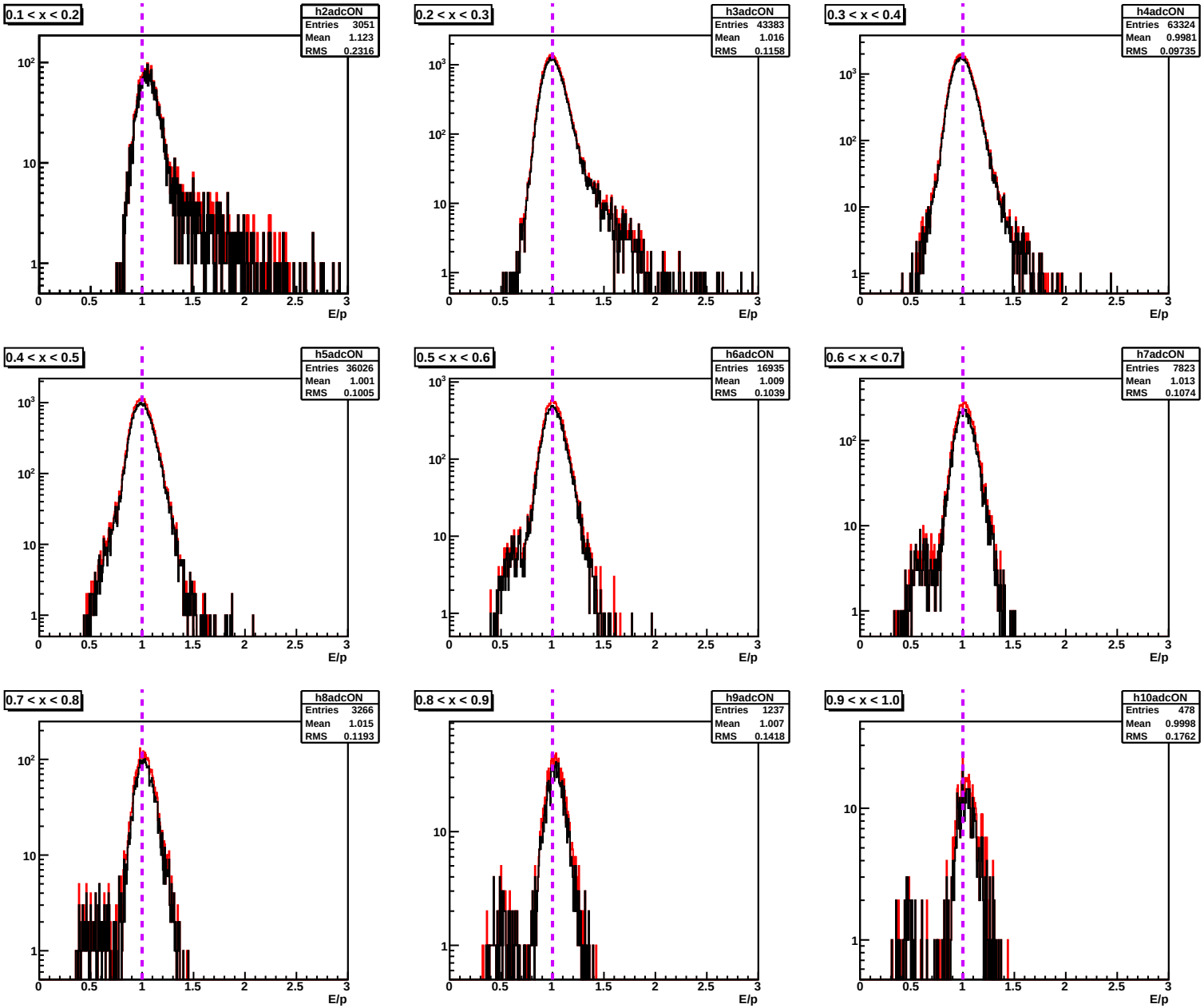
Early



Late

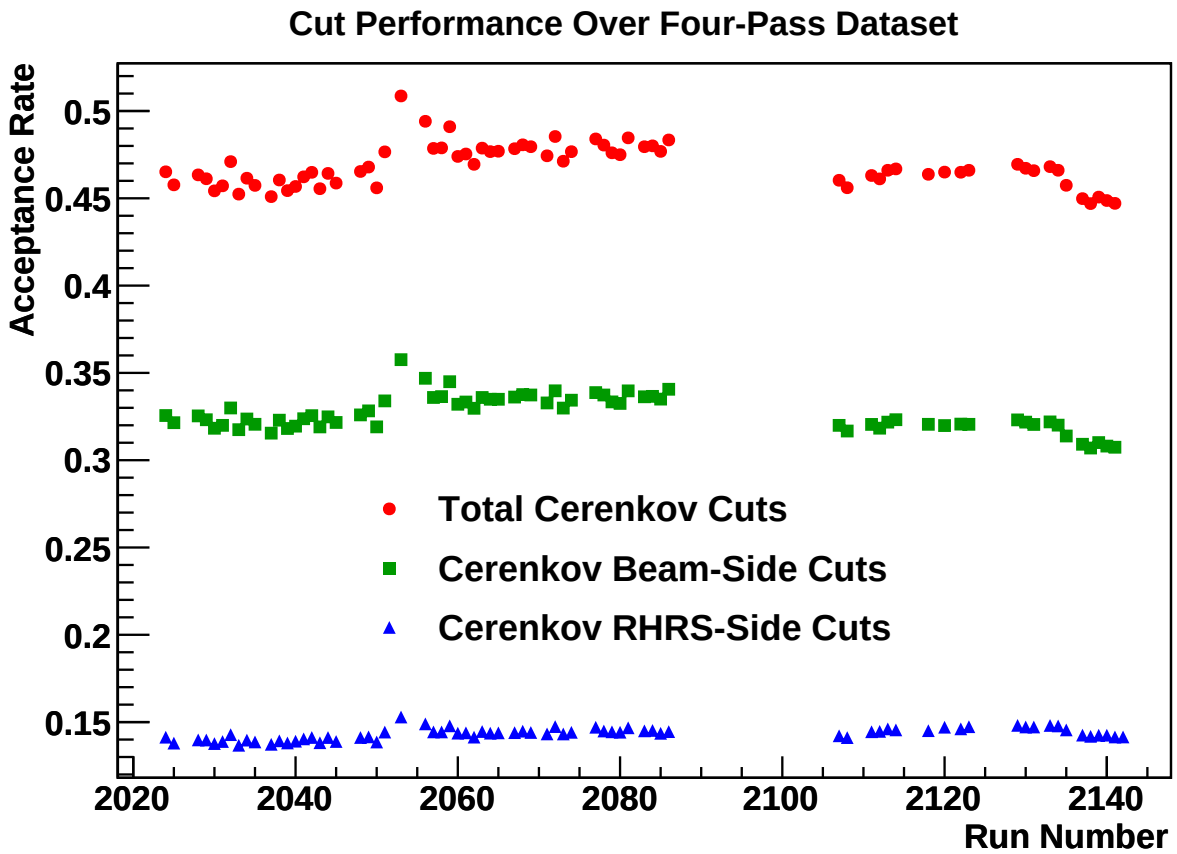


Čerenkov ADC Cut



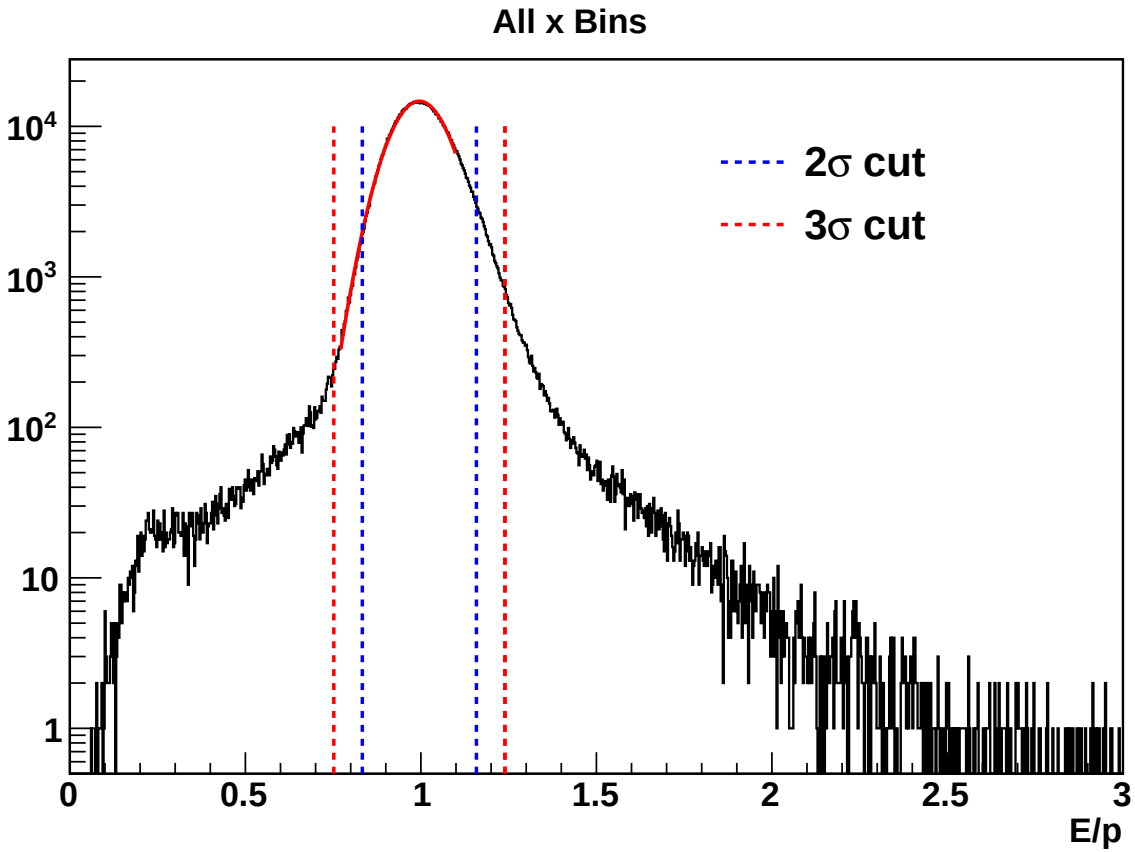
Čerenkov Cut Consistency

- Final Čerenkov cut requires that the following conditions be satisfied for *at least one* PMT:
  - At least one hit
  - Hit timing congruent with trigger window
  - Track intersects PMT acceptance

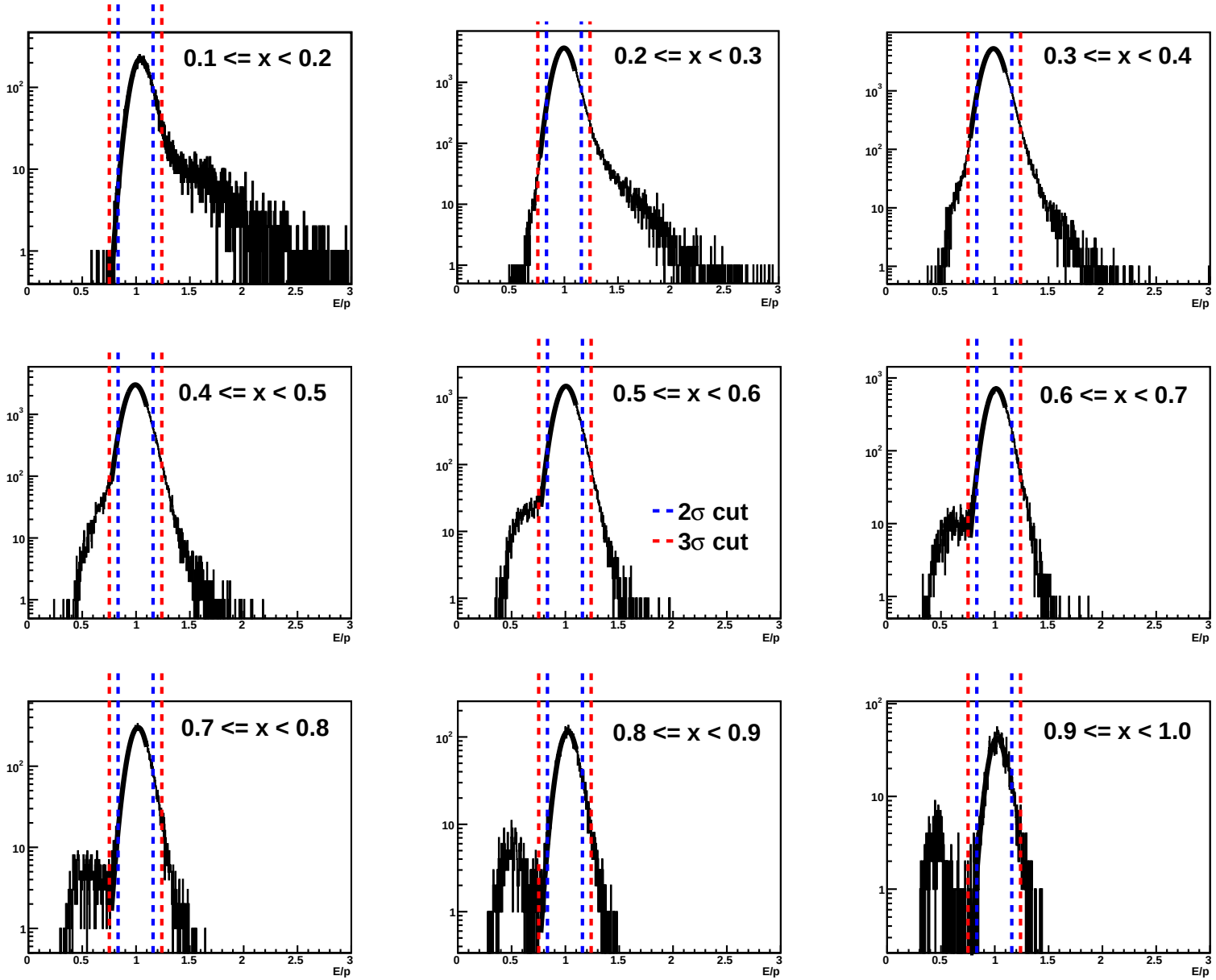


E/p Cut (i)

- Let's apply all our other cuts and look at the shape of E/p
- A Gaussian fit gives us 2σ and 3σ cuts
  - 2σ: $0.833 < E/p < 1.158$
  - 3σ: $0.752 < E/p < 1.239$

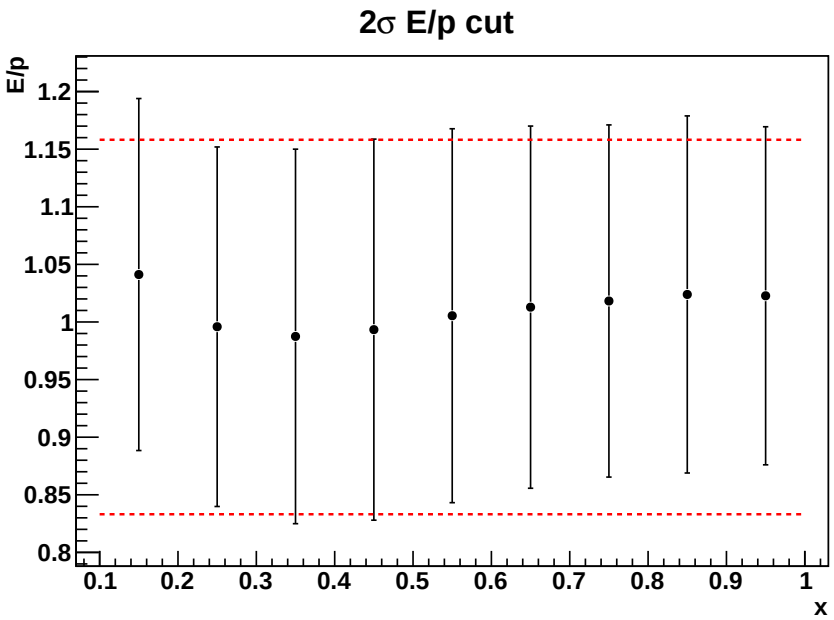


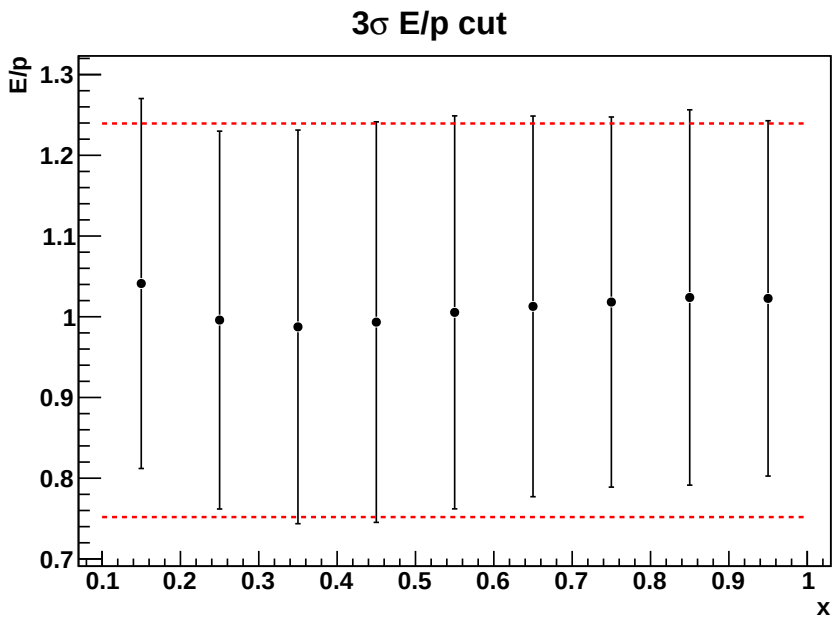
E/p Cut (ii): Binned in x



E/p Cut (iii)

- I fit the E/p distribution in each x bin
- This shows more clearly what a bin-specific cut would look like

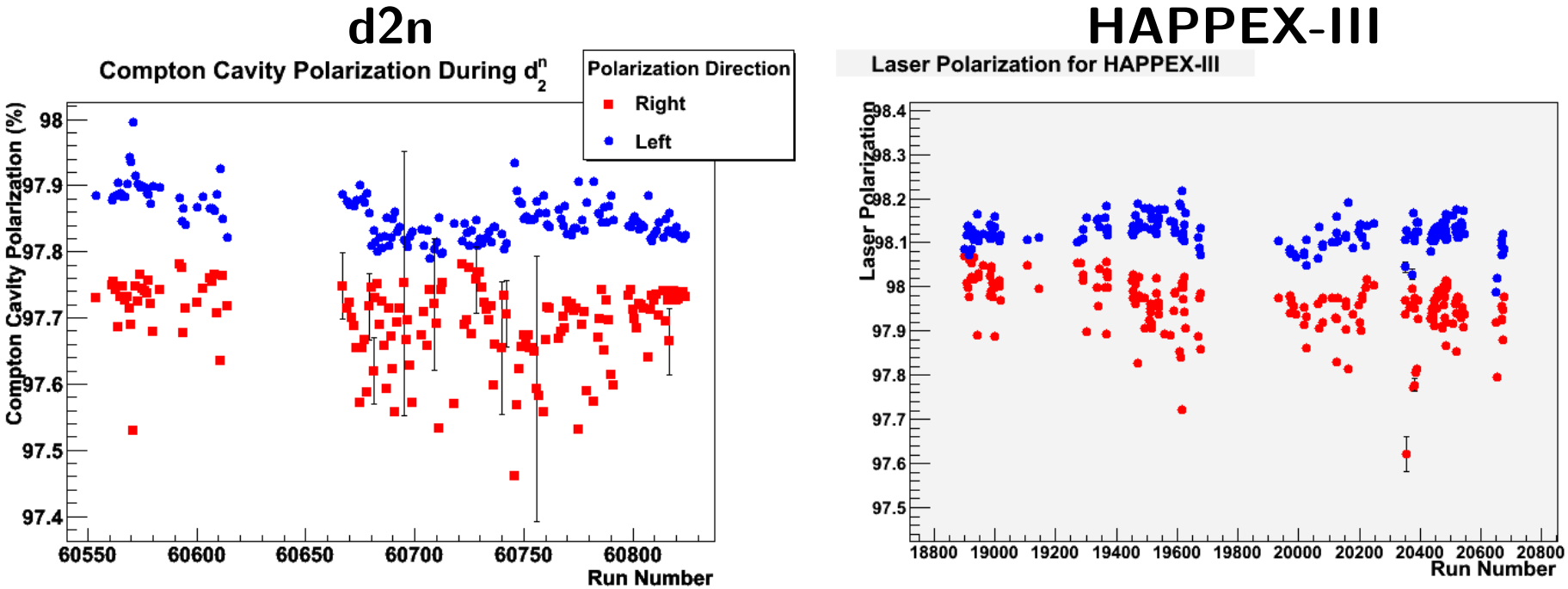




Compton Photon Polarization (i)

- We need P_γ to extract P_e
- Our P_γ measurements rely on an old and undocumented transfer function
- HAPPEX-III used (almost) the same system and took much better P_γ measurements
- How comparable are our measurements to theirs?
- Quick reminder about P_γ:
  - Two polarization states (left- and right-circular)
  - Polarization measured at cavity exit.
  - Two power meters (S1 and S2) each measure a polarization component
  - Asymmetry in S1 and S2 gives P_γ^{exit}
  - Transfer function then gives us P_γ^{CIP}

Compton Photon Polarization (ii)

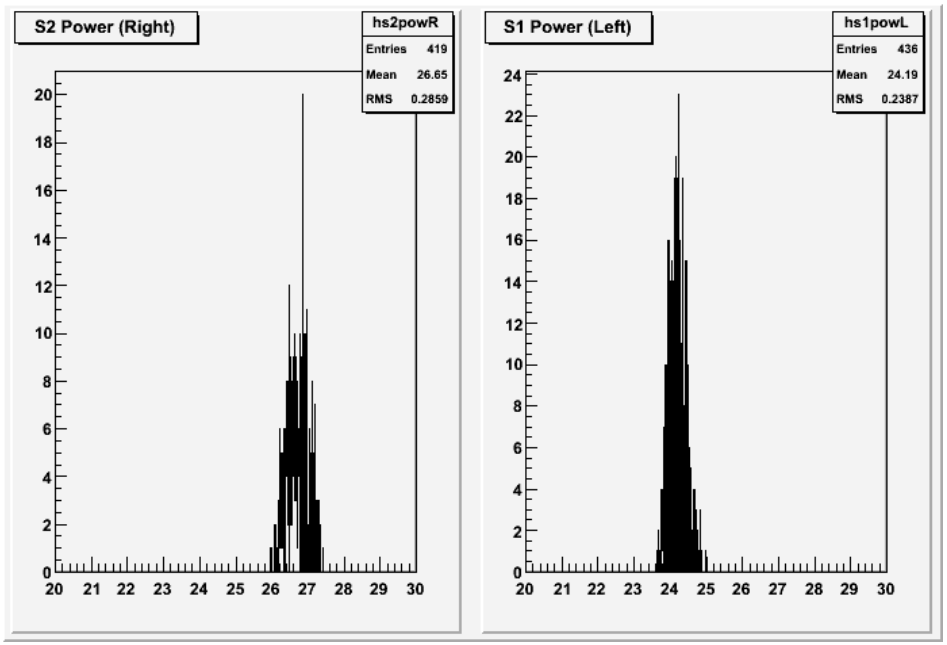


- Photon polarization is very stable over time
- This means we can trust conclusions from representative runs

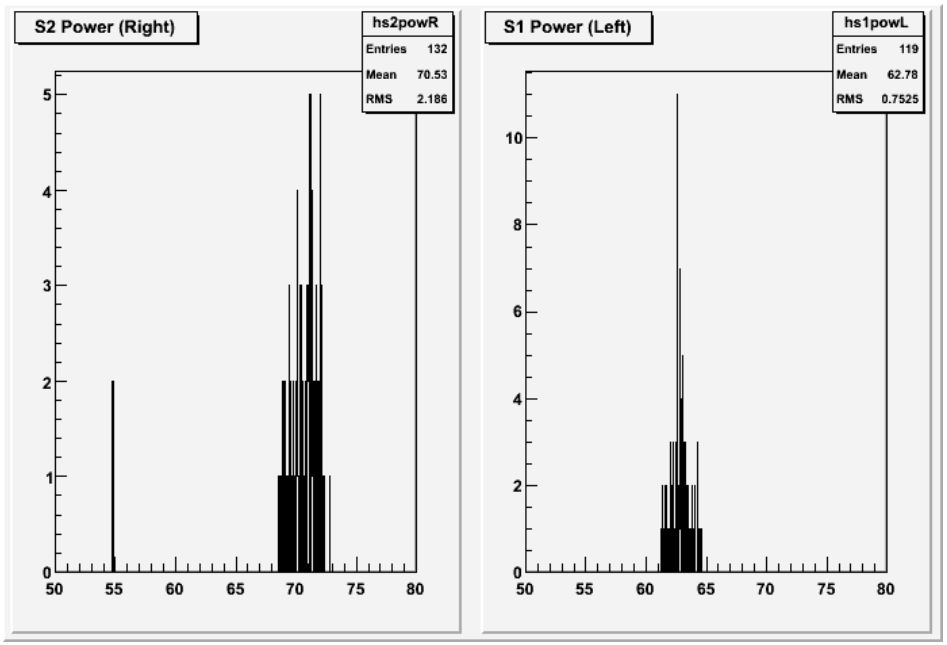
Compton Photon Polarization (iii)

- HAPPEX-III ran with much higher laser power, so absolute S1 and S2 readings are higher
- We can infer the relative gains of S1 and S2 from the ratio of $\max_{S2}$ to $\max_{S1}$
- This ratio is 1.10 for d2n and 1.12 for HAPPEX-III

d2n



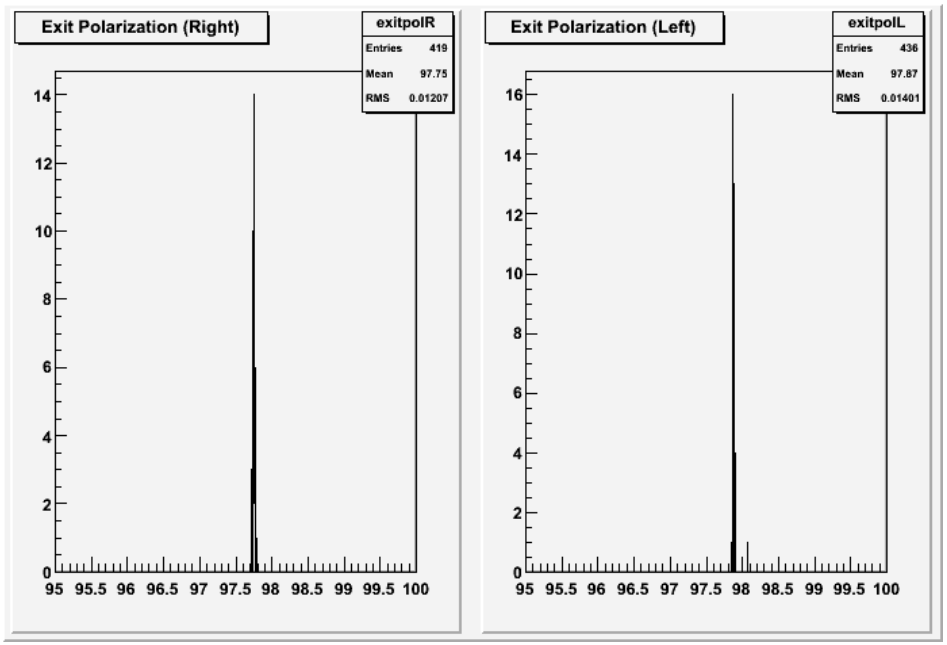
HAPPEX-III



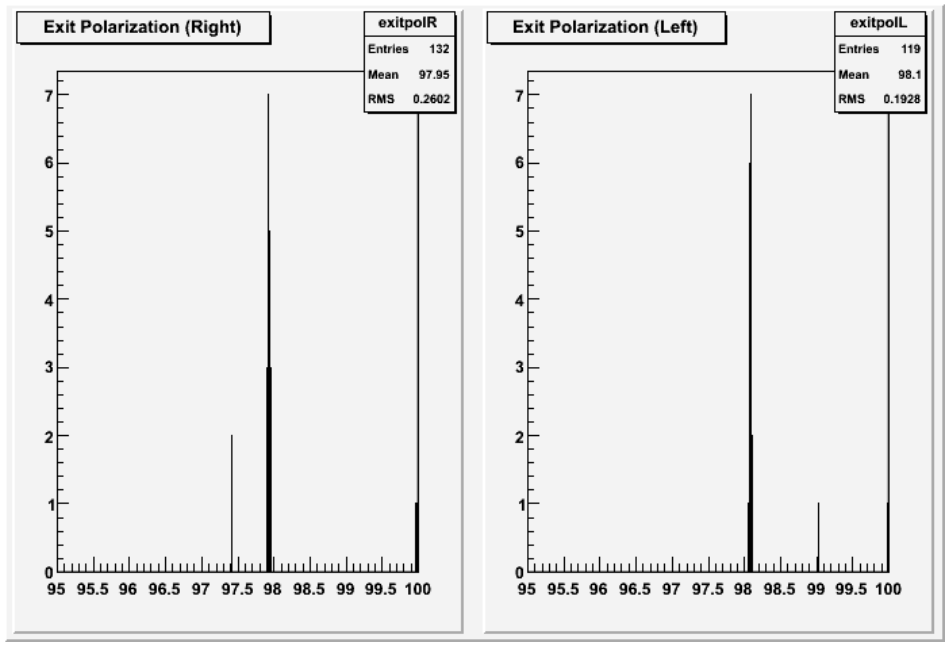
Compton Photon Polarization (iv)

- How about the exit polarization?
- $P_{\gamma}^{exit} = \frac{|S_1 - S_2|}{S_1 + S_2}$
- This is 0.2% lower for d2n than for HAPPEX-III

d2n



HAPPEX-III

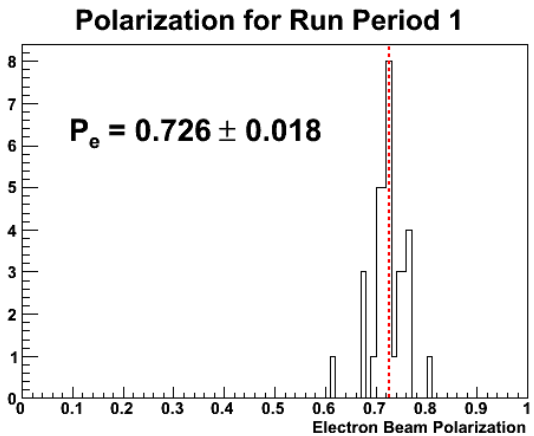


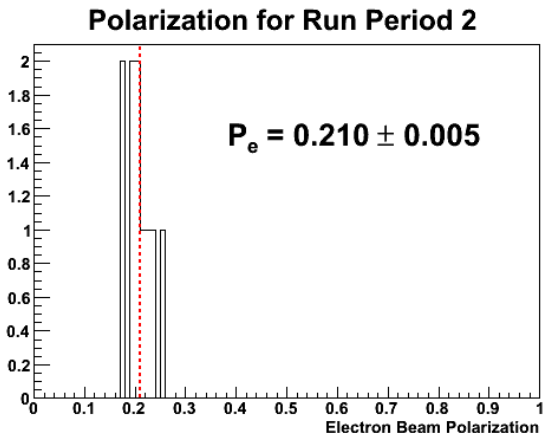
Compton Photon Polarization (v): **FINAL**

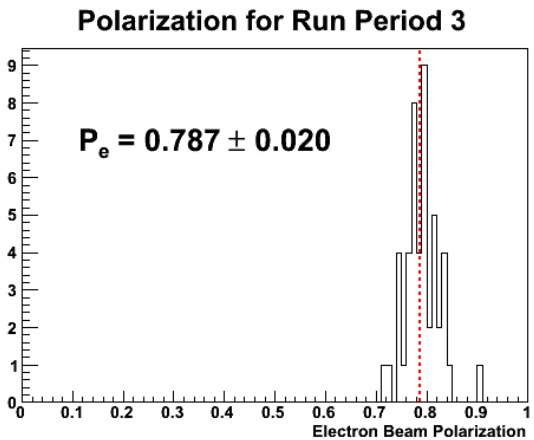
- We take the HAPPEX-III polarizations and reduce them by 0.2%
- Laser left: $P_\gamma = 0.98792 \pm 2.15\%$
- Laser right: $P_\gamma = 0.988419 \pm 2.15\%$
- Error budget:
  - 0.8% on HAPPEX-III P_γ measurement
  - $< 2\%$ on agreement between HAPPEX-III and d2n

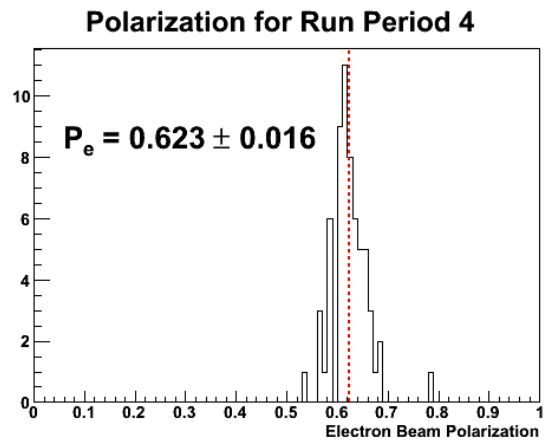
Compton Results (i)

- Reduce statistical errors by averaging over an entire run period
  1. 5.9-GeV polarized beam
  2. 4.7-GeV unpolarized beam
  3. 5.9-GeV polarized beam
  4. 4.7-GeV polarized beam









Compton Results (ii)

Systematic Error: 2.49%

- 2.15 % on photon polarization P_γ^{CIP}
- 1.04% on analyzing power A_l
- 0.7% on use of thresholds in asymmetry measurement

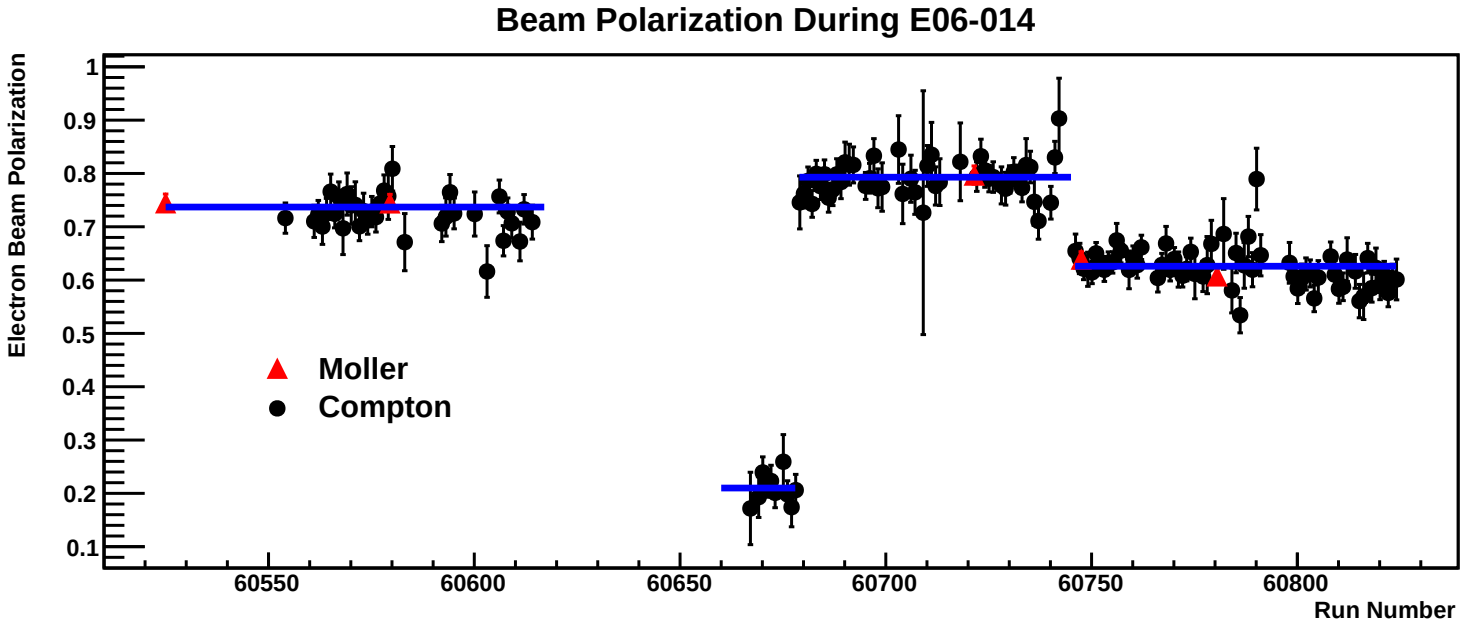
1. $P_e = 0.72554 \pm 0.01854$
2. $P_e = 0.21003 \pm 0.01110$
3. $P_e = 0.78718 \pm 0.01987$
4. $P_e = 0.62337 \pm 0.01573$

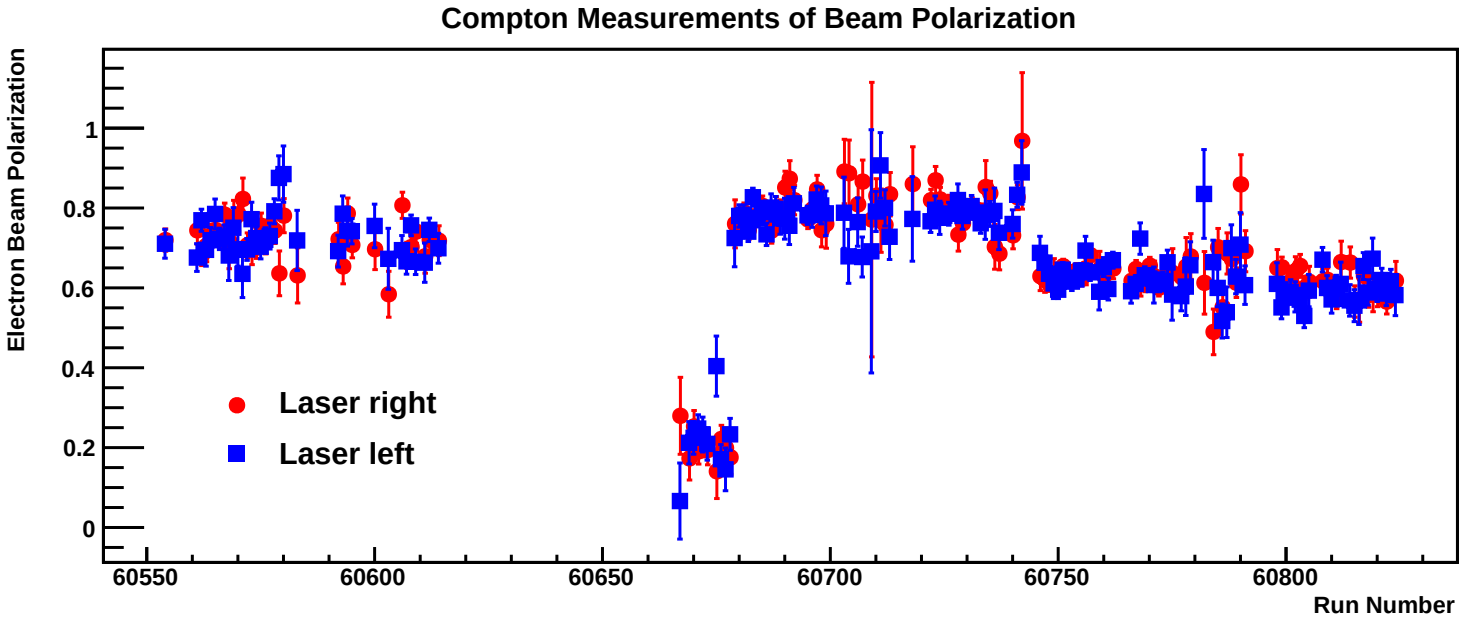
Final Beam Polarimetry Results (i)

- We also have Møller measurements
- Let's take the mean Møller result for each run period and average it with the mean Compton result

1. $P_e = 0.7370 \pm 0.0115$
2. $P_e = 0.2100 \pm 0.0052$
3. $P_e = 0.7931 \pm 0.0124$
4. $P_e = 0.6260 \pm 0.0098$

Final Beam Polarimetry Results (ii)





Summary

- Yawei is doing a target polarization interpolation for BB runs
- We have a database of total charge for all BB runs
- Our cuts remove target windows: change in vertex distribution could be a change in trigger
- Software threshold in Čerenkov ADC levels does not help us
- E/p behavior is relatively uniform over x bins
- We have final beam polarization numbers for all four run periods!
- Error on P_e is about 1.6%

What's Next?

- PID
  - Fit E/p background in each x bin
  - Quantify amount of background that survives E/p cuts
- Asymmetries
  - Confirm times of HWP switches
  - Elastic ^{3}He asymmetry to check sign
  - Asymmetry on particles that scattered from pole piece
  - Asymmetry on new good electron sample
  - Nitrogen dilution factor
- Dissertation