

DIS analysis for NPS RG1a : absolute luminosity of the experiment

J. Roche, on behalf of M. Mathison, July 2024

Run plan for January 22, 2024

3. Production: Label CODA runs **KinC_x50_3**" NPS Sweep ON, Correctors OFF

1. LH2 Target

1. **Two** 1 hour runs, ps6=0, 35 uA CODA config coin_sparse,
2. One 20-min run at 20 uA, coin_sparse, ps6=0
3. One 40-min run at 10 uA, coin_sparse, ps6=0
4. One 20-min run at 20 uA, coin_sparse, ps4=0
5. One 15-min run at 40 uA (or same as production), **coin** , ps6=3

2. Dummy Target

1. 15 min run at 30 uA, coin_sparse, ps6=0
2. 20 min run at 20 uA, coin_sparse, ps6=0

3. LD2 Target

1. **Six** 1-hour runs, ps6=0, 15 uA CODA config coin_sparse,
 1. First run, make screen shots of CODA Data Rate, Event I
2. One 40 min run at 10 uA, coin_sparse, ps6=0
3. One 40 min run at 5 uA, coin_sparse, ps6=0
4. One 20-min run at 10 uA, coin_sparse, ps4=0
5. One 15 min run at 15 uA (or same as production), **coin** , ps6=3

ps6: coincidence HMS-NPS

ps4: HMS only (EL_Real)

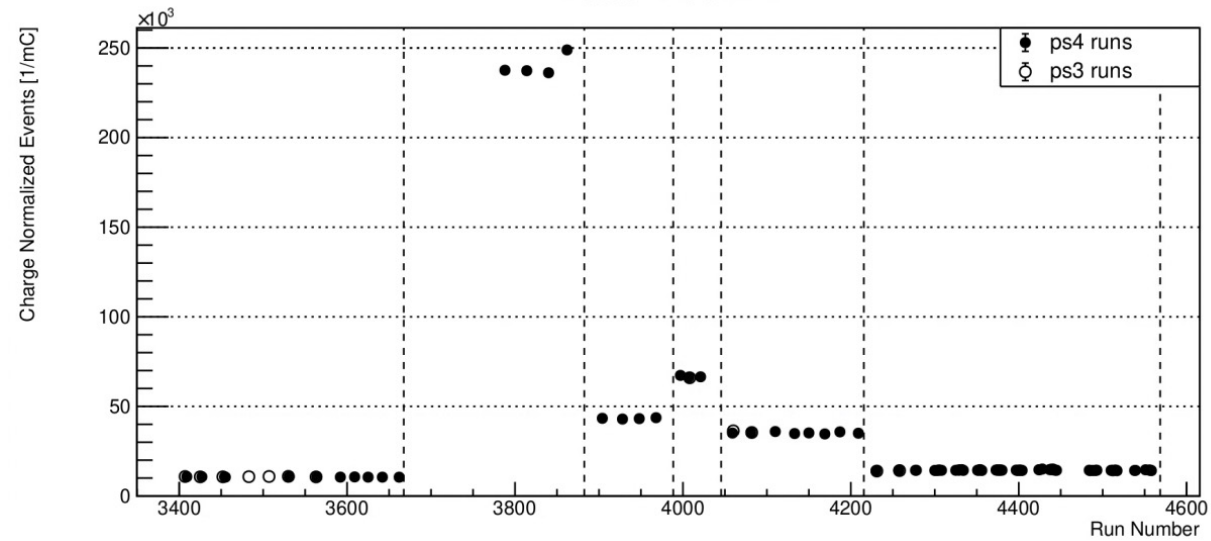
Each cycle was about 12h.

- ps4 only (no ps6) when HMS rates were low enough.
- We have DIS data on all kinematic points.
- At first, the standard run plan did not include ps4 on dummy. We did repeat all settings with low statistic in May 2024 with ps4 on all 3 targets.

DIS Yields

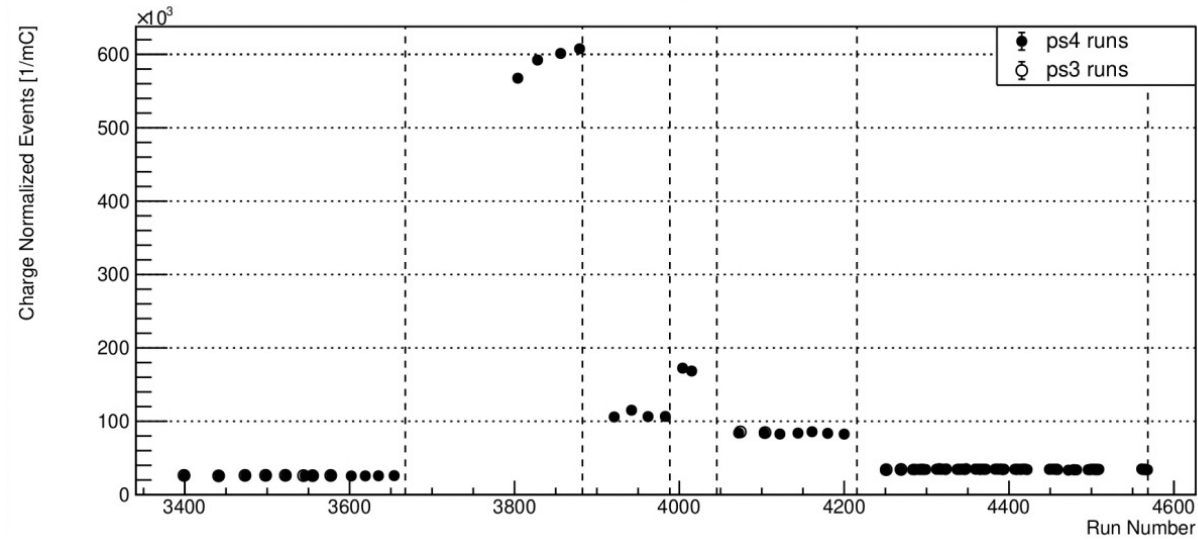
- All runs between December '23 and mid-March '24.
That's kinematic settings: x60_2, x50_2, x50_3, x36_5, x60_3, and x60_4
- Using online replays and the following HMS cuts:
 - Cerenkov: $npeSum > 0.7$
 - Delta between $\pm 8\%$
 - Calorimeter: $etotnorm$ and $etottracknorm > 0.6$
- Normalized by charge
- Corrections for livetime and DC tracking efficiency
- No target cell wall subtraction

Electron Yield: LH2



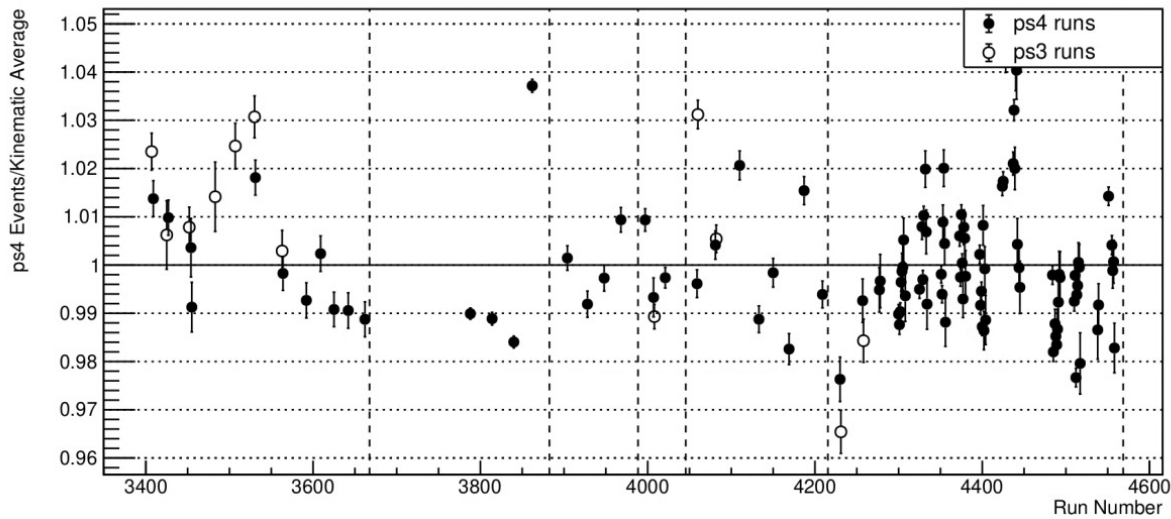
LH2

Electron Yield: LD2

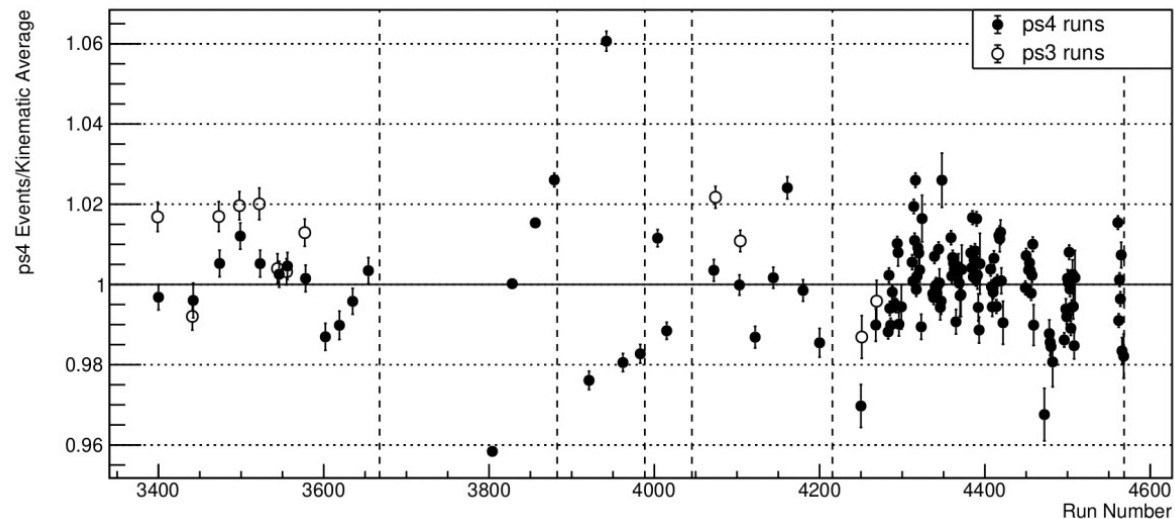


LD2

Relative Electron Yield: LH2



Relative Electron Yield: LD2



SIMC (see B. Henry and D. Gaskell's talk today)

Mark worked under the guidance of B. Henry and C. Morean.

Casey on Redmine <https://redmine.jlab.org/attachments/download/2503/Inclusive%20DIS%20Pass%201.pdf>

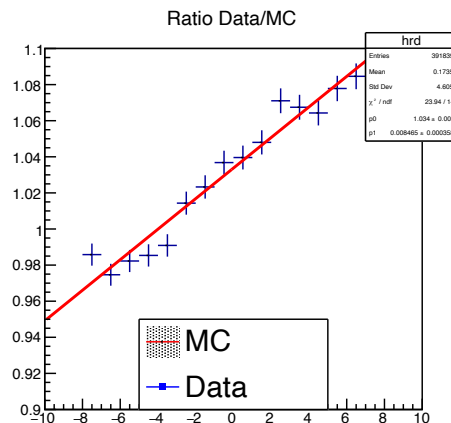
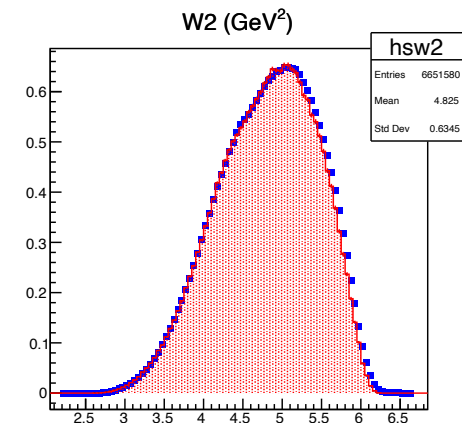
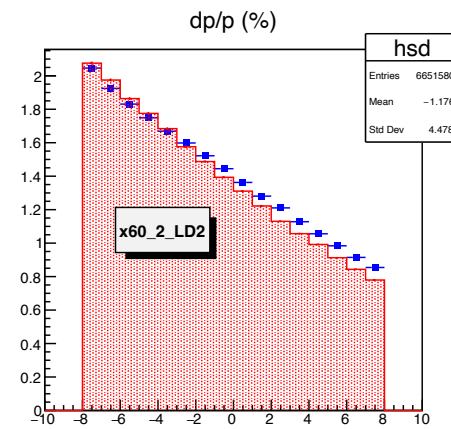
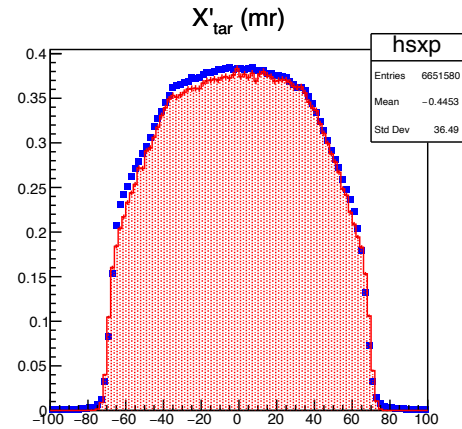
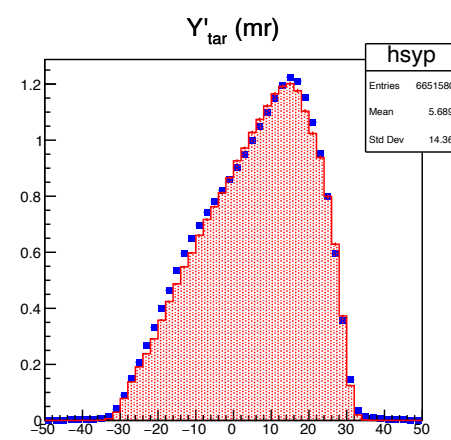
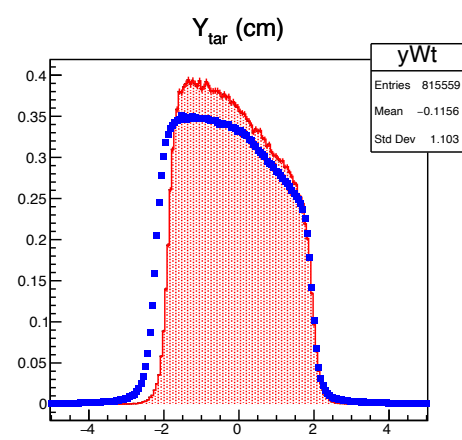
Peter on ELOG (recording) <https://hallcweb.jlab.org/elogs/NPS-RG1a-Analysis/12>

Dave G. this meeting https://indico.jlab.org/event/866/contributions/14917/subcontributions/228/attachments/11515/17826/simc_nps.pdf

Simulation steps:

1. generate events at vertex over a large phase space (including a model for the cross-section and a phase space)
2. introduce radiative effects
3. compute reconstructed variable (momentum, angles, vertex)
4. fold in nominal luminosity to obtain counting rates
5. Produce a ROOT file with variables equivalent to the data.

Dave Gaskell cross-checked Mark's results on kinematic 36_4 LH2 and found similar results to Mark.

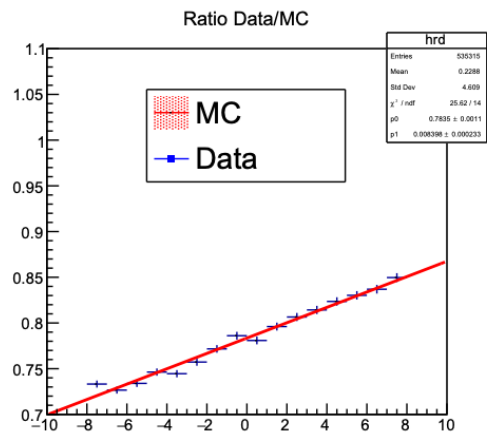
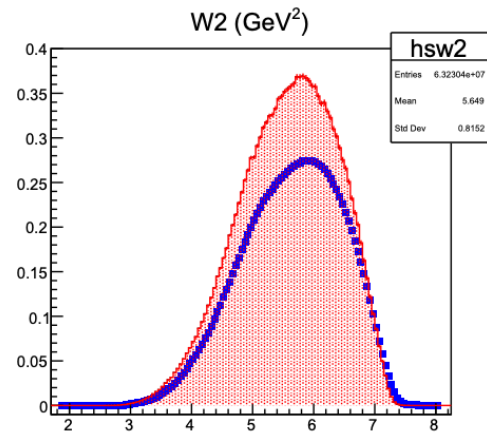
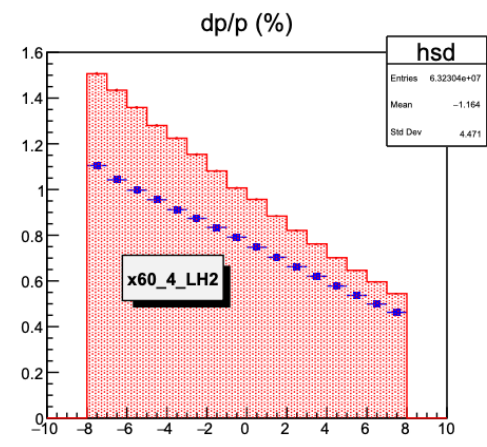
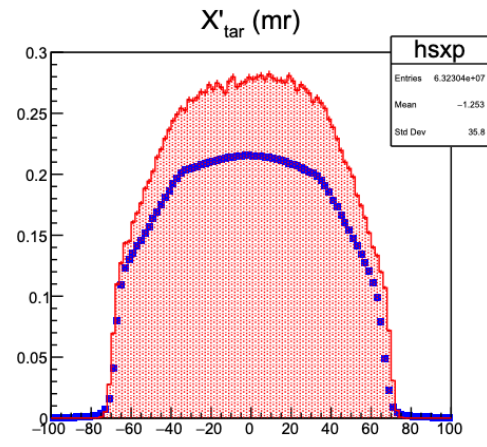
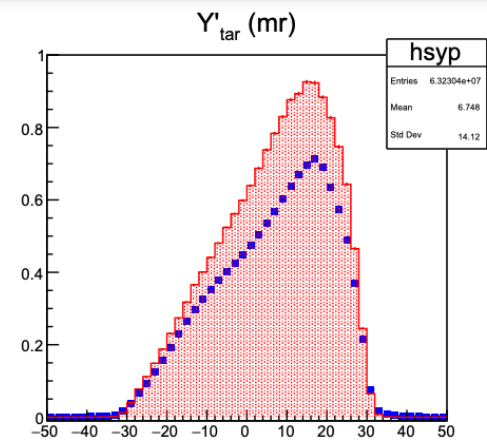
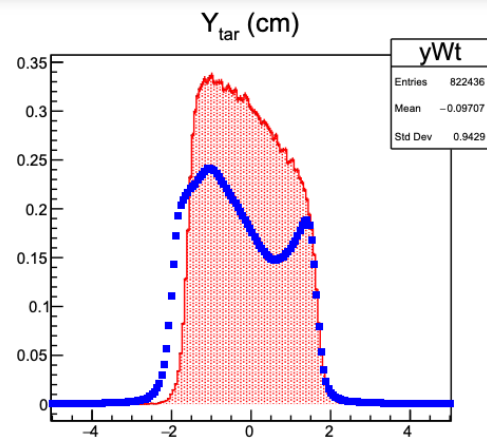


LD2
no target cell wall subtraction
in the data

”Good” agreement MC-data:
few % agreement

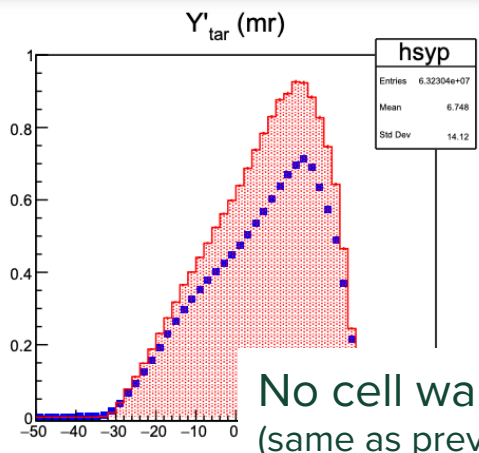
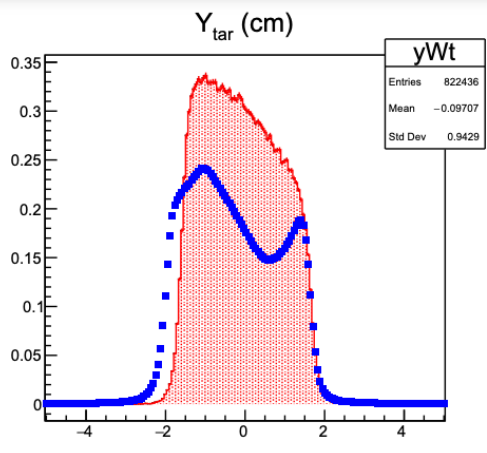
But not perfect.
Note:
-y_{tar} distribution, and
-dp/p distribution.

Cell wall contribution
-not in the simulation
-but here in the data (about
5% for this kinematic)

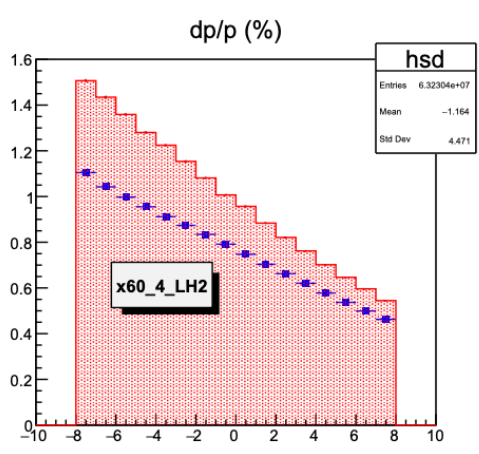
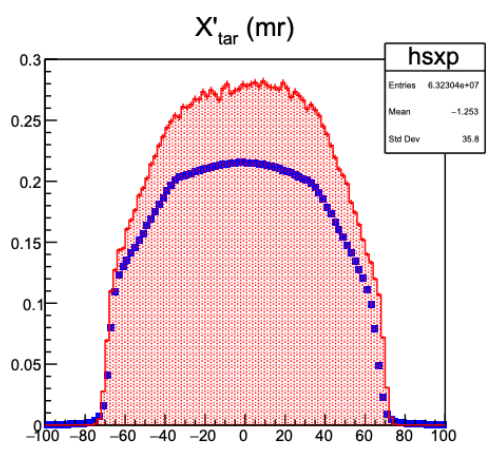
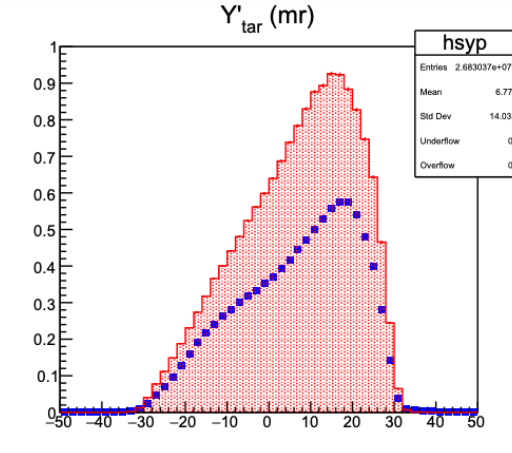
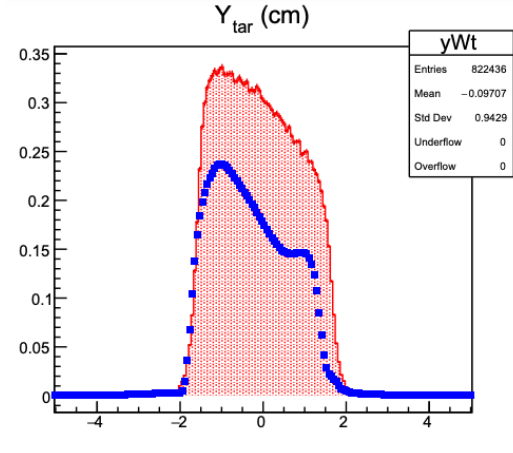


Loop 2, 58 Hz

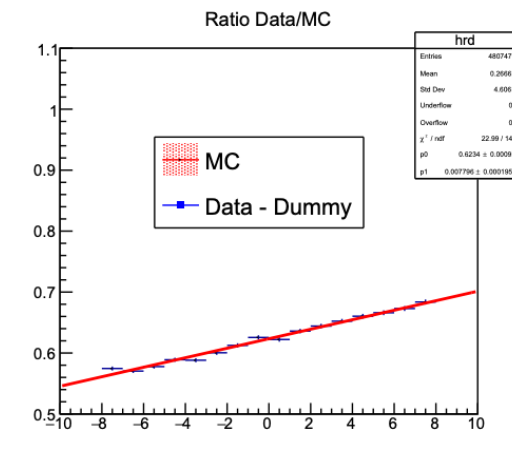
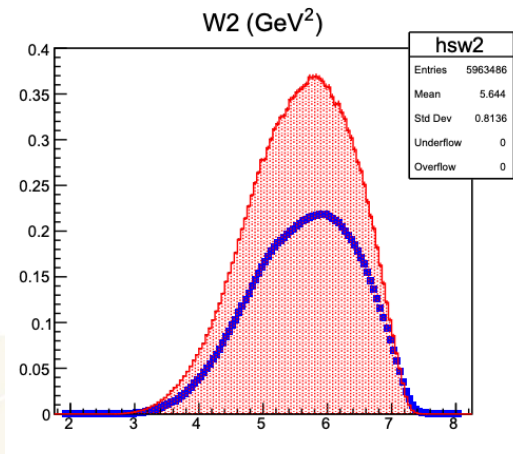
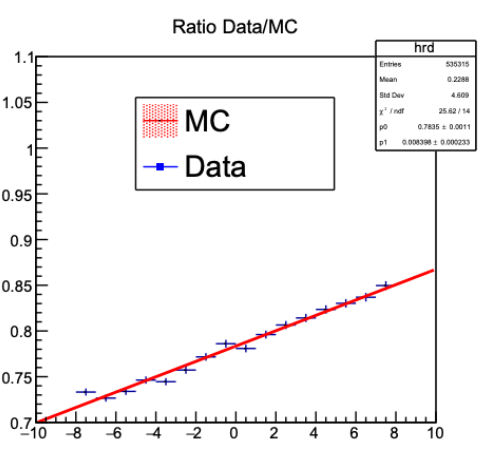
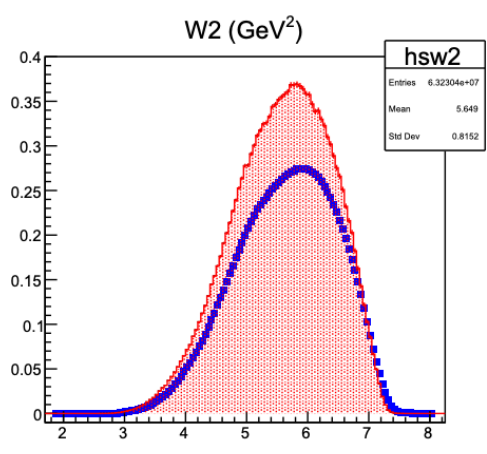
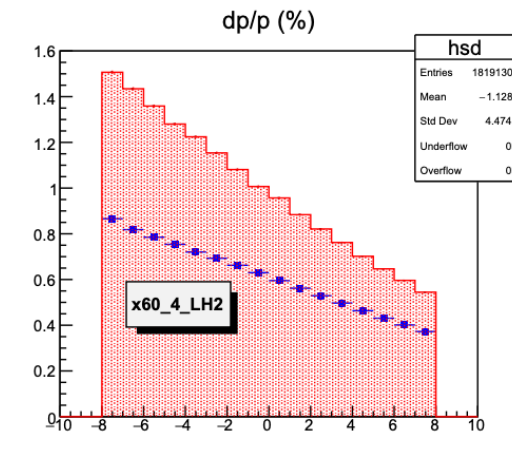
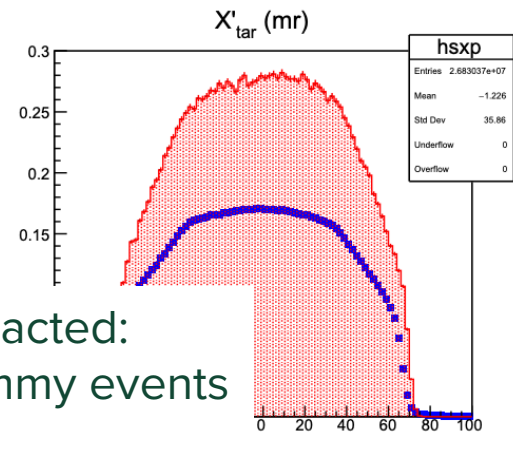
no target cell wall subtraction



No cell wall subtraction
(same as previous slide)



Cell wall subtracted:
Rescaling dummy events
for charge.



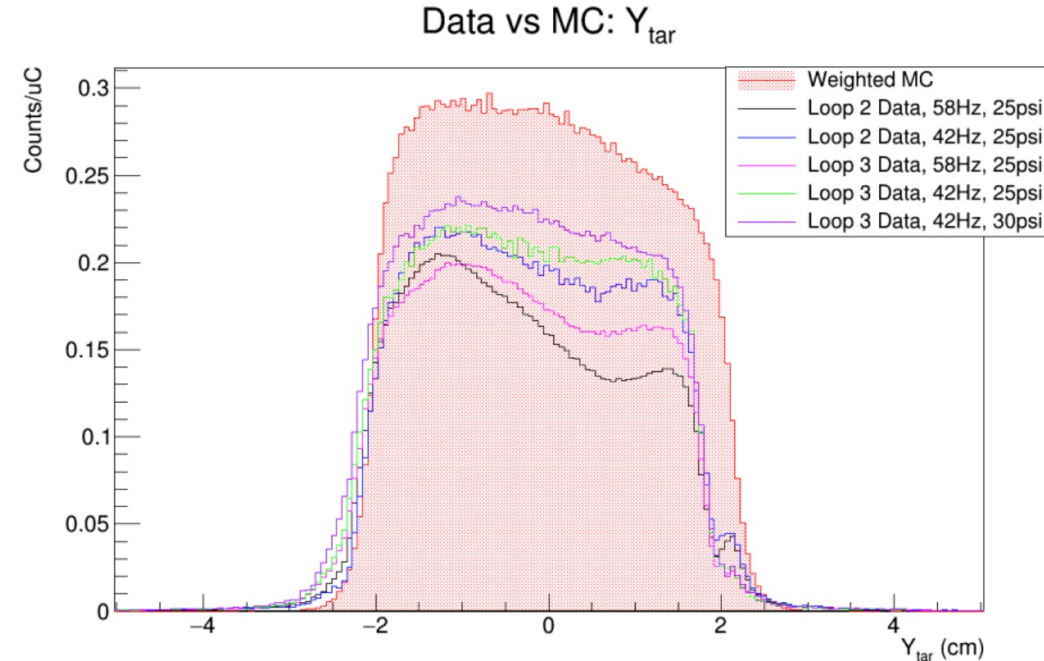
Multiple kinematics, multiple loops and fan frequencies

Here's a ytar plot with all of the different target settings for LH2 on x36_4 superimposed on the MC simulation.

<https://logbooks.jlab.org/entry/4297882>

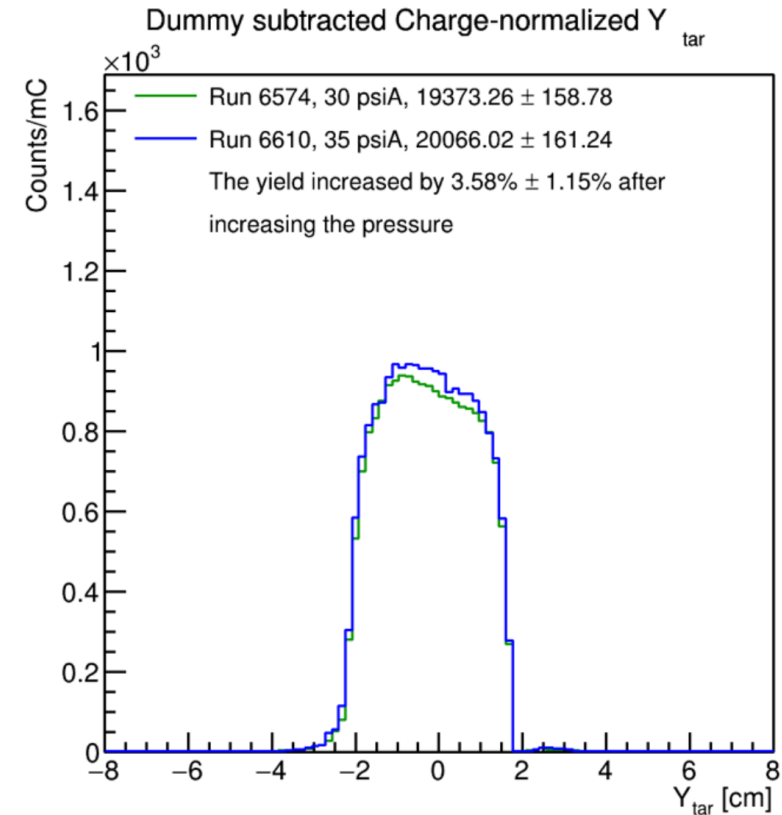
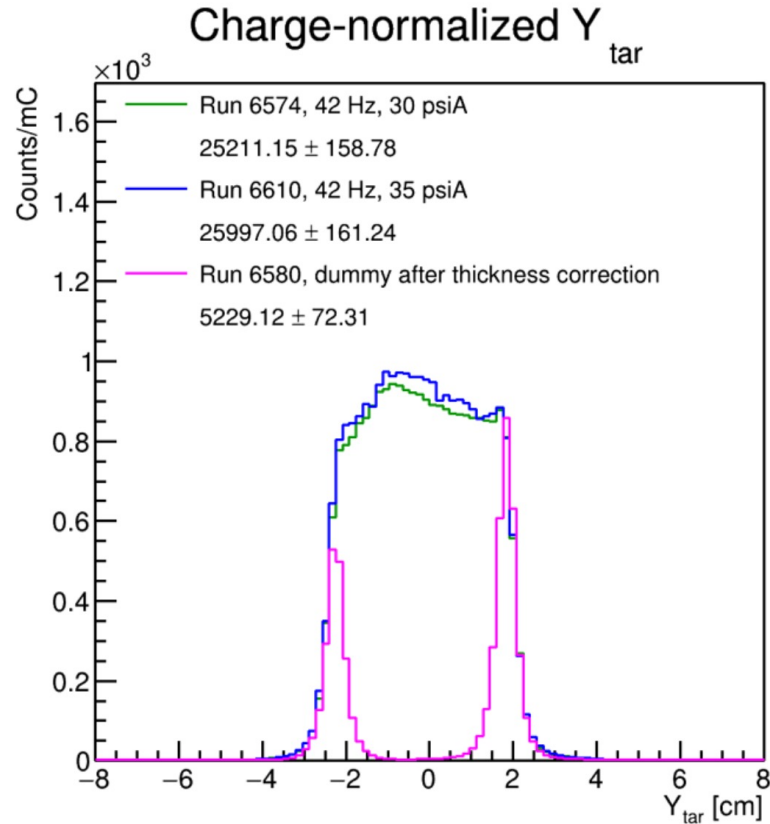
LH2									
Kinematic	E_{beam} GeV	E_{HMS} GeV	θ_{HMS} Degrees	Dummy subtracted?	Dates	Target Cell	Fan Speed	Pressure	Data yield/Predicted
KinC_x60_2	8.483	3.803	22.93	No	12/6/23-12/15/23	Loop 2	55Hz	25psi	77.41%
KinC_x60_4	10.558	5.052	19.31	No	2/8/24-2/22/24	Loop 2	58Hz	25psi	78.4%
KinC_x60_4	10.558	5.052	19.31	Yes	2/8/24-2/22/24	Loop 2	58Hz	25psi	62.3%
KinC_x36_4	8.483	2.562	24.77	Yes	4/30/24	Loop 2	58Hz	25psi	60.0%
					4/30/24	Loop 2	42Hz	25psi	70.1%
					5/2/24	Loop 3	58Hz	25psi	64.0%
					5/2/24	Loop 3	42Hz	25psi	73.6%
					5/4/24	Loop 3	42Hz	30psi	79.6%

LD2									
Kinematic	E_{beam} GeV	E_{HMS} GeV	θ_{HMS} Degrees	Dummy subtracted?	Dates	Target Cell	Fan Speed	Pressure	Data yield/Predicted MC yield
KinC_x60_2	8.483	3.803	22.93	No	12/6/23-12/15/23	Loop 1	50Hz	25psi	103.4%
KinC_x60_4	10.558	5.052	19.31	Yes	2/8/24-2/22/24	Loop 1	50Hz	25psi	96.9%
KinC_x36_4	8.483	2.562	24.77	Yes	5/2/24	Loop 1	50Hz	25psi	96.8%



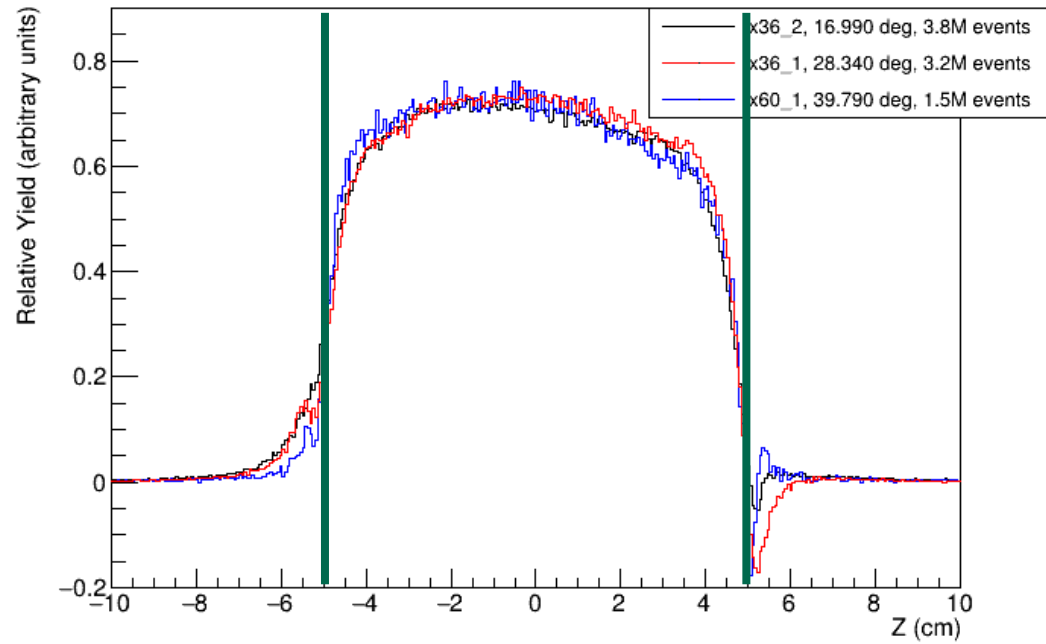
AI subtraction off the cryotargets

<https://logbooks.jlab.org/entry/4298054> (H. Huang)

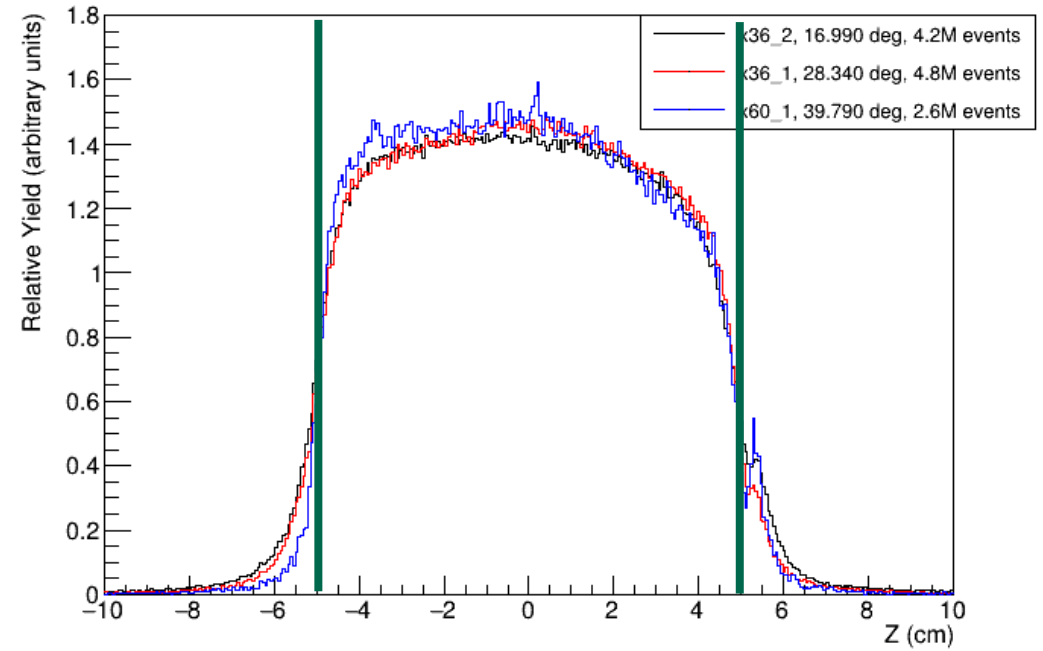


- The alignment of dummy and cryo-target is not great (see over subtraction downstream)
- Should we consider other scaling than charge to subtract the dummy?

Z React LH2



Z React LD2



Next steps

Mark M. will continue working on this.

He aims to produce great density maps of the LH2 and LD2 targets versus time (kinematic).

Currently, Mark is:

- creating vertex kinematic files for all 17 settings (including radiative effect)
- studying the LH2, LD2, and dummy target alignments

NB: Improvements to yield determination are also being made (but not just by Mark).

Comments, suggestions??

Volunteer to work with Mark?