d_2^n H2 Coin

Rough H2 Cross-Section

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Outline

Experimental Absolute Cross-Section

$$\sigma_0^{raw} = \frac{d\sigma^{raw}}{d\Omega dE'} = \frac{ps_5 N}{N_{in}\rho LT} \frac{1}{\Delta\Omega\Delta E'\Delta Z}$$

- N is the total number of scattered protons detected in the LHRS with the chosen cuts
- ps_5 is the prescale factor for events of type $T5$
- $N_{in} = \frac{Q}{e}$ is the incident electrons determined by the charge
- ρ is the target density
- LT is the livetime correction, in this case $T5$
- $\Delta\Omega\Delta E'\Delta Z$, are the angular acceptance, momentum acceptance and the target length seen by the detector.

Acceptance Cuts

LHRS Acceptance Cuts

The following cuts were made on the LHRS acceptance (see next slide for plots)

- $abs(L.tr.tg\_y) < 0.04$
- $abs(L.tr.tg\_ph) < 0.02)$
- $(L.tr.tg\_th > -0.05)\&\&(L.tr.tg\_th < 0.02)$

Note that there is some odd structure in the tracking theta...currently looking into.

Acceptance Cuts

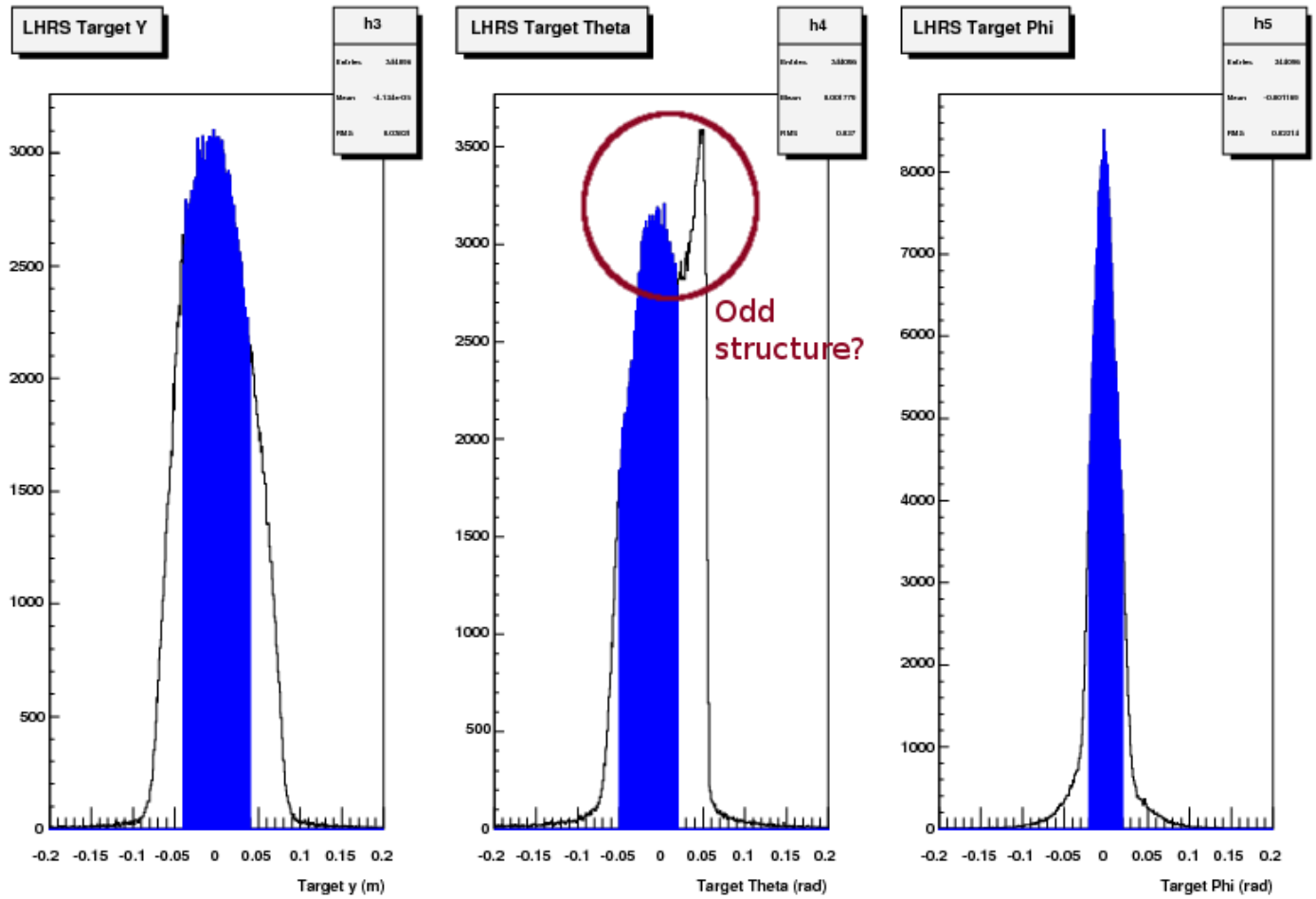

Figure: LHRS acceptance cuts for H2 runs. Target y(Left), target theta(middle) and target phi(right)

Acceptance Cuts

LHRS Momentum/Energy Cuts

The following cuts were made on the LHRS momentum and energy (see next slide for plots)

- $abs(L.tr.tg\_dp) < 0.035$
- $(ExTgtCor_L.p < 0.9)\&\&(ExTgtCor_L.p > 0.83)$
- $(L.prl2.asum\_c + L.prl1.asum\_c) < 400\&\&(L.prl2.asum\_c + L.prl1.asum\_c) > 15$

Acceptance Cuts

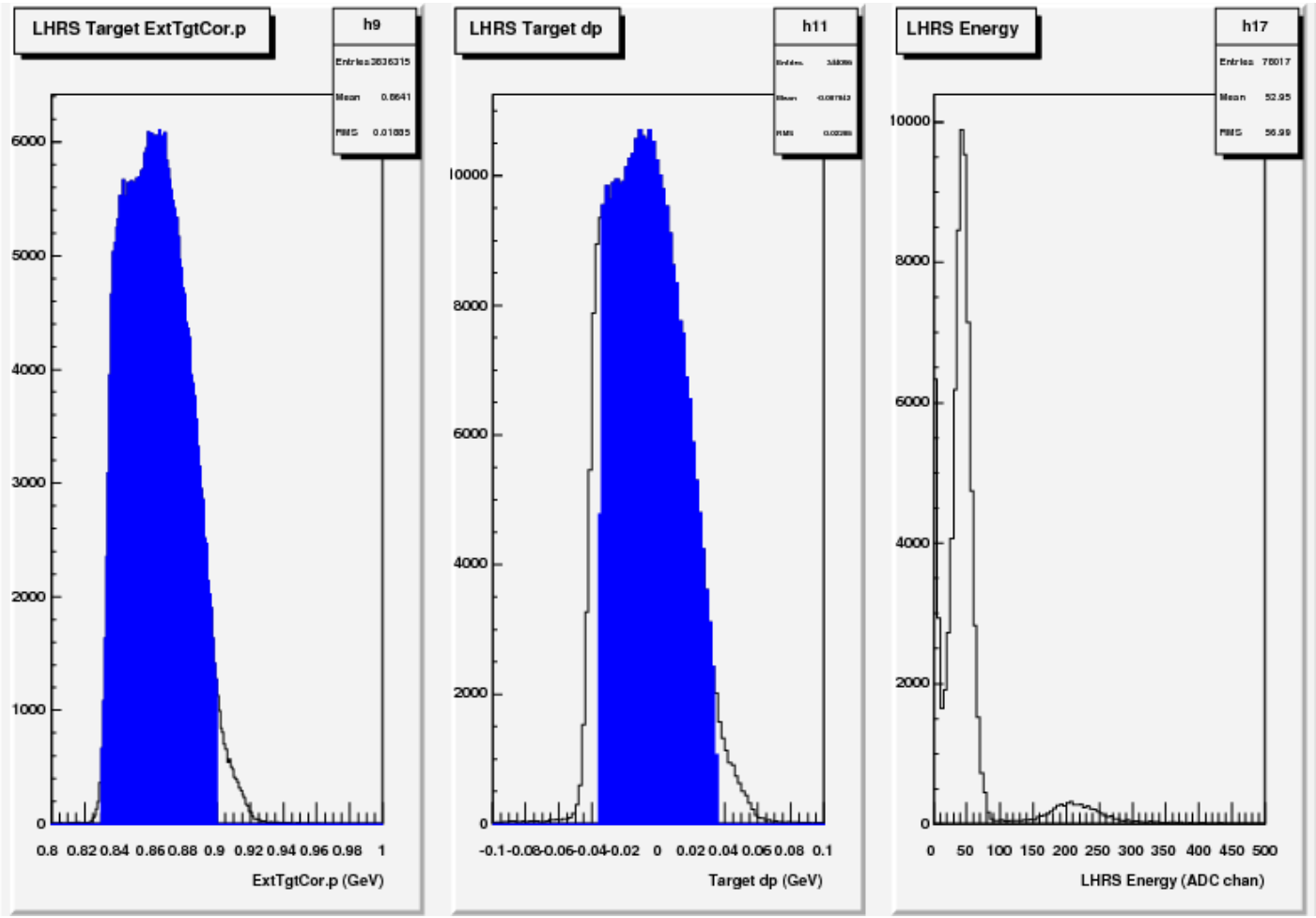

Figure: LHRS momentum/energy cuts for H2 runs. Extended target momentum(Left), target $\delta p/p$(middle) and pion rejectors energy(right)

LHRS Cuts

Other LHRS Cuts

The following cuts were also made on the LHRS
Coin Trigger cut:

- $(DL.evtypebits\&1 << 5) == (1 << 5)\&\&(DL.edtpl == 0)$

one reconstructed track in LHRS:

- $(L.tr.n == 1)$

require VDC cluster hit:

- $(L.vdc.u1.nclust == 1)\&\&(L.vdc.v1.nclust == 1)$
- $(L.vdc.u2.nclust == 1)\&\&(L.vdc.v2.nclust == 1)$

Čerenkov cut:

- $(L.cer.asum\_c == 0)$

beam trip cut,Avg. Current $14.75\mu A$:

- $abs(((evbbite\_u3r - 453.393)/6480.30) - 14.75) < 1.0$

N Protons

Protons in LHRS

The following Shows the number of protons in the LHRS with just a coin trigger cut and then those that satisfy all the previous LHRS cuts.
There are 11,153 "good" protons in the LHRS.

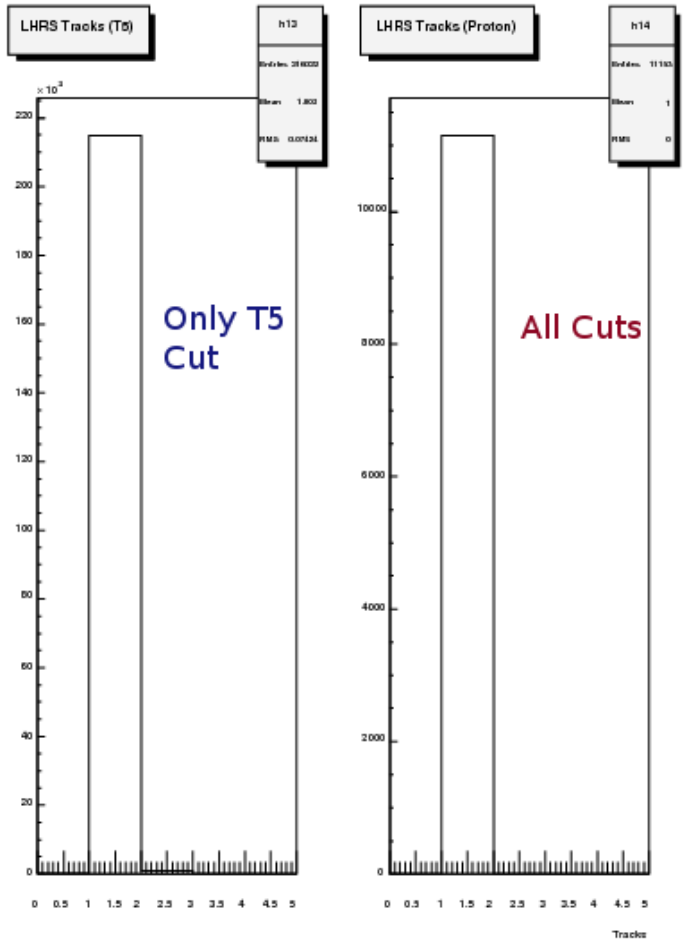

Figure: Events in LHRS that pass T5 coin cut(Left). Events that pass all cuts(right)

Charge Calculation

Charge was computed by using the BCM scalers and Diana's calibrated BCM coefficients.

$$charge[Coulombs] = \left(u3c - off_{u3} \times \frac{clock \times 1000}{103.7} \right) \frac{10^6}{calib_{u3}}$$

- $u3c$ is the scaler u3 counts (count difference of last and first events)
- $clock$ is the scaler 103.7KHz clock (gives run time, difference of last and first events)
- $off_{u3} = 453.393$ and $calib_{u3} = 6480.30$ calibrations to BCM from Diana.

Live Time Calculation

Live time was computed by using the BCM scalers and trigger cuts. Very similar to charge calculation.

$$LT_{T5} = \frac{event_{T5}}{T5c}$$

- $event_{T5}$ are number of T5 type events (events that pass T5 trigger cut)
- $T5c$ are scaler counts of T5 type events (difference of last and first events)

Charge/Live Time Results

Table row Total/Avg. shows total charge and average live time.

Run #	PreScale	Charge (C)	Live Time
1258	1	0.01434	0.802972
1260	1	0.01418	0.761411
1261	1	0.01412	0.767407
1262	1	0.01425	0.781923
Total/Avg.	1	0.05689	0.77842825

LHRS Acceptance Parameters

- In order to obtain the actual acceptance parameters $d\Omega$,dE' and dZ Monte-Carlo simulations need to be done
- However since we are looking for only a rough estimate of the H2 σ_0 I will take the parameters listed on the Hall A LHRS page `http://hallaweb.jlab.org/equipment/high_resol.html`

LHRS Acceptance Parameters Values

- Solid Angle: $d\Omega$ = 6msr
- Momentum Acceptance: $dE' = 4.5\%$, $p_0 = 0.870GeV$
  - Momentum Acceptance Value : $0.045 \times 0.87 = 0.039GeV$
- Target cell length Z: $40cm$ (need to double check with Lamiaa)
- Effective cell length at $45°$: $dZ = 28.28cm$

Target Density

- Waiting to hear from Lamiaa about the GMA reference cell

BigBite Track Comparison

While waiting for the target info to compute the H2 cross-section, it is still worth while to check out how the LHRS compares to the BigBite:

- Select ”good” proton events in the LHRS
- Since the BigBite and LHRS are in coin mode, ideally for every ”good” proton track in the LHRS, there should be a ”good” electron track in BigBite
  - This is done by plotting all BigBite tracks that satisfy ”good” proton cut
  - Then plot all BigBite one track events with ”good” proton cut
  - If ideal LHRS ”good” proton tracks will match BigBite one track events with proton cut

LHRS/BB Events

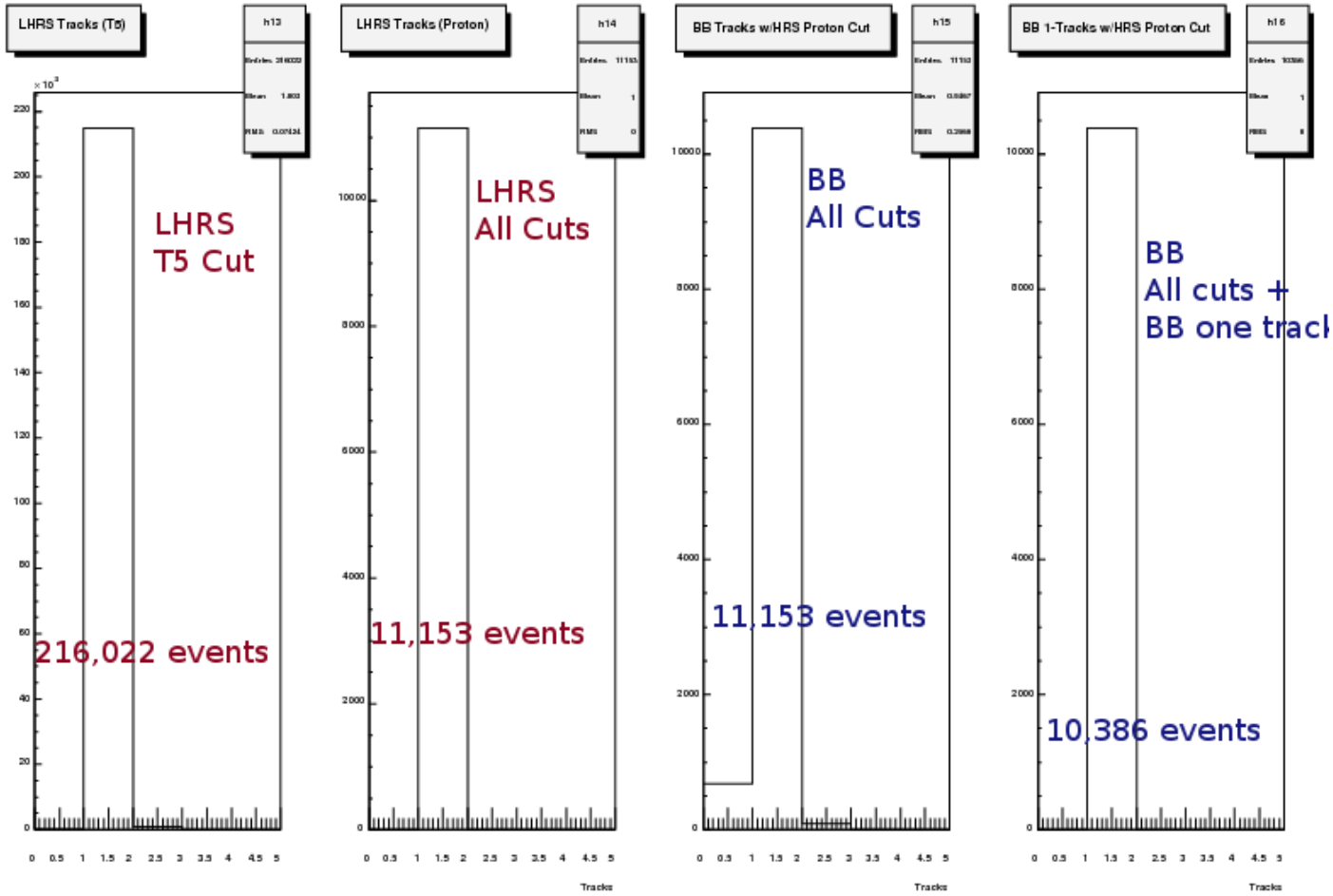

Figure: LHRS tracks T5 only (left), LHRS tracks proton cut (mid-left),BB tracks proton cut (mid-right), BB one tracks +proton cut (right)

BigBite Track Comparison Results

- We see that 93% of the LHRS "good" proton tracks are reproduced in the BB with one track + proton cut
- The open nature (large solid angle) of the BigBite detector could be a reason for the difference in tracks
  - BigBite is exposed to more background
  - is open to a wide electron momentum range
  - Tracking efficiency of the BigBite could be less than the LHRS

Summary

- Odd structure to the $L.tr.tg\_th$ variable
- nearly have all information to compute the H2 cross-section
- Comparison of the LHRS tracks to those in the BB look encouraging
- 93% of tracks left in LHRS show up in BB

What's Next?

- Get target density for GMA ref. cell
- Compute H2 cross section and compare to world data
- Understand the theta distribution structure in the LHRS