Gen01 $Q^2 = 1.0$: Commissioning

October 25, 2008

PRE-BEAM

HMS Detector Checkout (JLab/Hampton)

1. Take a long cosmics run with all detectors on.
   - Look for dead & hot wires in the wire chambers.
   - Check HMS dead/hot wires against an earlier plot to look for any possible inconsistencies in wiring.
   - Look at ADC distributions for the hodoscopes. Are they all firing?
2. Turn on HV in wire chambers one sector at a time, take short cosmic run and make sure the correct wires got HV.
3. HMS Cerenkov
   - Gain match the top and bottom PMT's by taking cosmic runs at different HV settings; top PMT should be fine while bottom PMT may need its current HV setting to be increased.
   - Check that C4F10 gas is at same level as the end of t20, i.e. temp of 24 and pressure of 11.

Perform TE measurement (McKee)

Defer to target experts.

Gain Match ndet (Warren)

Defer to Glen Warren.

STRAIGHT-THRUS

Superharp Scan (Danagoulian)

HMS			target	slow raster	fast raster	I_0
collimator	θ_e	P_0		diameter	radius	
n/a	n/a	n/a	C	varies	0.5 mm???	200 nA

1. Scan the superharps 3H00A and 3H00 with raster off. Get two pictures for two wires. Compare with the SEM picture.
2. Turn the raster on, put the size of 5 mm, 10 mm, 20 mm Repeat the scan. Compare with the SEM picture.
3. Scan the superharps 3C07 A&B, 3C12A&B, 3C17A&B
4. Verify that the beam size is as expected ($\sigma_x \approx 80\mu m, \sigma_y \approx 150\mu m$).

Initial Checkout (JLab/Hampton)

HMS			target	slow raster	fast raster	I_0
collimator	θ_e	P_0		diameter	radius	
large (pion)	17.9^o	2.810 GeV/c	C	2 cm	0.5 mm	200 nA

1. Take a small run and verify that most detector channels are working.

SEM Calibration (Zeier)

HMS			target	slow raster	fast raster	I_0
collimator	θ_e	P_0		diameter	radius	
large (pion)	17.9^o	2.810 GeV/c	C	2 cm	0.5 mm	100 nA

1. Check analog signals, adjust amplification.
2. Verify synchronization with raster
3. Check gate timing/width
4. Event mode (300 nA, fast raster off, slow raster on)
   - Take runs in event mode (adjust gate width if ADC overflows)

- Calibrate raster current vs sem position → gain

5. Static mode (was not tested in beam before)

   - Compare display information with scaler values
   - Test functionality by moving beam and changing raster diameters
   - Measure average beam position, compare to BPMs

Reestablish Standard HMS Tune (JLab/Hampton)

HMS			target	slow raster	fast raster	I_0
collimator	θ_e	P_0		diameter	radius	
sieve	17.9°	2.810 GeV/c	C	0	0.5 mm	200 nA

1. Measure a short carbon spectrum (≈ 20,000 triggers).
2. Produce an ntuple, and do the following: make a spectrum of x vs y at the nominal focal plane. What you should see is a “spider” with 5 legs. The non-straightness of the central leg indicates there is an offset in the Z or Y direction. If you don’t see a “spider” or something resembling it one of the polarities of the HMS magnets is set wrong (or the magnet is off). If you see a “spider” next thing to figure out is what the X, Y, and Z offsets are of your present beam-target interaction point, but at least your tune is fine, so we start some more electronics/detector checkout.

Electronics Checkout (Ent, Zeier)

HMS			target	slow raster	fast raster	I_0
collimator	θ_e	P_0		diameter	radius	
large (pion)	17.9°	2.810 GeV/c	C	2 cm	0.5 mm	200 nA

1. Rate should be approximately 400 Hz.
2. At the same kinematics, check that all electronics signals are well timed.
3. Determine correct thresholds.
4. Verify that all detector channels are counting.
5. Verify all scalers are incrementing.
6. Check for double pulsing and time the wire chamber signals.
7. Determine the scintillator plane efficiency for detecting electrons with the correct discriminator threshold, and make sure that the scintillator signals for detecting hadrons are on scale in the scintillator ADCs.

HMS Detector Checkout (Hampton)

HMS			target	slow raster	fast raster	I_0
collimator	θ_e	P_0		diameter	radius	
large (pion)	17.9^o	2.810 GeV/c	C	2 cm	0.5 mm	200 nA

1. Rates should be approximately 400 Hz.
   - Wire Chambers
     - Fit for new time-to-distance map
     - Look at drift time spectra, is shape reasonable? in the right time range? (something like -25 ns to 150 ns, with half-height of the leading edge near 0)
     - Look at focal plane distributions, they'll be screwed up if any cabling got screwed up
     - Check fiducial tracking efficiency, is it around 95%? Optimize tracking properties.
     - Align the wire chamber positions in software and enable linked stub fitting, check the detector positions, check the timing and calibration constants (shower counter gains, pedestals, timing offsets, pulse height corrections, attenuation lengths, efficiencies, position dependencies).
     - Make sure that θ and ϕ spectra are wide as expected. Construct x,y,θ, and ϕ spectra at the nominal focal plane. Does everything look reasonable?
     - Check tracking with one wire chamber against tracking with two wire chamber sets. Reconstruct target quantities.
   - HMS Hodoscopes
     - Look at all hodo histograms, compare against standard histograms in HMS/SOS notebook
     - any channels firing very hot (possible light leak)?
   - HMS Cerenkov
     - Look at histos (Npe vs x; and Npe vs Shwr), compare with standard histos in HMS notebook, ideally there should be no x dependence.
   - HMS Shower Counter
     - Check histos to be sure all ADC and TDC channels are firing.

2. HMS Shower Counter
   - ^{12}C "white" spectra run using pion trigger for re-calibration of all the blocks; run fit program and install new coefficients
   - LH2 or LD2 run using electron and pion trigger, check normalized shower distributions and peak positions for e- and pi, are they clearly separated? is the e- peak centered at 1.0? does a cut requiring no Ckv eliminate e-'s from the spectra? how well?

Coincidence Timing Checkout (Zeier)

HMS			target	slow raster	fast raster	I_0
collimator	θ_e	P_0		diameter	radius	
large (pion)	17.9º	2.810 GeV/c	C	2 cm	0.5 mm	$<$ 200 nA

1. The rates are about 400 Hz for the 6.8 mm C target at 200 nA.
2. Verify calculated time difference between electron and hadron
3. Check the HMS electron signals and neutron detector charge particle signals at the electronics level.
4. Use the HMS and Raster information to pinpoint the momentum transfer
5. Check analog/logic signals (The amps have a tendency to produce additional spikes when the input signals are to big. This creates multiple pulsing for the logic signals)
6. HMS trigger
   - Check retiming coincidence
   - Adjusting gates vs analog signals
   - Adjusting TDC starts and stops
7. e*B trigger
   - Look at B signals
   - Adjust delays of B signals vs HMS (check coinc rate vs delay time)
   - Adjust time at input to 8LM
8. Check scaler channels used for normalization
9. Verify that you see the charged particles where you expect to see them.
10. Check that all the timing corrections in HMS (path length corrections, Pulse Height Corrections, etc) and in the neutron detector (flight path variations) are taken into account properly, by plotting the coincidence timing versus various HMS focal plane positions, and neutron detector veto scintillators.

    Note that if you changed some of the electronics timing before this stage you may want to start this process by taking a large HMS electron sample and optimizing the timing parameters.

Beam Energy Measurement [1 hr] (MCC)

1. Use the Arc as a Dichromat to obtain the beam energy (MCC can do this for you, give them a warning a few hours before you want this done).

Setup HV for ndet paddles (Warren)

HMS			target	slow raster	fast raster	I_0
collimator	θ_e	P_0		diameter	radius	
large (pion)	17.9^o	2.810 GeV/c	ND_3	2 cm	0.5 mm	< 200 nA

1. Take data for 20 minutes. Examine the TDC vs. ADC histogram for each paddle. Is there a clear separation of the proton peak from the discriminator threshold? Look at the histogram for different positions within the paddles by cutting on the time differences.
2. Adjust paddle HV until there the proton peak is clearly above threshold.
3. Take 1 hour of data. Look for evidence of protons in the neutron spectra to confirm HV settings.

Neutron Detector Checkout (Warren)

HMS			target	slow raster	fast raster	I_0
collimator	θ_e	P_0		diameter	radius	
large (pion)	17.9^o	2.810 GeV/c	ND_3	2 cm	0.5 mm	< 200 nA

1. Take ample D(e,e′p) and D(e,e′n) data to calibrate the neutron detector paddles.
2. Check the timing of all neutron blocks with respect to each other.
3. Check the light output response of all blocks.
4. Confirm ndet gain calibration
   - Run for 1 hour on the carbon target with 2 cm diameter slow raster and 500 nA of beam. Record coincidences via the open trigger.
   - Analyze the data generating the ndet ntuple. From the ntuple, generate ADC histograms for the charged and uncharged particles.
   - Confirm that neutron ADCs for the bars look similar. Confirm that energy deposited agrees roughly with energy loss calculations in gen/Documents/gen01_eloss.dat.

TARGET FIELD ON

Check vertical position of target with beam (McKee)

HMS			target	slow raster	fast raster	I_0
collimator	θ_e	P_0		diameter	radius	
large (pion)	17.9°	2.810 GeV/c	C	2 cm	0.5 mm	200 nA

1. Inform MCC that the target will be moved slightly
2. Monitor rates as adjust vertical positions of the target stick.
3. Find location of minimum rates.

Determine optimal slow raster size (McKee)

HMS			target	slow raster	fast raster	I_0
collimator	θ_e	P_0		diameter	radius	
large (pion)	17.9°	2.810 GeV/c	C	varies	0.5 mm	200 nA

1. Inform MCC that they will be adjusting the raster size several times.
2. Have MCC adjust slow raster diameter, starting at 0.7 cm and going to 1.3 cm in 0.1 cm steps. MCC wants to know the *diameter* of the slow raster.
3. For each raster setting, record run and monitor rates.
4. Find raster size at which rates begin to increase.

Study rate dependent gains in ndet (Warren)

HMS			target	slow raster	fast raster	I_0
collimator	θ_e	P_0		diameter	radius	
large (pion)	17.9°	2.810 GeV/c	NH_3	2 cm	0.5 mm	varies

1. Take a 1 hour run at 50 nA.
2. Increase current to 100 nA and take a 30 minute run at 100 nA.
3. Compare the proton peaks in the ADCs for the bars and paddles between the two runs. Do the peaks shift?

Study Current Asymmetries and leakage (Yun,Warren)

HMS			target	slow raster	fast raster	I_0
collimator	θ_e	P_0		diameter	radius	
large (pion)	17.9°	2.810 GeV/c	NH_3	2 cm	0.5 mm	100 nA

1. Study various charge asymmetries values
2. Calibrate current asymmetry feedback slope
3. Study leakage from other Halls.
   - Take a 20 minute run at 100 nA on the ND3 target. Record the beam current according to BCM1.
   - Ask MCC to turn off the Hall C laser.
   - Take another 20 minute run at 100 nA on the ND3 target. Record the beam current according to BCM1.
   - Leakage from other halls should be $<$ 3% of the Hall C current. If not, contact the Run Coordinator because this issue needs to be investigated.

Setup HV for ndet paddles (Warren)

HMS			target	slow raster	fast raster	I_0
collimator	θ_e	P_0		diameter	radius	
large (pion)	17.9°	2.810 GeV/c	ND_3	2 cm	0.5 mm	< 200 nA

1. Take data for 20 minutes. Examine the TDC vs. ADC histogram for each paddle. Is there a clear separation of the proton peak from the discriminator threshold? Look at the histogram for different positions within the paddles by cutting on the time differences.

2. Adjust paddle HV until there the proton peak is clearly above threshold.

3. Take 1 hour of data. Look for evidence of protons in the neutron spectra to confirm HV settings.

BCM Calibration (Mack)

Defer to Dave Mack.

Spin Dance or Møller Runs (Fenker)

Defer to Howard Fenker or Marko Zeier.