E97-111 Run Plan

October 23, 2000

1 Preliminaries

- both spectrometers should be surveyed. They should be surveyed at the location where the first optics runs will be taken. **Nilanga** should provide these numbers. **Done!**
- target must be surveyed. **Done!**
- beamline must be surveyed (where are the HARPs) **Done!**
- "bullseye scan" : **Zhengwei** is supposed to be writing documentation on how to do this. Mark Jones is coordinating.

2 Optics Commissioning of HRS pair at 824 MeV

From Nilanga Liyanage

A ^{12}C(e,e) elastic delta scan with the new 9-foil ^{12}C optics target can be used to determine the detector offsets and to check optics of the HRS pair.

2.1 Requirements

- Both spectrometers in **negative** polarity.
- Both spectrometers positioned at 16^o.
- Survey of spectrometers at this setting.
- Beam energy measurement.
- $\sim 5\mu$A of beam with **NO-RASTER**
- Fast-feed-back system on.
- A BPM-Harp calibration.
- Beam centered within 0.2 mm of origin. (**in the absolute coordinate system as determined by the Harp calibration**)

setting	momentum
+4%	855 MeV
+2%	838 MeV
0%	821 MeV
-2%	805 MeV
-4%	789 MeV
-7%	764 MeV

Table 1: Settings for $^{12}\mathrm{C}(e,e)$ runs. The momenta were calculated assuming $E_{\mathrm{beam}} = 824$ MeV.

2.2 Procedure

- At every setting adjust beam current so that the dead-time is not more than $\sim$ 30% with PS-factors for T1 and T3 set to 1.
- Set the spectrometers at the +4% momentum setting.
- take 5 minutes of data with 6msr collimators.
- take 5 minutes of data with no collimators.
- take 10 minutes of data with sieve slits.
- repeat the last three steps for the other five momentum settings

before leaving 16 deg setting, make deadtime measurement (electronic deadtime):

- use ps factors to keep DAQ deadtime below 10%.
- take 5 minute runs
- use either 6 msr collimators or open collimators
- use ^{12}C target
- take runs with currents 5, 10, 20, 40, 50 μA (not higher than 50).

Important

- Cycle Q2 and Q3 magnets on both spectrometers when the spectrometer fields are increased. HRSL: bring Q2, Q3 to 1600 A before going to the desired momentum, HRSR: Q2, Q3 to 1400 A
- When changing spectrometer magnet settings: wait till all the read-back fields are green on the MEDM screen. Then wait for another 5 minutes before start taking data.

3 Target Commissioning

For an absolute normalization, we will run at the position of the second maximum of the ^{4}He elastic form factor. The reason is that we cannot run at the surveyed position (16 deg) due to excessive rate. If we do not run at the surveyed position, our angle knowledge is decreased, and the elastic cross section is steeply angle dependent (as much as 10% per mrad). Running on the second maximum reduces this problem.

Second max rate at 824 MeV should be approx 0.4 Hz/μA (this number is not acceptance averaged). The associated scattering angle at 824 MeV is 53.8 deg. This rate is too low for the boiling tests, so these will be done at some smaller angle.

Waiting for input from target guru. Also Bob M will provide a lead target commissioning plan.

1. no raster harp scan; put σ in logbook. if σ less than 100 μm then get MCC to increase size.
2. put raster on: get 4x4 (square with side 4) on spot++
3. for runs below, want max coda rate 1.5 kHz; adjust ps factors accordingly.
4. change spectrometer angles: L arm at 30 deg, R arm of 40 deg
5. change spectrometer momenta: $p_0 = 800.78$ MeV$/c$ for L arm, $p_0 = 683.91$ MeV$/c$ for R arm (ep free scattering => quasielastic)
6. for all runs below, want to replay using ESPACE and verify 100k counts in elastic (or quasielastic) peak. Expect count rate of 1 kHz/μA for helium elastics at this setting. We don't really know what to expect for the quasielastic.
7. before runs below, **slowly** open JT valve to 97% (slowly means take about 30 min to do it). as we increase the beam current below, we need to watch the heater of the target system. we don't really know where we will have to stop increasing beam current, expect somewhere around 60 μA to be max. LOOP1 fan 60 Hz.
8. take following runs on ^{4}He target: currents of 1, 2, 5, 10, 25, 50, ? μA.
9. take following runs in same configuration for ^{12}C at currents of 1, 2, 5, 10, 25 μA.
10. change L arm angle to 53.8 deg, $p_0 = 756.04$ MeV$/c$. Expected rate 0.4 Hz/μA. Measure elastic scattering, 20k counts on disk . Leave R arm set up as for previous measurements, set prescale factors so that it counts as least as fast as L arm.
11. at this point, target program is completed. If it is before 1 PM Sunday afternoon, see JT who has an provisionary ^{4}He$(e, e'p)$ program at 824 MeV.

12. lead target commissioning program begins at 1 PM sunday (or after completion of point 10 above).

13. Futile attempt at *ep* measurement.

14. try to understand x-axis HARP vs. BPM scans.

4 Commisioning options in case of beam availability

4.1 75 deg program

Move both spectrometers to 75^o (still in negative polarity), momenta to 500 MeV. Collect data with 6 msr collimator and No collimator (sieve not required) using the multi-foil^{12}C optics target. Adjust beam current so that the dead-time is not more than $\sim$ 30% with PS-factors for T1 and T3 set to 1. Raster can be turned on if necessary. Need about 250 k events per spectrometer.

Any questions: Please call or page Nilanga any time (office 7254, page 849-7254)

5 Production Running

Assumptions: 0.1377 g/cm^3 ^{4}He target, 70 μA beam current, 70% efficiency rating. These are what were used to generate the time estimates. Also quoted is a Coulomb figure for absolute purposes.

5.1 PY-I running, 2384 MeV

Left Spectrometer (SL) will be detecting electrons, Right Spectrometer (SR) will be detecting protons.

Prescale factorization:

for settings A,B: set both SL and SR prescale factors so that we get 100 Hz of singles in each arm. Once we are reasonably sure we know the fraction of singles triggers which are good triggers, we can set prescales so we accept 50 Hz of *really* good triggers, *e.g.* we assume that half of each singles trigger population is junk.

for settings C,D,E,F: here the runs will be very long so it is reasonable to set the prescale factors so that we accept 20 Hz of singles.

Stuff to remember during production data

- Keep computer deadtime in all runs below 22.5%.
- Keep an eye on electronics deadtime (see Bob's "hana" program to find this value), keep it also below 20%.

- For loading the trigger, type "trigsetup" on an adaq account, and follow directions. Make sure to check it. If it is set up wrong, we will acquire garbage data.
- **Don't forget** for each new setting of spectrometer momentum or angles, put a snap of the MEDM overview screen (Hall A magnets and Angles) in the halog!!!
- For ^{12}C pointing runs, raster should be **off**.
- For link measurements and ^{12}C measurements, should be taking about 800 Hz of singles in each arm, around 100 Hz of T2 and T4, and prescale T5 out of the way (<50 Hz).
- keep one "running shift summary" halog entry for each shift, preferably in the same screen as the time accounting shift summary window
- check the scalers, the hana plots, and the dhist plots, as listed on the run sheets. This is very important to make sure the data are really coming in correctly!

Ident	θ_L deg	p_L MeV/c	θ_R deg	p_R MeV/c	est. duration hours	desired # of Coul
PY-1D (330)	16.88	1765	36.40	1193.5	3.4	0.6
^{12}C pointing	16.88	1765	36.40	1193.5	0.2	rast off
dummy cell run	16.88	1765	36.40	1193.5	0.2	rast on
analyze dummy cell run here before going on, check if we need more						
Link/Elastics (^{4}He)	17.76	2359.74	36.40	1193.5	0.5	
Link/Elastics (^{4}He)	17.76	2359.74	44.98	1014.8	0.5	
dummy elastics	17.76	2359.74	44.98	1014.8	0.5	
don't forget to download and check new coinc trigger						
PY-1C (230)	16.88	1911	44.98	1014.8	1.4	0.2
^{12}C pointing	16.88	1911	44.98	1014.8	0.2	rast off
dummy cell run	16.88	1911	44.98	1014.8	0.2	rast on
Link (^{4}He)	16.88	1911	52.44	869.9	100k gd/arm	
don't forget to download and check new coinc trigger						
PY-1B (130)	16.88	2020	52.44	869.9	0.2	
^{12}C pointing	16.88	2020	52.44	869.9	0.2	rast off
dummy cell run	16.88	2020	52.44	869.9	0.2	rast on
Link (^{4}He)	16.88	2020	58.83	743.8	100k gd/arm	
don't forget to download and check new coinc trigger						
PY-1A (29 MeV)	16.88	2105	58.83	743.8	0.5 (10^5 coincs)	15 μA·hr

At this point, we stopped and opened the Hall for the DNP tour. The table which follows is for the part of the run which begins about midnight (the border between 10/05 and 10/06).

Ident	θ_L deg	p_L MeV/c	θ_R deg	p_R MeV/c	est. duration hours	desired # of Coul
^{12}C pointing (PY-1A)	16.88	2105	58.83	743.8	0.2	rast off
dummy cell run	16.88	2105	58.83	743.8	0.2	rast on
Link (^{4}He)	16.88	2366	58.83	743.8	100k gd/arm	
Link (^{4}He)	16.88	2366	19.86	1657.1	100k gd/arm	
don't forget to download and check new coinc trigger						
PY-1F (500)	16.88	1354	19.86	1657.1	29.9	5.3
^{12}C pointing	16.88	1354	19.86	1657.1	0.2	rast off
dummy cell run	16.88	1354	19.86	1657.1	0.2	rast on
analyze dummy cell run here before going on, check if we need more						
Link (^{4}He)	16.88	1354	26.90	1430.5	100k gd/arm	
PY-1E (430)	16.88	1559	26.90	1430.5	29.9	5.3
^{12}C pointing	16.88	1559	26.90	1430.5	0.2	rast off
dummy cell run	16.88	1559	26.90	1430.5	0.2	rast on
analyze dummy cell run here before going on, check if we need more						
Link/Elastics (^{4}He)	17.76	2359.74	26.90	1430.5	0.5	
dummy elastics	17.76	2359.74	26.90	1430.5	0.5	
elastic pointing ^{12}C	17.76	2359.74	26.90	1430.5	0.5	
total time					75 hr	
switch to 3164 MeV						

5.2 PY-II running, 3164 MeV

Left Spectrometer (SL) will be detecting electrons, Right Spectrometer (SR) will be detecting protons.

Prescale factorization:

for settings A,B: set both SL and SR prescale factors so that we get 100 Hz of singles in each arm. Once we are reasonably sure we know the fraction of singles triggers which are good triggers, we can set prescales so we accept 50 Hz of *really* good triggers, *e.g.* we assume that half of each singles trigger population is junk. Also, here the deadtime will likely limit the current (see below for deadtime limitations).

for settings C,D,E,F: here the runs will be very long so it is reasonable to set the prescale factors so that we accept 20 Hz of singles. Here the deadtime will likely limit the current as well. We may choose to back off if the randoms rate becomes excessive.

This was for production data. For other points:

for link points: take 800 Hz of singles in each arm (T1,T3), take 50 Hz each of T2,T4 and set T5 prescale factor so their DAQ rate is less than 50 Hz. Take the link points at the same current as where the production data were taken, as long as the deadtime (esp. watch out for electronic deadtime) does not exceed limits.

for pointing points: the same as for link points Except here, the maximum current is 50 μA.

for (non elastic) dummy cell points: set prescale factor ps5=1, take T1,T3 rates of 100 Hz each, take T2,T4 rates of 50 Hz each. For **elastic** dummy cell, see below. Dummy cell maximum current is 30 μA, and make sure the raster is on.

for elastic points: set prescale factor so that T1 (right spectrometer) rate is 100 Hz, T2 rate is 50 Hz, T3 rate is around 1200 Hz, and T4 rate is about 50 Hz; set ps5=54321.

for (elastic) dummy cell points: the same as for elastic points, except recall that the maximum current is 30 μA.

Stuff to remember during production data

- Keep computer deadtime in all runs below 22.5%.
- Keep an eye on electronics deadtime (see Bob's "hana" program to find this value), keep it also below 20%.
- **Each new "PY" setting may require a new trigger!** For loading the trigger, type "trigsetup" on an adaq account, and follow directions. Make sure to check it. If it is set up wrong, we will acquire garbage data. Try to get the good timing peak (ESPACE variable `tc`) in the middle. It requires ESPACE replay with reconstruction cuts on the `reactz` variable on both spectrometers, in order to exclude the coincidence peak from pulser events. Make sure that if the good time peak is not in the middle, that it is to the right of the middle. But try to get it as close to the middle as you can. See the extensive halog entries from Monday 9 October on this subject.
- **Don't forget** for each new setting of spectrometer momentum or angles, put a snap of the MEDM overview screen (Hall A magnets and Angles) in the halog!!!
- For ^{12}C pointing runs, raster should be **off**.
- keep one "running shift summary" halog entry for each shift, preferably in the same screen as the time accounting shift summary window
- check the scalers, the hana plots, and the dhist plots, as listed on the run sheets. This is very important to make sure the data are really coming in correctly! If the runs are coming in very fast, it is OK to carry out these tasks every two run sheets instead of one, but do not skip them.

Ident	θ_L deg	p_L MeV/c	θ_R deg	p_R MeV/c	est. time hours	charge (Coul) comments
Harp scans, $100 < \{\sigma_x, \sigma_y\} < 200\,\mu$m; get raster spot set up 4×4 mm						
Elastic/Link	14.00	3146.7	39.58	1418.9	0.5	
^{12}C pointing	14.00	3146.7	39.58	1418.9	0.2	rast off
dummy cell	14.00	3146.7	39.58	1418.9	0.2	rast on
PY-2C	18.62	2372	39.58	1418.9	1.5	0.3, rast on
^{12}C pointing	18.62	2372	39.58	1418.9	0.2	rast off
dummy cell	18.62	2372	39.58	1418.9	0.2	rast on
Link C/B (^{4}He)	18.62	2372	45.90	1249.3	0.3	
PY-2B	18.62	2517	45.90	1249.3	1.0	
^{12}C pointing	18.62	2517	45.90	1249.3	0.2	rast off
dummy cell	18.62	2517	45.90	1249.3	0.2	rast on
Link B/A (^{4}He)	18.62	2517	51.50	1104.6	0.3	
PY-2A	18.62	2633	51.50	1104.6	1.0	
^{12}C pointing	18.62	2633	51.50	1104.6	0.2	rast off
dummy cell	18.62	2633	51.50	1104.6	0.2	rast on
Link A/F (^{4}He)	18.62	2633	19.03	2153.8	0.3	
PY-2F	18.62	1689	19.03	2153.8	29.9	5.3
^{12}C pointing	18.62	1689	19.03	2153.8	0.2	rast off
dummy cell	18.62	1689	19.03	2153.8	0.2	rast on
Link F/E (^{4}He)	18.62	1689	24.80	1899.7	0.3	
PY-2E	18.62	1931	24.80	1899.7	62	10.9
^{12}C pointing	18.62	1931	24.80	1899.7	0.2	rast off
dummy cell	18.62	1931	24.80	1899.7	0.2	rast on
Link E/D (^{4}He)	18.62	1931	32.54	1627.0	0.3	
PY-2D	18.62	2185	32.54	1627.0	3.4	0.6
^{12}C pointing	18.62	2185	32.54	1627.0	0.2	rast off
dummy cell	18.62	2185	32.54	1627.0	0.2	rast on
Elastic/Link	14.00	3146.7	32.54	1627.0	0.5	
^{12}C pointing	14.00	3146.7	32.54	1627.0	0.2	rast off
dummy cell	14.00	3146.7	32.54	1627.0	0.2	rast on
Begin with hydrogen in tuna can — *ep* scan						
ep-I	81.0	823	15.0	3142	2.3	0.4
ep-II	50.00	1435	26.13	2497	20 min	0.06
ep-III	33.00	2049	37.67	1826	10 min	
ep-IV	20.00	2629	52.37	1135	10 min	
ep-V	13.00	2912	63.52	732	10 min	
Switch to ^{4}He target, do *ep* energy measurement (4 hr)						
total time					106.8 hr	
switch to 3944 MeV						

The point *ep*-I at this energy is a bit skimpy on statistics but we can't afford to run longer. We may or may not scrap the *ep* measurement for these kinematics, it will be done if necessary to avoid an energy change during the weekend.

The *ep* measurements assume at least 20,000 coincidence counts per setting. This is only a consideration at the backwardmost point. At other points, it is reasonable to get more than this since 10 minutes are almost negligible compared to magnet settling times and time needed to move the spectrometer.

Also, question about *ep* scans: do we need ^{12}C pointing runs at each *ep* point?

5.3 CQΩ-II running, 3944 MeV

Check whether angle changes are relected in total times.

Ident	θ_L deg	p_L MeV/c	θ_R deg	p_R MeV/c	est. duration hours	desired charge Coulombs
Elastics	12.5	3925	47.51	1499.9		
dummy cell	12.5	3925	47.51	1499.9		
^{12}C pointing	12.5	3925	47.51	1499.9		
QE high-rate test	12.5	3093	47.51	1499.9		^{4}He target
low-p_m ^{4}He$(e,e'p)$	20.85	3093	47.51	1499.9	0.5	
low-p_m ^{12}C$(e,e'p)$	20.85	3093	47.51	1499.9	0.5	
dummy cell	20.85	3093	47.51	1499.9	0.2	
Link to CQΩ-2A	20.85	3427	47.51	1499.9	0.2	
CQΩ-2A	20.85	3427	59.96	1040.9	43.7	7.7
^{12}C pointing	20.85	3427	59.96	1040.9	0.2	
dummy cell	20.85	3427	59.96	1040.9	0.2	
CQΩ-2B	20.85	3427	68.31	1040.9	87.4	15.4
dummy cell	20.85	3427	68.31	1040.9	1.2 (w.a.c)	
^{12}C pointing	20.85	3427	68.31	1040.9	1.2 (w.a.c)	
^{12}C pointing	20.85	3427	72.56	1040.9	1.2 (w.a.c.)	
CQΩ-2C	20.85	3427	72.56	1040.9	87.4	15.4
ep energy measurement probably sometime during CQΩ-2C						
dummy cell	20.85	3427	72.56	1040.9	1.2 (w.a.c.)	
link 2C/3	20.85	3427	60.31	960.0	0.5 hr	
CQΩ-3	20.85	3465	60.31	960.0	2 shifts	
dummy	20.85	3465	60.31	960.0	0.5 hr	
^{12}C	20.85	3465	60.31	960.0	0.2 hr	
Elastic Link	12.5	3925	60.31	960.0	0.6 hr	
switch to ^{1}H target, do *ep* energy measurement (4 hr)						
ep-I	13.0	3560	59.34	931	10 min	
ep-II	22.00	3020	44.67	1609	10 min	
ep-III	31.00	2464	34.72	2228	10 min	
ep-IV	40.00	1988	27.83	2737	20 min	0.06
ep-V	50.00	1577	22.40	3170	1.2	0.2
total time					106.8 hr	

5.4 CQΩ-I running, 3944 MeV

This set of kinematics was scrapped due to lack of time.

1. CQΩ-IA – 4.6 hr, 1.15 C
2. angle change - 1 hr
3. CQΩ-IB – 20.7 hr, 5.2 C
4. angle change - 1 hr
5. CQΩ-IC – 41.4 hr, 10.4 C
6. angle change - 1 hr
7. CQΩ-ID – 41.4 hr, 10.4 C
8. optics - 1 hr