Commissioning Run Plan for the PrimEx Experiment

(pre-run tasks with photon beam)

1. Establish a Good Electron Beam:

a) radiator off, collimator off, PrimEx target off, HYCAL out of beam, TAC out of beam, Beam Position Monitor (LG_BPM) off

a) ask for ~50 nA electron beam (or ask to start a photon beam);

b) take electron Harp scans, check the position, width and ratio;

2. Establish a Good Photon Beam:

a) insert the radiator "B" (10^{-4} R.L.) (*Note: labels for radiators will change -DSD)

b) check the photon beam spot at the "beam-dump" screen;

c) take photon harp scans, and check the quality;

d) ask for ~1 nA beam: insert the LG_BPM in pre-calibrated position (see Appendix #1 for details). Arrange (compare) the photon beam position at the pre-defined position (this is needed for the HYCAL survey, think about this more).

3. Plateau the Tagger (T-counters, E-counters ?);

4. Insert the Be target (in Harp) (?) in, Plateau the Pair Spectrometer (PS) detectors; (Note – optics a bit better for a PrimEx physics target -DSD)

5. Scan PS magnet B field to get an optimum deltaP acceptance for e+e- pairs from the energy interval E=(T1-T19) (see Appendix #2) (Note: to speed things up, just look at T*PS occupancy.-DSD)

6. Regular TAC Runs:

1) radiator "B" in, "no-collimator", no targets, no HYCAL;

2) ask for ~10 pA current; (Note: typical TAC runs with 70pAmps, radiator D)

3) PS field is the same as for the run (B~20. KG);

4) insert TAC, with pre-set HV~1650 V, and discr. threshold;

5) check the ADC gate timing in counting room;

6) get an "access" and fix the timing (unless it is remote);

7) check the ADC spectrum, HV and discr. threshold (~0.1 GeV level);

8) measure the "tagging ratio";

9) set PS B=0, measure again;

10) insert 8.6 mm "collimator" in, measure again;

11) set PS B=20 KG, measure again, if this “collimator” cuts more than 1-2%, go to the item #6.14 ;
12) move “collimator” x= +1. mm, measure again;
13) move “collimator” x= -1. mm, measure again;
14) insert the 12.7 mm collimator in, measure again;
15) set PS B=0. KG, measure again;
16) set PS B = 20. KG;
17) move “collimator” x=+1 mm, measure again;
18) move “collimator” x=+2 mm, measure again;
19) move “collimator” x=-1 mm, measure again;
20) move “collimator” x=-2 mm, measure again;
21***) make a decision about the “collimator”, insert it in or out;***
22) insert the 5% C12 target in, B=20. KG, measure again;
23) set PS B=0 KG back, measure again;
24) beam off, insert HYCAL in beam (center);
25) beam is back, B=0.KG, C12 in, measure again;
26) set PS B=20. KG, measure again;
27) move HYCAL x= +2 mm (from center), measure again
28) move HYCAL x= -2 mm , measure again;
29) move HYCAL y= +2 mm, measure again;
30) move HYCAL y= -2 mm, measure again;
31) bring HYCAL back to the center, insert Pb target, measure again;
32) set PS B=0. KG, measure again;
33) insert 1% Be target in, measure again;
34) set PS B=20. KG, measure again;
35)…

6.4Pair spectrometer, 8.6 mm collimator, 5% converter (a)”thick” brems radiator, (b)”thin” radiator. This studies effect of brems radiator thickness on beam profile.
-1 hour total

6.5Pair spectrometer run with collimator in and no convertor to look at scraping effects. MOR = 20 MHz, 0.5 hours

6.6 TAC runs with full tagger on with and without 5% target to see photon absorption (2 hours)

7. PS Intensity scan (for the photon flux control);
1) radiator “B”, “collimator” 12.7mm (?), PS B=20. KG, C12 target, HYCAL still in(???), TAC is in;

2) 50kHz on MOR –1.5 hour;
3) 150kHz on MOR – 3.0 hours (cross calibrates TAC and p.s.)
4) (TAC out) 1 MHz on MOR – 0.25 hour
5) 10 MHz on MOR -- 0.25 hour
6) 20 MHz on MOR – 0.25 hour
7) 30 MHz on MOR – 0.25 hour
8) 50 MHz on MOR – 0.25 hour

8. Target Scan with PS and Beam:

Goal: to map the relative thickness of physics targets.

1) radiator "B" (may change -DSD), "collimator" in, C12 in, PS B=~20. KG, HYCAL maybe in, TAC out, LG_BPM in, current I~ 1 nA;
2) measure PS rate normalized to current (think here) (Relative tagging ratios -DSD) for the central position;
3) move the target X= +1, +2, +3, +4, +5 mm, for each position measure the same rate;
4) move the target X= -1, -2, -3, -4, -5 mm and each time measure the same rate;
5) move the target Y=+1,+2,+3, +4,+5 mm, each time measure the rate;
6) move the target Y=-1,-2,-3,-4,-5 mm, measure again
7) insert Pb target and repeat from #8.2;

9. HYCAL Gain Equalizing:

1) radiator "B", "collimator" 12.7 mm, no targets, PS B=20.KG(?), current ~5 pA (lowest possible), HYCAL is in "TOP" position; Trigger = HYCAL or MOR (timing problem, talk to Dave L.), tagger energy range = 100. MeV and up;
2) insert "bottom right" LG module in (center);
3) make a timing scan to define the gate delay;
4) get access and set the delay (cable);
5) decide the gain value for LG modules: E~5.GeV to ADC~5000 channel (think more);
6) start gain equalizing: scan to each centers, show the anode ADC and dynode ADC for that channel for T19 (?), change HV, wait ~2 min., change again to bring the gain to preset ADC channel for the Dynode ADC, write and save the ratio anodADC/dynodeADC;
7) repeat this process for all LG modules (think here more);

8) insert “bottom right” PbWO module in the beam (center), starting from item8.5 and finish with 8.7 for all PbWO modules;
9) leave the HYCAL “ON” for ~1 hour, random check gains of several channels, goal is to reach 5% level;

9.b. HYCAL “Consistency” Check vs. HV Reset (“zero” policy check);
Goal: to see if we can fix a HYCAL inside problem with HV disconnection for some time (or what if HV tripped?). Possible method: temporary calibrate a part of HYCAL (say 7x7 PbWO area), get a good statistic in the middle of this area, disconnect HV for ~1 hour (?), bring them up to the same HV, measure the energy on the center again, use LMS information here, it would be better if we supply LMS “reference” tube from the separate power supply (think here more).

10) HYCAL Calibration:
1) run HYCAL about 5 hours after the gain equalizing (think what can be done during this time);
2) start from the one corner (“bottom right” probably) move the HYCAL with ~1min/module continues motion and illuminate all modules with a continues motion. Run the DAQ without the “sparsification”, store the data with the HYCAL X,Y coordinates from EPECS.
3) stop DAQ by the end of each row (or 1 hour), move HYCAL one row up, take a new DAQ run starting from the pedestals and LMS;
4) end the calibration at the last “top left” module;
5) come up with on-line calibration constants, use two methods: the iteration and the Chi-square methods;

11) HYCAL at the Transition Regions:
Goal: from the upper scanned data we suppose to have good enough information for the transition regions. But, to make sure we have enough statistics at the edges, we better to run these regions separately.
1) LG-PbWO transition: pick up one of the transition corner (say, “top-right” corner), start from the center of the left third PbWO module, go to the right with a “slow motion” (~5min/module, to be defined after), go and pass LG transition region up to the center of the right third LG module. From here go down to the center of the next row and repeat the same path. Include in this scan three horizontal rows at least;

2) central transition region (the beam hole): start from the beam hole close to the last crystal (~10 mm apart) on the level of the center of one of crystals and move "slowly" to the right up to the end of the second crystal (the central "absorber" better to be in the "locked" position, see appendix #);
3) edge of the HYCAL: pick up one of the outside corners (say "bottom right"), same way illuminate 3x3 LG section with "slow" motion" reaching to the ¾ part of the "edge" modules (see appendix #);

12) HYCAL Energy and Coordinate Resolutions:
1) stop at the middle of PbWO crystal area get "reach" statistics (one run with pase#1)
2) there is now way to get a precision calibration of the position resolution with this setup. Will try to use the upper data where X,Y of the beam (or HYCAL) suppose to come from EPICS.

13) HYCAL Photon Registration Efficiency Measurement:
1) we should be able to extract this number from the upper data, if the trigger was from the tagger MOR, and very low intensity.
2) if not, change the trigger from the MOR, adjust the timing (think about this) and make new runs at the several spots on HYCAL (see attachment);

14) Efficiency of Veto counters: (it will be measured when HYCAL is on the "Run" cart).

15) HYCAL on the "Run Cart"
1) get "controlled access", release HYCAL from the "transporter" and put on the "run" cart; move HYCAL to the "run" position;
2) survey it to the beam center, get accurate Z-position;
2) install the "He bag" (or extend it to the new position)
3) set the PrimEx trigger: any two "cluster" with Eg>0.5 GeV;
3) radiator "B", "collimator" is the same, insert C12 target in:
4) ask for beam (I~100 pA);
5) scan with PS magnetic field: from B=0 to B=20 KG, for ~10 points (B=0, 1, 3, 5, 8, 10, 13, 16, 20 KG, to be corrected soon), take enough data (to be determined soon) for the each B setting. The goal: measure the pair production diff. cross section for the each setting;
6) set PS B~8. KG (to be fixed soon) in order to hit with g->e+e- pair (max photon energy) in the middle of HYCAL (correct soon);

7) measure the symmetrical pair production diff. cross section. Scan the beam intensity to determine the upper level of the trigger rate when we still measure the e+e- production diff. cross section in within the ~2% level (see attachment #). This trigger rate must be used to set the intensity for the pio run, (I= 0.1, 1.0, 3.0, 5.0 10.0, 15.0, 20.0 nA, the range will be calculated soon);
8) the efficiency of the Veto counters will be measured from these e+e- data (think about the ADC gate timing);

16) Compton Runs:

Goal: to measure the Compton (on atomic electron) diff. cross section, and try to normalize the pio cross section to the Compton.

1) radiator "B", "collimator" the same, 1% Be target (I think this is 0.5%) in (that is on the target ladder), PS B=0, HYCAL trigger is about the same: any two "cluster", only energy threshold E(cluster) > 0.1 GeV; Tagger energy: (T1-T20) + (one of T counters from E = 2.5 GeV)
2) start with a low current (I~1nA), get "clean" Compton data (~ 4 hours), definition the HYCAL alignment on-line (see attachment #);
3) if all histograms are Compton-like, then increase intensity up to "tolerable" trigger rate, difined from the e+e- scan
4) run for ~ 2 shifts (16 hours);
5) insert C12 target in, with the same manner define the intensity level;
6) run for ~1 shift (8 hours);

17) Start the pio Life-Time Measurement:

1) Goal: to extract the pion--> g + g decay width with an unseen precision. (we will need to discuss this part separately soon, the bottom few items are very preliminary yet).

2) insert the C12 target in, set back the pion trigger (any two "cluster" with Eg > 0.5 GeV);
3) set the intensity to not exceed the maximum trigger rate defined from the e+e- intensity scan (see item #15.7);
4) run for ~20 days;
5) we will see then…