TPE Run Plan
Draft 1.2
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Summary plan:

1. Tune beam to tagger dump
2. Vary radiator/photon collimator/convertor to optimize detector rates (chicane off)
3. Optimize chicane settings
4. Reoptimize beam current/radiator/convertor/photon collimator choices
5. Measure e+ and e- beam profiles with the TpeCal at low intensity
6. Trigger studies
7. Optimize Minitorus current (find minimal acceptable current)
8. Take data
9. Measure 2.2 GeV direct electron beam
10. Reverse torus and chicane fields every two weeks (out of phase)
    a. check chicane tune (e+/e- beam spot locations) after reversing chicane field
    b. remeasure beam profiles after reversing chicane field
11. Take alignment data with minitorus and torus off

Detailed plan:

Component	Value
Beam Energy	5.5 GeV
CLAS Detectors	OFF
Torus	1500 A
MiniTorus	6000 A
Pair spectrometer	OFF
Italian Dipoles	OFF
Cryo target	COLD and EMPTY
Beam PMTs	ON
Tagger Dump Screen	UP
Tagger Radiator	OUT
Photon Collimator	12.7 mm
Convertor	OUT
Lepton Blockers	OUT
TPE Calorimeter	OUT

1. Tune beam to tagger dump (MCC)
    a. Check beam quality with harp scans (5 nA)

- Do we want to find the e+ and e- beams before optimizing stuff???

2. Vary radiator and photon collimator to minimize detector occupancies with chicane OFF
    a. Conditions
        i. Turn on TOF, EC, and DC
        ii. Turn on DAQ and start a run (needed for CED to determine occupancies)
        iii. Save all occupancy plots to the elog.
        iv. Convertor OUT
        v. Radiator OUT
        vi. 12.7 mm photon collimator
    b. Measure baseline rates
        i. Measure detector rates and occupancies (DC1, 2, and 3 and TOF) and DC currents at 5 and 20 nA (should be negligible)
        ii. Insert 0.02 RL radiator
            1. Measure detector rates and occupancies (DC1, 2, and 3 and TOF) and DC currents at 5 and 20 nA
        iii. Insert 0.05 RL convertor
            1. Measure detector rates and occupancies (DC1, 2, and 3 and TOF) and DC currents at 5 and 20 nA
    c. Vary Photon Collimator to minimize detector occupancies
        i. Remove convertor
        ii. Tune beam for 10 nA (20 nA should also be OK)
        iii. Measure detector rates and occupancies (DC1, 2, and 3 and TOF) for
            1. No collimator
            2. 6.4 mm collimator
            3. 12.7 mm collimator
        iv. select the collimator that minimizes occupancies. **Record this prominently**
    d. Vary radiator thicknesses to minimize **scaled** detector occupancies (multiply by the scale factor)
        i. Measure detector rates and occupancies (DC1, 2 and 3 and TOF) and DC currents for
            1. 0.01 RL, scale factor = 2
            2. 0.02 RL, scale factor = 1
            3. 0.05 RL, scale factor = 0.47 (see ENOTE p370)
        ii. select the radiator that minimizes the **scaled** detector occupancies (focus on DC3 and TOF). **Record this prominently**
    e. Leave optimal collimator and radiator in
3. Optimize chicane settings
    a. conditions
        a. CLAS detectors OFF
        b. optimized radiator and collimator choices,
        c. 0.05 RL convertor
        d. 1 nA beam
        e. monitor the quartz detectors, see rate dependence on chicane tune

b. Turn on chicane (turn beam off while turning on chicane magnets) (test run values were B_{ID} = 0.434 T, I_{ID} = 293 A; B_{PS} = 0.385 T, I_{PS} = 590 A. These should be scaled by 1.15 to cover 0.6 < E_lepton < 4.8 GeV)
    a. Italian Dipole field 0.497 T; current 335 A
    b. Pair Spectrometer field 0.4406 T; current 675 A
    c. **Make sure you know the magnetic field direction in each magnet so you know which side of the chicane is e+ and which is e-**
c. Measure beam profile on sparse fiber monitor (SFM)
    a. Determine centroid and FWHM
    b. **If you do not see a beam on the SFM, block one beam and then vary the ID field to find it. Check with the RC FIRST!**
d. Block the electron beam by inserting the correct lepton beam blocker
e. Measure SFM position (centroid and FWHM) as a function of ID current
    a. Change the ID current in 0.5% steps to sweep the beam across the SFM
    b. See elog entry 22007 from 2006-10-14
f. Unblock the electron beam and block the positron beam. Repeat step (f) to measure the electron beam position as a function of ID current.
g. Fit a line to the SFM position vs ID current for each beam (e+ and e-)
h. Set the ID current to the value that gives the same centroid for both beams (interpolate as needed). **Post this value prominently**.
i. Unblock both beams

Component	Value
Beam Energy	5.5 GeV
CLAS Detectors	ON
Torus	1500 A
MiniTorus	6000 A
Pair spectrometer	ON
Italian Dipoles	ON
Cryo target	COLD and EMPTY
Beam PMTs	ON
Tagger Dump Screen	UP
Tagger Radiator	IN (from step 4)
Photon Collimator	IN (from step 4)
Convertor	OUT
Lepton Blockers	OUT
TPE Calorimeter	OUT

4. Optimize convertor thickness
    a. Ask MCC for 10 nA
    b. Start a run and start CED. Save all occupancy plots to the elog.
    c. Measure CLAS detector rates and occupancies for
        i. No convertor
        ii. 0.02 RL convertor
        iii. 0.05 RL convertor
        iv. 0.10 RL convertor

d. Fill LH2 target
e. Measure CLAS detector rates and occupancies (DC1, 2, and 3 and TOF) for
    v. No convertor
    vi. 0.01 RL convertor (scale factor 3.9) [might not be available]
    vii. 0.02 RL convertor (scale factor 2.5)
    viii. 0.05 RL convertor (scale factor 1.4) (preferred by simulation)
    ix. 0.10 RL convertor (scale factor 1.0)
    a. Determine the optimal convertor thickness by multiplying the full target occupancies by the scale factors and selecting the minimum results. Note that the scale factor is proportional to the simulated number of leptons at the target for the different convertors. **Record this prominently**
f. Determine the optimal radiator for the optimal convertor and photon collimator
    a. Measure CLAS detector rates and scaled occupancies (DC1, 2, and 3 and TOF) for
        i. 0.01 RL, scale factor = 2
        ii. 0.02 RL, scale factor = 1
        iii. 0.05 RL, scale factor = 0.47 (see ENOTE p370)
    b. select the radiator that minimizes the **scaled** detector occupancies (focus on DC3 and TOF). **Record this prominently**

Component	Value
Beam Energy	5.5 GeV
CLAS Detectors	OFF
Torus	1500 A
MiniTorus	6000 A
Pair spectrometer	ON
Italian Dipoles	ON
Cryo target	COLD and EMPTY
Beam PMTs	ON
Tagger Dump Screen	UP
Tagger Radiator	IN 10^{-4} RL
Photon Collimator	IN (from step 4)
Convertor	IN (optimal)
Lepton Blockers	VARIED
TPE Calorimeter	IN

- Do we want to vary the chicane field (all three magnets together)?

5. Measure beam profiles with the TpeCal
    a. Conditions:
        i. Beam off
        ii. Electron beam blocker IN and positron beam blocker OUT
        iii. Radiator 10^{-4} RL
        iv. Convertor: use optimal (nominally 5 10^{-2} RL but determined in previous step)
        v. Move TpeCal into the beam and turn HV on

vi. Change DAQ triggers to TpeCal trigger
vii. Beam current 1 nA

b. Measure the positron beam profile with the Dense Fiber Monitor (DFM). Check that the beam is centered. **If it is not centered, call the RC immediately**.
c. Check TpeCal trigger rate. Change the beam current and radiator thickness so that the trigger rate is 10^4 Hz or the dead time is 15%, whichever happens first. Do not change the convertor if possible.
d. Take a 30 minute data run (10^7 events)
e. Take a 30 minute data run (10^7 events) with the positron beam blocker HALF-IN (and the electron beam blocker IN)
f. Move the electron beam blocker OUT of the beam and the PBB IN
g. Measure the electron beam profile with the Dense Fiber Monitor (DFM). Check that the beam is centered and at the same location as the positron beam. **If it is not centered or not the same as the positron beam, call the RC immediately**.
h. Take a 30 minute data run (10^7 events) with the PBB IN and the EBB OUT
i. Take a 30 minute data run (10^7 events) with the PBB IN and the EBB HALF-IN
j. Insert both beam blockers. Measure 30 minutes with both beams fully blocked to characterize the TpeCal background. This time can be reduced with RC approval.
k. Compare the electron and positron full beam profiles in the SFM and in both the TpeCal and the Dense Fiber Monitor (DFM).
    i. If the e+ and e- profiles differ, call the RC immediately
l. Finish:
    i. Move the TpeCal out of the beam
    ii. Move both beam blockers out of the beam
    iii. Turn TpeCal HV off (**check this** – we might want to take events with high threshold at a few hertz in case we can see any pi0s)

Component	Value
Beam Energy	5.5 GeV
CLAS Detectors	ON
Torus	1500 A
MiniTorus	6000 A
Pair spectrometer	ON
Italian Dipoles	ON
Cryo target	FULL
Beam PMTs	ON
Tagger Dump Screen	UP
Tagger Radiator	IN (optimal)
Photon Collimator	IN (from step 4)
Convertor	IN (optimal)
Lepton Blockers	OUT
TPE Calorimeter	OUT

6. Trigger studies
    a. Standard trigger (TOF panel 1 AND EC)AND(opp sector TOF)
    b. L2 trigger effects

    c. Supplemental (TOF panel 2)AND(opp sector TOF2)
    d. Turning off some of the rearmost TOF detectors
7. Take a run with EBB IN to double check chicane polarity
8. Beam quality measures and beam steering studies