Source Test Plan Goals

• Test compatibility of PREX with concurrent "high-current" experiment in Hall C

- "cathode interaction"
- problems associated with QE hole

• Near "parity-quality" setup to support lumi tests

• New switch?

Time Allocated

• before beam start (Dec 22-Jan3)

• during run?

• after beam off (Jan 31-?… ~6 shifts?)

Cathode interactions

•What we know about two-hall running:

• There is an observed non-linearity of intensity vs. laser power… QE is not constant over the range of applied light.

• Commonly seen: when Hall C laser turns on, Hall A intensity drops. (current feedback brings it back) When Hall C laser turns off, Hall A intensity jumps up.

• The effect was extreme on the badly damaged (non-anodized) superlattice photocathode used in 2004.

• A_Q also jumped when Hall C turned on or off, even if A_Q^C was small (tuned using Hall C IA system).

• Tests done in (July 25, 2004?): Showed that A_Q^A was dependent on A_Q^C as well as I^C, and not linear.

Possible Causes

The goal is not really to develop the correct microscopic model.

The goal is to do the right test to figure out where we stand.

Reasonable questions to ask:

- might the effect be the "RC constant" in the cathode circuit? What is the current to the HV bias?
- Does a varying C-beam laser profile "deplete" QE creating a helicity-dependent "QE hole"? (n.b. laser profile shouldn't vary much)
- Does a spatial variation in C-beam DoLP modify QE *anisotropy*?
    - if so, could this get ugly (by involving "alpha" phase shift differences, or "S2" linear polarization? The parameter space could become unmanagably huge.)

If we run with Hall C

If we run with Hall C, that laser will be imperfectly tuned.

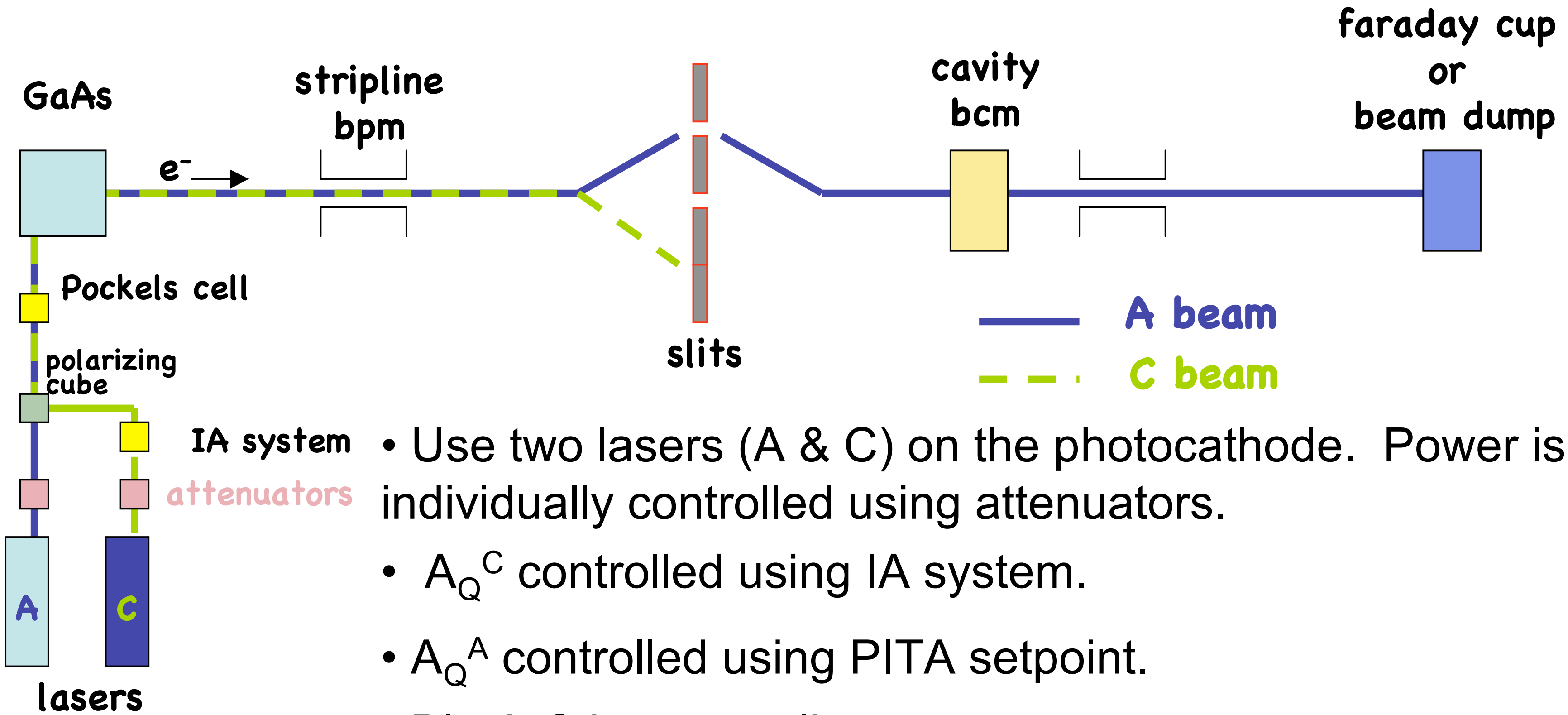
The IA system will be used to zero the Hall C polarization.

The "best" test we can do now is

- set up Hall A for PQB,
- take any available Hall C laser configuration and zero A_Q^C with IA system,
- look at how Hall C changes Hall A A_Q and Δx.

The beauty of the Hall C system isn't important, since it is not clear how beautiful the second beam alignment can be… (new research project?)

Polarized Source: Features



- Use two lasers (A & C) on the photocathode. Power is individually controlled using attenuators.
- A_Q^C controlled using IA system.
- A_Q^A controlled using PITA setpoint.
- Block C beam at slit
- stripline in forced gain can serve as "approximate bcm" for tuning C attenuator to various current levels.
- measure A beam after slit
- measure (A+C) before slit

“Two Laser” Test Plan

Current setpoints

	A	C
1	80	0
2	0	80
3	40	40
4	60	20

- calibrate Hall C IA. Calibrate BPM pedestals
- Find attenuator setpoints for a mix of beams.
- Measure pita slopes for A (m^A_{PITA}) and C, separately.
- Use IA to zero Hall C asymmetry.
- For setpoints [1,3,4]
    - measure m^A_{PITA} . Find PITA setpoint to zero Hall A A_Q. Take enough data on each run to measure for position differences to 100-150 nm.
    - Find new IA setpoints to zero Hall C asymmetry. measure A_Q^A, and zero it again, if necessary. Measure position differences again.
    - Induce big A_Q^C using IA cell, if one was not already seen. Remeasure A_Q^A and Δx^A without changing PITA

What we'll learn:

- Disentangle C-beam DoLP vs A_Q^C effects A_Q^A or Δx^A
- (Maybe we can figure out) if C-beam changes average analyzing power?

“Two Laser” minor checks

- Check raw position for each beam individually, and together. If there is a shift, check it again to try to extract a systematic shift, if it exists.
- Oversample with A, then A+C (3). Does the time profile of charge or position change?

RHWP scan?

RHWP scans can be the most complete diagnostic, but they will be difficult to interpret with two beams each interacting separately.

- Typical run plan is set of 4 RHWP scans (In/Out * PITA 0 / PITA+100), 10 pts each 5 min per. = 1 hour per scan.
- Can I really do that for 4 different beam current mixtures?

Burn in

A damaged cathode may have different Q.E. anisotropy gradient or the Q.E. hole may simply exacerbate (amplify) other gradients (since the tails of a gaussian laser spot are enhanced by higher Q.E.)

Test:

- Before run, have "clean" setup, do full set of Hall A RHWP scans.
- Choose a spot that you expect to remain undamaged. Move spot to that location, and take baseline set of scans there, as well.
- (It *might* prove useful to get the same for the Hall C laser individually.)
- After the run, perform the full set of RHWP scans again from Q.E. hole position.
- Then move to "fresh" cathode spot and retake full set of scans.
- It seems that the Two Laser test should be re-done in the QE hole.

Setup/Baseline Goal

Goal:

- reasonable position differences (<500nm? with m_{PITA} ~3ppm/Volt) at source, without obvious mis-tune. This can be *checked* using electron beam alone (RHWP scans). [approx. 8 hour beam study, approx 16 hours in the tunnel if the system starting point is bad.]

-Check for known weirdness: Excessive 4-peak structure, poor transmission, helicity signal pickup

- RHWP scans at a position not expected to see significant damage, for studies after the beam period. This would require a spot move which is very painful the first time…

Setup/Baseline Plans

• Calibrate forced gain pedestals for BPMs [1 hr]

• Pockels cell off run to look for pickup issues. [0.5 hr]

• If transmission is bad, call in expert to fix it.

• QE scan. [0.5 hr.]

• PITA scan. Zero AQ. [0.5 hr]

• RHWP scan for PITA zero. Repeat scan for PITA=+100. Repeat both for toggled IHWP. 10-12 pts, 5 min per = 1 hour per scan. [4hr]

• If there are large position difference in scan (check offsets carefully, compare to 2005 data), then we will go into the tunnel with a QPD and kill 16 hours with standard PC alignment.

• If not, settle on reasonable analyzing power and measure position differences.

• If >500 nm at 3 ppm/V in either IHWP state, then we need to go into the tunnel…

Potential Complications

1. IA operation -> position coupling?
2. C alignment… if C is too badly aligned, are we grossly overestimating problems?
3. A/C spot overlap.
4. cathode condition at start (since it might be somewhat damaged at the start)
5. Relative orientation of A/C polarization?
6. Any ground loop leakage?

#2-5 are "common" problems. Our random starting point is probably as good an approximation as any.

Schedule:

- Dec 22- Jan 3: Source setup and baseline
- Jan 3-Jan 30: Any accelerator down period, attempt opportunistic RHWP scan / PITA scan in 100 keV region to track changes. Possibly we could schedule 15 minute PITA scans to track changes?
- Jan 30- Feb?:
    - Two Laser study in QE hole
    - QE hole study.
    - Two Laser study away from QE hole.

- Test