Run0 running log, daily status updates

Day 20, week 4 of run 0, Friday August 14, 2020

1. I wanted to revisit the 7.2 MeV/c setting, which is the highest momentum obtained so far at UITF. Clyde worked remotely to change some setting for the 7-cell, and he was able to turn the cavity ON in GDR mode following yesterday’s quench trip. I was too impatient hitting buttons
2. Procedure for recovering from a “trip”, where trip means the rf switches from GDR mode to SEL mode. We can’t drive beam in SEL mode
   1. Hit master reset on expert page
   2. Close the switch
   3. Wait for the discriminator value to become small, then switch to GDR mode using the “seltogdr” button
   4. Don’t resend beam until you see Gmeas = to GSet, this takes about a minute
   5. Clear the FSD assuming the BLMs are not masked, look for beam on viewer
3. While trying to restore the 7.2 MeV beam, I learned that RF settings (warm and cold) are not saved at all in the save/restore file. Michele will add signals once I tell which signals I want saved. Until then, grab screen shots of the rf! write values in a notebook
4. Five magnets were mismatched. Once the magnets were functioning properly, and once I typed in the RF settings appropriate for 7.2 MeV beam, things restored pretty well, good beam on viewers.
5. While walking UP the 7-cell GSet, I recorded the forward power, see logbook
6. The beam was very trippy at GSet 19.5, 7-cell switching from GDR mode to SEL mode every two or three minutes.
7. We performed another radiation survey breakpoint measurement, at 7.22 MeV and 10uA CW, beam delivered to the spectrometer dump M703 and for the first time, to insertable Faraday Cup 3 adjacent to the control room. Radiation at 7.22 MeV/c was slightly higher than we measured at 6 MeV, no surprise there. But radiation was about 10 times higher with beam delivered to FCup3, and with significant levels in the control room near the ceiling. David will discuss with Keith. We might decide to lock out this cup. To be honest, I don’t know why we installed one there, it would never be used for anything
8. Ran both harps, I only get a signal from one of them and only in CW mode. Nothing from the spectrometer harp. We need these harps for next week’s optics measurements
9. FYI: spectrometer dump is labeled D2 by Pete, and the straight ahead dump is labeled D3
10. During the radiation survey tests at 7.2 MeV, the 7-cell tripped every 2 to 3 minutes. When this happened the BLMs detected loss and did their job, setting the gun mode to beam synch. So use the BLMs, don’t mask them! Another reason for the breakpoint tests of BLMs

To-do:

1. Work with Michele to get the rf signals saved in the save/restore file
2. Create a look up table: GSet, dipole magnet, and beam momentum
3. Post the power vs GSet measurements I made into the logbook
4. Get harps to work
5. Get BPMs to work
6. Solve the magnet mismatch problems

Next week, the last week of Run 0, what to do? Set momentum to something stable, like 6 MeV/c, which is very relevant to CEBAF.

1. Discuss with RadCon the recent survey, beam to FCup3, lock out cup?
2. Something “simple” to quiet the 7-cell at higher gradient? Do it
3. Chopper setup
4. Measure electron bunchlength with chopper slit
5. Optics measurements: emittance, energy spread, beam envelope, proper quad focusing
6. Bunchlength measurement downstream of the booster, can this be done at the spectrometer?
7. Write the start-up procedure, submit it to Andrei, Bob May and Steve Smith on Friday
8. Parasitically, measure microphonics?
9. Consolidate the magnets, reconfigure the steering magnets, optimize to free up channels and large haimsons (or maybe we have enough already? Inventory the magnets)
10. Plan the tasks that must happen during the week when the cave is Open, while we wait for approval to operate.
    1. Beamline bakeout
    2. Install magnets
    3. Hot check out all the equipment
    4. Correct ion pump cable problems
    5. Upgrade the vacuum chassis
    6. SRF repeat their rf measurements?
    7. Figure out the GSet puzzle, modify screens such that GSet roughly corresponds to the beam energy?
    8. Microphonics measurements
    9. Solve the magnet mismatch problems

Day 19, week 4 of run 0, Thursday August 13, 2020

1. The 5.1 MeV/c machine restored relatively easily today: the issues – a few strange magnet settings that were resolved using BURT, am I accidentally typing/setting/changing values as I move my cursor over the magnet screen?; noisy laser light which might be related to the tune mode generator? then it quieted down on its own; the MDLM504 vertical dipole was mismatching and moving the beam up/down by ~ 2 cm at ~ 1 Hz, so I pulled the card. The card is in the rack but pulled out from seating.
2. I turned on the spectrometer quads and formed a nice spot at spectrometer dump, did an all-save. RadCon came over to measure radiation, another breakpoint and companion survey of the one yesterday to the straight ahead dump. 5.1 MeV/c and 10uA. These are the best radiation break point measurements so far, today and yesterday. Yes, they measure more radiation on top of Cave2 as we increase energy and beam current
3. Ran the M7 harp but the fitter program would not open, so I don’t know if the harp is working
4. Vacuum degrades with 10uA CW at dump, the dump has not seen much beam, this is to be expected. Will clean up with time. Noticed errors in labels and the way the pumps are cabled up.
5. Increased 7-cell gradient, saved a good setup for 6 MeV/c beam
6. Increased 7-cell gradient, saved a good setup for 7 MeV/c beam
7. I looked at Joe’s plot posted earlier today of the 7-cell GSet calibration. Extrapolating to zero suggests the gun and 2-cell provide 0.63 MeV/c, which implies the 2-cell adds only 100 keV to the 200 keV input beam. I had increased the 2-cell GSet earlier to 3 but not enough. Joe’s plots provide the 2-cell GSet calibration: 0.1528 (MeV/c)/(2-cell GSET), or 0.1521 (MeV)/(2-cell GSET). So from the original 2-cell GSet of 2.2 providing the 100 keV boost, I need to increase the 2-cell GSet by 1.5 units to obtain the desired 333 keV boost. GSet of 3.7. I made this change to the 2-cell while watching beam on the MeV spectrometer viewer and adjusting phases. In the end I settled on 2-cell GSet of 3.6 as providing nice tight beam on viewers, small energy spread. I tweaked the buncher and 7-cell phases too. As long as the 2-cell GSet is somewhere near 3 to 3.6, I think we are fine. We don’t have diagnostics available to tell much difference in the beam. i.e., we don’t have CEBAF and Users and synch light monitors to see if there are “tails”.
8. I then continued to increase the 7-cell GSet. At GSet of 25, the power was 2.5 kW, the booster was not happy, very trippy. I reduced the GSet to 21 (1.8 to 2kW power) and then I got a quench fault, my first I think. I could not reset the cavity and get to GDR mode. Tomasz says it takes time for LHe to become happy after quench trip. I had enough beam at GSet 21 to determine this corresponds to 7.68 MeV/c
9. What is the gradient inside the 7-cell when the GSet is 20 and making beam 7.18 MeV/c? If the 7-cell provides all the momentum, this means the 7 cell makes 6.6 MeV beam, and I divide this by the effective length of the 7-cell which is 0.7 m to get a gradient of 9.4 MV/m. If on the other hand I subtract the 0.91 MeV/c from the 7.1 MeV/c total, the 7-cell KE is 6.0 MeV and gradient is 8.6 MeV/m. Joe says my math is bad, I can’t just add/subtract momenta this way, something about the electron rest mass….
10. Looking at Mike Drury’s summary from booster calibration with RF but no beam, I see the 7-cell exhibited Emax was 16.5 MV/m (with quench?), stable operation at 16.0 MV/m for one hour and field emission at 11.5 MV/m. My estimates for KE and gradient are still pretty far from Mike’s numbers. Mike made these measurements at UITF in self-excited-loop mode. Apples to oranges comparison?
11. If I use Mike’s “onset of field emission” as the limiter for the 7-cell ops, this is 11.5 MV/m. Assume all this comes from the 7-cell, then the KE is 8.05 MeV, and corresponding to momentum of 8.5 MeV/c. If I violate the math rules related to rest mass and add the contribution from the 2-cell, adding the two momenta 8.5 MeV/c + 0.9 MeV/c = 9.4 MeV/c which is tantalizingly close the HDIce request.
12. What to do? Can we drive the 7-cell to higher GSets and not trip? Pretty far from the 11.5 MV/m “onset of field emission” gradient. To a great extent we are simply bound by the practicality of keeping the 7-cell powered ON. At Gset of 21, the power to the 7-cell was ~ 2 kW, and then it tripped OFF and it was hard to turn ON again. It seems stability, reliability and klystron power will determine our beam energy.?

Things to fix:

1. The ion pump cables need to be sorted out, labeled and sent to the correct UHV supplies upstairs. I say this because ion pump current increased on a pump labeled M8 which is the vertical chicane (there was no beam there)
2. Need to get the harp scans working easily from control room.
3. As Scott has been saying for awhile now, the BPMs are strange because of an auto-gain feature. Tune mode vs CW mode? Problems are not related to the trigger timing relative to 60 Hz. BPMs look good in CW mode but is that because they are saturating?

Things to do:

1. Stop trying to push the beam energy, since pushing the beam energy results in cavity quenches which take a long time to recover from. Call this momentum good, maximum ~ 7 MeV/c? get some advice from RF and SRF experts
2. Radiation survey at 7 MeV/c at 10 uA, both dumps
3. Optics measurements: harp swipes with quad scans, measure emittance
4. Energy spread
5. Chopper setup
6. RC#2

Day 18, week 4 of run 0 (Wednesday, August 12)

1. Beam restored to the 5.1 MeV/c settings obtained the day before, except viewer M701 was not working. Later I found it had fallen out of the camera housing
2. There’s ongoing debate about the large discrepancy between old GSets that SRF used and the ones we are using at UITF. At the moment, we are trusting the dipole magnet spectrometer. Mike Drury will keep an eye on things remotely when we increase beam energy tomorrow
3. Today was a breakpoint day, working with SSG to verify BLM functionality. Overall, it was a good day of “hot check out with beam”. The BLMs work but finding settings that are sensitive to small beamloss that trip beam, while not tripping the beam when it is safely delivered to a cup or dump is hard to do. There are two things to fix in the coming days: move BLM M401 upstream between dif pump station and the booster, and once the radiation shielding measurements are complete we should put the lead-brick shielding over the dumps.
4. There was no point including in the commissioning plan BLM tests at energies we never intended to operate at, 500 keV and 1 MeV. It was a mistake to schedule the BLM tests with no shielding on the dumps
5. While doing a stability run for the BLM tests, we called RadCon to measure radiation levels with 10 uA delivered to the straight ahead dump M601. The highest current and highest energy radiation survey to date. WE can call RadCon back once beam is steered to the M701 dump (camera wasn’t working, so I couldn’t steer the beam, and didn’t want to drop the sweep to fix it)
6. There was a period of beam current instability that I couldn’t track down. No beam movement on viewers, just switching between bright and dark, suggesting to me a laser problem. The tune mode current did not match what I expected (1.5% of CW). But I couldn’t pin it down. It happened once before. I guess eventually we will figure it out.

Tomorrow:

1. Lock up at 9am, Beam to M601 and M701 dumps at energy up to ~ 8 MeV/c

To fix or to address:

1. Provide SSG with description of the accident each BLM is supposed to protect against
2. Start using the alarms tool
3. Current ramp?
4. Get ready to look at laser light with power meter, when beam instability happens again
5. Unrelated to above, the laser power fluctuates a large amount over minutes time scale, related to room temp and cycling AC?
6. Are the RF settings saved and archived?
7. Measure the laser macropulse, and the laser micropulse
8. Chopper bunchlength scan

Day 17, week 4 of run 0 (Tuesday, August 11)

1. Had to reseat the 10 A card for quad MQJM504, once I did this beam restored to MeV viewers the way I left things the day before
2. When Larry Farris restarted the chopper hot water skid, he restored good coupling to the cavity, problem solved. Gary and Scott also provide temp readback of the warm RF cavities including the chopper, good
3. I increased a variable called GDCL for the 7-cell cavity and this helped keep the cavity in GDR mode, Tomasz came by and verified this was OK to do.
4. With this new clamp value for the 7-cell, I left 2-cell GSet constant at 2.2, and then I varied the 7-cell GSet from 6.5 to 13.5 and measured the dipole magnet Bdl, making sure to crest the two cavities for each measurement. Cavity phases moved, but not by much.
5. With the 7-cell GSEt calibration mentioned above, extrapolate to GSet = 0. This tells me the 2-cell provides momentum 0.776 MeV/c, whereas it should provide 0.910 MeV/c in order for the 2 cell to provide the 333 keV kinetic energy of the design.
6. With the 7-cell GSet constant at 13.5, I varied the GSet of the 2-cell and measured momentum in MeV spectrometer. I found the 2-cell GSet provides 0.17 MeV/c for every unit of GSet.
7. With these two calibrations, I added 0.776 to the 2-cell GSet, which means the 2-cell provides the desired 0.910 MeV/c momentum, or 333 keV acceleration
8. In the middle of all this, we sent 4 MeV beam to both waist-height MeV dumps and performed the radiation breakpoint surveys (6 and 4 uA to the inline and spectrometer dumps, respectively)
9. Beam momentum is now 5.1 MeV/c (2-cell GSet at 2.98 and 7-cell at 13.5). Tomorrow we will check out the BLMs at this setting, we can call RadCon over too. Beam looks very good, it’s very transportable
10. Rama visited late in the day when the 2-cell started to trip to SEL mode. He showed me what to mask when this happens.

Tomorrow:

1. Breakpoint tests of BLMs at 5 MeV/c, working with SSG
2. Invite Radcon over for 5 MeV/c breakpoint measurement, at 10uA current
3. Joe to plot the GSet calibration scans, check my calculations
4. Go to higher energy, HDIce want 9.5 MeV/c

Things to do, stuff to fix:

1. BPMs, we will adjust the SCAM trigger point
2. Mu-metal on beampipe
3. Move magnets, consolidate, free up some large haimsons for the elevated beamline
4. Harp at M703 doesn’t work

Big tasks:

1. Set up 10 MeV/c beam (do I need to be careful with the booster, field emission onset?, power?)
2. Energy spread measurements
3. Electron optics checks
4. Emittance
5. Bunchlength
6. Chopper setup, measure the electron bunchlength
7. Bunching too hard, right? Need to fit Brock’s data and optimize waist location at the 2-cell
8. Deflection from the booster
9. x/y rotation from the booster
10. Rowgowski coil #2 tests

Day 16, week 4 of run0 (Monday, August 10)

The goal of yesterday's work was to calibrate the booster cavity GSets, with “so-so” progress, work will need to be repeated

1. the machine restored to previous settings, which we believe to be 2.1 MeV beam. 2-cell GSet = 5, and 7-cell GSet 3
2. At this point, with both cavities powered at last week's values (GSets 5 and 3, 2 and 7 cell) Joe and I added/subtracted gradient to each cavity in modest increments, one cavity at a time and we measured the dipole magnet BL for each new energy setting, beam into spectrometer. With this info, we thought we could extrapolate to Zero Gset for each cavity to infer what the other cavity was doing....this gave confusing results, not in agreement for each cavity extrapolation.
3. Next we turned OFF the 7-cell and just put beam into the MeV spectrometer using only the gun and 2-cell which surprised me, it wasn't that hard to do. At this point, with 7-cell OFF, we varied the 2-cell GSet. THis seemed to be the most direct way to calibrate the 2-cell GSet, the GSet of 5 that we have been working with generates beam with kinetic energy of 951 keV. From this we determined that a GSet of 2.2 would boost the kinetic energy of the beam from 200 keV to 533 keV, what Haipeng recommended for the booster design.
4. Then I tried to make 5 MeV beam, using the 2-cell GSet of 2.2. The highest beam energy I could make was 2.8 MeV, 7-cell GSet of 6.5. Going higher with the 7-cell GSet was difficult, there appears to be something clamping the GSet.
5. At this energy, beam spots look great and it was pretty easy to move beam between the two MeV dumps. Unfortunately, I learned at this stage that I was making a big mistake measuring beam energy: I was using the spectrometer line quads to focus/manage the beam. THis is not good, at least in terms of making an accurate energy measurement. But the bigger problem relates to operating the 2-cell. When you change 2-cell GSet, large phase changes are required for both the 2 and 7 cells, to operate on crest. I think the puzzling nature of some of the data stems from me not religiously optimizing the phases of both cells. And this was made harder by having the quads energized in the spectrometer line.
6. For the 2.8 MeV beam, with no quads ON in the M7 line, I could easily phase up the 2 and 7 cells, cresting each cavity. Phases are quite a bit different from where Yan and I had them last week. Like I said above, these phases will depend on the gradient in each cell, particularly the 2-cell....

The save/restore program appears to be working great, with all variables accounted for

Tuesday: repeat the GSet cal measurements, try to make 5 MeV beam

Wednesday morning at 11 am, work with SSG to check BLM functionality

After making 5 MeV beam, do next set of rad break point measurements

Things that are wrong:

1) M5 and M7 quads mismatch frequently

2) can't stay in GDR mode, lots of trips to SEL mode

3) 7 cell GSet seems clamped

4) check viewer M703 (probably fine)

5) focus viewer M401

6) BPMs still provide nothing useful in tune mode

7) Harp in M7 line yields garbage

Day15 – week 3 (Aug 7)

1. Mike Beck installed the functional spare quad at M7 spectrometer line, Kevin Banks installed the steering magnets back on the spectrometer line
2. Scott Windham modified the pads on the first three BPMs, did things to the BPM syste, sorry I don’t know more than that
3. Locked up at 11am, Yan recovered the beam to straight ahead dump. Many magnets were mismatched, easy to fix. But had to pull the card for quad M504 twice and reset before it started to cooperate.
4. Yan quickly found the beam in the spectrometer line, impressive. With the phases for the two cavities as determined using viewers in the straight ahead line, we calculated 1.4 MeV beam using Joe’s calibration relationship for the dipole magnet: BL [G-cm] = -1673 \* p[MeV/c]
5. Next Yan crested the two cavities. The 7-cell was way off, he did this with two iterations, stopping midway to adjust the straight ahead quads before reaching crest. The 2-cell was fairly close to crest. The buncher phase was pretty good where we had it. After doing all this, beam energy was 2.1 MeV
6. Then the booster tripped on low liquid level, sigh, but recovered within 30 minutes
7. Also, at some point during the process, the laser became unstable, with amplitude variations, not periodic. Then the fluctuations went away. I’m sure we will have to solve this sometime!
8. Yan continued to refine the setup, quad focusing in particular
9. RadCon came to perform the breakpoint radiation measurement, in tune mode and then at 1.5uA CW beam to M701. David said he could see lots of radiation above the cave, I guess expected. That’s why Cave2 rooftop is High Radiation Area.
10. Finally, beam to FCup3 for Kevin to check the RC#2

Next week, what to do:

1. Invite SSG to look at BLMs
2. Need to decouple the acceleration of 2 and 7 cell cavities. We have 2 MeV now, how much from each cavity? In other words, we need to set the 2-cell gradient to provide the design energy 500 keV, and then perform a GSet calibration with the 7-cell.
3. Then we go to 5 MeV and compare performance to Alicia and Yan models, with breakpoint
4. Then we go to 10 MeV, with breakpoint
5. And we need to change temps of chopper cavities to reduce reflected power
6. Setup the Chopper
7. More RC#2 tests

Day14 – week 3 (Aug 6)

Summary of today’s work

1. Day shift was a “maintenance day” with the following jobs getting worked:
   1. Quad M701 was declared bad, Mike Beck submitted atlis to replace with our spare, to happen tomorrow morning
   2. I rotated camera M401
   3. Carlos moved the Wien filter back into cave for HV testing (unrelated to run0)
   4. Andy hooked up a cable, the Italian collaborators are talking to something
   5. Kevin Wei replaced a bad lockin amplifier for Rawgowski coil tests
   6. Kevin Banks moved steering magnets back to the MeV spectrometer line per Yan’s guidance
   7. Jim Kortze, Scott and Sue tried to load new firmware to the valve/vacuum chassis, to address the three waistheight MeV valve, M5, M6 and M7 that can complicate operation of other valves. The fix didn’t take so they backed out.
   8. Cryo made some adjustments to CTF to help stabilize operations when VTA is taking liquid
   9. Tomasz and company updated some cal numbers for the rf system
   10. Tomasz and company flipped the sign of the temp diode on cold windows, we should have protection now
   11. Michele and Theo updated Save/Restore to include all MeV devices
   12. Brock Roberts completed the analysis of the Buncher GSet scans, results look good, see logbook
2. We locked up at 4pm and Joe studied the chopper setup
3. The BPMs were not functioning as expected: Scott Windam power cycled the 10 MHz sync system, more study required
4. Quad magnet M504 won’t reach setpoint

Day13 – week 3 (Aug 5)

Summary of today’s work

1. Yan locked up and Tomasz showed him how to turn ON the rf to the booster
2. Yan steered beam through the booster and then turned ON the 2-cell, it was easy to use downstream in-line viewers to find the phase of the 2-cell, crest provides a tight beam spot. So we accelerated beam with the booster!
3. We noticed the now-familiar fast beam motion on MeV viewers M504 and M601, related to magnet instabilities. Magnet folks replaced some card with ones that have the correct “analog blocks”. Beam stability restored. If it happens again, frequent culprits are quads 503 and 504
4. After restoring stable beam on viewers, we saw beam moving around again, but this time because the RF mode went to SEL (self-excited loop). RF could not be restored because of CTF problems with Kinney pumps

What’s next:

1. Pickup where we left off: 2-cell optimization, clean up orbit, adjust quads for focusing, save setup. Then add rf to the 7-cell, phase it up, repeat above, good beam to M601 dump, save setup.
2. Stop, go into the cave and re-install steering magnets on the spectrometer line, use channels from elevated beamline? Running out of magnets, running out of channels. I hope with MeV beam we don’t need all the corrector magnets Yan added to the beamline!
3. Put beam into the spectrometer and measure the energy, calibrate the 2 and 7 cell GSet values

Cave OPEN tasks

1. Investigate what seems to be a short to ground for quad M7 on the spectrometer line
2. Rotate the camera on viewer M401
3. Andy needs to connect a cable to something

Day12 – week 3 (Aug 4)

Summary today’s work:

1. Joe checked quad wiring (all was well) and the keV dump viewer (it was oriented fine)
2. the cave wouldn't sweep because the crash button at the labyrinth had accidentally been pressed.  Jerry helped figure this out
3. gun ramped fine, beam restored on viewers just as they appeared the previous day, good
4. Tomasz checked the rf to the 2 and 7-cell booster cavities, adding power to cavities with no beam through booster, the tuners moved and the cavities were set to resonance, forward power reading back, happy in GDR mode, I think we are ready to make MeV beam tomorrow. Thanks Manny, Rama, Tomasz, Clyde, Mike D., Steve Dutton, Larry King and a slew of others.
5. noting that we need to use the chopper for UITF operations, I revisited the keV lens settings, in particular, I powered both of the lenses that straddle the master slit (one was OFF). Similarly, it seems to me the outer most solenoids should be set similarly.  Figure1 below. MFAK301 and MFAK303 are now at about 1 A, MFDK302A/B are now at 1.2A.  Model predictions of solenoid settings, I will hunt for them. After making these changes, I spent time lens centering, but there's still work to be done.  While also minimizing loss on apretures.  I think I am losing beam somewhere.
6. beam to keV spectrometer, Joe and I hashed out methodology for cresting, satisfied with our old numbers for zero crossing and cresting, but we came to realize we were on the wrong zero crossing for bunching
7. repeated the buncher GSet scan using brock cavity, this time we obtained a very nice data set representative of obvious bunching for GSet about 70 waist at brock cavity.  We also did a buncher Phase scan using the brock cavity, not so obvious from scope pics what the correct phase should be.
8. Beam to FCup3 for Kevin and RC#2 tests.  I can't tell how it's going but Kevin notices when the beam trips OFF
9. while sending this trickle of CW beam (0.8 uA) to FCup3, there were lots of FSD trips with the downstream booster valve closing.  Yes, Jim volunteered to swap out a chassis but I wanted to keep running beam.
10. the gun tripped once, no obvious problem with QE

what's next:

1. chopper setup required at some point, refine the lens values and orbit
2. turn ON the two cell with GSet to make 500 keV beam (GSet should be 2.6 MV/m assuming accurate cal factors in epics).   adjust phase while looking for beam to tighten up on viewer M504, use BPMs to steer and ditherer to center in quads.  Before this, gather the predicted quad settings....
3. do the same for the 7-cell.....

Day11 – week 3 (Aug 3)

Summary today’s work:

1. Wrapped up work inside the enclosure: resistor removed from the SF6 tank, pumped down and then backfilled with ~ 60 psi SF6. The gun went to 200 kV no problem
2. Scott pulled cables through the trench for lock in amp rack that is now inside the UITF control room, with RadCon’s permission
3. Joe analyzed last week’s buncher Gset results. The graphs seem to suggest we were at zero crossing, but the buncher studies using the Brock cavity suggest we were not on the bunching zero crossing.
4. RF guys worked on stuff and made good progress:
   1. Klystron 1 awaits testing. The problem was with software . One needs to use column 3 (for nonexistent klystron 3) to enter proper numbers for column one (klystron 1, the two-cell).
   2. Fibers cable between LLRF chassis and Stepper controller have been added.
   3. GMES reading values now. Mike provided right coefficient and we will test it soon.
   4. Interlock chassis – RF window temperature reading still looks suspicious. After few modifications we can read voltage from sensors but when we increase the temperature of test resistor, the output voltage drops instead of rising (as it is happening in C100).  We need help form Steve Dutton, Mike Drury and Larry King team to understand the different behavior of this sensor and how can we set the trip level
5. Locked up and beam restored on viewers, which is nice
6. I steered beam and finally delivered it to the straight ahead M601 dump: beam on all BPMs and harp scan. Beam sometimes seems noisy to me, moving around but adjusting quad values did not stabilize things. Beam is big on viewers M504 and M601, perhaps more time adjusting orbit and quad focusing would help. AS it is now, I don’t think we can perform the break point tests with RadCon and SSG using 200 keV beam to dump3 (M601)

For tomorrow:

Before lock up:

1. Check quads with hall probe, each wired properly and the same?
2. u metal?
3. Rotate the keV spectrometer dump viewer, Yan and I think it is opposite to reality, and this causes confusion cresting, zero crossing identification
4. RF guys will continue to address items listed above, but we can lock up after doing items 1 – 3 above

Lock up at ~ 9 am:

1. Buncher studies again. Hopefull we find the same zero crossings as last week
2. Chopper setup
3. Measure the electron bunch (laser pulse) with the chopper
4. Hunt for source of MeV beam noise
5. Assist rf guys with booster rf-interlock checks, booster setup
6. On swing shift, put beam into FCup3 for Kevin, study RC#2

Day10 – week 2 (July 31)

Summary today’s work:

1. Locked up and saw beam on MeV viewer M401 right where we left it yesterday. Good reproducibility
2. Then tried to steer beam to M504, saw the familiar stripe. Then while changing quad settings, the beam started to move around, sweeping across the viewer. Eric Diggs came to investigate, changed a board for a quad in the spectrometer line that won’t cycle, but the beam motion remained
3. I changed the settings of quad 3 (MQJM503) and the beam motion suddenly stopped. Gary Croke noticed MQJM503 was very noisy for about one hour. I noticed MQJM504 was also noisy during this same time period. When we see this problem again, let’s be sure to check these two quads
4. I used quad values close to Joe’s recommended settings for 200 keV beam, and I used tune mode beam to steer and maximize the BPM wiresums. The net result (once the beam motion stopped) was a tighter spot on viewer M504, similar in size and shape to M401.
5. Then I tried to steer to M601 without luck. After opening the enclosure, I see lots of steering magnets on the beamline, but apparently using the channels labeled M7 and M8, which are for different regions of beampipe on the quick reference. So we must make note of magnet names and temporarily change the quick reference to do the steer up
6. While beam steering was happening, Tomasz tried to add rf to the two cavities in the booster. Some progress but still stuff to address, per Tomasz:
   1. Klystron 1 (or LLRF drive)  is not producing power (Larry and Sam are working on it)
   2. Fiber cables between stepper chassis and FCC are missing (no detuning info for resonance control)
   3. Calibration of forward power measurement needs to be verify (Larry ?)
   4. GMES reading is way off! I can do some fudging using numbers (Q ext) Matt provided  but  why reading is wrong since SRF folks already calibrated it ?

For Monday:

1. Remove resistor in HVPS and backfill with SF6
2. Remove shielding in trench4, and pull cables for RC#2 and the lock in amp rack
3. New interlock chassis?
4. Pull optical fiber for stepper motor control of the cavity length
5. Remove pads on keV BPMs
6. Annotate the quick reference to be representative of the current placement of MeV steering magnets
7. Move steering magnets into the quads and add u-metal
8. The keV spectrometer viewer is flipped 180 degrees (that’s why we got the zero crossing wrong on Tuesday). Other viewers likely flipped or rotated strange ways
9. Shukui and Kevin, laser by-pass mode, verify modulation on laser light
10. Rapid access monitor in control room: “fail” light ON, and the second channel reports “BackUp RAM error”

Day9 – week 2 (July 30)

Summary to today’s work

1. RF guys working on the interlock chassis, maybe that’s the problem?
2. Shukui installed a new fiber, we have 9mW now at the laser table, with amp set at about 2A.
3. Swept and locked up ~ 10am
4. Beam restored to keV viewers perfectly, that’s nice
5. Unfortunately, buncher Pset values are completely different today, why? Hope this doesn’t happen frequently. Someone rebooted an IOC?
6. Yan and I mistakenly mixed up the two buncher zero crossing values on Tuesday, got it right today.
7. Calibrated buncher Gset vs Bdl and current to recent the beam when buncher phase was crested, for both accelerating and decelerating phases
8. We redid the Brock bunch length measurements vs Buncher Gset using the zero crossing that bunches, because like I said, I think we got it wrong on Tuesday. Joe will send files to Brock.
9. After buncher tests, we sent viewer limited and tune mode beam through booster to M601 BPM, Joe will suggest quad values for us, it would be worthwhile to improve the beam size, tighten it up, to throw 200 keV beam to one of the MeV dumps. Yan tried this many times, but perhaps not with good quad settings?
10. Beam to FCup3, and Kevin looked at the signals from RC#2. We decided to move the lockin rack into the control room, it will be easier to hunt for signal
11. We tried looking for current modulation on beam, but were unsuccessful, we should look for modulation on the laser power in the enclosure
12. Michele thinks she might have fixed the global channel access button
13. Gary said he changed the slider increments to 1 Gcm but it doesn’t seem like this is true. Logout and logon?

To be fixed:

1. BPM screen says we are in tune mode when we are in beam sync and the cave is OPEN
2. BPM wiresums are very different from region to region
3. MeV valves closing frequently, are we really having the ion pump current reach a trip limit of 100uA. I would like the ion pump signals to latch faulted, whenever I look at the screen I see green, all is well.
4. Wildly different buncher settings for zero crossing and crest.

Plan for tomorrow and Monday:

1. Lock up at 9am, work with Tomasz to power the booster with RF. Check functionality, resonance, etc.,
2. If things cooperate, try to make 500 keV beam
3. More beam steering in the MeV beamline
4. Rowgoski coil tests? Need cables pulled through trench to control room. If we can pull RC#2 coil cables through trench tomorrow before lock up, great. Otherwise it waits till Monday
5. Saturday, Carlos and Bubba pump out the SF6 in HVPS tank and remove resistor
6. Monday they will pump down and backfill with SF6
7. RF guys install a new/repaired interlock chassis?
8. Next week, MeV beam all the time!!!

Day8 –week 2 (July 29)

Remember at the end of each day to:

* Close valves
* Check Rapid Access Beacon before opening the cave
* Log status Cave OPEN

Summary of today’s work:

1. Steve Dutton verified proper functionality of the cold window temperature diodes. Both diodes behave similarly
2. Locked up and brought gun to voltage when Manny appears, dropped the sweep and let him in the cave
3. Manny and Chris Kerns attached the cables to the diodes, the one that didn’t work now provides a reading, but the one that previously worked provides no reading

Day7 – week 2 (July 28)

Summary of today's work at UITF

1) Joe made a new photocathode and he performed a QE scan, we operate from a new laser spot now, so steering was requried

2) Rama and Tomasz showed us how to operate the buncher (GDR mode, GSet and Pset are fine on the combo page, we read forward power)

3) Yan put beam in the keV spectrometer, we found zero crossings and identified the one that bunches

4) Yan steered straight ahead to FCup2, we went CW mode, noticed loss on aperture 3.  Getting into the habit of using all the tools available, we steered out the loss

5) We used the brock cavity and saved scope traces versus buncher Gset to 280W. Joe saved the scans and will send to brock for analysis.  We imagine we went through a "waist" at the brock cavity this time, i.e., bunchlength minimum.  WE can use this info to scale the Buncher Gset to put waist at two-cell

6) We noticed the beam orbit shifts versus CW beam current, because there's a conditioning resistor inside the HV SF6 tank.  It should come out when convenient. It;s not a problem to viewer limited mode or tune mode, but will complicate our RadCon measurements at energy break points.

7) noted some things to fix, separate elog

Tomorrow's plan.

1) hope to begin ~ two-shift operations from now till end of run0

2) beam to keV spectrometer, buncher on crest/accelerate and map Bdl versus Buncher GSet, to determine buncher gradient.  Use this to estimate buncher Gset to put waist at two-cell.  This method and brock cavity method should agree.

3) go straight ahead to FCup3 and work with RF/SRF group to turn ON the two-cell.  Maybe systems checks still needed?  are we resonant?  stuff I don't know.  Try to make 500 keV beam and send this to MeV dump

4) when not using the booster rf, 200 keV beam to FCup3 and commission the RC#2 with Kevin

Using the standard CEBAF tools (BPMs, current monitoring at aperture, comparing cup and gun currents, ditherer, etc.,), getting more confident in the setup, working toward a "gold" keV orbit

Need to leave the Buncher powered ON all the time

I want to lock up at 9am tomorrow.  I will be in control room through day shift, Kevin I might hunt you down for RC#2 tests if we can't power up the booster.  It's still unclear to me if we have the green light to turn ON booster.  I think until we have the green light for booster Ops, there's no point working two shifts.

Two concerns:

1) Vote: do we need to operate with the choppers ON.  If the consensus is Yes, there's a shift or two of work required.  Tomorrow I will try to flesh out a schedule (never been easy) and populate it with names.

2) There's no yao cavity system at UITF, can we phase things up with just spectrometer?

Day6 – week 2 (July 27)

1. Carlos was successful in blowing off a field emitter inside the gun on Friday at 250 kV. Then Mamun and Carlos pumped out the gun, restored the ion pump and set gun to 200kV under good vacuum conditions. The gun soaked at 200 kV over the weekend without a trip, so a good result. There’s still field emission, and it turns ON at only 120 kV, but the decarad counts are much lower than previously, and gun ion pump current is 7 nA with voltage ON, 3 nA with voltage OFF
2. Joe is heating photocathode to 300 C and then will let cool, activate this afternoon
3. Phil is setting up the elevated beamline bake
4. Manny is checking booster interlock cables, fixing connections

Day5 – week 1 (July 24)

1. Krypton processing the gun to blow off a field emitter or two. After some eight hours of processing, an emitter appears to have blown off at 250 kV.
2. Mamun is waiting for vacuum to recover inside the gun chamber, after closing the krypton valve. He will bring the gun to 200 kV under good vacuum conditions, and we will let it soak at 200 kV over the weekend. Carlos will monitor from home. Decarad activity was about 2500 counts/sec from one of the heads on bottom of gun chamber before krypton processing, we want to see the counts now after blowing off the emitter and during a long weekend soak.
3. RF group checked the interlock cables and indeed they found problems with wiring. Manny will work on the cables this weekend and on Monday he can install them.
4. I note that we still have the conditioning resistor inside the gun HVPS, so we must remember that gun bias voltage will depend on the current we are extracting. With 100 MOhm resistor and 50 uA, we lose 5000 V at the gun. So beam orbit past bend magnets will depend on extracted current. Set up with VL beam or Tune mode beam, and we must expect different orbit in CW mode at 10 uA (1000 V drop at cathode)

Plan:

1. Soak the gun at 200 kV over the weekend, monitor field emission
2. Monday: re-install the RF cables, heat the photocathode and activate on Tuesday morning
3. Beam on Tuesday, work to set the buncher phase and gradient. From there, try to make 500 keV beam. Then in afternoon, test Rowgowski coil?

Note: If field emission is high, and the gun won’t sit at 200 kV without tripping off, we should reduce voltage to 190 kV and set up the booster there.

Day4 – week 1 (July 23)

1. The HV cable does not appear to be damaged, the cable was regreased and tightened into place per instructions from vendor
2. The photocathode has 30x less QE today, following a few hours of running and HV trips
3. Ramping to HV without a puck, there seemed to be less FE, things looked good. Beam restored to Faraday Cup 3 but with significant vacuum rise inside the gun. Eventually the gun tripped OFF again. Decided to pull puck and krypton process on Friday. Gun voltage needs to be stable and ON. Meanwhile….
4. Larry measured the attenuation of various connectors for buncher, these will get added to epics to provide a relatively accurate measure of power delivered to the buncher
5. Some issues remain with booster RF, interlock connection not making up
6. Gary installed the HDIce dump module, pumping down

Plan, once the gun becomes reliable:

During Day shifts, try to lock up by 10am

1. Buncher zero crossing and bunchlength measurements vs gradient, set gradient to put waist at 2-cell
2. Make 500 keV beam using two cell, beam on viewers all the way to the dump? How to set phases?
3. Make 1 MeV beam using two-cell and seven-cell, beam on viewers all the way to the dump?

During Swing shifts

1. Restore 200 keV beam to Faraday Cup 3, commission RC#2 with Kevin Wei

Day3 – week 1(July 22)

What happened today:

1) With help from Anthony Delacruz, Chris Norris and Scott Higgins, Team HDIce verified the viewers installed in the HDIce dump will not collide.  
2) Scott Windham terminated the 1 MHz reference cable for rowgowski coil#2 commissioning, Kevin Wei prepping for tests with beam  
3) Manny re-connectorized the heater cable used to provide heat to booster cryostat, seems to be working fine  
4) Clyde, Tomasz, Larry and Rama made great progress on the buncher controls. Screens look good, we can set buncher Gset and phase. Larry will note the attenuation of various components and with Rama's help, these numbers will get loaded to software so that we can relate Gset to forward power. Our models tell us the approximate forward power necessary to put longitudinal waist at the booster two-cell cavity, so it’s good to have a readback representative of the actual power at cavity  
5) Yan locked up and set the gun voltage to 200kV, there was a rather large vacuum burst at 40 kV which might have significantly reduced QE, but there's still enough for viewer limited, so we could perform HCO-with-beam.  
6) loading a saved file, unfortunately beam did not transport to previous destinations. Sigh, we didn't change anything in the keV beamline. We make beam from a different laser spot, but even after centereing in first two lenses, significant changes were requried downstream more than I thought should be necessary  
7) Gun HV tripped off at 200 kV and then repeatedly at voltages < 100 kV  
8) before the gun HV problems, Yan had 200 keV beam downstream of booster delivered to Faraday Cup 3

What to do tomorrow:  
Enclosure OPEN until ~ 11am  
1) Team HDIce will install the dump module and pull vacuum. That means vacuum from gun to HDIce, a nice milestone  
2) Phil will begin prepping the elevated beamline for a mild bakeout, anticipating run#1 follows on the heals of run0 (set t happen through August 20)  
3) need to QE scan at low voltage, to see what sort of QE remains  
4) turn on the Brock cavity o-scope  
5) inspect gun HV cable, re-grease it? replace it?

Enclosure locked up, don't know exact order of these activities but in the coming days we must....  
1) more HCO with beam, 200 keV beam to Faraday Cup 2, and then Faraday Cup 3 just downstream of booster  
2) buncher commissioning using harmonically resonant cavity (Brock cavity). Beam to spectrometer, find zero crossing, then set to crest, then striaght ahead. Find longitudinal waist at cavity, compare distances, scale power to put waist at two-cell  
3) Work with RF and SRF folks to verify the booster interlock connections are functional  
4) Work with RF and SRF folks to set cavities to resonance  
5) heat and reactivate the photocathode?  
6) work with Kevin and see if rowgowski coil #2 can see beam motion, i.e., acts like a BPM but at nA or even pA currents  
7) when Chris Norris is back next week, and with Yan's guidance, finalize the connections to the HDIce dump viewers, which keV viewers are we giving up?  
8) unrelated to lockup status, check the bluejeans connection between two control rooms  
9) update the quick reference to include rowgowski coils 1 and 2, an image of chopper slit, polaimeter presently in keV dump line

10) check the elevated beamline re: names and order of elements, update UED

Day2 – week 1 (July 21)

Some progress today at UITF, day#2 of run0:

1) we have formal beam authorization for MeV beam delivery to waist height dumps

2) Opened all the valves along the waist height beamline, decent vacuum, but the booster still pumps on the beamline, which I guess is no surprise.  Pressure at downstream ion pump doubles from 5 to 10 nA when all beamline valves are opened

3) viewers are working, still figuring out how to test the HDIce dump viewers, Gary hooking up compressed air, Chris Norris installed the anticollision circuit, Scott working on software mods

4) Clyde is making new epics screen for the buncher

5) Manny fixed the heater cable problem, we can add heat to the booster.  He added the interlock chassis

6) Scott figured out how to implement the circuit for QE scans

7) Kevin is wiring up Rowgowski Coil #2 to the lockin amp rack

Plan for tomorrow:

1) Scott, can you help Kevin with bnc cables:  make cables from RC#2 to lock in amps, and 10 MHz reference signal - probably best to cut the cable near the rack, add male connectors to each end, then the cable can be used to provide reference at two locations for the rack

2) figure out who will help energize the booster, call it ready for handoff to me/Yan/Joe and Reza

3) test the HDIce dump viewers?

4) get the ion pumps ON on the elevated beamline?

5) lock up at 10am for HCO with beam, at 200 keV

6) RF group continue buncher and booster work, while we make keV beam

Day1 – week 1 (July 20)

Folks, here's status of UITF today, a pretty good day:

1) Dave Hamlette of RadCon completed the shielding credited control checklist. He will tweak Keith to sign off on beam authorization, then I will ask Camille to grant it.  
2) the beamline vacuum seems good enough. A little high at the new ragowski coil, 2x10^-8 Torr but I think the dif pump station will protect the booster. Tomorrow we will open the valve between rowgowski coil and booster and see how ion pumps respond  
3) the laser RF is ON now, but there are now two RF issues that impact run0. a) it seems we have different buncher hardware now, we lost Gset and Gmeas. b) still no heater control which is needed to stabilize CTF operations  
4) one magnet pair needs to be added to beamline  
5) two valves need to be reconnected to controls  
6) two cameras need to be reattached to viewers  
7) the pump cart can be removed from beamline  
8) Andy and Gary finished installing all the new nipples on elevated beamline, turbo pump cart still attached, will pump on line until ion pumps can turn ON  
9) need to add compressed air to the two IBC dump viewers, then we can exercise them and make sure the anti-collision circuit is working properly, then HDIce can install dump  
10) Scott and Joe and I want to try the QE scan tomorrow, the old hardware should still work just fine! Scott asked Pete to reboot the picoammeter software which got hung up

I would like us to use white board at the UITF labyrinth entrance again, we will post the week's plan, etc.,

Yan, how about we let folks complete some of the work outlined above and then try to lock up at 10am for "HCO with beam". But others can chime in with urgent requests.

Thanks everyone  
Matt

Things to fix:

1. Ion pump at the chopper, replace it
2. At the UHV ion pump patch panel near MeV spectrometer, cable for pump M301 (?) doesn’t appear to be connected as imagined. More labels are required on pump cables, on the patch panel, and the red cables going upstairs
3. Many ion pumps appear to suffer field emission, e.g., M301A/B
4. Configuring the viewer interlock screen is puzzling to me, why click three buttons to reset?
5. Current limit potentiometer on Gun HVPS is not a good way to limit beam current where there’s field emission
6. BLM K402 appears to be tripped
7. The 100 MOhm resistor is still in the Gun HVPS. This means the gun voltage is different depending on the CW beam current, 50 uA = 5000 V voltage reduction, 10uA = 1000 V reduction. The beam orbit is going to vary with CW beam current
8. Need a pig with conditioning resistor
9. We did not actually perform HCO
10. We did not use the HCO tool
11. Some groups refuse to make logbook entries, no idea what’s going on or status of systems
12. Haimsons should be attached to BPMs as designed, this would let us wrap more of the beamline with u-metal
13. When RF trips OFF, at CEBAF, this pulls an fsd. But not at UITF, should we make this happen?
14. Diode temp sensor on cold window not working
15. Temp readback in epics for buncher and chopper cavities
16. BPMs read “tune mode” when we are in BeamSync and the Cave is OPEN
17. MeV valves close frequently, current at ion pump near RC#2 spikes to 100uA? How is that possible, clipping beam on RC#2? Make sure the coil wires are shorted/grounded when not using
18. Today the laser phase setting is the reference for the entire machine. Is this the best approach for long run? 125 degrees? Seems like we will pay dearly for our loose approach to a phase reference. At CEBAF, it’s the buncher phase, and over 20 years, it has remained relatively constant, remarkable.
19. Some cameras on viewers could be rotated, fine tuned, focused, etc.

What to do between run0 and run1?

1. Survey and Alignment, the elevated beamline, the gun? MeV beamline where RC#2 was installed
2. Install a new fsd related to rf tripping OFF

The tasks include:

1. Obtain, refine “gold orbit”
2. Use chopper slit to measure the electron bunchlength
3. Chopper setup
4. Buncher gradient calibration with spectrometer: GSet to put waist at two-cell
5. Buncher gradient calibration with brock cavity: GSet to put waist at two-cell
6. 2-cell ON, 500 keV beam to MeV spectrometer
7. 500 keV breakpoint: BLM checks with SSG, and RadCon checks
8. 7-cell ON, 1 MeV beam to MeV spectrometer
9. 1 MeV breakpoint: BLM checks and RadCon checks
10. 7-cell making 5 MeV beam
11. 5 MeV breakpoint: BLM checks and RadCon checks
12. 7-cell making 10 MeV beam
13. 10 MeV breakpoint: BLM checks and RadCon checks
14. Emittance measurements with MeV beam
15. Energy spread measurements with MeV beam
16. Yao cavity bunchlength measurement, develop the procedure
17. Rowgowski Coil nA BPM evaluation: a) calibrate viewer intensity vs Faraday Cup reading, b) calibrate viewer position vs steering magnet setting, c) modulate beam and see if RC#2 signals vary with beam position, do this for a variety of beam currents, identify lowest current at with RC#2 works

Tasks with Cave Open:

1. More laser light, install new fiber
2. Modulation: set and measure it for RC#2 tests
3. Remove conditioning resistor to maintain gold orbit in CW mode