Running Log run2

(Poelker)

Day12 of run2, November 9, 2020

Last day of Run2.

1. We began by studying the Rogowski coil. Still no sign of a signal
2. We checked out an FSD node associated with beam position as determined by the halo counters. It did not work. Unmasking this node simply turns OFF beam.
3. We finished with DAQ checkout, Tsuneo looking at the asymmetry measured with the holo counters that see beam at the target. Beam intensity is still being modulated at the laser table.
4. The photocathode QE is very low now, we need to heat/reactivate
5. Xiangdong will study NMR signals at 9pm
6. Roof tiles come off tomorrow morning, at the end of beam Ops, Yan will lockout the gun and the high power RF and send a note to Keith, David and Harry

Day11 of run2, November 7, 2020

1. We picked up where we left off last night, helping Tsuneo validate the DAQ functionality. We sent ~ 1uA beam to keV cup FCup2, and we adjusted pockels cell conditions while Tsuneo looked at the k403 BPM wiresum cabled into his DAQ.
2. Then we went into the enclosure and added a waveplate and fixed linear polarizer and verified there was ~ 10% asymmetry on laser power. We locked up and restored beam to FCup2. Tsuneo needs Hall B staff to report the result.
3. Then Matt Mock steered low current beam to HDIce, centering in keV solenoids and MeV quads, very nice beam to HDIce
4. At ~ 100 pA current, we can see the beam intensity modulation resulting from optics installed on laser table and Tsuneo reports a 5% asymmetry from the HDIce halo counters. Nice result
5. We then calibrated the beam motion at the HD target as observed by halo detectors, by moving the beam ~ 2mm at aperture A6.
6. At end of shift, there was 500 pA to the HDIce dump and Tom was studying the NMR measurement, performing a “sweep” of something, which will continue till 8pm. Afterwards, more of the same after making a change to conditions.

Day10 of run2, November 6, 2020

1. Began by turning RF and there was a large heat burst that Jonathan noticed, and it made the booster interlocks unhappy. Tomasz was nearby and he cleared the interlock faults (which we didn’t know how to do). After this there was one more instance of a rash of booster trips to SEL mode but for most of the day, the booster was very happy
2. Steering magnet MHBM803H mismatched a few times, clicking the equals sign on the rack page restored the field every time.
3. We learned we must stop the current lock when beam disappears (for example because of magnet MHBM803H mismatching), otherwise the attenuator keeps walking up and this can lead to excessive current when beam gets restored
4. Rogowski coil tests at 2 and then 20nA, first with lockin amplifiers and then a 4-channell scope. No obvious indication the device sees the beam. At the end, it was decided we should NOT be looking at the coil resonance frequency of ~1 MHz
5. Then we tried to create an artificial physics asymmetry by operating the pockel cell with voltages off normal, i.e., creating a large charge asymmetry so Tsuneo can verify his DAQ is working

Day9 of run2, November 5, 2020

1. We locked up and gave the machine to Tomasz. He patiently waited for SEL trips but there weren’t any! The booster is very happy today. He left the oscilloscope upstairs and we will call him with things act up
2. Peter Owen captured data from the booster field control chassis and Tom Powers analyzed it. Tom thinks things look pretty good. There are two dominant frequency oscillations, one at ~ 26 Hz, the other at 59 Hz. Per Tom, both modes look to be driven by external sources.  Neither is terribly bad.  Peter will visit the enclosure with accelerometers. It will be important to compare results when things are bad.
3. We then sent beam to HDice, the orbit recovered easily. Because there was time available, we tried to measure emittance using the 803 and 905 harps with qsutility, but configuration files do not yet exist, so we punted on emittance measurements. Sue will update the config files
4. Then beam through HDIce for their studies

Day8 of run2, November 4, 2020

1. In the morning, Shukui and Kevin verified the light going into the gun has ~ 1 MHz modulation when Kevin turns ON the function generator driving the in-line fiber optic modulator. So this means the electron beam possesses 1 MHz modulation. It remains a mystery why the Rogowski coil sees no beam
2. We locked up and beam restored to HDIce very easily, we didn’t bother to lens and quad center. Mike McC. expertly put beam on the golden orbit with negligible beam loss on apertures 5 and 6. I will write a procedure for this, which will be a recurring task.
3. HDIce explored the raster amplitude by measuring the temperature of the 3He and 4He mixing chamber as a function of raster size. Yesterday, they noticed smaller temperature rise when the raster amplitude is smaller, more temperature rise when the raster amplitude is bigger. They believe beam strikes the target cell walls when raster is too big, which they want to avoid.
4. The new decarad system provides useful information on beam orbit through apertures 5 and 6 and likely can be used to help us empirically set the correct diameter of the aperture A6.
5. The booster operated happily today from noon till 6 pm, with only a small number of trips to SEL mode. During these trips Tomasz was watching and he sees a large voltage spike of the CPS, followed by vibrations ~ 3.3msec later
6. Yan and Eric will continue to support HDIce measurements through midnight

Tomorrow: we lock up at 9am for rf measurements by Tomasz and Peter Owen. Then beam to HDIce starting around noon

Day7 of run2, November 3, 2020

UITF/HDIce run2 day shift summary:

Cave OPEN work

1. investigate why chopper slit won't work, no joy
2. Tomasz installed a little amplifier in the booster 2-cell circuitry

Locked up and:

1. beam to the MeV spectrometer and we phased the 2-cell, necessary because of the new amp, ignore all 2-cell phase values in previous saves
2. centered in lenses and quads, beam to FCup2 at whopping 1uA, looked for modulation using an oscilloscope and saw none
3. Beam back to HDIce
4. no improvement in booster performance, all soft faults masked to keep cavities in GDR mode, and we masked the 2-cell quench node with Mike Drury's permission. Once these things are masked, beam ON no problem
5. orbit drifts around, suspect energy related but also magnet related, because we steer in horizontal plane too. Learned we must keep beam OFF HDIce apertures for stable current
6. current lock works good, as long as there's little beam loss on A5 and A6 apertures
7. a few instances of mysterious magnet setting changes. Maybe accidental clicks? save/restore saves the day
8. HDice used CW beam at different currents, first 0.75nA and now 0.25nA, developing a methodology to perform the NMR target polarization measurement. This will go on till closing time tonight.

what's in store for tomorrow?

* With cave open, Shukui and Kevin to look for laser modulation near the gun, necessary for Rogoewski coil tests, then lock up and more of the same, beam to HDIce so they can accomplish their run2 goals.
* On Thursday, Peter Own makes microphonics measurements while we are locked up.
* When it's convenient, we need to measure emittance with new 905 harp on the elevated beamline

Day6 of run2, November 2, 2020

I didn’t make notes but we struggled the whole day with booster trips to SEL mode. Rick Nelson said the CPS noise Clyde identified was likely not real, and therefore not the reason the booster is so unhappy. So no identified causes or cures. Once we masked the soft faults, we could keep beam through HDIce. Masking these soft faults does not seem problematic for UITF but likely not something we can live with at CEBAF.

After masking faults, beam to HDIce was pretty easy, Team HDIce studied the NMR measurement.

Day5 of run2, October 31, 2020 (Saturday)

Short Summary: Clyde thinks he discovered why the booster is so unhappy. The cathode power supply (CPS) exhibits large spikes not present two days ago when the booster was happy. Great sleuthing by Clyde, now we need to fix the CPS, life will be much better at UITF.

1. Measured the laser circular polarization, it’s > 99%
2. We played with the fiber laser modulator. Looking at the pickoff photodiode in the laser room, Kevin learned how to apply modulation and adjust the offset to obtain a nice sine wave modulation at desired frequency ~ 1 MHz (if the offset is not correct, the modulation frequency is double the applied frequency). Then we looked for the modulation on the laser beam in the UITF enclosure but could not see it with the laser power meter, which is fast enough to see tune mode structure. It seems perhaps we have not actually been modulating the intensity of the laser beam? although the pickoff photodiode clearly shows it. It would be “good news” to learn we are not actually modulating the beam, because so far the Rogowski coil reports no signal. We need to talk this over with Shukui, look for modulation on laser light near gun, and look for modulation on the e-beam using BPMs or a cup.
3. Beam restored to HDice at 9.7 MeV/c but I had to adjust MBHM904H, MBHM904AH, and the radiabeam correctors to steer through the A5 aperture. Over the course of the day however, the orbit shifted and magnet settings seemed to drift back to the saved settings. Andy seems more willing to live with these drifts, permitting tweaks to the last three magnet sets to keep beam positions on the viewers as specified by gold orbit.
4. Booster very trippy again today, just like yesterday. If we mask the soft faults for cavity 7, the booster stays in GDR mode, and the beam stays ON. But beam energy excursions happen and the beam flies wildly. We think the apertures protect HDIce
5. Clyde called with good news, he thinks he knows why the booster is unhappy. The cathode power supply is not stable. Lots of spikes, and these are correlated with 7-cell GMeas drops. When the booster is happy, the CPS signal is a flat line. Today, there’s lots of spike/hash on the signal.
6. Raster studies baby! Team HDIce seems to like this raster.
7. At end of day shift, HDIce was performing an energy deposition measurement: they measure the temperature of the "mixing chamber" as a function of beam current and this relates to how much energy the electron beam deposits in the target. This is something they can compare to expectation, and represents one of the big run2 milestones.

To do:

1. Modulate the drive laser light, verify modulation on electron beam using BPMs or a Faraday Cup. There must be something in the HDIce apparatus that can see 1 MHz beam modulation, right?
2. Schedule Peter’s microphonics measurement
3. Get the CPS fixed
4. Decarad at apertures
5. Emittance measurement on the elevated beamline

Day4 of run2, October 30, 2020

Short summary: Tony got the harp working, a brace used to support the harp was actually making the fork short out during portions of its travel. Without the brace, all is well, no shorts. HDIce used the harp to better quantify raster amplitudes for X and Y, to make a more circular rastered beam profile. The booster was very unhappy today, many trips to SEL mode. Details:

1. Facilities replaced the fan belt on the ventilation system #2, this work is now finished
2. Although we’ve had official beam authorization since the start of run2, we now have a new beam authorization page that delineates the four possible beam destinations. Thumbs up for 25 nA MeV beam.
3. We removed the support bracket from IHAM905 harp and this eliminated the short, harp works fine now. Unrastered beam size near FCup4 ~ 300 x 200 um (1 sigma values). Andy says the X and Y are flipped, based on changing the size with raster magnets. Or the magnets are flipped.
4. Beam orbit seems to settle into place with time, hours timescale. I say this because I have to vary the aperture insertion depth in the morning, and then over the course of the day, I move these apertures to the previous night’s settings to maximize transmission
5. Booster tripped to SEL mode often today, every 10 minutes, maybe something related to VTA work today?
6. The booster FSD works, but it take many minutes to recover from trip to SEL mode. Even when it seems GMeas = GSet, and the faults are clear on the rf expert page, it take minutes for the “reset” button to clear the fsd on the fsd screen.? (actually, I learned I needed to click the master rest button on the expert page to clear the fsd fault)
7. HDIce played with the new toy, the harp, to adjust raster amplitude
8. In the afternoon, there were two strange incidents of finding a magnet at completely new and random setting. For each instance, we lost beam, and had to use the save/restore compare feature to discover random magnet change, one in the keV region, and one in the MeV 900 region.
9. Kevin applied too much modulation to the seed laser and this tripped the fiber amplifier OFF on too little seed laser power. Modulation changes should be coordinated with Ops
10. Finished the night frustrated by frequent booster trips to SEL mode, no troubleshooting joy

To-do:

1. The second decarad system is in the enclosure, there are many heads available. We need to pull back some cables and make connections. And we need the epics page to read these new monitors, placed at the aperture crosses. We will use the GM signals to properly steer through apertures, monitor interception real time. Will do all this on Monday next week
2. Measure emittance of beam with harp IHAM905, compare to emittance measured with IHAM601. Add harp swipe at IHAM803 and that should cover all bases, in terms of optics assessment.

Day3 of run2, October 29, 2020

The biggest achievement today was a new and improved raster from Bill Gunning, which more uniformly distributed the beam across the target cell. And now we can read current at Faraday Cup 4 with excellent resolution, 10 pA resolution or better (with averaging). In more detail:

1. Facilities replaced the fan belt on one ventilation blower, enclosure OPEN for this work. They will replace the other fan belt tomorrow, and this will finish the job until next year.
2. Vacuum pressure in the 904/905 region is fine for ops but still not good enough to use the UHV supplies. Maybe it will improve with time? It’s ok if it doesn’t
3. Beam restored to all viewer and HDice dump easily, although perhaps not exactly at viewer locations specified by Andy.
4. With Faraday Cup4 now working (Kevin had to turn something ON), we can now very clearly set beam current with 10pA resolution, nice. I used Faraday Cup 4 to fine tune the insertion depth of apertures A5 and A6, so now these steppers values are slightly different, with actual locations different by less than 1 mm, which I think is great
5. We scanned the harp in tune mode, with 25 nA average current. Maybe one of the wires indicates beam (middle one), the other two don’t show beam (shorted?). WE made an access and hooked up the silicon PMTs to the harp cross hoping we could scan the harp and determine beam size using x-rad detection instead of current. The silicon PMTs provide no signal. Puzzling.
6. Kiarra learned from Clyde how to use the booster rf fsd, which has probably been fine the whole time. I apologize to the many people I’ve complained to! The issue for me….I click buttons too fast and I was not patient enough for GMeas to equal GSet following trip to SEL mode. “Autorestore” does this for Ops at CEBAF, I believe. Now I know we don’t need to mask the booster rf fsd, it will turn OFF beam when we trip to SEL mode, I must be patient to clear the fault. All is well, Kiarra documented instructions and logged them.
7. Bill Gunning loaded a new raster pattern and Team HDIce likes it. I don’t know if they like it enough to stop work on laser blanking, the new User mode Roger Flood is working on. There’s less beam in the center of the target now, which is good, no hot spot.
8. We finished Day shift with Team HDIce trying to develop a procedure to quantifiably set the raster amplitude. I think we need a detector instead of viewers, and perhaps Decarad will serve this purpose. I will get with Keith Cole to see if the second decarad box is functional, it’s on the wall near HDIce.
9. Yan and Ken will support more raster studies, then Kevin’s Rowgowski coil measurements, and then Yan wants to study the harp futher.

To do:

1. See if decarad2 is functional, put GM tubes on the aperture crosses, use GM counts to steer through apertures, and set raster amplitude

Day2 of run2, October 28, 2020

Pretty smooth running today. The machine turned ON easily, beam at ITVM905 using settings from day before. Briefly, we seem to have found golden orbit with A5 and A6 inserted, and the new raster is better, providing more uniform beam across the target.

1. Turned ON the machine and heeding Yan’s advice from day before, we put the 9.7 MeV/c beam into the MeV spectrometer to check buncher and booster phases. Phase adjustments were necessary. Then we did a careful job quad centering all the way to HDIce
2. Andy wondered if beam was stable at our old momentum at 9.5 MeV/c, because Charles performed all his geant simulations with 9.5 MeV/c beam. Kiarra and I put the beam back in the spectrometer and we reduced momentum to 9.5 MeV/c, and then we adjusted the chicane dipole for lower energy beam, checking quad centering in 801 and 901. Beam on ITVM905 was pretty good, but we decided 9.7 MeV/c was more stable, although this was decided just by looking a small motion on the 905 viewer. We returned to 9.7 MeV/c but the difference in beam quality was small, if any.
3. Next we steered beam to the center of viewer ITVM904, and then we inserted A5 until beam came out the other side, corresponding to stepper position 660. It seems most of the beam sails through this 2mm hole.
4. Then we sent beam to the HDIce dump with raster ON. We varied the A6 insertion depth in increments of 10 units, while centering beam on A6 aperture using MHBM904A H&V and on the dump viewer with shadow of KelF target material visible, using MCRM904C H&V. All this while Team HDIce varied the IBC solenoid magnet. We did this a few times and found A6 insertion depth 660 provided the least motion of the dump viewer image while the IBC solenoid was varied, our golden orbit. Not perfect, but pretty good, probably as good as all our other golden orbits. It seems good that both A5 and A6 are set to 660 units.
5. The current monitoring at A5 and A6 works fine, although at today’s operating current of ~ 50 pA, there wasn’t much to see
6. We looked at beam on the two dump viewers, the 4 mm thick YAG provides more light than the 2 mm thick YAG, as expected.
7. All of today’s work was performed in CW mode with ~ 50 to 100 pA. At this current, beam looks good on all viewers, YAG or chromox. But indeed, we might need to swap out one dump viewer for something much thinner, if our plan is to operate at 1nA and monitor beam position with viewer. WE believe beam images will be too bright on thick screens at 1 nA.
8. At end of Day shift, Team HDIce was trying to set the diameter of the raster profile at the dump viewer and aperture A6. Lots of discussion and head scratching. What are we trying to protect?

To do for Swing and tomorrow:

1. Continue to support HDIce raster studies, and Rowgowski coil measurements at currents up to 20 nA. For Rowgowski coil studies keep FCup4 IN
2. We must reboot iocitf2 tomorrow morning
3. Facilities will change fan belts for ventilation system, behind UITF enclosure, before lock up
4. Investigate why FCup4 is not reporting current like the HDIce dump (not your equipment Pete)
5. Harp swipe with IHAM905 in tune mode, 25 nA average current, 1.7 uA macropulse current
6. MHBM904A H&V are swapped, H moves in Y, and V moves in X, rotate the steering magnet set 90 degrees
7. Puzzles: tail on beam in chicane and elevated line. For some 900 series quads, I get round beam at ITVM905, for others I get beam that looks clipped on leading edge. Time to revisit qsutility and model based quads
8. Get with Scott and talk about chopper slit stepper motor stage. Can it be made to work? Chopper might help clip off tail. Waiting for new motor to arrive
9. We quad center and then later have to do it again, what’s up?
10. Discuss with HDIce what it means to see uniform beam on dump viewer (what we have today, not what we had during run1). Maybe the raster plus radiation baffle combined provide uniform beam distribution on target?

Day1 of run2, October 27, 2020

Some rough patches in the beginning, but then things started to click. Beam restored to the elevated beamline viewer ITVM904 at the end of day shift. Yan and Ken will continue pushing things along.

1. We fretted over the vacuum in the section of beamline that was modified between runs 1 and 2. This section has new apertures, bellows, beampipe, harp and ceramic breaks. Much thanks to Phil Adderley for putting it together with CEBAF jobs looming, same to Scott Windham and Scott Higgins for getting the stepper motor stages working. Each of the four pumps now operates at ~ 150uA (end of the day), and currents will likely keep falling. Eventually, I hope to put two pumps back on UHV supplies that provide machine protection.
2. Thanks to Tony Delacruz for harp installation, haven’t looked for beam yet. Kiarra worked with Sue and Michele to add it to the UED, excellent, thanks
3. Chris Norris adjusted voltages to the video switcher and not both dump viewers work: ITVMA01A and ITVMA01B, excellent
4. I reattached the steering magnet MHBM904A H&V, Andy set the z-location properly. But alas the trim card for horizontal motion is unhappy. When I left for the day, Yan and Ken were inside the enclosure checking things out. Yan thinks he needs this steering magnet.
5. We locked up around 1pm, ramped gun to voltage. Not as much FE present on first viewer. Carlos turned ON the decarad system, and he reports count rates similar to before. So nothing good, nothing bad – heating and reactivating the cathode did not hurt the gun.
6. We loaded the most recent allsave, and then Kiarra and I centered beam in keV viewers, which we expected to do, because activating the photocathode is like a spot move steer. We ran from x/y=10,000/8000 in run1, and now we run from 10,000/7500. The keV orbit seems good to me.
7. The 7-cell was a bit unhappy to start with, but Tomasz came in and coaxed it into GDR mode. After this, the 2 and 7 cells stayed in GDR mode the rest of the day
8. We found MeV beam on MeV viewers, with a bit of flailing around. Eventually we delivered beam to the spectrometer and I think (will verify) the buncher phase needed to be flipped 180 degrees. I am pretty sure we had a power outage sometime during the UITF SAD and so it’s perhaps not surprising that one of the field control chassis turned ON locked to the other zero crossing. With buncher phased to bunch, life got easier
9. An epiphany for me: the beam was very jittery until we steered beam down the bore of the booster. Once beam was on-axis, there was MUCH LESS jitter. It’s possible much of my complaining related to booster jitter and quad magnet instability was actually due to bad trajectory through the booster, not on axis. This definitely needs more study.
10. I need to check the 7-cell GSet from run1, I think we are running a smidge lower lower GSet now (12.8 versus 12.68), to get what I call 9.7 MeV/c beam, granted I have not been methodical accounting for steering magnets along the line. The point here....warming the booster to room temperature did not adversely impact gradient performance, at least for the desired 9.7 MeV/c beam with same (or lower) GSets, no field emission.
11. Ken quad centered and beam arrived at ITVM904 looking pretty good, there’s a small tail on the beam, it will be prudent to fine tune the phases of buncher and booster further.
12. We swapped a bunch of trim cards, we are down to 2 spare now

To do:

1. DO NOT pull FCup 4 without HDIce permission – there’s a frozen target installed in the IBC and even VL beam (with uA level macropulse) can vaporize the target. So keep FCup4 inserted until we are all happy with setup, and have HDIce permission
2. Beam to ITVM905 just upstream of FCup4 and HDIce
3. Find the insertion depths for A5 and A6 (should be ~ 670 or so, which corresponds to 67 mm). Steer to minimize loss on these apertures. A5 = 2mm, A6 = 7mm
4. Recover the golden orbit, with HDIce help
5. Set raster amplitude, use the rastered beam to center it in A6
6. Harp scan new harp, do not exceed 25 nA average current (1.7uA macropulse current)
7. Fix magnet MHBM904AH if still not operating properly
8. Get more trim cards

Day 0 of run2: October 26, 2020 (HCO day, pre-run checks)

Today we finished the beamline modifications (apertures, harp, ceramic break on rowgowski coil, new nipple), pumping down.

VIPMA01 is now on UHV supply upstairs, the vacuum between beamline and HDIce is good, high -9s Torr (ip = 9 uA).

We recovered RF and this allowed a QE scan. 70 MHz RF synthesizer (LMX xxxx) in the MO chassis was in "undefined" mode. Chassis power cycling (re-programing) solved the problem. Active area similar to before, slight spot move required at start up.

Loaded an allsave and no apparent problems

Pete to hook up apertures to ammeters, Kevin to check I installed MHBM904A H&V correctly

Beam authorization to HDIce (but want authorization to all dumps, will work on that)

Locks removed from gun and high power RF