Running Log run3

(Poelker)

Day19 of run3, Thursday, December 17, 2020

Smooth operations today: two “high current runs”, both with reduced duty factor 2/3 obtained using the original User mode, free running clock at 200 Hz, ON for 3333usec, OFF for 1667usec.

Average current 333pA, peak current 500pA and Average current 500pA, peak current 750pA.

After these runs, HDIce wants to calibrate rates versus dump current for all the IBC magnet and raster configurations used (there were three configurations, I think)

Then finish the shift by measuring the beam momentum with M703 viewer in waist height spectrometer line

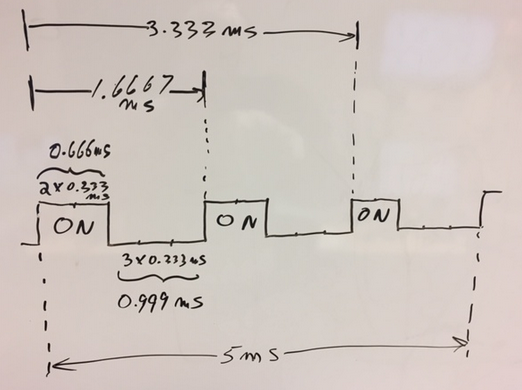
End run3

Day18 of run3, Wednesday, December 16, 2020

The day was messy as we tried to build and implement a new User mode, as shown in picture below. In short, things didn’t work out because we did a poor job communicating the beam requirements. Roger Flood, Gary Croke and Scott Windham did a great job trying to accommodate our request, but by 6pm we had to back out.

Scott found a VME board that can convert electrical to fiber signals, and vice versa. It is now installed in rack 7 for future use. Although, using this converter with the raster trigger was found to introduce noise on the raster signal….

There was one run, 0.5nA CW. Target polarization was only 5% before this run.



The raster frequency is 3 kHz, period 0.333msec, during each ON interval, there are two complete raster periods, and during the OFF period interval, there are 3 raster periods. Unfortunately, we did not provide Roger this picture.

Day17 of run3, Tuesday, December 15, 2020

We restored beam to FCup4, but this was mostly an exercise to kill time. We are waiting on a new User mode. I tried to deliver 1uA to FCup2 for Tsuneo’s DAQ studies but the photocathode can’t support this, only 80nA to the cup at full laser power.

The target polarization is down to 5%, which corresponds to about 1 more day of running. The following tests come to mind:

1) explore the potential benefits of new User mode, synched to raster and with multiple beam blanking intervals within each raster cycle. The idea here is to let electrons in the target diffuse to ground before they can accumulate in sufficient number to arc to ground

2) vary the size of the raster and measure dependence on NMR measurement

3) measure halo detector rates vs beam current (target does not need to be polarized)

Day16 of run3, Monday, December 14, 2020

Restored beam, 125pA CW, and performed two runs to explore the target polarization relative to the applied magnetic holding field. HDIce observed a 3x steeper slope in dP/dt when the magnetic field was halved, and everything else held fixed. They interpret this as confirmation that the polarization of atomic electrons (higher at the larger field) is an important factor.

At the lower magnetic field, not all electrons reach the dump, there is a 16% loss which we accounted for with the lock (i.e., the lock was set to 105pA instead of 125pA).

Andy remains excited about Roger Flood’s new User mode, with multiple beam blanking periods within the reference period. If things come together, we will tests this Tuesday afternoon, maybe Wednesday.

Day15 of run3, Saturday, December 12, 2020

Target polarization dropped yesterday during the runs with 250pA peak current, with DF 1/3 and 2/3, with the rate of decay similar for both runs.

We started today with CW 125pA average current with duty factor 1.

Next run at DF=2/3, 83pA average current, 125pA peak

Then DF=2/3, 125pA average current, 188pA peak current

Smooth running mostly. There was an instance when 5 BLMs triggered an FSD trip. Couldn’t find a problem, beam quickly restored to golden orbit

Day14 of run3, Friday, December 11, 2020

Got off to a slow start as we tried to figure out why the calculated average value of the dump current varied so much, by far more than our desired run current setpoints. We were especially puzzled as to why the average current was not zero with no beam, while the average value looked like zero to our eyes viewing a striptool. We never figured out what was wrong with the math Kevin was using to calculate the average – he tried short and long term averaging. So Kevin implemented another method of averaging the dump current, which works wonderfully: he records max and min values and writes these to fields, and these max and min values are replaced when values change with time. Then he simply adds the two values and divides by two. With this method, the current lock has no problems even when locking on current < 100pA. The daily charge plot shows the dramatic impact of this method (it’s true the beam current is NOT this stable but at least we can run the current lock now)

On the subject of knowing the beam current, I asked Luca and Tsuneo to calibrate halo detector rates versus dump current. Then we can verify beam current throughout a run by looking at the rates, a good cross check.

Two runs were completes: duty factor 1/3, average current 83pA, peak current in macropulse 250pA and then duty factor 2/3, average current 167pA, and peak current 250pA (which is a repeat of yesterday’s run, when the average current at dump was unreliable)

The gun HV tripped OFF once, a magnet mismatched once (M803H)

Day13 of run3, Thursday, December 10, 2020

Restored beam and finished the data taking at 125 pA average current and then started another run at 167pA average current. During the swing shift, they will likely increase current to 250pA average.

We added a bnc tee to the tune mode generator signal output of the macropulse chassis and delivered a copy of the beam mode to an oscilloscope for Andy to verify the duty factor, presently 66.7% (User Mode, 200 Hz free running, 3.33msec beam ON, 1.67msec beam OFF). Splitting the signal, the tune mode generator is fine.

One magnet card needed to be reseated. One magnet mismatched during beam delivery (no alarm).

Kevin is now averaging the dump current which makes the signal less noisy, but we had difficulties with the current lock.

|  |  |  |
| --- | --- | --- |
| status | Average current | Peak Current during macropulse |
| Done | 83pA | 125pA |
| Done | 125pA | 187pA |
| In progress | 167pA | 250pA |
|  | 250pA | 375pA |
|  |  |  |

Day12 of run3, Wednesday December 9, 2020

The machine restored well today and we restarted the HDIce program with new polarized target, polarization about 32%, similar to target 1.

We delivered beam in User Mode: 200 Hz free running clock, 3.3 msec ON and 1.7 msec OFF which corresponds to a 0.667 duty factor. The first run was at 83 pA measured at the dump, which corresponds to 125 pA in the macropulse. This run will be compared to the 125 pA run with target 1 in CW mode. Is it the macropulse current that matters? Or the average current?

Team HDIce measures the polarization of the target via NMR about every half hour.

At the end of Day shift, Andy made an access to send one of the halo counter detector signals out of the enclosure to an oscilloscope in the HDIce “control room”. He hopes to see the macropulse structure on the beam.

Tonight, resume beam delivery, perhaps at a higher current, Team HDIce will let Yan and Matt know what they want.

Days X,Y,Z of run3, Tuesday December 8, 2020

Since Tuesday December 1, the UITF enclosure has been open so that Team HDIce can install another polarized target.

The roof tiles were replaced this morning, RadCon has verified shielding in place. Locks have been removed from the gun HVPS and high power RF 480VAC receptacle. Camille granted beam authorization.

This afternoon, Team HDIce will measure target polarization using NMR and then they will flip proton spin, to be aligned with electron spin, using “adiabatic fast passage”.

Replace the vacuum beam pipe, to connect IBC to the accelerator beamline, activate the NEG to restore good vacuum

Day11 of run3, Tuesday December 1, 2020

No beam. The rooftiles were removed this morning so that Team HDIce can remove the target and replace it with the spare, hopefully it is polarized. If things go well, the rooftiles will be replaced on Friday and we resume beam delivery till ~ December 18.

Day10 of run3, Monday November 30, 2020

DAQ tests with Tsuneo: first with beam delivered to FCup2 at 1uA and 0.5uA, using the BPMs to see the artificial charge asymmetry manufactured with optical elements on the laser table. These elements were then removed to look for a “genuine” charge asymmetry, which would be much smaller than the artificial asymmetry. Finally, beam to HDIce at 1nA and Tsuneo did two runs, pockel cell ON and OFF. While delivering 1nA beam, we also puzzled over sharp current drops registered at the dump. In the end, Xiangdong suggested these sharp drops are coincident with periodic NMR measurements.

Day9 of run3, Saturday November 28, 2020

Smooth shift, running 125 pA to HDIce with periodic NMR polarization measurements

Day8 of run3, Friday November 27, 2020

Smooth shift, running 125 pA to HDIce with periodic NMR polarization measurements

Day7 of run3, Thursday November 26, 2020

Thanksgiving, no beam operations. Tom and Kevin performed periodic NMR polarization measurements throughout the day

Day6 of run3, Wednesday November 25, 2020

Day started with Team HDice filling a dewar and measuring the target polarization without beam. Then we locked up and sent 250 pA to target, a repeat of the previous day’s measurement. Team HDice is investigating an apparent reduction in target polarization, could be real or could be some systematic issue.

Day5 of run3, Tuesday November 24, 2020

A good day, the machine was mostly very reliable and we delivered 250 pA to the polarized HD target for ~ 8 hours uninterrupted throughout Day shift. The program will continue this way through Swing shift.

We had one instance of lost beam due to quad magnet MQJM503 mismatching. We corrected this problem and then sent ~ 30pA beam to the 904, 905 and A01 viewers. We noticed beam position low on 905 and steered this out. It seems prior to the lost beam, our orbit was drifting with significant beam loss on A6, which the current lock was addressing by increasing the attenuator value. After putting the beam back on the golden orbit, the drift went away and the laser attenuator stayed ~ fixed at 150 to provide the requested 250 pA.

The lesson learned from the incident described above: strip tool dump current, laser attenuator, and beam current on A5 and A6. Interception on these apertures should be small and constant with time. If interception varies, put beam back on the golden orbit using the last three viewers, with ~ 30pA beam and laser attenuator set low (~ 120). Once orbit is good, let the lock return current to the requested value. Sure, this can take a while, but it’s better than accidentally sending too much current.

Periodically (every ~ 30 minutes), Team HDIce will measure the target polarization via NMR. When they do this, they must change the magnet settings at the target and the raster. HDice will ask you to mask and then unmask the raster fsd node for this measurement. It only takes a few seconds to do this.

Field emission from the gun was constant throughout the day, with channel 7 reporting 1500 counts/sec, which is about 3 times the value during previous runs. Fortunately, this does not seem to be a problem for gun lifetime at HDIce currents

On Wednesday morning, after letting the target sit overnight, they will measure polarization to see what sort of damage the beam might have caused. Then likely we will increase the beam current and do another run.

Day4 of run3, Monday November 23, 2020

Carlos and Bubba removed the resistor pig and attached the gun directly the HV power supply. I pulled dummy puck8 and installed puck31 which I verified still had QE. I paid more attention to minimizing the creation of particulates by following Joe’s advice related to puck installation, pulling on the long manipulator. And I did not engage the key slots of the puck with the ears of the schneedle. Puck went in on the first try and stayed in when I pulled out the schneedle.

Matt Mock steered beam to HDIce, lens centering all the way. We also sent beam to the MeV spectrometer line to verify momentum 9.7 MeV/c. Fairly large phase adjustment was necessary for the 7 cell. Don’t know why.

We spent time working with Andy to put beam on the golden orbit, and to set the insertion depth of the apertures A5 and A6.

Then we sent 50 pA through the polarized target and Team HDIce measured target polarization with NMR. We learned we must mask the raster FSD during the NMR measurement. No indication of depolarization at 50 pA. Then we increased current to 125 pA and this run will continue into swing shift. So far, so good.

Day3 of run3, Sunday November 22, 2020

Carlos krypton processed the gun and blew off a few field emitters. Then at 4pm we pumped out the line and applied voltage under good vacuum conditions. Field emission levels were much lower, and approximately 2x the values from previous runs, which we deemed low enough to run beam.

Day2 of run3, Saturday November 21, 2020

Team HDIce finished the NMR tweaks and then flipped polarization via “adiabatic fast passage”. At ~ 3pm we were given the right-of-way to fix the gun

Carlos turned OFF the heat tapes to the turbo pump out line, and then he and I re-cabled the gun using the resistor “pig”. Then Carlos started krypton processing

Day1 of run3, Friday November 20, 2020

Team HDIce successfully installed a polarized HD target into the IBC, and they worked inside the cave to fine tune their NMR measurement.

Earlier I had heated and activated the photocathode for final run. Unfortunately, problems related to installing the puck created excessive field emission from the gun. There were three HV trips, half the QE remained.

Carlos and Marcy reattached a turbo pump for krypton processing and began baking the line from bake ion pump to turbo

Things to do before run3:

1. heat and reactivate the photocathode
2. we will investigate the stubborn chopper slit, although we have not used the chopper yet, so maybe we won't use it for run3 either
3. I would like more laser power so I will see if I can couple more light into the fiber
4. Tsuneo, can I remove the optical elements used to make the charge asymmetry?  can you summarize your results, did you see a charge asymmetry for the first runs where we only changes PC voltage?
5. will we be adding a smaller hole to aperture A6?  vacuum is good in this region now, with a healthy purge, we can likely restore equally good vacuum but sooner is better than later, to make a decision
6. Matt Bickley is making a coulomb counter for us
7. fsd or some software program that uses the halo detectors as go/no go signal (I will discuss with software)