Quench Commissioning

Beam tuning should be performed initially and the beam collimator should be configured so there is little chance of a direct beam hit to the superconducting magnet coils. As long as its not a direct hit the coils should be able to withstand heat from the beam shower of secondary scattering. In the 4.4 second spill the temperature of the magnet former and coils are gradually increasing. If the heat load to the magnet does not result in any part of the coils rising above the critical temperature (6.3 K) to go resistive then a quench will not occur. Once the beam is well positioned on target location it is necessary to study what the maximum intensity is that can be achieved without the target magnet quenching. The UVA simulations indicate that running at 0.85×10^{12} proton per second for 4.4 seconds should be possible if we don't pump the He-vapor from the magnet reservoir, but this pushes the limit.

Pumping the He vapor using the KNF pump allow us to increase the intensity up to the 2.7×10^{12} proton per second for 4.4 seconds. In the near future, a small modification on the KNF line allow us to use the Sogevac SV630 to pump the He vapor. This provides an opportunity to increase the intensity even further to 3.5×10^{12} proton per second. Most likely, we will run with the KNF pump and hence, 2.7×10^{12} proton per second is the predicted upper limit of the intensity.

Notes: The quench-limit prediction described on the previous paragraph is for the NH3 target.

Once the magnet quenches, we will need a Hall access to fill the magnet and setup for the next run. After each quench about 100 LHe is required to refill. The system can be used again once the magnet space is refiled and the magnet is fully cooled again, this takes about 1-4 hours including fill time. Once the system is ready and ramped up again a beam intensity just below the last beam intensity should be used to pin-point the quench threshold. Because of the LHe and recovery time this part of commissioning should be expected to take two or three weeks. We will likely need more than 10 quenches for this phase of commissioning:

2 quenches for when we first put the beam on target (leeway): These are accidental and shouldn't happen unless we mess up with beam width or beam/target position which should all be confirmed before we ramp up the target magnet. Starting at 5×10^{10} we should increase in steps of 5×10^{10} until we get a quench running for 10 spills before increasing for each step.

3 quenches for when we get the limit and reproduce it for a full target cell of NH_{3}.
3 quenches for when we get the limit and reproduce it for a full target cell of ND_{3}.
2 quenches for when we are checking this limit for each target cell position.

Based on what the numbers are we may try to reconfigure the target cell to hold less material, or rebuild the ladder to have less aluminum, or modify the NMR coils, or other such changes, and then try again. We will also have the option of running the magnet pump at a higher rate to increase the cooling power in the magnet reservoir while decreasing the temperature of the coils. The KNF magnet pump can run over 100 SLPM so its possible to cool the magnet below 2.5 K with forced convention to reduce the heat load to the coils during a spill. This of course increases helium consumption.   How to optimize the pumping cycle for cooling and helium consumption will then need to be studied as well.