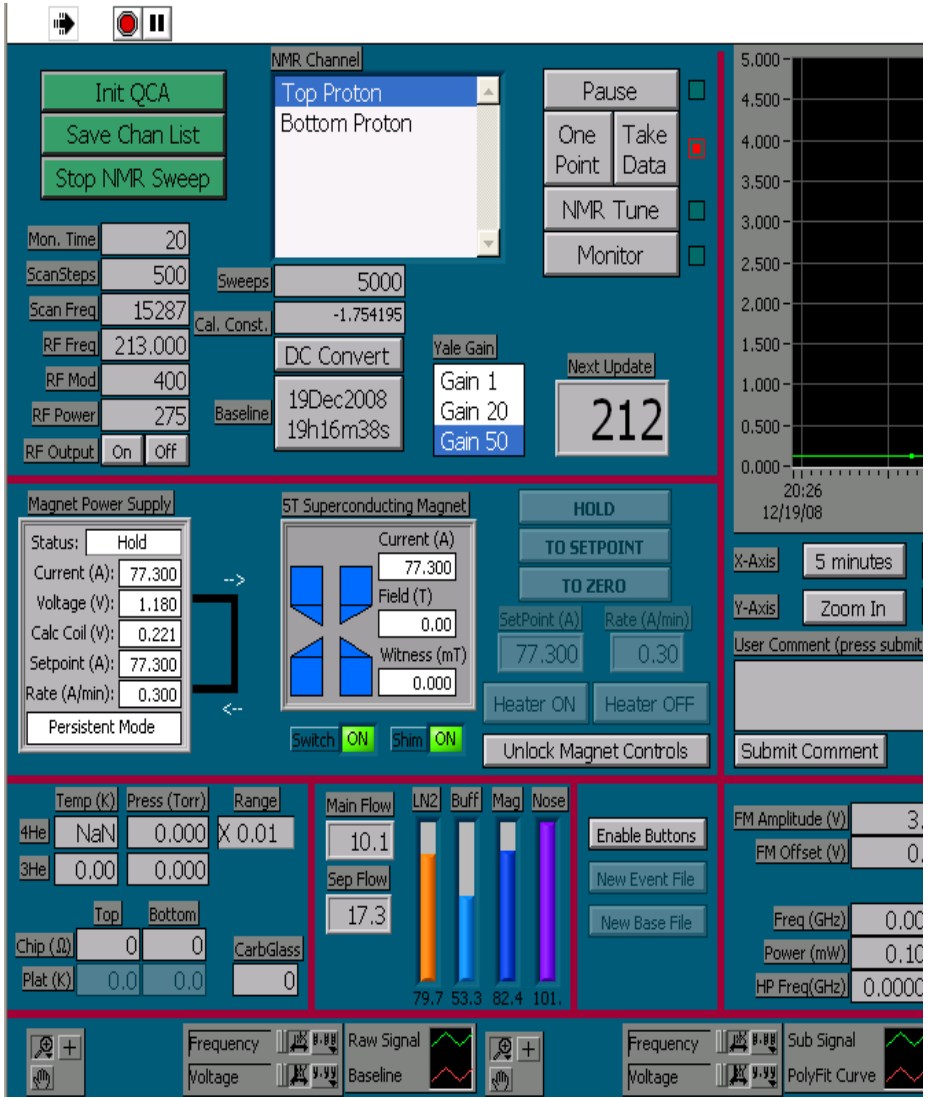
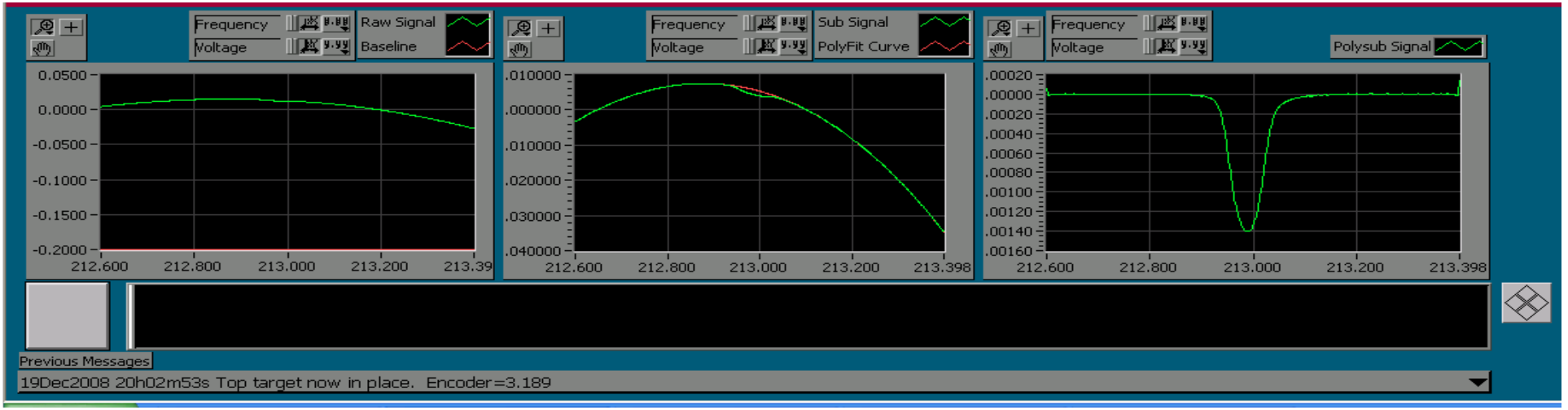
SANE Magnet Review

- Repaired polarized target magnet was successfully energized and put in persistent mode on 12/18/08 after the review, following the procedure described in the review report
- On 12/19/08 the refrigerator was cooled down and CH2 was loaded in the insert



SANE Magnet Review

- Thermal NMR signals from CH2 were observed on 12/19/08 at about 7:00 PM.
  - The frequency on 12/19 after ~24 h of field on was 213.4 MHz, B(ν) = 5.012 T
  - The current at time of persistent mode switch was 77.300 A
  - Current was adjusted to 77.135 A to center the frequency at 213 MHz
  - the NMR frequency 212.98 MHz corresponds to 5.0019 T



Magnet Review Implementation

- Modified operating procedures for energizing and de-energizing maget are posted on the SANE wiki under
  - http://hallcweb.jlab.org/experiments/sane/wiki/index.php/Magnet_Ramping

Magnet Ramping

From SANEWiki

Ramping the magnet is to be done only by target experts: Don Crabb, Donal Day, James Maxwell, Jonathan Mulholland.

Ramp Up Procedure

Restrictions:

- DO NOT run up the magnet with the shim heater or power supply off − magnet will quench
- DO NOT exceed rate limits listed below − magnet can quench
- DO NOT allow loss of cryostat isolation vacuum − magnet can rupture
- DO NOT allow persons with medical implants near magnet − death can occur
- AVOID the need for a fill during ramping - warm gas can cause quench. Induce a fill if the level is near 20%.
- Ensure safety prerequisites for magnet ramping are met.

Procedure:

1. Turn on magnet power supply and, if necessary:
   - Remove any unsecured magnetic objects from area within 4m of magnet
   - If no hall access has been made since last magnet use, search can be skipped
   - Turn on shim power supply and set shim heater on to 0.1 A, if necessary (on top of Magnet PS, Rack D)
2. Put PDP in "Monitor," if necessary, to allow update of switch and shim status
3. Hit "Unlock Magnet Controls" button in the Polarization Display Panel, **PDP**
   - **Verify** that there is no current in the leads (Power supply icon, far left)
   - **Verify** the Shim Heater is On (indicator in PDP and camera on PS). This must always be On!
4. Hit "Hold" button

Magnet Review Implementation

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5. Hit "Heater On" button and confirm this action in the dialog box that presents itself
   - **Ensure** the Heater On status with cameras on the PS and the indicator in PDP
   - Wait until timer counts down to zero
   - If the countdown starts before the indications, wait at least 30 seconds from the time the heater is on, ignoring the count-down
6. Set the first Setpoint and Setrate values. PDP should not allow you to exceed these rates, but be mindful.
   - Type the value 60.0 (this is in Amps) into the "Setpoint" box
   - Type the value 1.20 (this is in Amps/min) into the "Setrate" box
7. Hit the "To Setpoint" button
   Monitor the Voltage in the Coil and Leads (camera, PDP)! A high voltage is a sign of a coming quench.
   If it is increasing rapidly or exceeds 7.5 V, press "Hold"!
   Lower the rate and try again, ensuring the voltage stays low.
8. Wait for magnet to reach 60.0 A (45 min)
9. Press "Hold"
10. Set the Setpoint and Setrate values for the next current step:
    - Type the value 72.0 into the "Setpoint" box
    - Type the value 0.60 into the "Setrate" box
11. Press "To Setpoint"
12. Wait for magnet to reach 72.0 A (20 min)
13. Press "Hold"
14. Set the Setpoint and Setrate values for the last current step:
    - Type the value 0.30 into the "Setrate" box
    - Type the desired magnet current into the "Setpoint" box
    - Currents for full−field and for baseline measurements are on whiteboard
15. Wait until magnet current reaches the requested value (20 min)
16. Hit the "Hold" button
    - If persistent mode is not desired, stop here
17. Wait for 30 seconds
18. Hit the "Heater Off" button
    - **Ensure** the Heater Off status with cameras on the PS and the indicator in PDP
    - Wait until timer counts down to zero

Magnet Review Implementation

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  - http://hallcweb.jlab.org/experiments/sane/wiki/index.php/Magnet_Ramping

    - If the countdown starts before the indications, be sure to wait at least 30 seconds from the time the heater is off, ignoring the count-down

19. We are going to be leaving the leads up with the magnet, so do not ramp down! DO NOT: Hit "To Zero" button to ramp leads down
20. Hit "Lock Magnet Controls" button

Ramp Down Procedure

1. Hit "Unlock Magnet Controls" button in the Polarization Display Panel, **PDP**
   - **Verify** the Shim Heater is On (indicator in PDP and camera on PS). This must always be On!
   - **Verify** the Switch heater is OFF
2. Put PDP in "Monitor," if necessary, to allow update of switch and shim status
3. If necessary, Ramp the Power Supply to the Magnet Current
   - Type the value of the magnet current (this is in Amps) into the "Setpoint" box
   - Press "To Setpoint"
   - Wait for the PS current to reach the Magnet current
4. Hit "Heater On" button and confirm this action in the dialog box that presents itself
   - **Ensure** the Heater On status with cameras on the PS and the indicator in PDP
   - Wait until timer counts down to zero
   - If the countdown starts before the indications, wait at least 30 seconds from the time the heater is on, ignoring the count-down
5. Set the first Setpoint and Setrate values. PDP should not allow you to exceed these rates, but be mindful.
   - Type the value 72.0 (this is in Amps) into the "Setpoint" box
   - Type the value 0.30 (this is in Amps/min) into the "Setrate" box
6. Hit the "To Setpoint" button
   Monitor the Voltage in the Coil and Leads (camera, PDP)! A high voltage is a sign of a coming quench. If it is increasing rapidly or exceeds 7 V, press "Hold" and contact Don Crabb!
7. Wait for magnet to reach 72.0 A (20 min)
8. Press "Hold"
9. Set the Setpoint and Setrate values for the next current step:
   - Type the value 60.0 into the "Setpoint" box

Magnet Review Implementation

- Only 4 expert operators are allowed to modify or ramp the magnet current. These are: Don Crabb, Donald Day, James Maxwell, and Jonathan Mulholland
  - **Names listed on procedure**
- The ramp rates are limited as follows:
  - 0 to 60 A 1.2 A/min
  - 60 to 72 A 0.6 A/min
  - 72 to 78.9 A 0.3 A/min **Programmed on PS firmware & LabView**
- When in persistent mode the power supply is to remain on at the last setting -- **operated in this mode in Dec. 2008 until quench; will continue in the future; step 19 of ramp up procedure**
- The helium level in the magnet is to be continually monitored.
  - **saved in EPICS logger, displayed on target screen (PDP)**
  - **extensive target data logged by LabView converted to ASCII files for charting**

Magnet Review Implementation

- The EMF across the magnet terminals is to be monitored
  - **installed a DVM that reads the coil voltage across taps a-k of "D" connector.**
  - **DVM displays the voltage locally and is readout by LabView via RS-232 for display on target screen, and logged in EPICS.**
    - **readout of all taps too complicated to implement on time**
- The CoO will be modified so that the magnet need only be off during work on the lower platform. It is to remain on during other access work. --
  - **Modified COO reviewed by D. Skopik. Shift personnel are acknowledging reading it with signatures and e-mail. ACC staff have been informed and are aware of new procedure**

Target Status

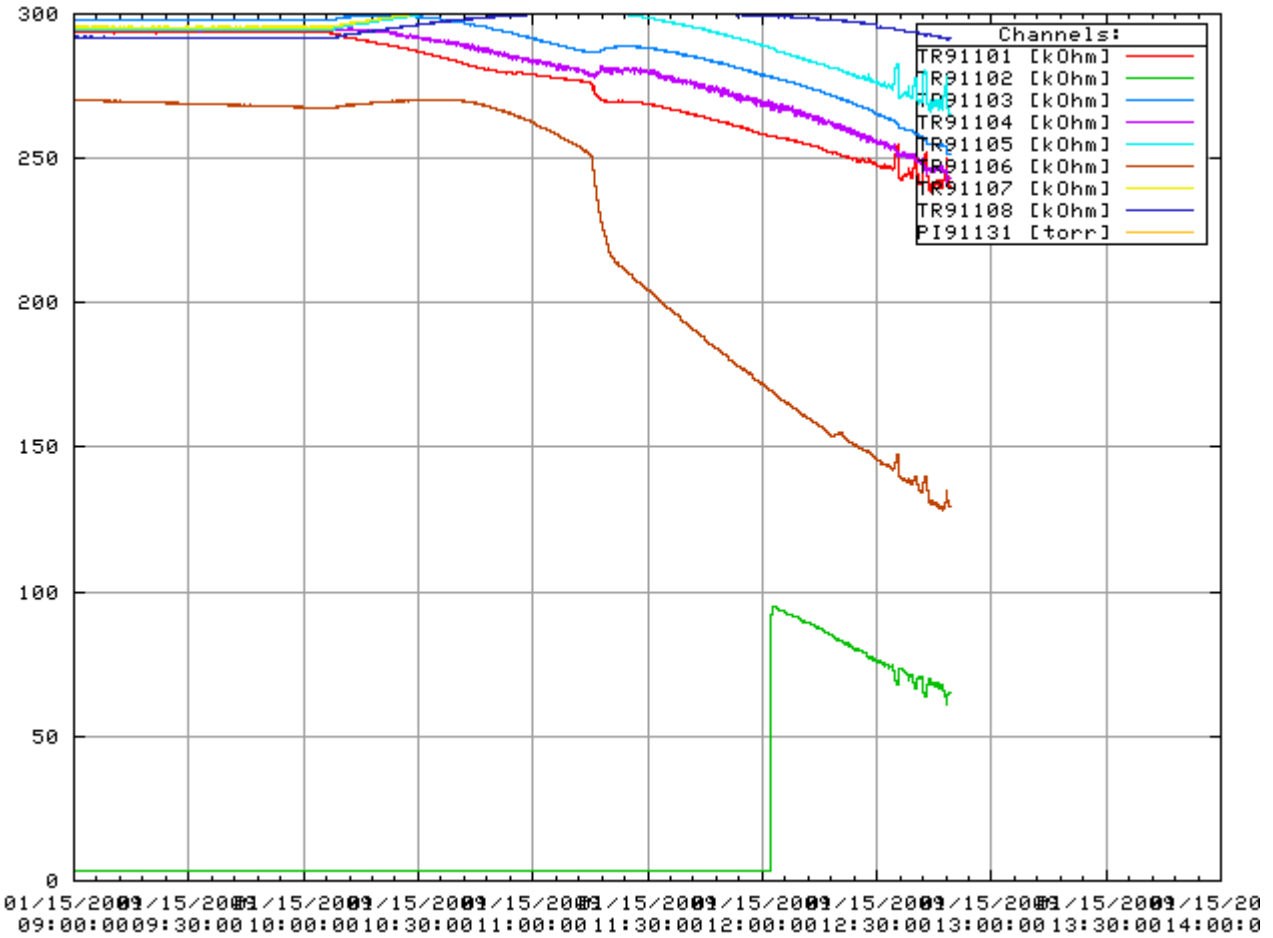
- Magnet operated until quenched at 11:00 PM on 12/19/08
- Target developed a leak, which prevented further operation
  - Leak required target warm up, but was not detected when target was disassembled
  - Cold cathode gauge reading chamber vacuum was off at that time, due to earlier rack power trip (gauge requires local reset):
    - no record of chamber vacuum during period before and sometime after quench. Gradual, unsuspected vacuum deterioration might have contributed to quench.
  - Damaged 4 K shield was found and rebuilt
  - Two failed rotary pumps and a damaged needle valve on the refrigerator have been replaced

Target Status (II)

- Quench
  - Target insert encoder calibration was in progress at that time
  - Beam was being horizontally centered on the target, both rasters were on, envelope was 21 mm in diameter, current was 93 nA (ibcm1)
  - BPM data at time of quench and survey on 1/9/09 of refrigerator "nose" which holds insert indicate that
    - insert is 1.6 mm left of coil center, coil center is 2.6 mm left of beam
    - when beam was steered right the raster envelope was more than 1 mm away from the coil package at the moment the quench was already in progress (timed from magnet flow data)
    - combination of distance from coils, very short time in the vicinity of coils (< 1 s at ≤ 1.1 mm) and very low current density (0.3 nA/mm^2) of rastered beam makes it unlikely beam may have caused quench
  - Future insert and beam centering will be done with reduced (≤ 10 mm) raster diameter.
  - SEM crate trip at time of quench may indicate power transient.

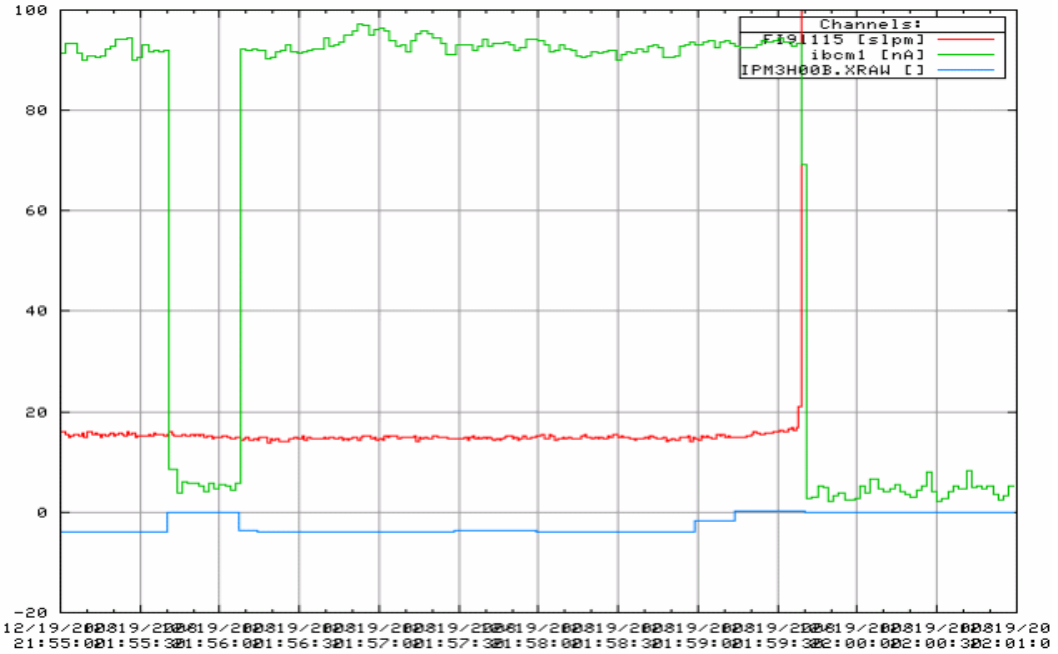
Target Status (III)

- Target has been cooled and it may be ready for magnet powering today
- All Dec. 2008 review measures have been implemented



Magnet and Beam Data

- Magnet flow [slpm] (red; FI91115), beam current [nA] (green; ibcm1), and beam position [mm] (blue; IPM3H00B.XRAW) vs EPICS time (add 1 h for clock time) on 12/19/08.



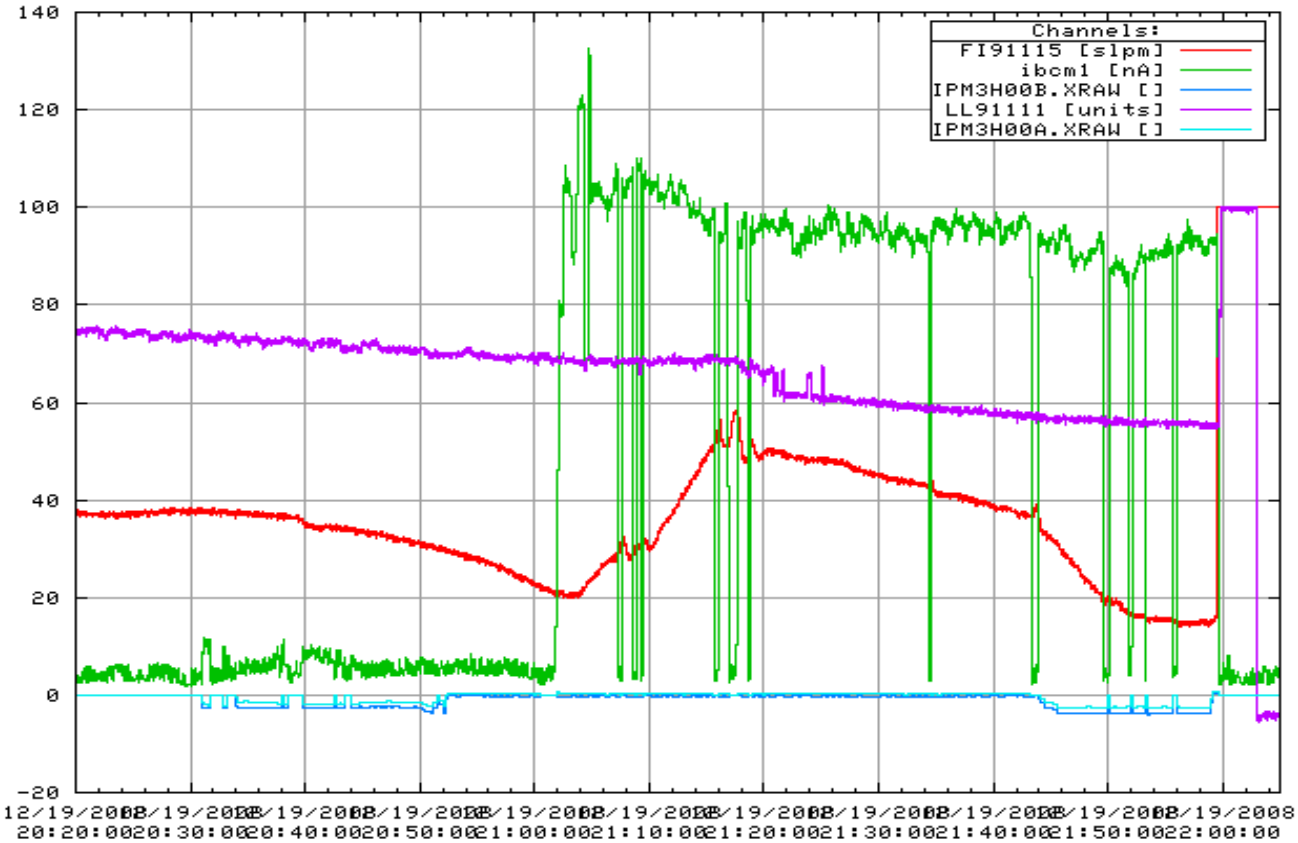
Magnet and Beam Data

- Beam position [mm] (IPM3H00A and IPM3H00B), Beam current [nA] (ibcm1) and Magnet flow [slpm] (FI91115) vs EPICS time (add 1 h for clock time) on 12/19/08.

Time (EPICS)	IPM3H00A.XRAW mm	IPM3H00B.XRAW mm	ibcm1 nA	ibmc2 nA	FI91115 slpm
21:59:13.78					14.94
21:59:13.91	0.74	0.28			
21:59:14.38	0.735	0.279	92.682	109.76	
21:59:17.78	0.702	0.27			15.03
21:59:17.91	0.695	0.269	93.392	109.095	
21:59:21.78	0.662	0.209			15.98
21:59:21.91	0.66	0.207	92.59	109.283	
21:59:26.76	0.645	0.244	93.547	110.93	
21:59:26.78	0.645	0.245			15.86
21:59:26.91	0.644	0.246			
21:59:27.78	0.671	0.279			15.80
21:59:28.78	0.703	0.318			16.03
21:59:29.78	0.734	0.357			16.09
21:59:30.78	0.765	0.396			16.16
21:59:30.88	0.768	0.401	94.391	111.87	
21:59:30.91	0.769	0.402			
21:59:31.78	0.864	0.515			16.35
21:59:32.78	0.974	0.646			16.05
21:59:33.78	1.084	0.776			15.93
21:59:34.78	1.194	0.907			16.72
21:59:34.91	1.209	0.925			
21:59:35.01	1.226	0.949	92.918	110.11	
21:59:35.78	1.365	1.148			16.93
21:59:36.78	1.545	1.407			16.22
21:59:36.91	1.569	1.441			
21:59:37.07	1.599	1.484	93.317	110.64	
21:59:37.78	1.730	1.676			16.88
21:59:38.78	1.916	1.946			21.11
21:59:38.91	1.940	1.982			
21:59:39.13	1.981	2.042	69.263	81.39	
21:59:39.78					99.99

Magnet and Beam Data

- Magnet flow [slpm] (red; FI91115), beam current [nA] (green; ibcm1), beam position [mm] (blue; IPM3H00B.XRAW), LHe level (purple; LL91111) and BPM (cyan; IPM3H00A.XRAW) vs EPICS time (add 1 h for clock time) on 12/19/08



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