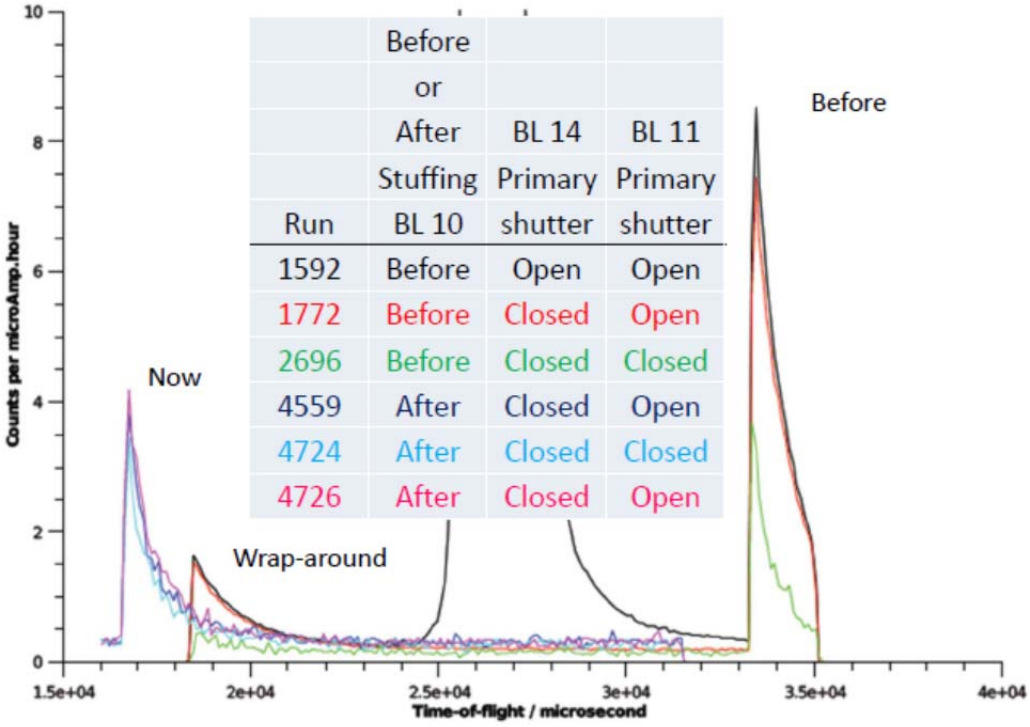
HYSPEC Status, February 28, 2012

A month ago, on January 25, we provided a status report on the HYSPEC instrument; this is a quick follow-up report on each of these issues, a month later.

1. Background

Previous status:
We previously have had an issue with a "prompt" pulse that corrupts the data. We had tracked down that ~70% of this was coming from the BL10/11 area and went away when the BL11 shutter was closed. During the winter shutdown the shielding on BL10 was planned to be re-stacked and more shielding added.

Update:
There is good news all around on this issue, although we still have some work to do. Firstly the extra shielding proposed by our Neutronics group for BL10 has been installed, and at the start of this SNS cycle the ~70% from BL11 has basically gone. See the figure below to see the effect of this new shielding on the prompt pulse. The blue and purple lines are "with BL10 shielding", while the other lines are without shielding.

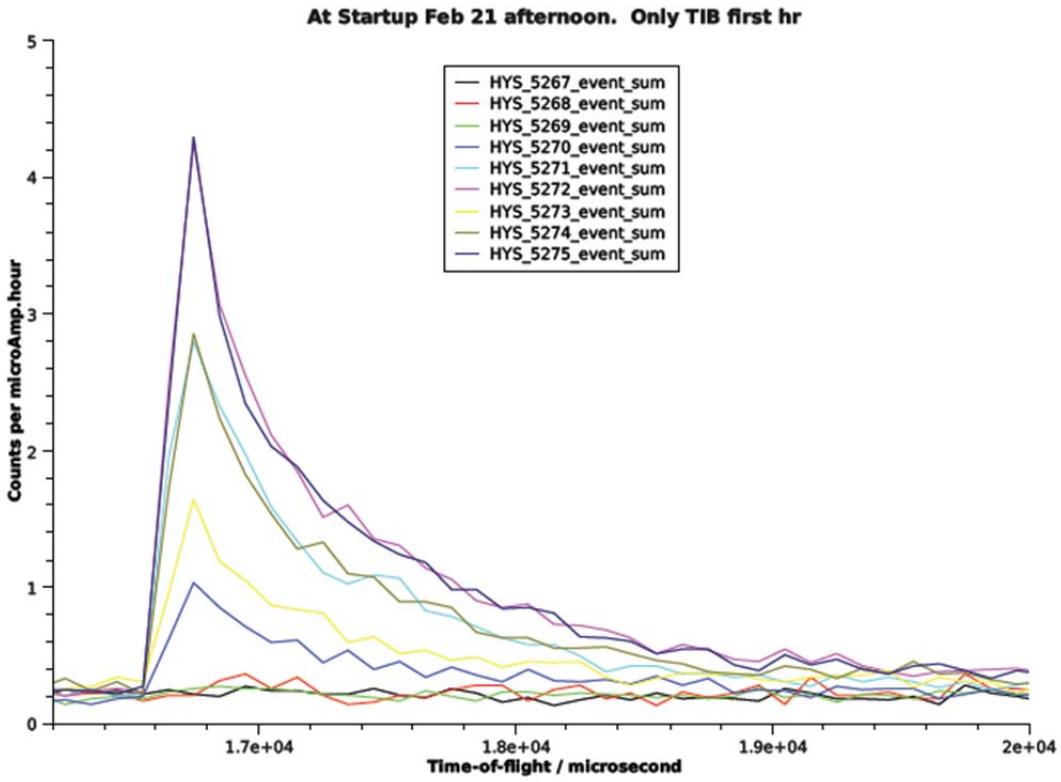


Run	Before or After Stuffing BL 10	BL 14 Primary shutter	BL 11 Primary shutter
1592	Before	Open	Open
1772	Before	Closed	Open
2696	Before	Closed	Closed
4559	After	Closed	Open
4724	After	Closed	Closed
4726	After	Closed	Open

The first two runs on the plot are the same ones shown in the previous report, but here the y-axis scale is linear instead of log. The runs were made at different nominal Ei's, so the frames are a bit offset; for the first three runs made before the December shutdown, the prompt pulse wraps around the frame.

This however leaves the “remnant” prompt pulse. Previously our working hypothesis was this was due to high energy neutrons coming directly out of BL10, simply because BL10 has temporary shielding and all other beam lines have full shielding. However on the afternoon of Tuesday, February 21, at the startup after a day off for accelerator physics time, we had a wonderful surprise for ~2 hours.

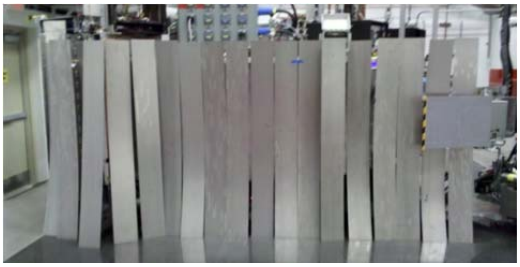
The beam had been off from 7:30am in the morning and came back on, at full power, 1MW/60Hz. When it came back on, we initially observed no prompt pulse feature. Then, after a short while the prompt pulse feature started to grow. Over the next ~2 hours the feature eventually formed, fell back slightly, and then returned to full “intensity”. This is shown in the figure below for ~20 minute runs. The flat lines at the bottom were with the accelerator on and then it starts to grow.

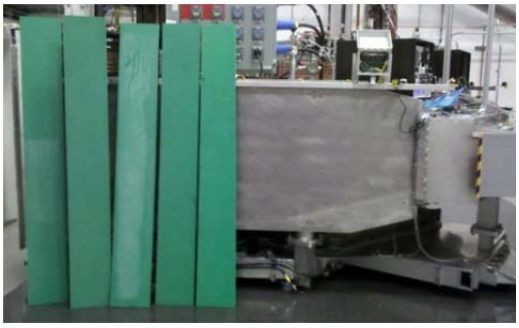


No primary shutter on other beam lines activity coincided with this effect, so we have been in discussions with accelerator and target about what could have happened. They are both involved with “steering” when the beam comes up in order to settle things down for steady running. A first look at the logs from Tuesday 21st indicates no clear “smoking gun”. However on Tuesday, February 28th when we have a similar “day off” we, and CNCS, will repeat our measurements at re-start to see if it happens again. Then on Wednesday 29th the accelerator will try “tweaking” the beam, within acceptable parameters, while we watch, in order to see if they can do something that will help.

Clearly we cannot damage the accelerator or target to help HYSPEC, but if we cannot find a safe solution then maybe we can find a clue as to where this is coming from, and then improve it with targeted shielding, as in the case of BL10.

We are also pursuing other avenues as well, in case the accelerator and target adjustments were not the cause. We are preparing to track the activity of some secondary shutters on other beamlines, in case this activity was instead the source of the variations we observed on February 21. We have also tested temporary shielding, of either 1 mm thick B-10 aluminum, or 25 mm thick borated polyethylene, at various regions to the side of, above, and below the detector vessel, but have seen no effect on the background, suggesting that the neutrons observed in the prompt pulse are significantly epi-cadmium, and cannot be readily mitigated at the detector vessel. Example configurations are shown below:





Finally, the detector group is preparing a new portable detector array for further background measurements. This will become a facility-wide resource, using some 0.5” diameter LPSD tubes.

If we have a big success this week, we’ll let you know, although it is possible that we may have to wait for another Tuesday to fully confirm things, again we can’t interfere with the schedule for the other beam lines just to help HYSPEC, but fingers are crossed.

2. Neutron flux at sample

   Previous status:
   Barry is revising the McStas model in order to make a more realistic comparison with the flux measurements and the $KTaO_3$ measurements, by checking the model against the as-built instrument, incorporating the new moderator models developed by the Neutronics group. This outcome will form the basis of our path forward.

   Update:
   McStas simulations of the HYSPEC instrument, which use a vanadium sample and the new moderator models, have been completed. We have also taken into account transmission through the as-built aluminum windows, monitors and air. We are working on some slides for a presentation now, to solicit constructive feedback.

   We have observed a $T_0(E_i)$ offset that was substantially larger at low incident energies than the original MCNP source term suggested.

   McStas modeling using the 'single_crystal' component has presented difficulties, but we just got it working, so we plan to start modeling the $KTaO_3$ scans of the phase time of the Fermi chopper later this week.

3. Vacuum and the T1A chopper

   Previous status:
   The upstream leak is being repaired now, during the SNS shutdown. If the vacuum achieved after this leak is repaired is still too high, then the leak in the external building will be repaired at the start of the next cycle.

   Update:
   Many small leaks, on the order of 1-10 mtorr, were found and fixed in the target building. A very large leak of the order 100 mtorr was located under the chopper racks in the HYSPEC external building. Due to the major effort and time required, we have decided to not repair the large leak at this time. It would take at least a month to get the shielding/ racks/electrical/etc. off in the region where the leak is, fix it, and then get them re-installed. So we have basically run out of time for the moment.

   We are now re-installing the shielding, chopper racks and cabling in the target building, in order to begin taking beam as soon as possible (hopefully by Friday, March 2, 2012 or earlier). We will explore other options, to add windows to the T1A chopper, and see whether our vacuum group can develop a more reliable technique to seal and repair the guide system. Note, the pressure in the guide is too high to run the T1A, it does not significantly affect neutron transmission, and we can run

the T1B and Fermi with the vacuum valve closed.

4. Detector vessel location, motion and collision avoidance

   Previous status:
   The latest encoder error (for detector vessel rotation angle) will be evaluated during the shutdown, hopefully this week. Analysis to determine relative detector angles and positions is ongoing.

   Update:
   The logs for motor, encoder, and motor shaft monitor have been evaluated, and suggest two things. First, the detector vessel motor is missing steps when it tries to start from some (a small number of) locations, so the torque limiting clutch is not reaching its limit. Second, the on-axis encoder error seems to arise from a mechanical slippage. The Proffibus and remaining control electronics don't present a problem, according to the logs. To address the first problem, we have a larger motor on order, and have begun optimizing the number of microsteps per step (along with acceleration, deceleration and velocity) with the current motor. To address the second problem, we are purchasing a new on-axis encoder in case the current one is damaged, and will in parallel remove the rotation stage in order to look for and fix likely sources of slip. In addition, we are adding an encoder on the worm gear, in order to have an independent check of the detector vessel position.

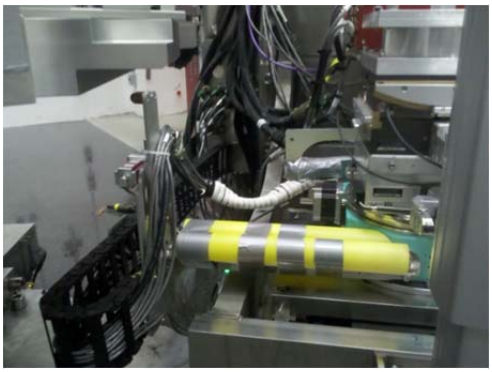
   To obtain relative positions of individual detector tubes, the incident beam (attenuated, collimated, apertured and un-focused) was directly measured using the detector array at several detector vessel angles during the last cycle. These have not been evaluated yet.

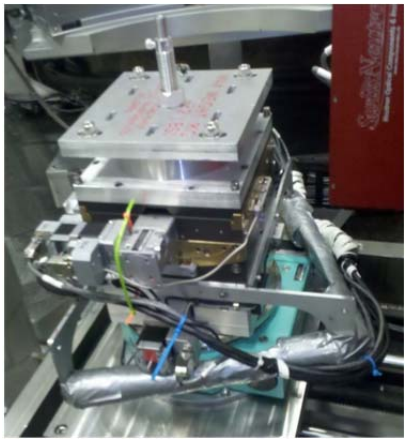
   More of the reliable collision avoidance sensors that point sideways are in hand, design work for the new mounts is complete, and mounting hardware is mostly in-hand.

5. Goniometer & Cable management

   Previous status:
   The crude prototype permits full rotation but limits some translation.

   Update:
   The cable management problem has been solved. It is not an attractive solution, but it seems to work at all tilts and translations. The duct tape, zip ties and plastic pipe allow for some needed flexibility as the cables wind and unwind.





6. Preparation for polarization

Previous status:
Work is ongoing. Commissioning with neutrons of polarization components is planned for this cycle, 2012.

Update:
In the syringe system, most Viton o-rings have been replaced by Indium metal seals. During the 4th test the cell held vacuum while connected to the syringe system and during baking for two weeks, but the pump cell cracked during the "tipping-off" of the cell after baking. Another cell has been baking for two weeks and is being cooled off on Monday, February 27. Alkali will be chased into the cell on Monday as well. It will be tipped off on Tuesday.

The Bellows and valve redesign that completely eliminates Viton o-rings is complete and vendors are bidding and making comments. Our plan is to prototype one valve, before committing to a full Syringe system that includes four valves.

We have made progress on other aspects of polarization analysis as well. We have purchased a Heusler crystal from ILL and are fabricating a yoke system to hold it in the sample position for testing. The aluminum wire of the Mezei flipper has been successfully wound by the magnet support group at the SNS, and they expect to be done with the full assembly by mid-March. The Helmholtz-like coil frame modification design is being finalized. We will check the performance of the Heusler focusing array using a separate and portable polarized 3He cell during this cycle.