HYSPEC Status, March 29, 2012

A month ago, on February 28, we provided a status report on the HYSPEC instrument; this is a quick follow-up report on each of these issues.

1. Background

   Previous status:
   We previously have had an issue with a “prompt” pulse that corrupts the data. We had eliminated ~70% of this by adding shielding on BL10, but the remnant remained. We had observed a time dependent amplitude effect and were tracking that down, by finding out information about secondary shutter activity at other instruments and by planning for slight proton beam adjustment tests with the accelerator group.

   Update:
   Our attempts to find any correlation between prompt pulse amplitude change and anything else have failed so far. We did confirm with several Tuesday afternoon startups, that the amplitude did gradually increase while at full power. However, on March 13, with a much slower startup process due to conditioning a foil, the amplitude variation was different than at previous startups. We will continue monitoring startups to better understand this effect, until we have eliminated the remaining prompt pulse signal.

   In addition, we have observed abrupt disappearances and reappearances of the prompt pulse. The drop or reappearance occurs on the time-scale of ~2 minutes (the weak signal is difficult to identify at lower time-scales), and the disappearance itself lasts roughly ~20 minutes when it disappears.

   Primary shutter activity on other instruments are definitely not the cause, and secondary shutter activity is most likely not the cause (this is not tracked for all instruments, but other instrument teams have been surveyed and there is no known correlation).

   Our current hypothesis is centered on a known neutron leak, just upstream of the target monolith and above the proton beam. We suspect that a small part of the proton beam clips something, generating fast neutrons that come out through a shielding crack, and ultimately to our detectors. We’ve been pursuing two approaches, one to prevent the proton beam from clipping something, and the other to shield at the leak.

   For the first strategy, the proton-beam-on-mercury-target profile was adjusted within an acceptable range (a few mm), for vertical and horizontal size and location, but with no significant effect on the prompt pulse intensity. Scrapers in the ring were also tested, but again to no significant effect (since these shape the narrow proton beam that is then painted onto the target, a negligible scraper effect is not a surprise).

For the second strategy, we are doing radiological measurements to map around the shielding we suspect, and planning for a shielding test at the neutron leak.

We are also pursuing other avenues as well. Our RAD colleagues are preparing to archive the status of some secondary shutters on other beamlines. Also, the detector group has prepared a new portable detector array for further background measurements. They have measured our prompt pulse at HYSPEC and near beamlines 18, 11 and 12 so far, and more measurements are ongoing.

2. Neutron flux at sample

   Previous status:
   The McStas simulations using vanadium and the new moderator models were completed and we were preparing for an internal review of the results. We also prepared the $KTaO_3$ in the McStas model and were preparing some model tests of the Fermi chopper scans

   Update:
   The reduction in signal now looks to be more like a factor of 2 compared to predictions, mainly due to the large amount of aluminum in the beamline mitigating our predictions. There is some discrepancy between measurements and model results at various positions, so another gold foil test is planned for some time next month.

   With initial vanadium runs this spring, we have confirmed a similar detector count rate, so we have confidence that the work to improve vacuum did not significantly impact the guide alignment.

3. Vacuum and the T1A chopper

   Previous status:
   We were not able to get the pressure below 100 mtorr, the vendor's limit for T1A chopper operation. We were preparing for operation without the T1A chopper running.

   Update:
   We have had our primary shutter open and have been taking data since Thursday, March 9. We have also pressed the vendor concerning the justification for their pressure limit, but the response we received motivated a fresh look at the actual pressure requirements by our chopper group. They have determined by testing that 200 mtorr is acceptable, and we have just tested the T1A chopper operation successfully. We will be using the T1A chopper for the rest of the cycle, so long as the pressure holds at ~150 mtorr. For this operation, we must have the valve/window closed just downstream of our secondary shutter, but neither the window nor the poor vacuum in the guide are expected to cause significant attenuation of the neutron beam.

4. Detector vessel location, motion and collision avoidance

Previous status:
We had analyzed the errors in the logs and were purchasing new equipment for detector vessel motion, encoding and collision avoidance.

Update:
We have installed and set up a new, larger motor, which seems to not lose steps in the few remaining regions where there is mild singing of the air pads. We have installed an encoder on the worm gear, which for the moment we rely on to provide detector vessel position. Our spare on-axis encoder has arrived, and we have removed the rotation stage. As of this afternoon we are mostly done building back and have begun testing to make sure we are OK. We are halfway through installing new collision avoidance sensors to replace the ones that were not reliable.

5. Recent activity with sample environments

Previous status:
A dedicated cryostat and closed cycle refrigerator (CCR) were on order.

Update:
HYSPEC's new dedicated CCR has arrived and has been tested by the sample environment group. Adaptors for SNS sample mounts are being fabricated now. HYSPEC's new dedicated cryostat has arrived and it will be tested offline soon.

The CCR-10 system has been mounted at our sample table, and has been cooled to 5 K. Control for temperature is via a Lakeshore 336, which is connected to our control computers and has been operated and scanned using PYDAS. With the sample rotation cable management problem solved, the only constraint on rotation is the normal hose management limitation one experiences on triple axis spectrometers. Below is a photo showing this system.

6. Preparation for polarization

   Previous status:
   A successful test using the pump cell and o-ring based syringe system has been elusive to date. A Heusler test sample had been purchased and a design laid out for its yoke.

   Update:
   The latest test with the pump cell and o-ring based syringe is looking promising, but is still ongoing.

   The welded bellows syringe system that avoids o-rings entirely is being revised and vendor feedback is being solicited. The prototype valve is expected soon for testing; results from that testing will affect the final design of the new syringe.

   The test Heusler crystal is in its yoke. The Mezei flipper is assembled and will be tested next week offline. The Helmholtz-like coil modification is out for bids for fabrication. We will check the performance of the Heusler focusing array using a separate and portable polarized 3He cell during this cycle.

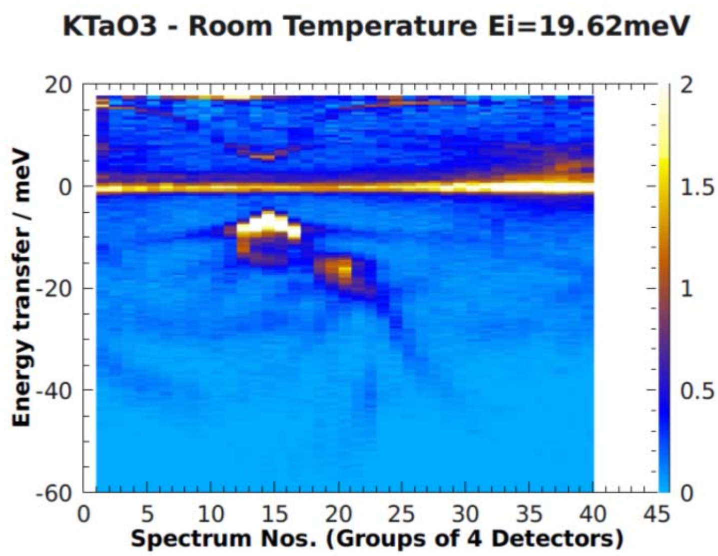
7. An example of some data

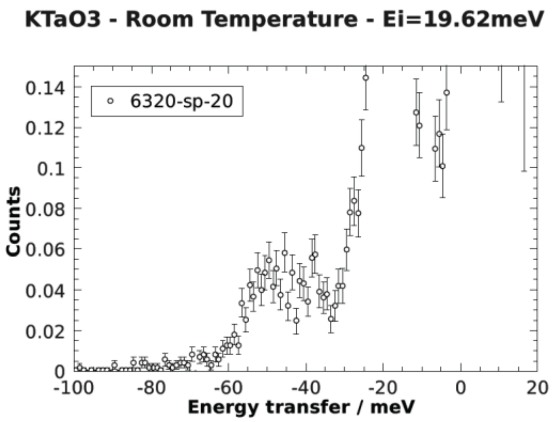
   The following are some plots of phonon data taken on a single crystal of KTaO3 (photo below). Its dimensions are 5 mm x 5 mm x 15 mm. At the moment we run like a triple axis, vertically focused with the crystals we then integrate vertically on the LPSD's and group 4 detectors together. This gives us resolution akin to HB3.

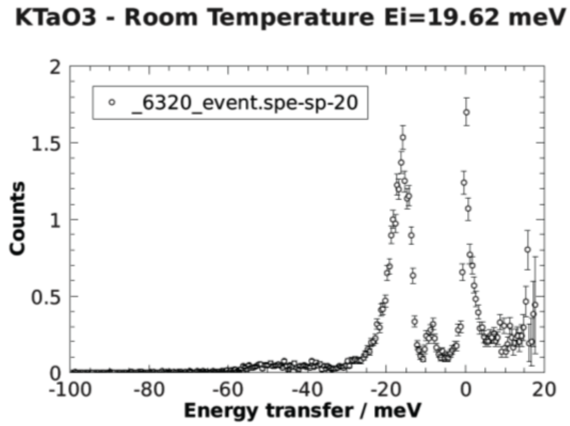
An incident energy of 19.62 meV puts the prompt pulse and its tail well out of both energy loss and energy gain. On energy gain we can transfer up to ~100 meV, in the slice through for spectrum 20 (detectors 80-84) the modes at 10 meV and 20 meV and then in the blow up the bands of modes 40-60 meV are clear. Although it's not clear from these plots, we are seeing scattering from air and from the incident beam in these spectra, that contribute to the background. We have been working to shield against this.

Because of the prompt pulse and the effective restriction to Ei ~ 20 meV we cannot get to background on energy loss (above the inelastic from KTaO3 or V) to work on sample dependent background in the cryostat, etc. We'll be trying some other samples soon and see if that helps. Of course, getting rid of the prompt pulse contamination would also make life much easier!

The following is raw data, not normalized to Vanadium, at room temperature, in CCR-10 and in vacuum.




KTaO3 - Room Temperature - Ei=19.62meV
6320-sp-20
Counts
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
-100
-80
-60
-40
-20
0
20
Energy transfer / meV


KTaO3 - Room Temperature Ei=19.62 meV
_6320_event.spe-sp-20
Counts
2
1.5
1
0.5
0
-100
-80
-60
-40
-20
0
20
Energy transfer / meV