HYSPEC Status, June 22, 2012

In cycle 2012-B (August to December of this year), HYSPEC will be running IDT experiments and commissioning experiments, as well as commissioning for polarization.

HYSPEC is now soliciting for proposals in the general user program this summer, for cycle 2013-A which begins in February; please see http://neutrons.ornl.gov/users/pdf/2013A_Call%20for%20proposals.pdf for the call. This call for general proposals is contingent on successful completion of the User Instrument Readiness Review. The User IRR is an internal ORNL review that determines readiness for the general user program. We encourage anyone in or associated with the IDT considering proposing an experiment for HYSPEC to discuss feasibility and availability with Barry Winn before submitting a proposal. General user experiment time will be limited for the 2013-A cycle due to continued commissioning of HYSPEC with polarized neutrons. Also, there may be limitations on which sample environments can be utilized on HYSPEC due to availability of SNS general sample environment equipment, testing of and functionality of various dedicated HYSPEC equipment, and supply of liquid helium.

At the ACNS conference next week there will be two talks and one poster related to HYSPEC:

-The HYSPEC polarized beam spectrometer, B. Winn et. al., Monday June 25, 3:15-3:30 PM, B2.5, rm G
-Polarized ^{3}He Development at SNS, T. Tong et. al., Wednesday Morning, June 27, 2012, 11:00 AM B4.2, Room A/I3
-Pressure Variable Wide Angle Polarized ^{3}He Analyzer System for the SNS Hybrid Spectrometer, D. Brown et. al., Tuesday, June 26, 2012, 3:30 PM, BP2.8

On May 21, we provided a status report on the HYSPEC instrument; this is a quick follow-up report on each of these issues.

1. Preparation for polarization

    Previous status:
    The first successful demonstration of 3-He polarization with the syringe transfer system had been done and fabrication of a welded bellow version of the syringe that avoids o-rings was about to begin. Slight modifications for the Mezei flipper were planned. The Supermirror Analyzer was physically ready for shipment to ORNL.

    Update:
    The Heusler focusing array was tested for polarization. The photo below shows the setup for polarization testing of the Heusler focusing array. Motorized apertures and the third neutron monitor were removed upstream of the sample, and replaced with guide fields. The gap between guide field and solenoid allowed for adiabatic steering of the polarized neutrons. The second guide field assembly had a simple cadmium aperture attached to it. The Heusler array was set to be unfocused, and the transmitted beam passed directly into the detector vessel. Where count-rates were above ~300 c/s, the beam was attenuated after the solenoid using a B-10 impregnated aluminum to avoid saturation of the detector tubes.

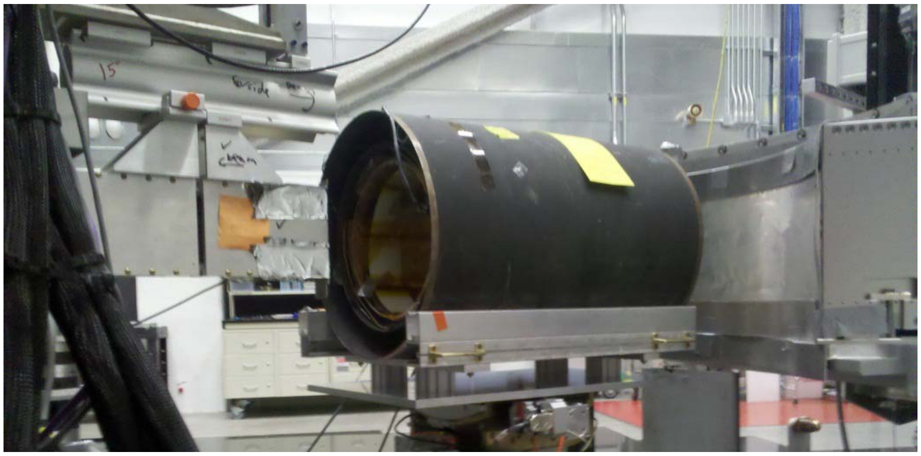

Figure 1. Heusler flipping ratio test setup.

The calculated Heusler flipping ratio for different neutron energies are:

Energy(meV)	Measured FR	3He FR	Flipping Ratio of Heusler
50	5.4	7.00	**23.01**
14.59	13.4	28.23	**25.44**
7.5	22.19	101.21	**28.41**

Calculation of the flipping ratio of the Heusler assumes a perfect guide field for Heusler array measurements, identical magnetic configuration with both PG and Heusler focusing arrays in use (not true since the Heusler array is lowered for the PG array to function) and that measurement time was much less than the lifetime of the cell (50 hours). We estimated about 10%-20% error for the FR results due to statistics and beam power etc.

The Helmholtz-like coil support has been reinforced and was mounted on the detector vessel to confirm that it no longer sags. At the same time we mounted the CCR-19 OVC on the tilt and translation stage for the sample to confirm it fits within the Helmholtz-like coil.

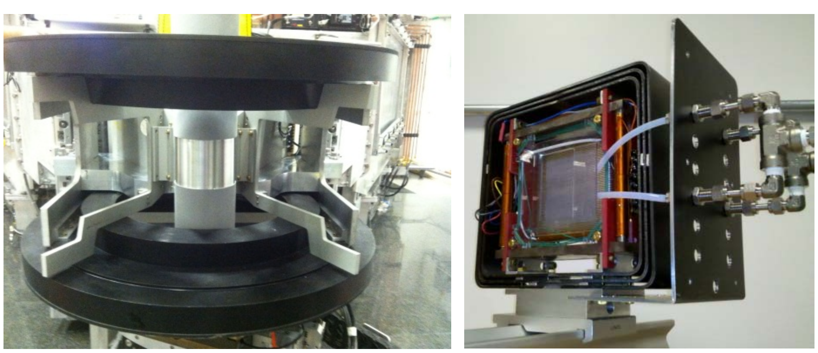

Figure 2: CCR-19 OVC inside the Helmholtz-like coil, mounted on the tilt-translation stage and detector vessel, respectively. The Mezei flipper with new guide field coils and air-cooling lines.

Modifications to the Mezei flipper, to apply air cooling and to strengthen the adjustable guide field about the flipper, are completed and will be tested offline this summer.

We have received drawings from PSI for the magnetizer, and are beginning the process of final design and fabrication, in preparation for commissioning the polarizing supermirror array at HYSPEC.

2. Background

Previous status:
Additional shielding placed at the known radiation area above the proton beam had demonstrated no change in the background feature. Portable detector array measurements continued, and indicated that our source term is not far upstream of the target. Time variations in the background feature remained unexplained.

Update:
A significant time correlation between our background feature and the secondary shutter status of neighboring beamline 13B has been found. The facility began archiving the secondary shutter status of many beamlines as of May 3, 2012. By identifying HYSPEC data files whose times correspond to 13B shutter transitions, we were able to find 21 correlations in May 2012, with changes in the background level of about 30%. The level of the background feature also depended on whether the sample 13B was studying was liquid hydrogen or liquid chlorine (the latter contributed more). An initial shielding test was performed, by adding three stacks of four 'yellow' blocks to the 14A side of the 13B wall, but this did not eliminate the 13B contribution. More shielding tests will be performed during the fall cycle to hopefully eliminate this time-dependent contribution.

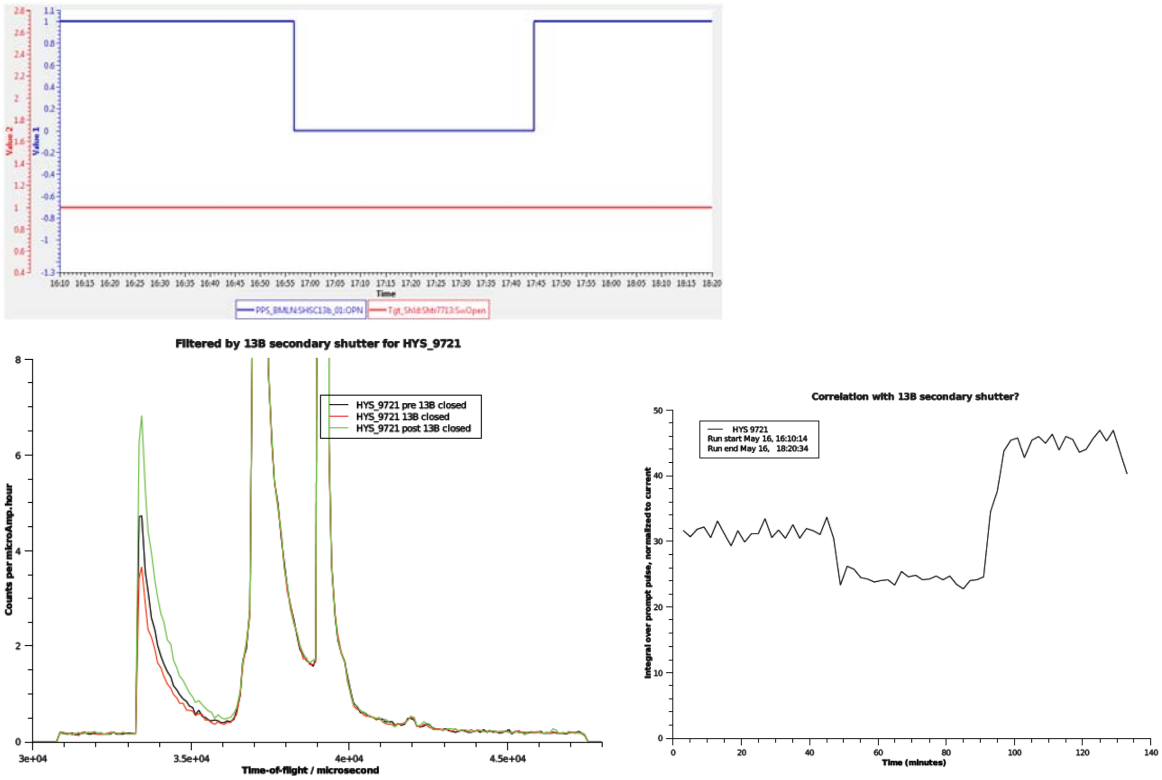

Figure 3: At top the secondary shutter 13B is closing and re-opening. Before closing the 13B sample contained liquid hydrogen; afterwards the sample was Chlorine. Bottom left shows the background feature for each of these periods. Bottom right mimics the shutter activity by plotting the background feature normalized to beam current, integrated between 33000 us and 35000 us in time-of-flight, and binned by two minute intervals.

An SNS-wide coordinated shutter test was performed, in order to locate sources of the time dependent background feature plaguing both HYSPEC and CNCS (beamline 5 on the opposite side of the target). Measurements were made of the background, for both an ‘all shutters open’ configuration (except for 13B which was an already known contributor and 16 which was closed throughout this test) and an ‘all shutters closed’ configuration. About 60% of this background feature remained at HYSPEC with all shutters closed, while at CNCS 100% of this background feature remained. A subsequent test was performed for the HYSPEC side of the target building, where individual primary and secondary shutters were opened while all other shutters were kept closed. With this subsequent test we observed a slight (~20%) contribution from the BL 11 primary shutter, and a very slight (~5%) contribution from the BL 14 primary shutter.

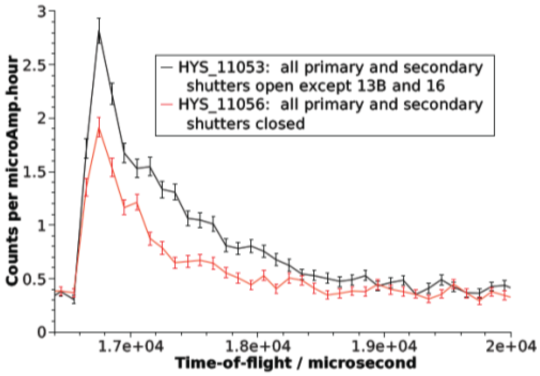

Figure 4: SNS-wide shutter test.

The portable LPSD was positioned both upstairs and downstairs in the HYSPEC stairwell, atop the HYSPEC curved guide close to the mezzanine in the target building, and once again in the 14A valley.

Additional shielding testing at the detector vessel was performed, by placing 1" of B4C just underneath the detector array, in the hope that any fast neutrons thermalized immediately below the detectors are the primary contributors, but no reduction of the background feature was observed.

Recent activity on other background:
Scatter from air, the drum shield, optics upstream of the sample, sample environments, and the detector vessel have been minimized using a crude prototype shielding about the sample, as well as additional shielding on the two extreme 8-packs. Based on lessons learned from making this prototype, using feedback from both ORNL staff and friendly initial users, we are now coordinating with engineering support to develop a more permanent shielding solution.

3. Detector vessel location, motion and collision avoidance

Previous status:
Physical repairs were complete and initial testing of collision avoidance sensors was underway. Software upgrades to simplify detector vessel motion control on the motors computer had begun. Cable management for sample tilt, translation and rotation was being fine-tuned after detector vessel repairs.

Update:
We now control detector vessel rotation and drum shield rotation from the control computer, using the same simple motor interface used for other motors. We can also move and scan both of these using the PYDAS software. A drifting of the sample table arm stage (which sets the distance between focus element and sample) was observed and fixed in the software and PLC system controlling these motions. A backlash was added to the drum shield rotation stage to account for a ~0.2 deg discrepancy observed by moving from different directions to the same nominal angle, then

optimizing both Fermi phase and PG focusing array angle to find a ~0.1 deg offset there. There are delays at the start and end of detector vessel motions, but these delays are not large compared to the time it takes for the detector vessel to move.

During the summer shutdown, limiting cases for detector vessel configuration will be determined systematically, by moving to extreme (a few inches from a wall or barrier) detector vessel angles for a set of drum shield angles.

Cable management for sample tilt, translation and rotation is back in good shape.

4. Recent activity with sample environments

Previous status:
A dedicated cryostat and closed cycle refrigerator (CCR) had been tested with neutrons at HYSPEC, and utility support for the new CCR had just been tested.

Update:
We have continued to use the new CCR-19 extensively. Its ability to do to low temperatures as well as rapid warm-up and low background have made it a popular sample environment with users. We have moved both the turbo as well as its compressor to the top of the drum shield, so that all cable management for that sample environment is now off the floor; this makes changing detector configuration relatively easy, compared to last month.

We are preparing to purchase new heat shields and outer-vacuum-chamber (OVC) tails for both CCR’s. The heat shields will have thinner walls (0.010” thick instead of 0.040” thick), and enable use of cadmium shielding about soda-can tails. The OVC’s will have an outer radius similar to that of a 100 mm orange cryostat, and will have attachment points for cadmium shielding inside the chamber. The current CCR-10 OVC will be replaced by this assembly, which will then use the same adaptors as CCR-19. CCR-19’s current OVC will still be used with the 3-He polarization analysis system, but the new tail is expected to become the main chamber to use.

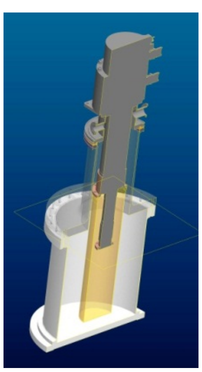
Figure 5: rendering of new tails for CCR’s.

5. Recent activity, general performance

The coarse collimator inside the detector vessel was removed. It's function was to minimize cross-talk between 8-packs, but due to slight bowing of the blades and an also-slight mismatch between blade period and gaps between 8-packs, a ~20-50% drop in intensity of one-detector-per-8-pack has been limiting performance since the start of commissioning. We have removed the collimator and will check whether there is additional cross-talk in later measurements. If so, we may re-work the coarse collimator to minimize this intensity drop. If not, then we will keep this component out of the detector vessel.

Radiological studies were performed with both the PG focusing array and the Heusler, to determine whether the stacked shielding behind the rolling door was truly required, or whether we could remove that, and find an alternative solution that enabled more rapid and less expensive transport of SNS's magnets to and from HYSPEC. These studies suggest that we can remove the shielding, so we are now working with the neutronics group and radiation safety officers to determine how to achieve this.

We refined our formula for setting the Fermi chopper phase for a given Ei, by optimizing phase when scattering from a single $KTaO_3$ crystal Bragg peak, instead of the vanadium used before. With this formula we determined t0 offset values at lower Ei that agreed better with predictions from MCNP models than our previous t0 values derived from scattering from vanadium. We also found a fixed time-offset for all incident energies, suggesting an electronics-driven offset that our data acquisition systems group is now looking into. We are less concerned about the source of this timing offset, and are very glad to be able to find desired Bragg peaks at whatever incident energy we choose, without having to optimize phase or focus-element rotation angle.

We have been beta-testing new electronics and software that are to be implemented at instruments throughout the SNS. The new timing board replaces two of the fast computers, and keeps pulse information self-consistent, unlike the older timing platform. The new timing board simplifies alignment of neutron data with specific accelerator pulses, and handling of neutron choppers and accelerator vetoes. Initial results show better chopper control stability. The new FEM-10 boards permit more configurability for the LPSD 8-packs, better diagnostics of the detector electronics, and provide for and easier and more reliable start-up of the system. Both new components employ state-of-the art electronics, instead of now-outdated-components that are hard to find.

6. Recent activity with users

In addition to following up on the $FeSb_2$ system with Andrei Savici, Igor introduced a new BNL PostDoc, David Fobes, to neutron scattering with a study of a single crystal of $Fe_{1.1}Te$ at HYSPEC. They also were initial testers of the new CCR-19 sample environment for this experiment.

Feng Ye and Songxue Chi studied the honeycomb lattice $NaIrO_3$ system at HYSPEC. This crystal pushed the performance of HYSPEC in an interesting way: the iridium is strongly absorbing and the sample is flake-like with a mass of 0.1 g. A magnetic excitation was observed at HYSPEC.

Steve Shapiro and Mark Hagen studied a single crystal of the negative thermal expansion material cuprite, Cu_2O. In prior work they observed excitations in the longitudinal polarization that have the same dispersion as the transverse acoustic phonons, in addition to the expected longitudinal acoustic phonons. This experiment complimented work done on HB-1 in December of 2010 to explore this behavior along off high-symmetry directions to characterize these "anomalous" excitations. This work was also an opportunity to work with a rather large detector vessel angle of 90^o.

Not surprisingly, we are finding that for phonon studies, users prefer large detector vessel angles, while for magnetic excitations, users prefer low detector vessel angles. Small angles are available at any Ei, while large angles are available on the inboard side for Ei < 20 meV, and on the outboard side for Ei > 20 meV.