HYSPEC Status, May 21, 2012

On March 29, we provided a status report on the HYSPEC instrument; this is a quick follow-up report on each of these issues.

In this report we present some unpublished results of our first friendly users. We ask for your discretion.

1. Preparation for polarization

    Previous status:
    A successful test using the pump cell and o-ring based syringe system had been elusive to date. A Heusler test sample had been mounted on a yoke. The prototype o-ring free valve is expected soon for testing

    Update:
    The latest test with the pump cell and o-ring based syringe demonstrates a 10 hour half-life on polarization in the lab. For the first time using SEOP we are able to achieve a NMR signal in a pneumatic valve-sealed cell configuration ever. The first test of using the syringe to remove the polarized gas from the pump cell, and then return it to the same cell, preserved 90% of the polarization. This is wonderful news, and credit goes to Tony Tong, Peter Jiang and Dan Brown for much hard work. Work is now ongoing to increase this half-life.

    The new prototype valve that avoids o-rings altogether (with the hope of increasing half life) has arrived and testing is successful. Therefore, we are moving ahead on an o-ring free syringe system, which is expected to have a much longer lifetime. The welded bellow version of the syringe is in its final stages of design and is expected to go out for bids for fabrication soon.

    The single Heusler crystal to be mounted at the sample position for testing, has been successfully checked at HFIR's CG1 for reflectivity in the (½ ½ 0).

    Current was applied to the Mezei flipper systems for the first time, and a few slight modifications are being made based on those tests. We hope to test this flipper in June.

    Preparations are being made for shipping the supermirror analyzer to ORNL, and for ORNL to receive the design for the magnetizer from PSI.

2. Background

    Previous status:
    Our current hypothesis was centered on a previously identified region of weak shielding. We were planning to do radiological measurements and a shielding test at this location (near the shutter drive control room at the Target monolith).

Update:
We performed both radiological and portable detector array measurements at this location, motivating the facility to do a shielding test using a significant amount of hematite concrete bricks, above the proton beam just upstream of the target monolith. Although dose rates in the near vicinity of this location have dropped, the time dependent background feature observed at HYSPEC is unfortunately unaffected. This distributed source was not fully shielded against with the bricks, because the dose rate was at its same high level, immediately downstream (along the proton beam) with respect to where we stacked, but this part of the source is in front of the door to the shutter drive equipment room and we cannot block the door. Moreover, this part of the source is mostly surrounded by thick regular concrete walls. We are continuing measurements using the portable detector array, to locate other likely sources of fast neutrons to shield against. It is clear from the first round of these measurements (in our control room) that our prompt pulse feature does not come from the upstream portion of the RTBT or from the accumulator ring.

Variations in prompt pulse intensity are still observed with time, complicating the possible strategy of simply subtracting out this feature. To date, we have restricted our incident energies for friendly user experiments to 7, 20 and 80 meV to avoid this feature on energy gain and energy loss. We are planning to expand the range about these energies to better understand the impact of this background source.

3. Detector vessel location, motion and collision avoidance

Previous status:
The on-axis encoder was repaired, a new worm-side encoder was added and a larger motor replaced the weaker, smaller motor.

Update:
Initial reassembly required tuning of air pads and re-leveling the rotation stage. User experiments have limited complete testing of the system to date, but the on-axis encoder has proven reliable and reproducible enough to use for rotation measurement. The air pad singing has once again been minimized and the sticking eliminated, and the worm encoder coupling is being redone to eliminate the slipping on this extra check of the detector vessel position.

We are currently testing a more automated method for moving the drum shield, detector vessel and sample table translation stages, that turns on air, then moves, then turns off air. We are at the tuning stage for the sensors of the detector vessel collision avoidance system, but are already using this system when moving the detector vessel. We hope to have a preliminary automated motion control interface for moving the detector vessel, drum shield, and drum shield to detector vessel sample table in the next couple of weeks.

Reassembly of the sample table, after fixing the on-axis encoder, also included redoing the cable management on the sample tilt/translation/rotation stages, which is being fine-tuned to become as robust as it was before.

4. Recent activity with sample environments

   Previous status:
   A dedicated cryostat and closed cycle refrigerator (CCR) had been delivered, and we had begun using CCR-10.

   Update:
   Adaptors for the new dedicated CCR are in hand, and once the chilled water system is in place, we plan to use this CCR for the first time. We also plan to test fit it in the Helmholtz-like coils by the end of May. The cryostat's flange adaptor has been mounted, its vacuum testing at room temperature was successful, and we mounted the cryostat at the sample position for initial testing, looking for and mitigating background, etc. Lessons from these studies will inform the long term shielding solution for between drum shield and detector vessel.

   We have installed utility support for the new dedicated CCR and ran this CCR overnight for the first time at the beamline; it is thin to fit inside the Helmholtz-like coil used with the 3-He filter. We have partially tested the transport for the 16 T magnet to HYSPEC, and have begun tests that will hopefully make transfer at the rolling door faster, easier and cheaper.

5. Recent activity with users and new samples

   We have hosted our first friendly user from the IDT committee: Igor Zaliznyak. He collaborated with

Matt Stone of ORNL on a $CrCl_2$ powder, and with Andrei Savici on a $FeSb_2$ set of four coaligned single crystals. The $CrCl_2$ powder was previously studied at ARCS, and the $FeSb_2$ was studied at the triple axis spectrometer HB1 at ORNL. Data was reduced with Mantid and viewed with Dave's Mslice. The use of these systems provided an opportunity to use lower scattering angles, and provided us with evidence of a new background feature using the $CrCl_2$ powder. We have prototyped a shielding solution for this feature and hope to test it soon.

At Igor's suggestion, we invited Bruce Gaulin's group, who provided two samples to study: LBCO and $Lu_2V_2O_7$. For the $Lu_2V_2O_7$ system the 1-day goal was to map out the three-dimensional spin wave dispersion. Katharina Fritsch was the primary user and kindly provided the following figures and captions of these unpublished results.

Fig. 1

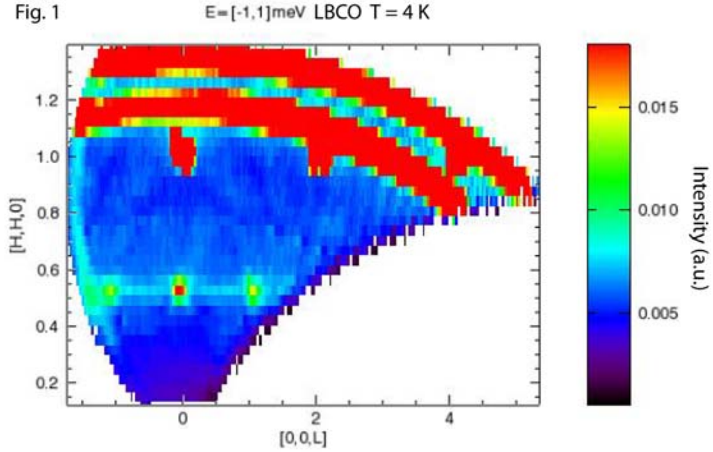

Fig. 1 Elastic magnetic neutron scattering from the two-dimensional incommensurate ground state of the quantum magnet La(2-x)Ba(x)CuO4 with x=0.025 is shown in the HHL plane. The rod of magnetic scattering along L, at HH ~ 1/2, 1/2, acquired using HYSPEC at T=4 K, is characteristic of the two dimensional nature of the ordered state of this layered magnet. For concentrations, x>0.05, this materials becomes a high temperature superconductor with Tc's approaching 30 K.

Fig. 2

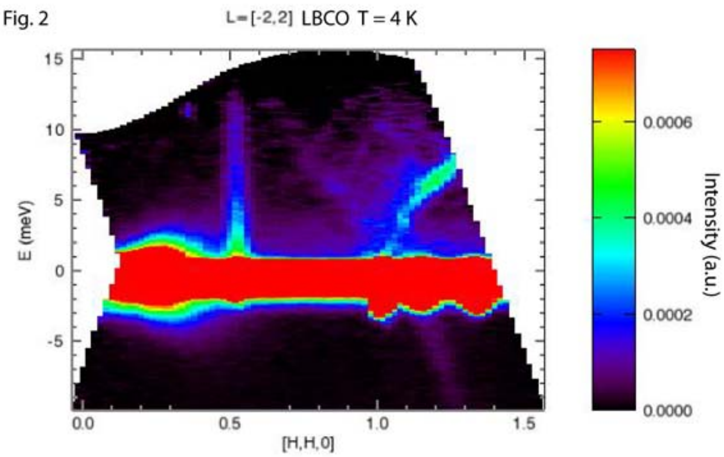

Fig. 2 Very dispersive magnetic excitations in the ground state of the quantum magnet La(2-x)Ba(x)CuO4 with x=0.025 can be seen emanating out of ~ 1/2 1/2 L. These particular data, taken with HYSPEC at T=4 K, integrate over much of the direction normal to L, that is normal to the two dimensional copper-oxide planes in this layered magnet. These spin excitations are gapless and are known to extend to very high energies (~ 200 meV). Acoustic phonons can also be seen emanating out of the nuclear zone centers near 11L.

Mark Hagen also provided a single crystal of $KMn_{0.25}Ni_{0.75}F_3$.

Mikhail Feygenson provided a small amount of powder, of nanoparticles of NiO, with which we could see Bragg peaks for but no excitations.

Wei Tian has performed an experiment with a single crystal of the magnetocaloric antiferromagnet Tb_5Ge_4 in an effort to distinguish between spin wave excitations and crystal field excitations. After preliminary reduction, it is already clear that the ~3 meV excitation is a spin wave excitation instead of a crystal field excitation, something that was difficult to distinguish from previous triple axis measurements.