2005 EXECUTIVE COMMITTEE REVIEW OF HYSPEC

On April 1, 2005, the HYSPEC executive committee, Rob McQueeney and Jim Rhyne, was treated to a very informative review of design progress on this instrument that is part of the SING project for the SNS.

Much of the information presented was drawn from the Design Criteria Document (March 2005) that we found not only very useful, but also to be a highly comprehensive and competently written summary of all aspects of the instrument. It is clear that a lot of thought and insight has gone into the design specifications for HYSPEC on the part of the SNS instrument team, Mark Hagen and William Leonhardt, who were assisted significantly by scientific input from Steve Shapiro, Larry Passell, and Igor Zaliznyak and the calculational expertise of Vinita Ghosh.

In our meeting, Mark Hagen presented an outstanding overview of the design issues of HYSPEC that gave us a clear picture of the design/construction timeline for HYSPEC as well as the major technical hurdles. This was supplemented by discussions of the design layouts by Bill Leonhardt, and polarization analysis techniques by Vinita Ghosh and chopper selection criteria by Larry Passell. Since the last IDT meeting, a firm decision has been made to place the T1b (order suppression) disk chopper, T2 (Slotted Fermi) chopper, sample chamber, and analyzer/detector tank in a building external to the SNS target building. This is clearly a vast improvement for access to the machine, sample handling, lower background levels, and potential stray magnetic field interference.

It is obvious that the design team has considered many of the technical issues and solutions well in advance and had ready answers to our questions. From the discussions, three issues did emerge (1) the choice of straight vs curved chopper elements for the Fermi choppers, (2) appropriate access to the HYSPEC external building for ancilliary equipment such as cryo-magnets, dilution refrigerators, etc., and (3) the magnitude of undesirable scattering from the Ar that is planned to fill the analyzer/detector tank.

On the chopper issue (1) the committee was quickly convinced by Larry that the choice was appropriate mainly due to the very short (10mm) length of the chopper element. Generally curved chopper blades are preferable due to the fact that they present the same opening to the neutron as it traverses the chopper element. However, in HYSPEC the 10 mm blade length means that the difference between straight and the more expensive curved path element is insignificant.

On item (2) Bill conceived of a creative solution and even showed us drawings prepared over lunch! The primary storage/staging area for environmental equipment at SNS is to be the mezzanine level, and Bill showed that a small platform built in the HYSPEC building at mezzanine level would be accessible by the HYSPEC crane with sufficient hook height and could effectively serve as a launching area for cryogenic and other equipment. This is deemed to be a good solution and the required penetration thought the Target building outside wall is not a major problem.

Item (3) is the only unresolved issue identified by the committee. The issue is that if a Bragg peak is in reflecting geometry during an inelastic measurement, then the Ar gas will scatter about 2% of this intensity into a 4π solid angle. Some of these neutrons will reach the detector and appear to represent inelastic scattered events or at best an increased incoherent background. The question is what is the relative magnitude of the true inelastic events compared to the spurious

scattering arising from the Ar? The obvious solution is to evacuate the tank; however this would add significantly to the cost of the detector tank and to the complexity of the air pad structure required to move the tank. An attempt will be made by Vinita to calculate these relative count rates from MCNP and also contact will be made with John Copley at NIST who has built the Disk Chopper Spectrometer at the NCNR with an Ar filled flight path. Note: In subsequent discussions with John Copley, he certainly acknowledged the possibility of Bragg peak intensity being scattered by the Ar and appearing as spurious inelastic events, but said that it has **not** been a problem on the DCS (4 m flight path). He did say, however, that **scattering cross-talk between detector tubes (not limited to adjacent tubes) is quite noticeable and he recommended strongly that absorbing barriers (e.g., Cd or B materials) be placed between each detector tube to avoid this problem.**

HYSPEC is the only instrument in the current SNS suite that will have full neutron polarization capability, and thus it has a considerable responsibility as well as opportunity. Two methods for polarizing the incident neutron beam have been evaluated – a Heusler (Cu_2MnAl) focusing crystal array and a ^3He cell combined with the pyrolitic graphite monochromator that will be used for non-polarized experiments. As currently configured, HYSPEC will use the Heusler array due to its proven performance, lack of a laser system for maintaining the polarization, and insensitivity to stray magnetic fields. In the opinion of the committee, this was a very prudent choice.

For full four cross-section polarized beam studies a polarization analyzer is also required. For this, two distinct methods have again been extensively studied – a supermirror bender transmission polarizer with a solid state collimator and a ^3He transmission cell analyzer. The supermirror bender will produced two beams displaced by a small angle each with opposite polarization. Both these beams can then be detected by the LPSD modules. With a single setting, the analyzer will have band-width of $\approx$ 10 meV and the center of this band can be tuned continuously over the range $\approx$ 5 meV up to $\approx$ 20 meV. Again because of the same arguments given above, the HYSPEC team decided to proceed with the supermirror bender; however the analyzer assembly is designed with sufficient flexibility that it could be later reconfigured to accept a ^3He analyzer. In addition to a required performance gain to achieve comparability with the supermirror bender, the ^3He analyzer would require a polarized ^3He production facility at SNS, which cost (estimated to be $1M) is far outside the budget of HYSPEC. Thus the optimal choice is clearly to use the supermirror bender in the baseline instrument.

In summary, the executive committee has concluded that the SNS/BNL instrumentation team has developed a carefully conceived plan for HYSPEC, and is to be highly complimented for the scientific and engineering insight inherent in the design. This instrument with its polarization capacity and excellent versatility of reaching a wide range of energies (particularly emphasizing low E) and wave vectors promises to be one of the truly world-class unique instruments at the SNS.

Respectfully submitted April 18, 2005:

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