SNS - HYSPEC Instrument Development Team

MEMORANDUM

Date: January 27, 2012

To: HYSPEC IDT Executive Committee

From: B. Winn, M. Hagen

Subject: Inelastic spurion from the prompt pulse

HYSPEC detectors reveal a time dependent background feature, which we call the 'prompt pulse', which has a count rate that is comparable to an expected inelastic count rate in some regions of the time window (Figure 1). The leading edge of this feature coincides with the proton beam incident on the mercury target, and the signal has a tail extending to about 4 milliseconds. Fig. 1 shows a vanadium rod measurement with Ei = 15.12 meV, integrated over our entire detector array. The sample is vanadium rod with a diameter of 6.35 mm. Roughly 20 mm along the axis was illuminated, corresponding to about 4 g. The intensity scale is logarithmic, so the maximum of the "prompt pulse" is about 400x weaker than the vanadium elastic line, and about 4x weaker than the acoustic phonon peaks in the vanadium density of states. If this peak is eliminated, then the intrinsic background on HYSPEC would be ~17,000x less than the incoherent elastic line from the vanadium, which is the sort of level desired for polarized inelastic neutron scattering.

Measurements with the added Cd shielding (including the Cd-blocking of the analyzer entrance) have revealed the "prompt pulse" neutrons have energies that are "epicadmium", which is relatively high energy. ^{3}He has approximately ~1 bn of cross section even at 1 MeV, and has some sensitivity to high energy neutrons.

The observation of a slight reduction in count rate of this feature when the detector vessel is closest to our equipment lift led to the remarkable finding on November 28 that closing the primary shutter shared by POWGEN and MANDI (BL 11) caused this feature to drop by ~70%. Radiological measurements, and also measurements with an array of 8 3He detectors, have established that prompt pulse neutrons originate at BL 10 near the monolith, and then scatter throughout the north side of the target building. This is an unused beamline, which has a temporary core vessel insert, shutter and shielding. We believe that neutrons 'leaking' from BL 11 through the weaker shielding on the BL 10 side. We suspect that the remaining ~30% of the prompt pulse background comes directly through BL 10. None of this is radiologically hazardous, but HYSPEC has a very low intrinsic background and is sensitive to this source.

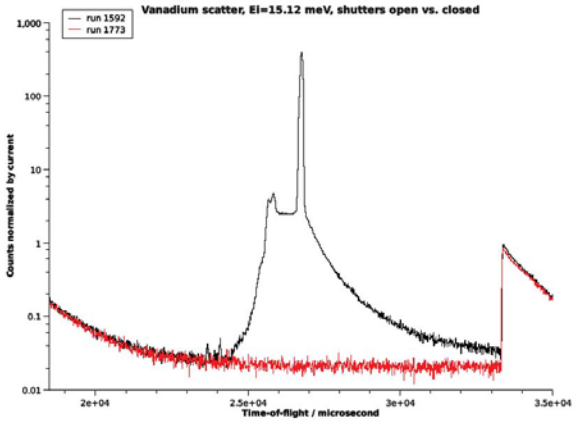

Figure 1. Intensity from Vanadium rod sample integrated over the HYSPEC detector array with open (black) and closed (red) primary and secondary shutters.

We anticipate that additional shielding, which will be added to the beamline 10 cavity before the next SNS operations cycle will remove this background term.