Table of Contents

Major Improvement of a High-resolution Pulse Cold-neutron Spectrometer AGNES

--- 3.3 times signal intensity and 0.1 times background ---

AGNES [1] is a chopper spectrometer installed at the top of the C3 cold guide of JRR-3M (JAERI, Tokai). Neutrons with a wavelength of 4.22 Å (standard mode) or 5.50 Å (high resolution mode) are selected by an array of five PG(002) monochromators (2.5 cmW × 4.5 cmH × 2 mmT) and pulsed by a Fermi chopper rotating at a rate of 6440 rpm (standard mode) or 8000 rpm (high resolution mode). The pulsed neutrons scattered by a sample were detected by 328 ^{3}He tube detectors (1 inϕ, 10 inH, 10 atm) arranged in a wide detector bank covering scattering angles of 10-130º. Time of the flight pass from the chopper to detectors (ca. 2.4 m) is measured by time analyzers with a resolution of 4 µs (1 µs option is available). The energy resolution, energy range, and Q range at the standard mode are 120 µeV, $-4 < \Delta E <$ 20 meV, and $0.2 < Q < 2.7$ meV, respectively. Those at the high resolution mode are 49 µeV, $-2 < \Delta E < 6$ meV, $0.15 < Q < 2.1$ meV, respectively. Fig. 1 is overlview of AGNES taken in July, 2005. Further details of AGNES is described in another booklet of the ISSP report 2005.

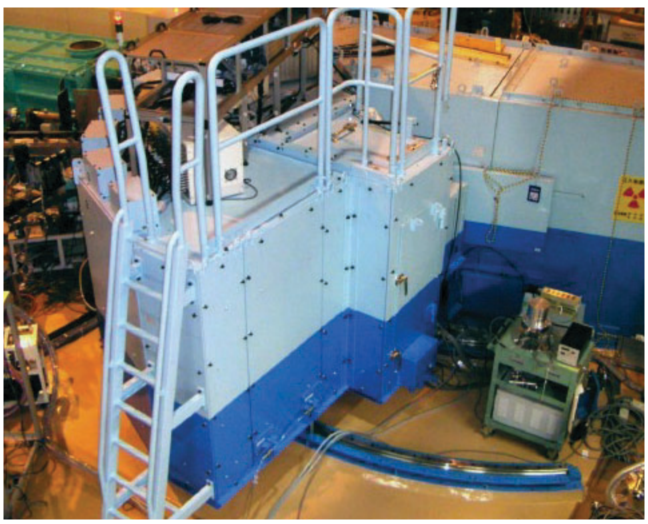

FIGURE 1:

Overview of AGNES after the improvements

In the shut down period of FY2004 (December-to-March), AGNES was greatly improved by installing (1) 104 detectors to make the detector bank complete, (2) new radiation shields composed of Fe (14 mm), polyethylene (50 mm), B_4C rubber (10 mm), and Cd (0.5 mm) sheets, (3) a new control system for the anti-frame-overlap chopper rotating simultaneously with the Fermi chopper, (4) a monitor counter at the space between the chopper and monochromator, (5) a neutron guide tube (50 cm) before the monochromator, (6) a new instrument control (monochromators, choppers, beam narrowers, etc.) and measurement control (real-time data monitoring, sample temperature control, etc.) systems, (7) a top-loading type cryostat workable at a wide temperature range of 8—470 K.

Figure 2 show the data of elastic scattering from a vanadium rod (10 mmϕ) comparing the intensities before and after the present improvement. The intensity after the improvement is about 3.3 times larger than that before the improvement. This is mainly because only the middle bank was actually used before the improvement while all of the upper, middle, and lower banks are used after the improvement. Another reasons for improving intensity are that the guide tube was installed before the monochromator and the beam alignment was carefully adjusted in the present improvement. The old AGNES data multiplied by 3.3 agreed well with the new AGNES data, indicating that the elastic peak profile was not modified by the improvement.

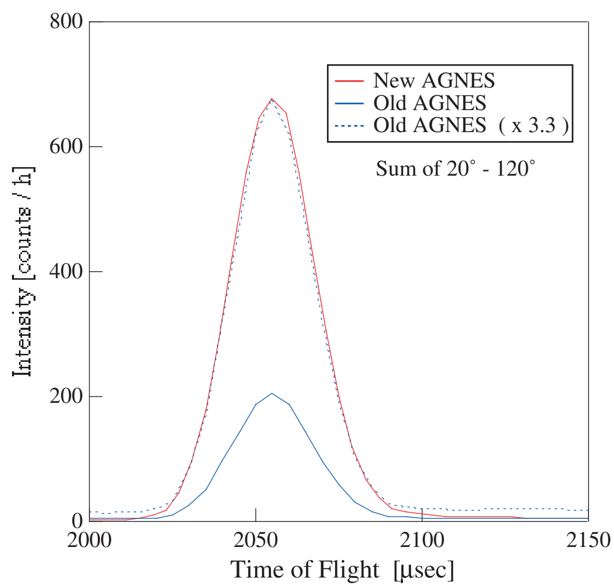

FIGURE 2:

Elastic scattering data from a vanadium rod (10 mmϕ) comparing the old (× 1 and × 3.3) and new AGNES. The data of detectors at scattering angles of 20-120º are summed up.

Fig.3 shows the background data comparing the old and new AGNES. The present improvement has reduced the background by 1/5 at the elastic peak position. This is due to the efficiency of the new radiation shields described before. Compared with the new shield, the

O. Yamamuro, Y. Inamura, Y. Kawamura, S. Watanabe,
T. Asami, and H. Yoshizawa
Neutron Science Laboratory, Institute for Solid State Physics,
University of Tokyo

previous shield was composed of thinner polyethylene and no B4C rubber and Cd sheets. The reduction of background when using the top-loading type cryostat (TLC) is due to the reduction of air scattering around the sample space. The new TLC has a large Ar gas chamber around the sample space. In total, the background has been reduced by 1/10 over the whole tof region.

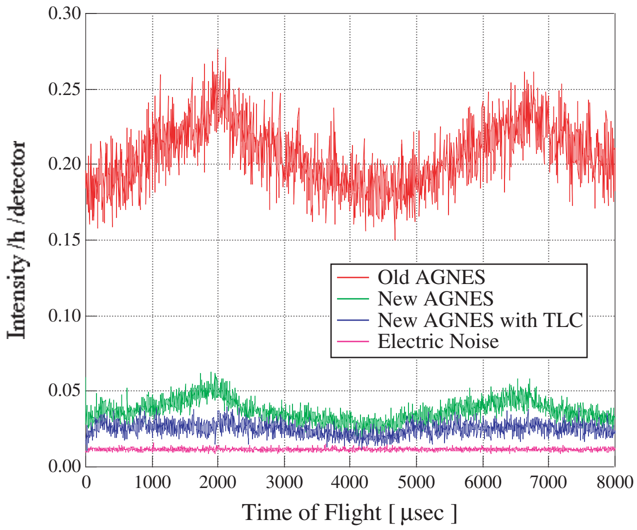

FIGURE 3:

Background data comparing the old and new AGNES with and without the top-loading type cryostat (TLC).

Other than the improvements of signal intensity (× 3.3) and background (× 1/10), all of the operations during measurements have become much simpler and easier than before. The monochromator angles and beam narrowers can be controlled by a touch panel, and tof data can be monitored in real time and sample temperature can be changed automatically by PC. The sample setting can be done in 5 minutes by using the top-loading type cryostat. Various safety devices for the choppers and vacuum pumps are attached for sudden electricity down.

At the shut down period of FY2005, we are planning to make further improvement of AGNES, i.e., installing larger monochrometors (4 cmW × 6 cmH × 3 mmT) and a cold Be filter. It is expected that the signal intensity will be increased by 1.2-1.5 times and inelastic scattering in an energy range up to 50 meV will be measurable by reducing the λ/2 effect (spurious peak around 25 meV) by the Be filter.

Before the present improvement, AGNES was actually suitable only for experiments of quasi-elastic neutron scattering. From now, however, inelastic and weak quasielastic scattering data can be measured as usual inelastic neutron spectrometers in the world. Fig.4 shows the quasielastic scattering data from a room-temperature ionic liquid nbminC measured after the improvementl. We are now planning gas high pressure experiments and various in-situ experiments using the top-loading type cryostat.

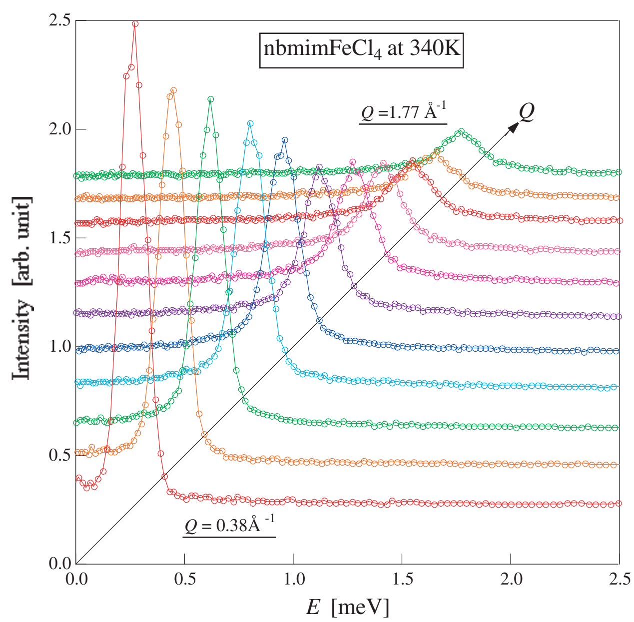

FIGURE 4:

Quasielastic scattering data from an ionic liquid nbmimCl.

Reference:

[1] T. Kajitani *et al.*, Physica B 213-214 (1995) 872.