Development Status of NMR System for Polarized ^{3}He Neutron Spin Filter in MLF at J-PARC

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A compact and movable ^{3}He neutron spin filter (NSF) based on a spin exchange optical pumping method (SEOP) has been developed in the Materials and Life science experimental Facility (MLF) at J-PARC [1]. The ^{3}He NSF is assumed as a convenient NSF because it is operated immediately after its installation in neutron beam lines without any neutron beam adjustments. For realizing such the NSF, a nuclear magnetic resonance (NMR) system is indispensable in order to monitor the ^{3}He nuclear spin polarization P_{He} of the NSF frequently regardless of neutron beams. In the MLF, NMR systems based on the adiabatic fast passage (AFP) and pulse NMR methods have been developed. The AFP-NMR system detects the NMR signal V_{AFP} by a pickup coil when the ^{3}He nuclear spins flip while maintaining the high P_{He} by sweeping a static field B_0 as applying radio frequency (RF) field B_{RF} through a RF coil. It enables that the ^{3}He NSF functions as both of the spin polarizer and flipper though the size and shape of glass cells containing in ^{3}He gas are limited by the RF coil and its device structure is often complicated. On the other hand, the pulse NMR system detects the free induction decay signal V_{FID} just after depolarizing the P_{He} slightly by applying the pulsed B_{RF} through the pickup coil. It functions as the flexible P_{He} monitor because it does not need the RF coil and its device structures is simple though it has demerit that the V_{FID} is sensitive to shifts of the B_0 and B_{RF} in comparison with the V_{AFP}.

This paper will report on development status of our NMR systems, and their feasibility test by using neutrons at a neutron beam line 10 (BL10) in the MLF.

References

[1] H. Kira, et al., Physica B **406**, 2433 (2011)