The first production of polarized Hydrogen-Deuteride(HD) target at RCNP

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The polarized Hydrogen-Deuteride(HD) target is developed mainly for the study of ϕ meson photoproduction on the proton and neutron. Using the polarized target and polarized photon beam at SPring-8, one can measure double polarization asymmetries to investigate the $s\bar{s}$-content in the nucleon [1] and the bump found in the ϕ meson production cross sections [2]. The proton in the HD is polarized by using the static method at low temperature and high magnetic field [3]. The polarization degree of 82% is principally possible for the proton. For 5 years up to now, we have prepared to produce the polarized HD target.

We carried out an experiment to polarize the HD target for the first time. The main purpose of this experiment is to measure the polarization degree and the relaxation time T_1 of the HD target. The HD was solidified, and the polarization was frozen by aging it at 15 mK and 17 T. After 53 days, we measured NMR signals of the HD target.

Figure 1 shows the first NMR signal of the HD target and cell. The H peak from the HD and the F(fluorine) peak from PCTFE(Kel-F) cell were confirmed. Then the relaxation time was estimated by measuring the intensities of the NMR signals. It's quite interesting that the polarization of F decreased quickly, while that of H was maintained for a long time (Fig. 2)[4]. The polarization degree of H was 42% which is lower than the expected value(82%), and That of D was 13%. Calibration data for the polarization were taken at 4.2 K. Possible explanations for the low polarization degrees are as follows.

1. The temperature of the HD target stored in the cell might not be low enough cause of Kapitza resistance between Al wires and a copper part of the cell.
2. Linearity between the polarization degree and the area of the NMR signal on the high polarization might not be good.
3. The polarization might not grow to the maximum value, if T_1 is very long at the beginning.

To solve these problems, we are preparing plans as follows. For the problem 1, we plan to make a new cold finger and cell with high purity copper, and to improve the thermal conductivity between the Al wires and cell. For the problem 2, to measure the NMR signals for calibration at lower temperature than 4.2 K. For the problem 3, we plan to measure the T_1 and confirm it is not long before the aging.

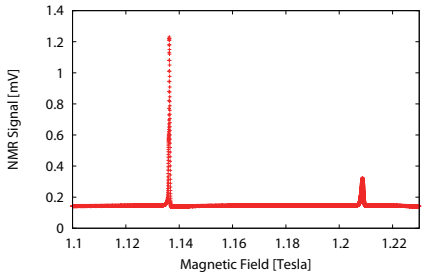

Figure 1: Observed H peak(left) and F peak (right). This NMR signal was measured by magnetic field sweep method at 48.395MHz.

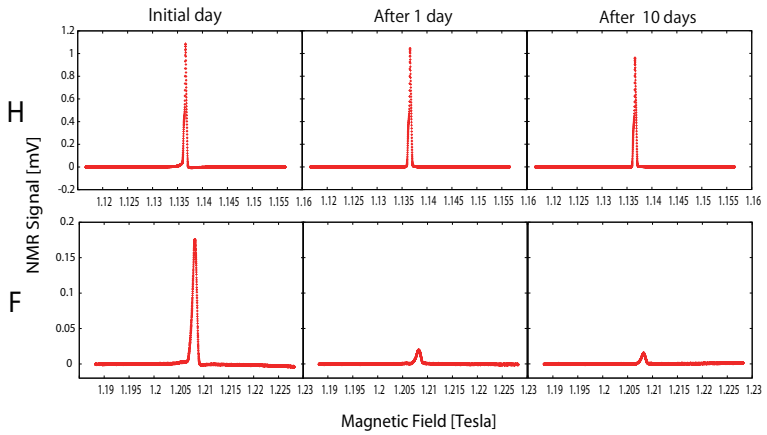

Figure 2: Decay of the NMR signals of H(top) and F(bottom). These sinals were measured at initial day, after 1 day, after 10 days.

References

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