

# New HD gas analyzer system for polarized HD target used by LEPS experiment

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We have been developing a polarized HD target [1] for future LEPS experiments. Introducing the polarized HD target to the LEPS experiments is very important for investigating the nucleon hidden structure with the  $s\bar{s}$ -quark content, reaction mechanisms of  $\phi$  and  $K$  mesons, and exotic hadron properties. We have obtained five large refrigerators for producing and transporting the polarized HD target and carried out the first production of the HD target in 2009 [2]. The relaxation time of the proton polarization was about 100 days which was acceptable for the actual use in the experiments. The polarization degree of the proton was about 40% which was much smaller than the expectation ( $\sim 80\%$ ).

A small amount of ortho- $H_2$  ( $\sim 0.01\%$ ) in an HD sample plays an important role in growing the polarization of the HD target. A commercial HD gas includes an ortho- $H_2$  impurity of a few %. We decrease the impurity by cryogenic distillation. If the period of the distillation is long, the ortho- $H_2$  impurity becomes smaller than 0.01%. Since we performed the distillation for about a month, the ortho- $H_2$  impurity might be much smaller than 0.01%. We could not measure the ortho- $H_2$  concentration correctly at that time.

We have developed a new HD gas analyzer system [3] shown in Fig. 1. The performance of the HD gas analyzer system is shown in Fig. 2. The ortho- $H_2$  is observed separately from the other components of para- $H_2$ , HD, and  $D_2$ . A small amount of ortho- $H_2$  concentration can be correctly measured by using this system. We will be able to efficiently polarize the HD target by optimizing the amount of ortho- $H_2$  in future productions of the target.

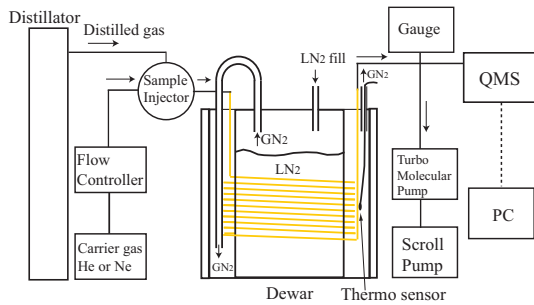


Figure 1: Diagram of the HD gas analyzer system. The gas chromatograph is cooled at 110 K by using liquid nitrogen. QMS is a quadrupole mass spectrometer.

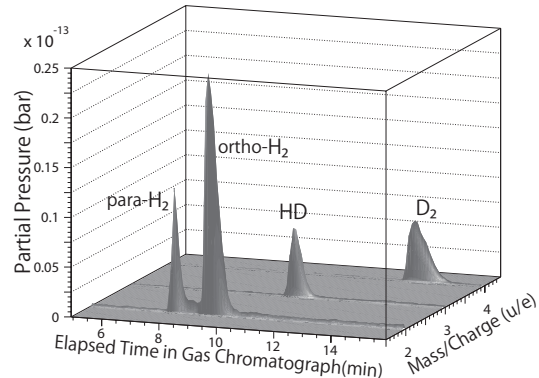


Figure 2: Gas analysis using the HD gas analyzer system combining the gas chromatograph and the QMS.

## References

1. M. Fujiwara *et al.*, Photoproduction experiment with polarized HD target at SPring-8, LEPS/RCNP proposal (2003).
2. H. Kohri *et al.*, Int. J. Mod. Phys. E 19 (2010) 903.
3. T. Ohta *et al.*, Nucl. Instr. and Meth. A 640 (2011) 241.