New liquid target system for the time projection chamber experiment at SPring8/LEPS facility.

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A liquid target system has been newly developed to be used in conjunction with a time projection chamber (TPC) [1] and is now in operation for the running experiment performed at SPring8/LEPS facility. In the experiment, the liquid target is installed inside the TPC which is operated under the 2 Tesla magnetic field provided by the superconducting solenoid magnet and thus the system has a long-nose structure to keep the refrigerator outside of the magnet (Fig.1 (a)). An employed cryogenic refrigerator (RDK-408D2) has high power with 1 W at 4.2 K at the second stage heat exchanger, whereas 40 W at 43 K at the first stage. The available lowest temperature is in the range of 3.5∼4.2 K so that the system can provide the liquid He target in addition to the liquid Hydrogen/Deuterium targets. The gas is first liquefied in the "Liquefied room" marked in fig.1 (a), which is just placed below the second stage, and the liquid is transferred through cupper pipes to the target cell. The target cell is a capsule made from 125μm thick Kapton foil and is cooled by a long-nose cupper-pipe (656 mm long). The target thickness along the beam direction is about 150 mm. The vacuum chamber around the target cell is made from 1 mm thick CFRP (Carbon Fiber Reinforced Plastics) in order to reduce the multiple scattering effects as well as the energy loss of the outgoing particles. An incident photon beam passes through the long-nose pipe, which has an inner diameter of 34 mm, from an entrance window on the vacuum chamber and meets the liquid in the target cell. The target temperature is controlled by a heater adopted at close to the second stage and the heater output is automatically tuned by the temperature controller (LakeShore model 331S) with which the temperature of the target cell and the second stage are measured using Cernox register sensors (Lake Shore CX-1030-CU), respectively.

Last year the first test of the system was carried out for the Hydrogen gas and the system has been operated with stable condition. The target temperature has been controlled within 17.09±0.01 (K) at the target pressure of 1 atm and full liquefaction takes about 8 hour after the cryogenic refrigerator is operated. Fig.1 (b) shows typical time dependence for the target pressure and the temperature for the Hydrigen gas. In this year the liquefied test for the helium gas was performed and the enough amount of the liquid was obtained after 11 hours. The achieved minimum temperature of the target cell was 3.82 (K) being consistent with the designed value of the refrigerator.

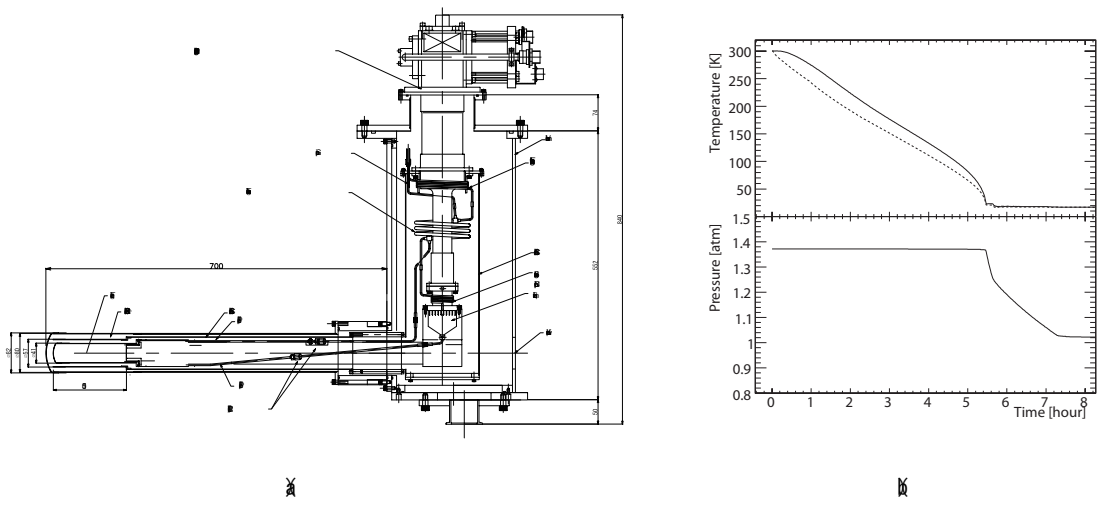

Figure 1: (a) Liquid target system (side view). (b)Time dependence on the temperature and the pressure in the target cell for the Hydrogen gas. The dependence on the target temperature (solid) and the temperature at the Liquefied room (dash) are shown in the upper panel, whereas the lower panel for the dependence on the target pressure.

References

[1] Y. Nakatsugawa *et al*, contribution in this report.