§27. Hydrogen and Helium Partial Pressure Measurement by the Penning Gauge Spectroscopy

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The partial pressures of neutral gases in LHD are measured by the penning gauge spectroscopy diagnostics which was developed at TEXTOR in order to distinguish the partial pressures of deuterium and helium [1]. Three penning gauge spectroscopy systems were operated on LHD in 2013. One is located at the upper port (2.5U) and the other two are located at the inner ports. The inner port gauges are located at the divertor regions with the baffle structure (9I) and without the baffle structure (3I). In this experimental campaign, the precise calibration of helium partial pressure was made. Then, the partial pressures at three different positions are compared. The behavior of the neutral partial pressures during and between the long pulse plasmas is also studied.

Figure 1 shows the calibration result of the partial pressure with helium gas for the gauges at (a) 2.5U, (b) 3I and (c) 9I. The signal sensitivity of the 2.5U gauge is high because the Alcatel gauge is used here. The sensitivity at 3I is better than that at 9I since the anode of the 3I gauge is improved for the observing the penning discharge. As the calibration was made after the long pulse plasma experiment with helium, the calibration with hydrogen gas was difficult due to the build up of helium pressure. Therefore, the hydrogen gas pressure is calibrated by subtracting the calibrated helium pressure.

The helium and hydrogen pressure at the end of a long pulse discharge #124576, which had the duration of about 2676 sec., at 2.5U is shown in Fig. 2 (a). The abscissa shows the time of the data acquisition. For this long pulse discharge, the penning gauge spectroscopy was operated for 7200 sec. in order to measure between plasmas. The neutral pressure at 2.5U reduced during the plasma discharge. The helium pressure increased at the and of the long pulse discharge. As this plasma was operated with only the helium gas-puff, the hydrogen pressure increased slightly later than the end timing of the plasma. Fig. 2 (b) shows the helium and hydrogen pressures at 3I and 9I during another long pulse discharge (#122263), which had the duration of about 350 sec. Both the neutral pressures at 3I and 9I became high during the plasma discharge. The neutral pressure at the divertor region with the baffle is higher than that at the divertor region without the baffle by about one order.

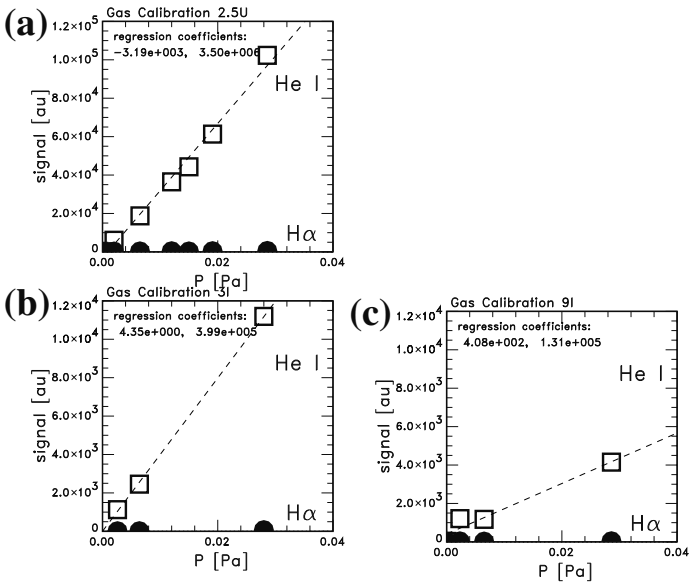

Fig. 1: Results of helium partial pressure calibration at (a) 2.5U, (b) 3I and (c) 9I.

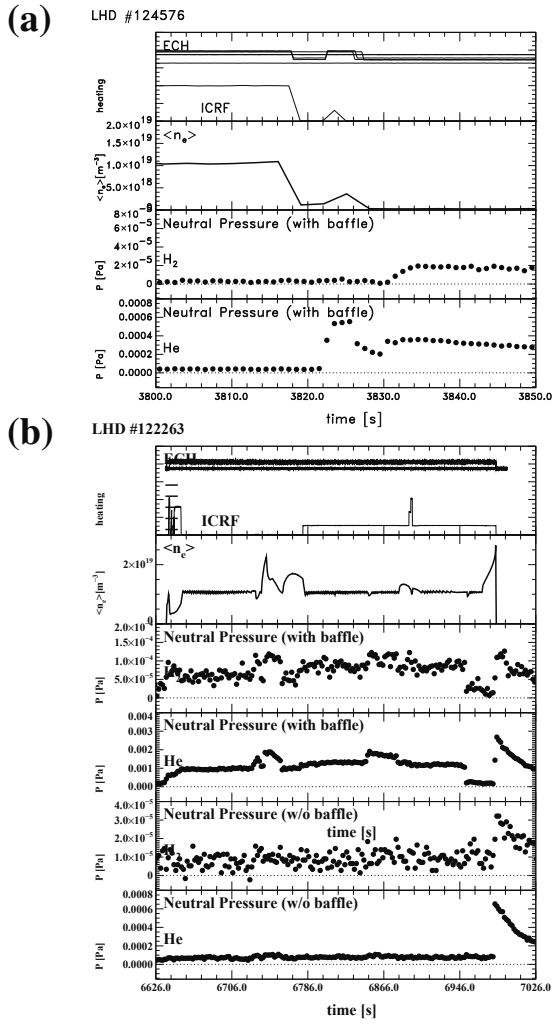

Fig. 2: Signals of ECH, ICRF, electron density and hydrogen and helium partial pressures in (a) the end of #124576 at 2.5U and (b) #122263 at 3I and 9I.

1) K.H. Finken, *et al.*, Rev. Sci. Instrum. **63** (1992) 1.