§13. Dynamic Retention of Helium Long Discharges in LHD

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Investigations of the wall recycling and dynamic retentions are important issues for steady state plasma operations in fusion devices. In the Large Helical Device (LHD), mainly helium working gases are used the steady state operation heated by ion cyclotron resonance frequency (ICRF). The penning gauge spectroscopy is one of the useful diagnostics for the partial pressure of neutral gases under strong magnetic fields [1]. Figure 1 shows an example of the spectra measured by the penning discharge. Hα line at 656.3nm and He I lines at 668 nm are observed, respectively. The time resolutions of this diagnostic are 200 ms for high density plasmas and 1s for the steady state plasma discharge.

The time evaluation of helium partial pressure measured by the penning gauge during 2.3 hours as shown in Fig.2. High peak intensities at plasma terminations are observed in four plasma discharges from #117206 to #117209. After long pulse discharges over 10 minutes in plasma discharges, #117206 and #117208, long-term decays of helium partial pressures are observed continuously until the next discharge.

Figure 3 shows a comparison between hydrogen and helium intensities before plasma discharges, #117208 and #117209, measured by the penning gauge. A pulse length at the plasma discharge, #117207, was a few seconds and aftereffects of the wall recycling by neutral helium gases are negligible and the helium partial pressure returns to the background level before the plasma discharge, #117208. But after the plasma discharge, #117208, which plasma pulse length is about 18 minutes, high wall recycling by neutral helium gases is remained until just before the next plasma discharge, #117209. The high recycling phenomenon is one of reasons for plasma terminations of steady state plasmas in LHD.

1) H.Funaba et al., EPS conference (2012).

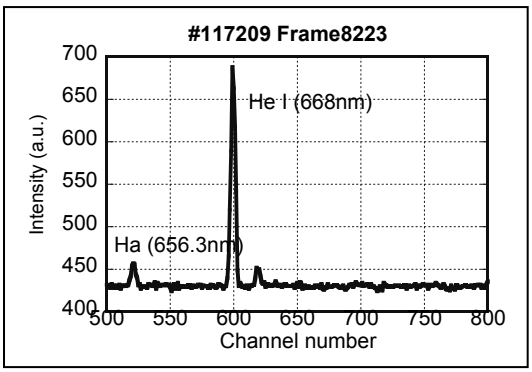

Fig.1 Visible spectrum from the penning gauge.

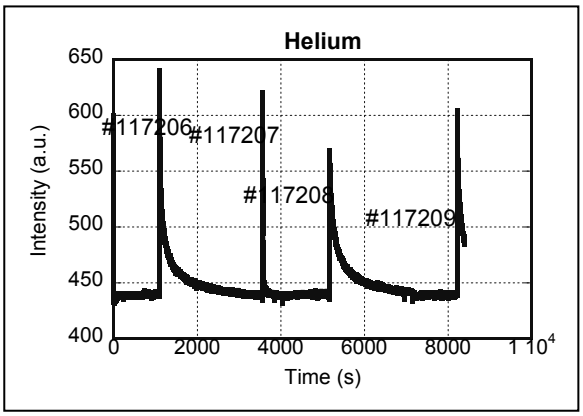

Fig.2 Time evolution of integrated intensities of He I line by the penning gauge.
(LHD plasma discharges from #117206 to #117209)

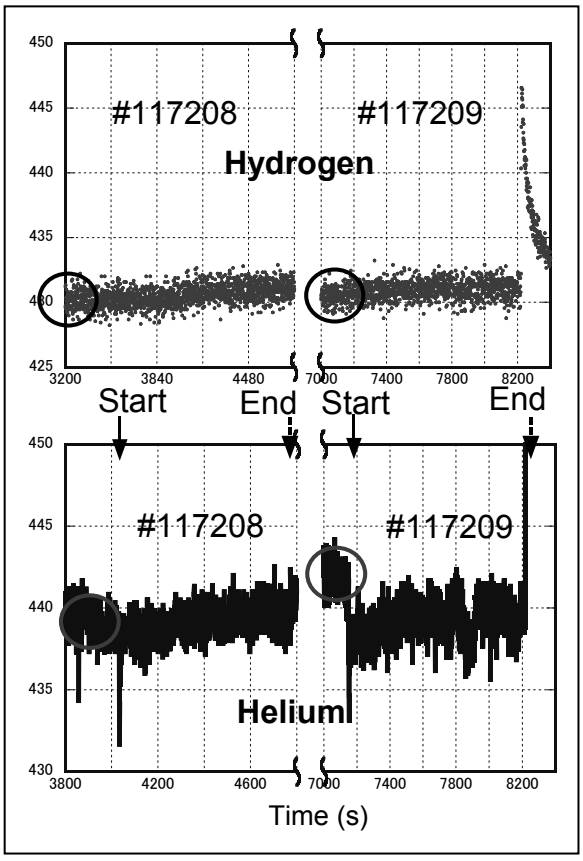

Fig.3 Comparison between hydrogen and helium intensities before plasma discharges measured by the penning gauge.