§19. Measurement of H/(H+D) Ratio in ICRH Plasma

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The ratio of hydrogen to deuterium (H/(H+D)) at the ion cyclotron heating (ICRH) experiments is related to the heating efficiency, the heating mechanism (the ion heating or the electron heating dominant) and the position of the resonance region. The H/(H+D) ratio has a toroidal asymmetry because of the positions of the gas-puffing and many in-vessel components, especially the antenna for the ICRH. We are interested in the ratios at the ICRH experiment and the electron cyclotron resonance discharge cleaning (ECR-DC) using the deuterium gas.

We set eight fibers with lenses at each Q-port (inner) in CHS. Each fiber is connected with a 1 m Czerny-Turner visible spectrometer (reciprocal dispersion of 8 Å/mm). The spectrometer has a multi-channel diode array detector (TN-6144, Tracor Northern Co.) controlled by OMD-V (Seki Technotron Co.).[1] Sixteen spectra per 10 ms are analyzed using the nonlinear fitting program of the two or three Gaussian functions. We can obtain the time history, toroidal distribution and so on of the H/(H+D) ratios.

The typical spectrum with the Gaussian fitting curve is shown in Fig. 1. The time history of the ratio is shown in Fig. 2. The seed plasma is produced by the electron cyclotron resonance heating (ECRH) and the plasma stored energy increases by the ICRH. Although the ratio is small in ECRH phase, it increases because the absorbed hydrogens in the antenna are remitted by the plasma in ICRH phase. This tendency is clear from the toroidal distribution of the ratio shown in Fig. 3. The ratios at the P-antenna positions are larger than those at other positions. In recent experiments, we can not yet control the ratio only by the gas-puffing because the hydrogen recycling from the vacuum vessel is too large. However the ratio can be reduced to 10% without NBI and to 30% even with NBI as the hydrogen recycling decreases after many plasma discharges.

The hydrogen spectrum disappears after several hours of the ECR-DC with the deuterium. The ratio recovers up to 30 % at the main discharge although the H/(H+D) ratio without ECR-DC with the deuterium is over 50 %. We can conclude that the ECR-DC with the deuterium is effective to the decrease in the H/(H+D) ratio.

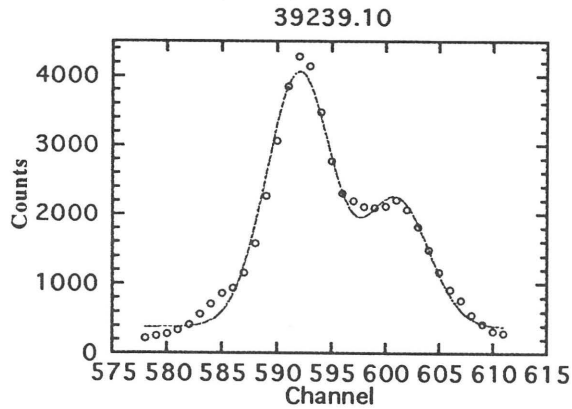

Fig. 1. The typical spectrum with the Gaussian fitting curve .

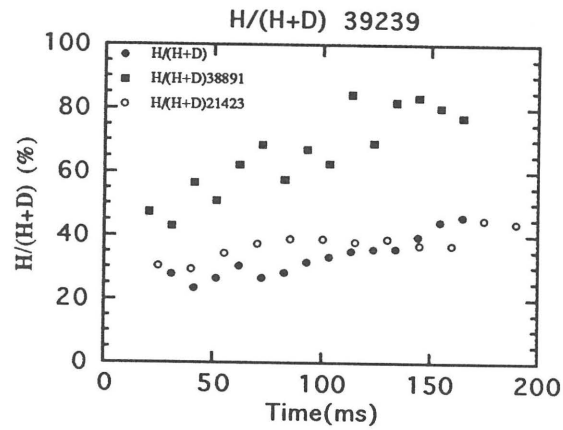

Fig. 2. The time history of H/(H+D) ratio.

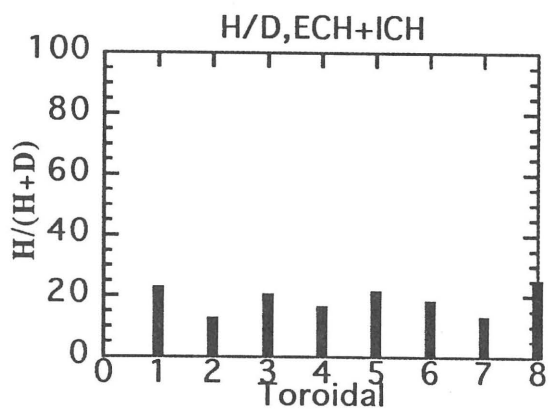

Fig. 3. The toroidal distribution of the H/(H+D) ratio.

Reference

1)Ozaki, T., Kadota, K., et. al., JJAP, 27 (1988) 2134.