§17. Study of Heating Modes in ICRF Experiment

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The ICRF experiment has been started from 2nd cycle of LHD experimental campaign. We calculated the location of resonance and cutoff layers at the plasma cross section in LHD.

Figure 1 shows the calculation result for the plasma parameters in the 2nd cycle experiment. The magnetic field strength is 1.5 Tesla and magnetic axis is located at 3.75 meter of major radius. The frequency of RF wave is 25.6 MHz. The central electron density is 1.05×10^{19} m^{-3}. Helium plasma with 10 % hydrogen mixture is assumed. The antenna is located at the right hand side of the plasma in the picture. R cutoff layer is located several centimeters inside from the last closed flux surface. Ion cyclotron resonance layer of hydrogen is located at about 1/2 of normalized plasma minor radius. The pair of L cutoff and two-ion hybrid resonance layers is located at a few centimeters outside from ion cyclotron resonance layer. RF wave which is launched by antenna approaches ion cyclotron resonance layer from low field side. When ratio of minority ion is small the wave is absorbed by minority ions at ion cyclotron resonance layer. When minority ratio increases the wave which penetrates the cyclotron resonance layer increases and is mode-converted to ion Bernstein wave (IBW) at the two-ion hybrid resonance layer. IBW is absorbed by electrons. Then, by changing the minority ion ratio in this heating regime we expect two cases: ion heating is dominant and electron heating is dominant.

Figure 2 shows the calculation for 3rd cycle experiment. The magnetic field strength is 2.8 Tesla and magnetic axis is located at 3.6 m of major radius. The frequency of RF wave is 43.3 MHz. The central electron density is 1.15×10^{19} m^{-3}. Helium plasma with 5 % hydrogen mixture is assumed in this calculation. Ion cyclotron resonance layer is located at the magnetic axis. We expect ion heating at the plasma center in this configuration of resonance and cutoff layers.

Figure 3 shows the example of the electron heating configuration for the 3rd cycle experiment. The wave frequency is 38.5 MHz and central electron density is 3.0×10^{19} m^{-3}. Hydrogen minority ratio is 30%. The two-ion hybrid resonance layer is located at the plasma center. It is expected that the mode-converted IBW is absorbed by electrons near the plasma center. The position of the two-ion hybrid resonance layer is moved by changing the frequency slightly in order to find out optimum heating condition.

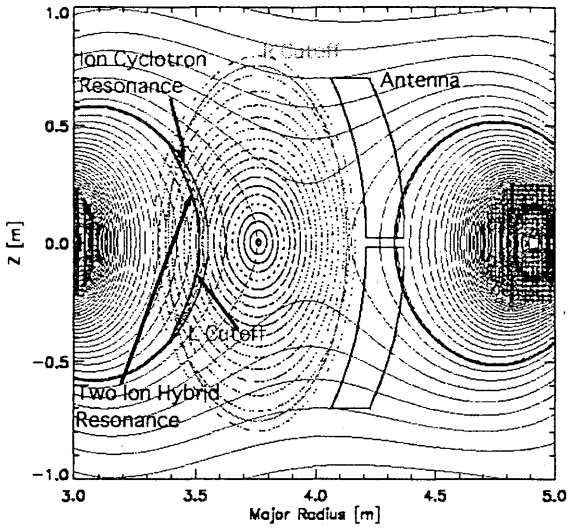

Fig.1 Resonance and cutoff for 2nd cycle experiment.

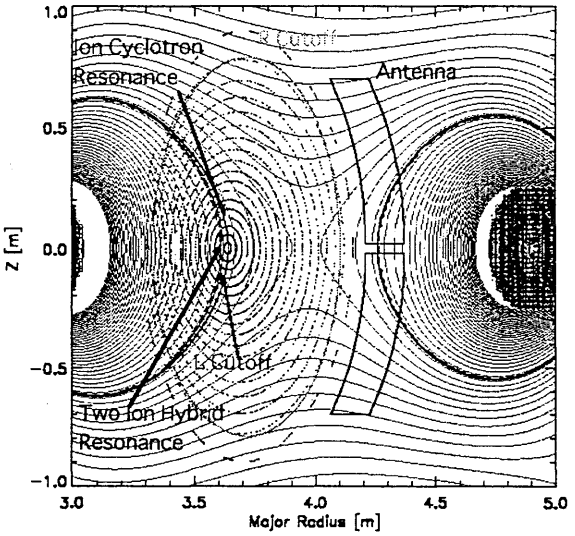

Fig. 2 Example of ion heating configuration for 3rd cycle experiment.

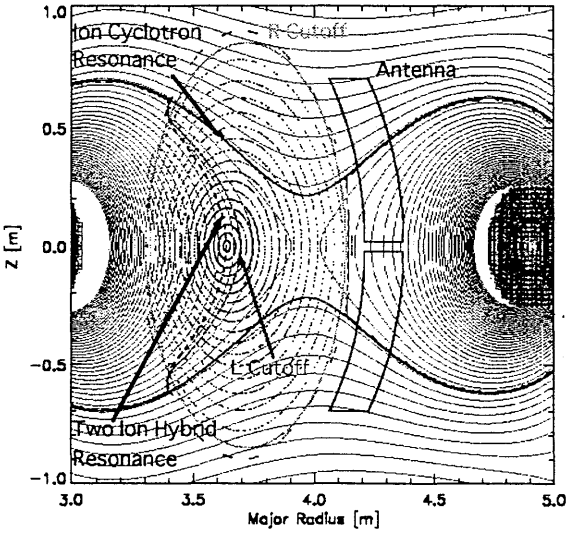

Fig. 3 Example of electron heating configuration for 3rd cycle experiment.