

§19. Code Calculation of Ion Cyclotron Range of Frequency Heating Using the Minority Isotope Ions

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We study the unique ion heating scheme using the isotope ions (Li^7 , C^{13} , Ne^{21}) as a "3rd" ion species, which idea is proposed by Dr. Vdovin et al. [1] Figure 1 shows the position of cyclotron resonance layer. The antenna is located at the high field side and the fast wave launched by the antenna proceeds into the plasma. At the two-ion hybrid resonance layer (ω_{i-i}) the wave is mode-converted to the ion Bernstein wave (IBW). If there is no 3rd ion species, the wave couples with the electrons and electron heating occurs. However, in the case of inclusion of the minority isotope ion the mode-converted IBW is absorbed by the added isotope ion at the 2nd harmonic resonance layer ($2\omega'_i$) and ion heating will be observed. This absorption is distinguished from another ion heating because the resonance layer does not degenerate into the layers of hydrogen and deuterium resonance.

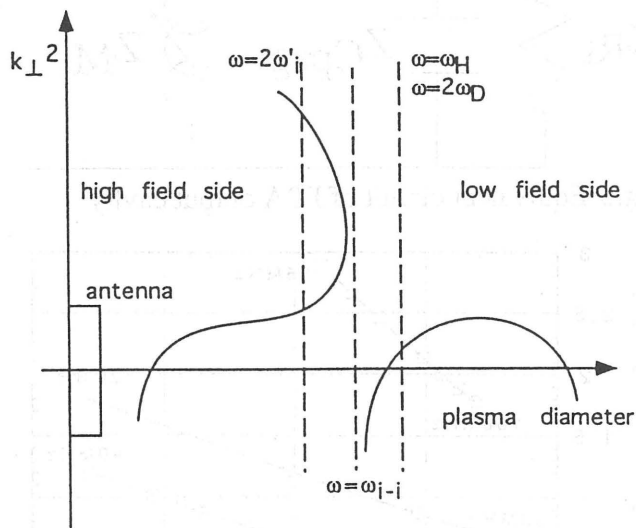


Fig.1 Position of cyclotron resonance layer.

We investigated the absorbed power using the global wave code, ORION [2]. We used the deuterium plasma including the hydrogen ion as a minority and 10 % of lithium isotope ion is utilized as a 3rd ion species. The strength of magnetic field is 3 tesla, frequency of the wave is 42 MHz, plasma density is $1 \times 10^{20} \text{ m}^{-3}$ and the temperature is 2 keV. Figure 2 shows the power absorption in changing the fraction of the minority ion. The absorption by the lithium ion (solid square)

increases gradually with increase of the minority ion concentration. The two-ion hybrid layer moves towards to the lithium resonance layer with increase of the minority fraction. The lithium absorption reaches maximum at 20 % of the minority fraction. Figure 3 shows the total power absorption profile in poloidal cross section of the plasma. In 15 % minority fraction case (Fig.3(a)) the two resonance layers of two-ion hybrid and lithium are observed in horizontal direction. However, in 20 % minority fraction case (Fig.3(b)) the two-ion hybrid layer is located very closely to the lithium resonance layer and only one layer can be seen.

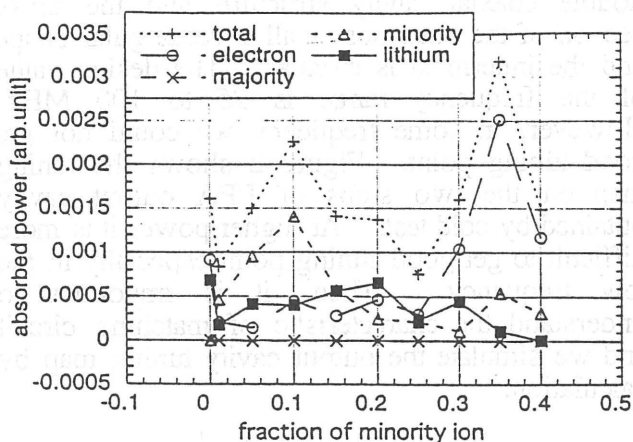


Fig.2 Power absorption dependence on fraction of minority ion.

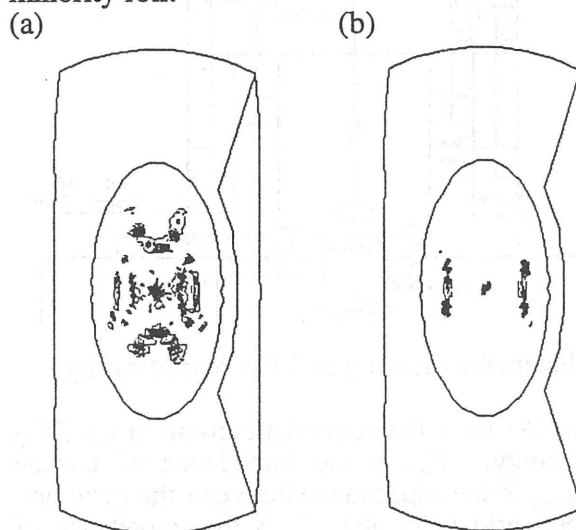


Fig.3 Power deposition profile in poloidal plasma cross section in the case of 15 % (a) and 20 % (b) of hydrogen ion.

References

- 1) Vdovin, V., et al. : submitted to NIFS report.
- 2) Jaeger, E.F., et al. : Nucl. Fusion 30(1990)505.