

Ion Cyclotron Range of Frequencies (ICRF) Heating System

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1. Objective

Launch fast waves (Ion Cyclotron Range of Frequencies (ICRF) waves) to heat plasma particles by wave-particle interaction.

2. Apparatus

2.1. RF amplifier (Heating Device Hall)

- Frequency: 25-100 MHz
- Pulse length and power: 1.3 MW x 6, 5 sec. (38.47 MHz)
0.8 MW x 6, CW (38.47 MHz)

2.2. Impedance matching device (LHD Hall)

- Double liquid stub tuner system for 4.5U,L ICRF antenna
- Triple liquid stub tuner system for 3.5U,L ICRF antenna

2.3. Antenna

- HAS (Hand-Shake type) antenna: toroidal double strap located at 3.5U,L
- FAIT (Field-Aligned Impedance Transforming) antenna: poloidal double strap located at 4.5U,L
- Excited wave: fast wave

3. Operation

3.1. Minority heating

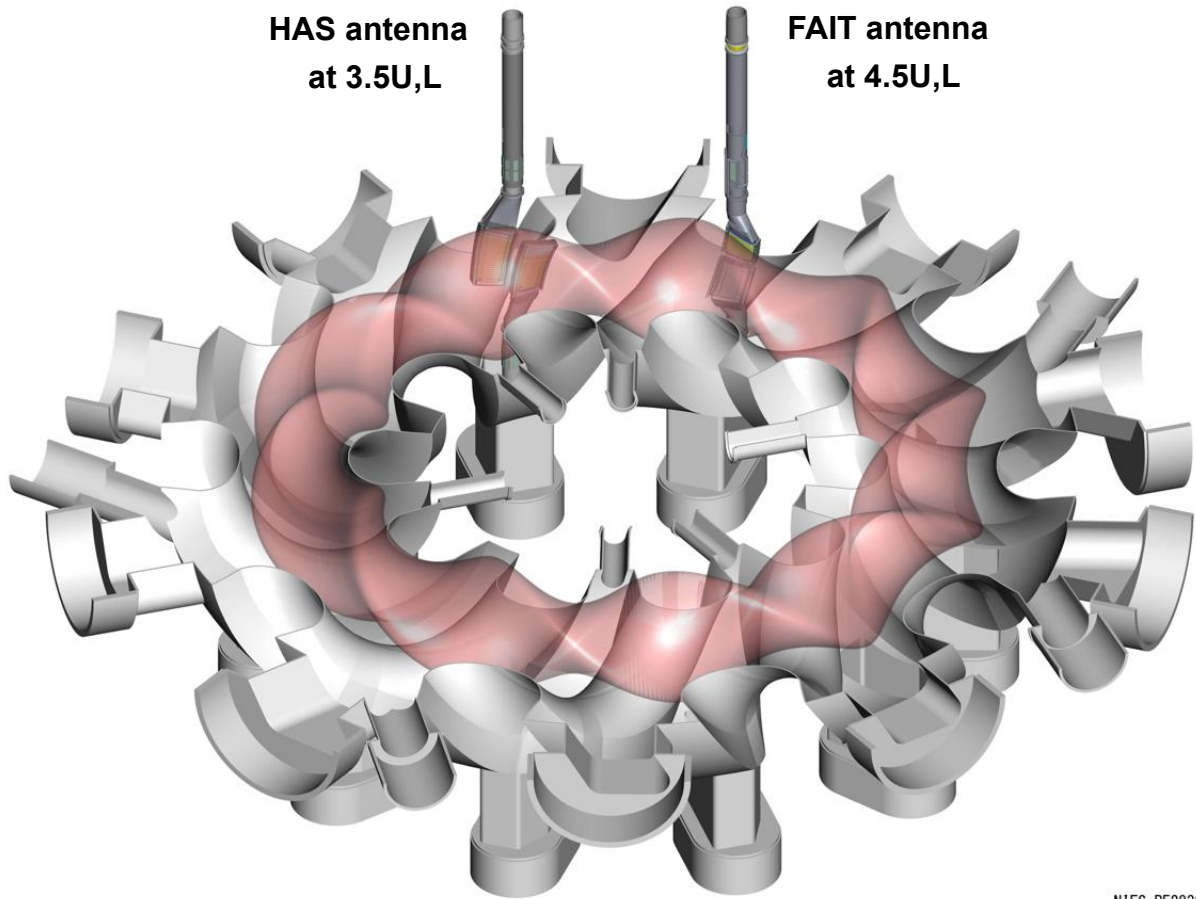
- Deuterium or helium majority and hydrogen minority plasma in $R_{ax} = 3.6$ m and $B_t = 2.75$ T and wave frequency = 38.47 MHz
- Minority hydrogen ions are accelerated at fundamental ion cyclotron resonance layer.

3.2. Second harmonic heating

- Deuterium plasma in $R_{ax} = 3.6$ m and $B_t = 2.75$ T and wave frequency = 38.47 MHz
- Deuterium ions are accelerated at second harmonic ion cyclotron resonance layer.

3.3. Other heating mode

- High harmonic heating is possible by change of magnetic field strength.



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Fig. 1. Location of antennas

4. Available data

4.1. Kaiseki-data server

ichpw: input power $P(=P_{\text{fwd}}-P_{\text{ref}})$ [MW]

time, HAS_3.5U, HAS_3.5L, FAIT_4.5U, FAIT_4.5L, Total ICRF power

ICRF-DC35: analyzed data about HAS antenna at 3.5U,L

time, P(U) [MW], Vmax(U) [kVp], R(U) [ohm], Delta_L(U) [m], P(L) [MW], Vmax(L) [kVp], R(L) [ohm],
Delta_L(L) [m], Phase [deg]

ICRF-DC45: analyzed data about FAIT antenna at 4.5U,L

time, P(U) [MW], Vmax(U) [kVp], R(U) [ohm], Delta_L(U) [m], P(L) [MW], Vmax(L) [kVp], R(L) [ohm],
Delta_L(L) [m], Phase [deg]

4.2. LABCOM

ICHVOLT: raw data of forward and reflected power, and voltage of transmission line

Antenna: data No.

3.5U: 66, 67, 12

3.5L: 68, 69, 13

4.5U: 4, 5, 16

4.5L: 6, 7, 17

ICHPXI: raw data of forward and reflected power, and voltage of transmission line

Antenna: data No.

3.5U: 18, 19, 2

3.5L: 20, 21, 5

4.5U: 6, 7, 14

4.5L: 9, 10, 15

ICRF-DC35: raw data of the directional coupler at the impedance matching tuner at 3.5U,L
ch #

1: time to trigger by internal timer

2: forward voltage of 3.5U

3: start time of ch 2

4: mix of forward and reflected voltage of 3.5U

5: start time of ch4

6: forward voltage of 3.5L

7: start time of ch 6

8: mix of forward and reflected voltage of 3.5L

9: start time of ch8

ICRF-DC45: raw data of the directional coupler at the impedance matching tuner at 4.5U,L
ch #

1: time to trigger by internal timer

2: forward voltage of 4.5U

3: start time of ch 2

4: mix of forward and reflected voltage of 4.5U

5: start time of ch4

6: forward voltage of 4.5L

7: start time of ch 6

8: mix of forward and reflected voltage of 4.5L

9: start time of ch8

5. Remarks

References

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