§63. Dependence of Antenna Phasing on Heating Performance in HAS Antenna

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Plasma experiment using a new type of the ICRF antenna, HAS antenna, has been carried out. The HAS antenna has two straps in the toroidal direction. Then, control of the parallel wave number of the launched fast wave is possible by changing the antenna current phase between the straps. Higher wave number is thought to be preferable since the wave-particle interaction in the plasma edge region will be reduced. We studied the antenna phasing effect on the heating performance.

Heating efficiency was estimated using power modulation technique. Figure 1 shows the modulated ICRF power and the plasma stored energy. The heating efficiency η is estimated as follows [1]:

$$\eta = \frac{\omega_{\mathrm{mod}}}{\sin\delta}\frac{|\delta W_p|}{|\delta P_{ICRF}|} \qquad (1)$$

where ω_{mod} is the modulation frequency of the RF wave, δ is the phase difference of the modulated RF wave and the stored energy, and δP_{ICRF} and δW_P is amplitude of the modulated ICRF power and stored energy. The ICRF power was modulated at the frequency of 2, 4, 6, 8, 10 Hz. The results are summarized in the Fig. 2. As a whole, high heating efficiency was obtained at 0-π phasing. In 0-0 phasing, data is spread to worse heating efficiency. Further precise analysis is required to know the effect on the heating efficiency by the antenna phasing control.

High density operation is one of the subject of the ICRF heating. The maximum achieved density was compared between the 0-0 and 0-π phasing. Figure 3 shows the ICRF power, line-averaged electron density, stored energy, ion and electron temperatures and radiation power in the both phasing case. The plasma is sustained by the ICRF heating only. The injection power is almost same in the both case and about 800 kW. The ion and electron temperatures are almost same in the both case. Higher density and stored energy was achieved in the 0-π phasing. The radiation loss is slightly higher in the 0-π phasing by higher density. The higher wave number is launched in the 0-π phasing. The result that the higher density was obtained in the 0-π phasing is predictable. The achieved maximum density is 2.5×10^{19} m^{-3} by injection of 800 kW in the 0-π phasing. In the previous poloidal array antenna, the density of 2.7×10^{19} m^{-3} was sustained by the injection power of 1.5 MW. Higher density will be obtained by the HAS antenna in the same injection power.

1) Torii, Y. et al.: Plasma Phys. Ctrl. Fusion **43** (2001) 1191.

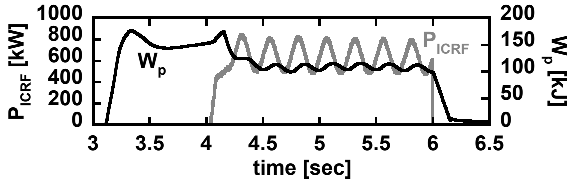

Fig. 1. Modulated ICRF power and stored energy.

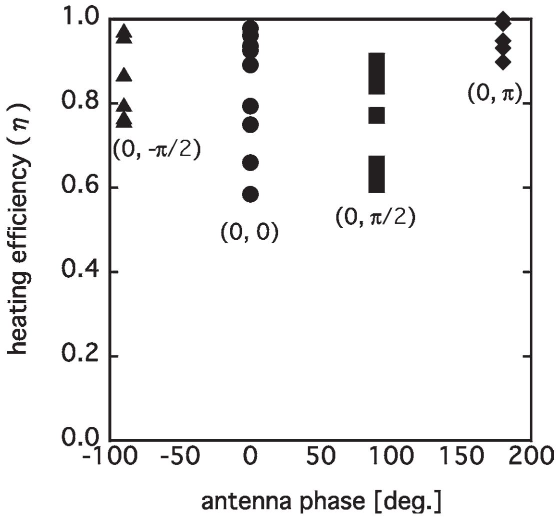

Fig. 2. Dependence of antenna phasing on heating efficiency.

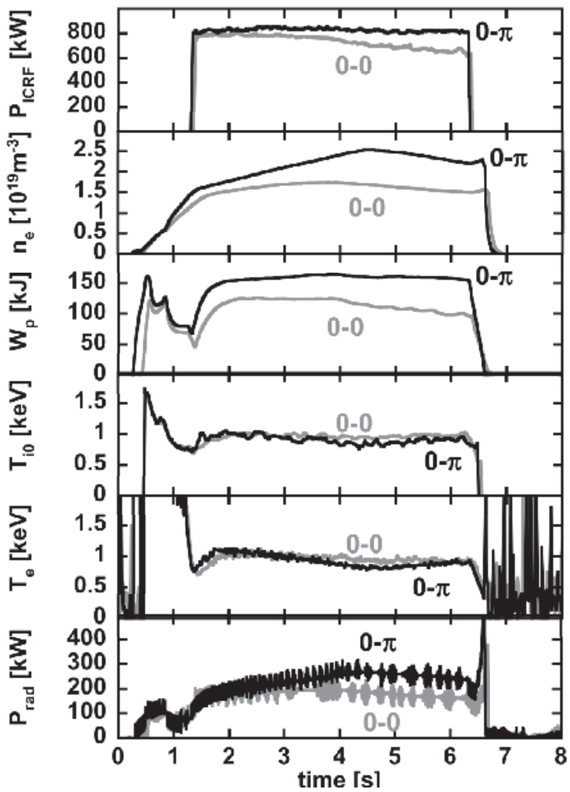

Fig. 3. Shots of the maximum density in 0-π and 0-0 phasing.