ICRF plasma heating in helical reactor

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Ion cyclotron range of frequency (ICRF) heating is a promising tool for plasma heating in helical reactor since the fast wave launched from ICRF antenna is transmitted to plasma core even in a high-density plasma. However, there are problems in this heating method. One is that the enhanced loss of fusion-produced α-particles by the RF wave. The other is existence of evanescence of the fast wave in vacuum region.

We propose the second harmonic tritium heating at the plasma core to solve the first problem. When the magnetic field on axis is 5 T, the resonant frequency is 50 MHz. Then the fundamental and second harmonic resonance layers of α-particles locate peripheral region of plasma. The frequency of 50 MHz is favorable for a tetrode tube since steady-state power injection of 1.6 MW/1tube was achieved at this frequency [1].

It was found by the calculation of antenna impedance [2] that the loading resistance of an ICRF heating antenna with the area of 1 m^2 is more than 10 Ω (characteristic impedance of feeder: 50 Ω) even in the case of long distance between plasma and antenna of 50 cm. Therefore high power injection is possible.

The ray-tracing calculation incorporating the electromagnetic field obtained by the calculation of antenna impedance was conducted. Efficient plasma heating was expected.

[1] T.Seki, et al. J. Plasma Fusion Res. SERIES, Vol. 3 (2000) 359-362.
[2] K.Theilhaber, J. Jacquinot, Nucl. Fusion **24** (1984) 541-554.