§18. Matching and Phasing Test of New Type Fast Wave Antenna

Watari, T., Kumazawa, R., Mutoh, T., Shimpo, F., Masuda, S. (Grad. Univ. Advanced Studies)

A new type fast wave antenna was installed in the JIPP T-IIU vacuum vessel. Since the number of current straps of this antenna is as many as 12 and the space between the straps is very narrow, it is expected that a mutual coupling between the straps is strong. Therefore, it is predicted that it is very difficult to accomplish at the same time impedance matching, phasing of strap current, and same current amplitude on the straps. We have conducted the cold test at the mock-up of the JIPP T-IIU vacuum vessel and it was successful. Then, we started the matching and phasing test at the real vacuum chamber of JIPP T-IIU in vacuum and plasma discharge.

After installation of the antenna in the vacuum vessel, it is impossible to measure the strap current directly. Then, we have set six voltage probes at the coaxial lines and made a relation between the antenna strap current and the probe signal in advance. Figure 1 shows the forward and reflected powers at the two coaxial lines from transmitter output. This is obtained after the adjustment of matching and phasing in the plasma discharge. The reflected power of both lines is suppressed in a very low level and impedance matching is accomplished. Figure 2 shows the amplitude and phase of the strap current and power spectrum of the antenna current, which are acquired simultaneously with the shot of Fig.1. The spectrum is calculated using the data of the strap current and represented as a function of wave refractive index parallel to the line of magnetic force (n//). The velocity of n// = 8 corresponds to the thermal speed of 4 keV electron. The phase is set to (0, π/2, π, 3π/2) (Fig.2(b)). The current on the straps estimated from the probe signal is unbalanced (Fig.2(a)). However, the calculated power spectrum is good in shape and extra sub-peaks are suppressed (Fig.2(c)). This is the good result of the special structure of the antenna. In calculation, if the phase is set up correctly, the spectrum keeps good in shape and the sub-peaks are still suppressed even though the ratio of the unbalance of the antenna current is 1 : 0.4. We prepared the decoupler to cancel out the unbalance of the antenna current, but the adjustment of the circuit is accomplished without it to the present.

![Fig. 1. Time history of the forward and reflected power launched from the two transmitter outputs.](image)

![Fig. 2. Measured amplitude, phase, and spectrum of the current of the antenna straps.](image)

References