27pC04

球状トカマクTST-2における交流オーミックコイル運転による プラズマ電流立ち上げ

Plasma current start-up by AC Ohmic coil operation on the TST-2 spherical tokamak

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Since it is envisaged that steady state tokamak reactors are equipped with no or a slim central solenoid (CS), plasma production and plasma current start-up in such situations are critical issues in fusion research. If we have a slim CS, we can apply an AC voltage to it and generate an inductive AC loop voltage V_{loop} within the limited flux swing. The inductive AC field would be useful for plasma production and heating. On the other hand, many spherical tokamak (ST) experiments suggest that (DC) plasma currents can be started and sustained by pressure driven current. Therefore, there is a possibility of DC current drive by AC V_{loop}.

In order to clarify the possibility, AC Ohmic coil operation was carried out on the TST-2 spherical tokamak device. Figure 1 shows the experimental setup. A bipolar power supply consisting of a capacitor bank (33 mF / 500 V) and an H-bridge switch is connected to the Ohmic coil (i.e., CS), and AC V_{loop} with amplitudes and frequencies less than 4 V and 10 kHz was applied.

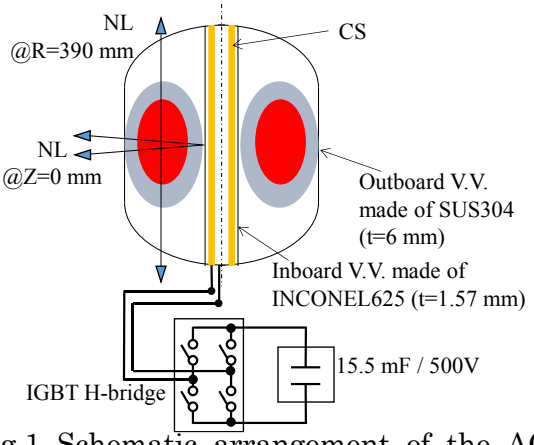

Fig.1 Schematic arrangement of the AC Ohmic operation in TST-2.

Figure 2 shows the waveforms of the discharge where AC V_{loop} (±3.5 V / 1.6 kHz) is applied. Plasma is generated about 4 ms after the start of AC V_{loop}, and bipolar symmetric plasma currents are driven. When a vertical field is applied from t = 18 ms, the current becomes more positive (the direction preferable for equilibrium), and the DC (i.e., slow) component reach 0.6 kA.

In summary, AC V_{loop}, can be used for plasma production, and it can drive DC current when a vertical field is applied. However, we have not yet succeeded in achieving completely unipolar current.

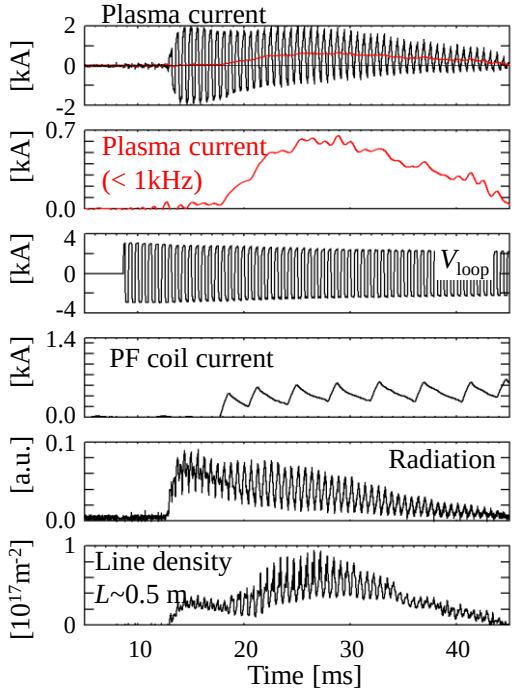

Fig.2 Time evolutions of plasma current, its low frequency components, V_{loop}, PF coil current, radiation and line density.