EDDY CURRENT-ADJUSTED PLASMA SHAPE RECONSTRUCTION BY CAUCHY CONDITION SURFACE METHOD ON QUEST

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CCS (Cauchy Condition Surface) method is a numerical approach to reproduce plasma shape, which has good precision in conventional tokamak[1]. In order to apply it in plasma shape reproduction of ST (Spherical Tokamak), the calculation precision of the CCS method in CPD (B_t = 0.25 T, R = 0.3 m, a = 0.2 m) has been analyzed[2]. The precision was confirmed also in ST and decided to be applied to QUEST (B_t = 0.25 T, R = 0.68 m, a = 0.40 m).

In present stage from the magnetic measurement, it is known that the eddy current effect is large in QUEST experiment, and there are no special magnetic measurements for eddy current now, so some proper model should be selected to evaluate the eddy current effect. As the eddy current model, we divided the vacuum vessel into 8 parts, in each part lots of filament with different current (distributed current density) represent the eddy current[3]. The eddy current density by not only CS (Center Solenoid) coil but also plasma current is calculated using EDDYCAL (JAEA). The eddy currents are taken as unknown variables and solved together with plasma shape reconstruction. In Cauchy-condition surface method, if $N_{EC} + M_{CCS} < N_{FL}$, the eddy current can be evaluated, and plasma shape is also reproduced.

Figure 1 shows waveforms of CS, plasma and vertical field currents in ohmic discharge assisted by ECRH. Eddy current effect must be regarded even in moderate phase, where the currents do not change. In the ohmic plasma with a lot of high-energy electrons, there may be an isotropic plasma pressure, which makes difficult a usual equilibrium analysis, but the CCS method can reconstruct the plasma shape precisely regardless of the anisotropy.

Eddy current model is considered to be essentially a projection (the necessary condition is satisfied but the sufficient is not). Since the tangential magnetic field on the flux loop measurement surface must satisfy a boundary integral equation, we can determine more physically consistent eddy current density and shape reproduction by installing tangential magnetic probes inside the vacuum chamber.

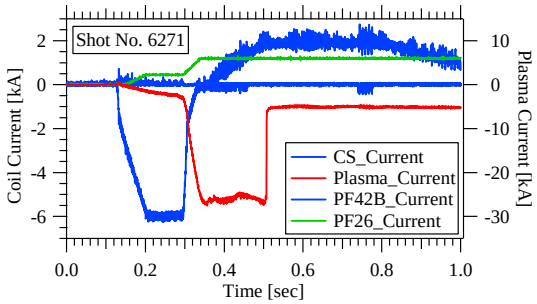

Figure 1: Coil and plasma current waveform in QUEST ohmic discharge.

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