# §82. Higher-precision Reconstruction and the Real-time Display of Divertor Plasma Shape in QUEST

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In the spherical tokamak QUEST ($B_t = 0.25\mathrm{T}, R = 0.68\mathrm{m}, a = 0.40\mathrm{m}$), as one of the methods to obtain a steady-state divertor plasma, a high-density divertor plasma is made by OH (ohmic heating) and the plasma current is planned to be sustained by EBW current drive.

OH divertor plasma of lower triangularity (Candy-shape) was produced with PF35-12 inner and divertor coils connected in series (Fig.1). And the one of higher triangularity (D-shape) was produced with PF35-1 inner divertor coil. The divertor plasma was designed by TASK/EQU code and the plasma boundary shape was reconstructed by CCS (Cauchy Condition Surface) method according to data from two kinds of magnetic sensors (FL: Flux Loops, MP: Magnetic Probes and PR: Partial Rogowski) (Figs.2-5). Though the latter magnetic probes and partial Rogowski detect local magnetic field, the reconstruction has become possible with the standard deviation and eddy current effect adjustment. The reconstructed result showed a double-null divertor configuration and was consistent with that by E-FIT code (Fig.6).

In the present OH plasma with a lot of high-energy electrons, there may be anisotropic plasma pressure, which makes difficult a usual equilibrium analysis, but the CCS method can reconstruct the plasma shape precisely regardless of the anisotropy[1)2)]. Since a lot of magnetic probes have been installed in addition to flux loops inside the vacuum chamber, CCS can be set on the measuring (magnetic sensor) surface. Vacuum vessel and the outer space are also outside of vacuum region. Boundary integral equation is applied also on the magnetic sensor surface. Eddy current and PFC do not have to be considered in this case.

1) K. Kurihara, Fusion Eng. Design, 51-52, 2000, pp.1049-1057.
2) K. Nakamura, Y. Jiang, X.L. Liu, O. Mitarai, et al., Fusion Eng. Design, 86, 2011, pp.1080-1084.

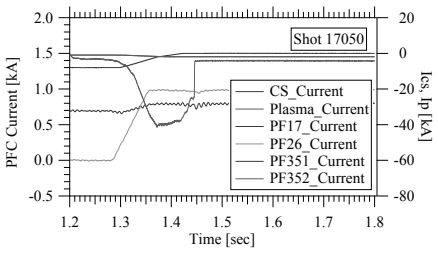


Fig. 1: Waveforms of plasma current and poloidal field coil current.

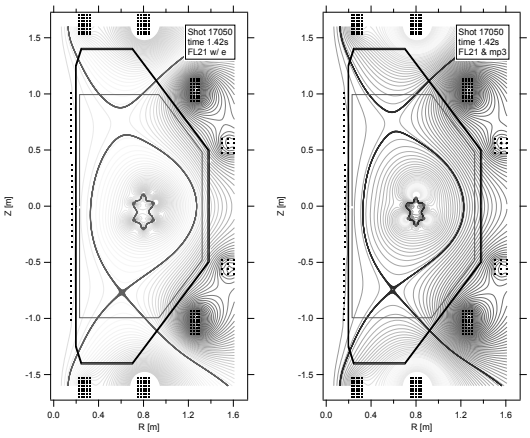


Fig. 2: Plasma shape reconstruction by 21 FL.

Fig. 3: Shape reconstruction by 21 FL and 3 MP.

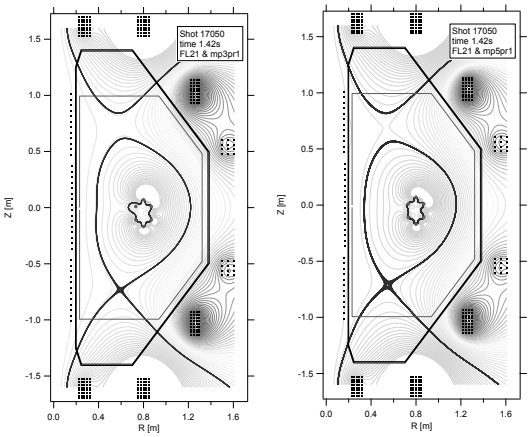


Fig. 4: Plasma shape reconstruction by 21 FL, 3 MP and 1 PR. Effect from inner PR may be weakened due to the detachment.

Fig. 5: Plasma shape reconstruction by 21 FL, 5 MP and 1 PR. Effect from inner PR may be weakened due to the large number of MP.

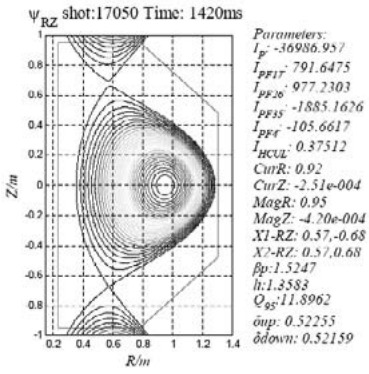


Fig. 6: Plasma shape reconstruction by EFIT.