Reconstruction of Tokamak Equilibria with Pedestal Profiles Using the SPIDER Code

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Equilibrium reconstruction codes are the main tools for the interpretation of experimental data in modern tokamaks. In case of non-monotonic reversed shear or "skin" profiles at the edge, the standard reconstruction methods [1, 2] do not perform satisfactorily and plasma boundary shape and profiles are not determined accurately. In particular, the pedestal profile measurements rely upon the magnetic surface mapping onto the real space that should be determined self-consistently using the reconstructed free-boundary equilibrium.

To avoid the restrictions of the previous generation of codes and to improve accuracy and efficiency of equilibrium reconstruction, a new adaptive grid plasma equilibrium reconstruction solver in the frame of the SPIDER [3] code has been developed. The automatic mapping of the magnetic surfaces provided by the adaptive grid code allows for accurate resolution of the pedestal region while using the same flux grid in the plasma for efficient free-boundary equilibrium calculations.

The changes in the mapping of magnetic surfaces due to the presence of pedestals are estimated for fixed and free boundary equilibrium reconstructions of ELMy TCV shots. Using the measured temperature and density profiles, the current density profile is reconstructed and the influence of the bootstrap current in the pedestal is investigated. The results can be cross-checked using the SPIDER code operating in the rectangular grid mode for the free boundary calculations.

The application of the developed methods to configurations with large fraction of noninductive current, like in the TCV shots with high bootstrap current fraction, is discussed.

[1] L.L.Lao *et al.* Nucl. Fusion 30, 1035 (1990)

[2] F.Hofmann, S.C.Jardin, Nucl. Fusion 30, 2013 (1990)

[3] A.A.Ivanov et al., 32nd EPS Conf. on Plasma Phys., ECA Vol.29C, P-5.063 (2005)

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