Status of Parametric Equilibrium Reconstructions for Wendelstein 7-X

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The reconstruction of the plasma equilibrium is a vital tool for toroidal fusion experiments to help understand plasma performance and interpret diagnostic signals. The procedure involves solving the MHD equilibrium, computing synthetic diagnostic signals based on that equilibrium, and comparing these signals to measured signals. The parameters that describe the equilibrium are adjusted to find a best-fit of the measured and synthetic signals. Information gained from the reconstruction includes details about the shape of the plasma, the location of the plasma edge, and profile information regarding the plasma pressure, current, and individual plasma species (e.g. T_e, N_e, T_i, N_i). These inferred profiles are used to interpret diagnostic information and are used for further analyses.

The constraints for the reconstructions of plasmas at Wendelstein 7-X (W-7X) include magnetic diagnostics ('segmented' and 'complete' Rogowski coils, diamagnetic and compensated flux loops, saddle coils, field coil currents), Thomson Scattering, interferometry, electron cyclotron emission, soft x-ray arrays and x-ray imaging crystal spectroscopy. Treatments of edge constraints related to the edge rotational transform and divertor location are also presented.

The MHD equilibrium solution is provided by VMEC, which assumes solution with nested, closed flux surface. The contribution summarizes a benchmarking of the three equilibrium reconstruction codes that use VMEC: V3FIT[1] (approximate quasi-Newton with SVD), STELLOPT (modified Levenberg-Marquardt, and others), and MINERVA[2] (a Bayesian modelling framework). Furthermore, the current status and future plans for equilibrium reconstructions for W-7X are shown and discussed.

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