Equilibrium Reconstruction in Stellarators: V3FIT.

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Abstract

The V3FIT code will perform fast, accurate equilibrium reconstruction for stellarators. The EFIT [1] code is the most widely used tool for axisymmetric equilibrium reconstruction. EFIT returns information about the plasma position, flux surface shape and radial profiles as the discharge evolves. It is used for equilibrium control, and input for comparisons with MHD stability and confinement predictions. As beta values and currents in stellarators increase, accurate reconstruction of experimental stellarator equilibria is needed. The V3FIT code will satisfy this need.

The equilibrium reconstruction (ER) will use signals from experimental diagnostics to constrain an MHD equilibrium so that the signals computed from the equilibrium are as consistent as possible with the observed signals. One portion of the ER problem is to compute the expected diagnostic signal, given an assumed MHD equilibrium. Diagnostics could include flux loops, magnetic probes, Thomson scattering and motional Stark effect. For magnetic diagnostics, we have written two codes, V3RFUN and V3POST, that efficiently compute expected diagnostic signals [3]. The two codes are currently being used to design magnetic diagnostic coil sets for the CTH and NCSX experiments.

To be most useful for experiments, the V3FIT code will need to a) run rapidly, b) be flexible, and c) be extensible. For the ER to be rapid, the evolution of the equilibrium parameters toward their true values will need to be tightly coupled to the iterative equilibrium solution. Currently, efforts are concentrated on the VMEC equilibrium solver, which is the most widely used 3D equilibrium code.

We have implemented a loosely coupled (meaning that each set of equilibrium parameters requires an evaluation of a completely converged VMEC equilibrium) ER capability using the STELLOPT code. The STELLOPT ER capability will help the V3FIT code effort with algorithm testing and comparison.

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