WINDING PACK DETERMINATION AND FIELD ERROR CORRECTION*

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Magnetic field errors due to non-ideal coil shape or positioning can cause broken magnetic surfaces (magnetic islands or ergodic regions) in stellarators. We have developed techniques to minimize these magnetic field perturbations and to determine deviations from ideal stellarator symmetry in the compact stellarators NCSX and QPS. One technique compares the measured magnetic field on a dense 3-D grid around a non-planar modular coil with the magnetic field calculated for the ideal (design) coil. The 3-D path representing the current center of the coil pack is found by minimizing the difference between the measured and design fields. This technique will be tested on a twisted racetrack coil and could be used on NCSX and QPS. Knowledge of the actual 3-D path of the current center of each coil pack then allows optimal orientation of the coils to give the best fit to the design field.

Residual magnetic islands can then be minimized by optimizing the current in each coil, calculated for each modular coil by following magnetic field lines and locating periodic trajectories in a symmetry plane. The residues, a measure of magnetic island size, are minimized in a nonlinear optimization. The magnetic surfaces and the departure from ideal poloidal symmetry for QPS can be found by following electron beam orbits. The deviation from the flux surface is a direct measure of the non-poloidally symmetric components of the magnetic field. Calculations of the flux surfaces assume low-energy electrons at high magnetic field and the calculations of the deviation from ideal quasi-poloidal symmetry are done with high-energy electron at low magnetic field including the perturbation due to the earth's magnetic field.

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*Oak Ridge National Laboratory, managed by UT-Battelle, LLC, for the U.S. Dept. of Energy under contract DE-AC05-00OR22725.