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ELIMINATING ISLANDS IN HIGH-PRESSURE FREE-BOUNDARY STELLARATOR MAGNETOHYDRODYNAMIC EQUILIBRIUM SOLUTIONS.

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For the (non-axisymmetric) stellarator class of plasma confinement devices to be feasible candidates for fusion power stations it is essential that, to a good approximation, the magnetic field lines lie on nested flux surfaces; however, the inherent lack of a continuous symmetry implies that magnetic islands responsible for breaking the smooth topology of the flux surfaces are guaranteed to exist.

Thus, the suppression of magnetic islands is a critical issue for stellarator design, particularly for small aspect ratio devices. Pfirsch-Schlüter currents, diamagnetic currents and resonant coil fields contribute to the formation of magnetic islands, and the challenge is to design the plasma and coils such that these effects cancel.

A new procedure, termed island 'healing', for suppressing magnetic islands in free-boundary high-pressure full-current stellarator magnetohydrodynamic equilibria is developed. The algorithm is based on the Princeton Iterative Equilibrium Solver [Comp. Phys. Comm., 43:157, 1986] which iterates the equilibrium equations to obtain the plasma equilibrium. At each iteration, changes to a Fourier representation of the coil geometry are made to cancel resonant fields produced by the plasma.

The coils are constrained to satisfy certain measures of engineering acceptability. Also, the plasma is constrained to ensure kink and ballooning stability. As the iterations continue, the coil geometry and the plasma simultaneously converge to a 'build-able' coil set that supports a stable equilibrium in which the island content is negligible.

The method played an important role in the successful plasma and coil design for the National Compact Stellarator eXperiment, a three field-period compact quasi-axisymmetric stellarator of major radius $1.4m$ with $\beta \approx 4\%$. Comparisons of the equilibrium magnetic field structure before and after 'healing' will be presented.