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Use of Non-Axisymmetric Shaping in Magnetic Fusion ALLEN H. BOOZER, Columbia University, New York, NY 10027

Two points define the importance of non-axisymmetric shaping to magnetic fusion: (1) Shaping is the primary design freedom of magnetic fusion plasmas. The other determinants of plasma equilibria, which are the pressure and current profiles, are largely self-determined. (2) Most of the freedom of shaping is non-axisymmetric. Non-axisymmetric shaping can increase the design freedom of axisymmetric concepts, most importantly the tokamak, or define a concept that has no axisymmetric analogue, the stellarator. W7-X is an example of a stellarator that has no axisymmetric analogue. The current along the magnetic field in W7-X is almost zero, which makes the magnetic configuration essentially independent of the plasma pressure. Non-axisymmetric shaping can be applied to tokamaks at any level if the quasi-axisymmetry of the magnetic field strength is preserved, B(l) = B(l + L), where l is the distance along a magnetic field line and L is a constant on that line. Recent tokamak innovations have used asymmetries at the 10^{-3} level to control ELM's, to feedback stabilize RWM's, and to mitigate error fields. Central tokamak issues, such as the maintenance and the robustness of the magnetic configuration, may require stronger quasi-axisymmetric shaping. Although the primary remaining design freedom of tokamaks is in stronger quasiaxisymmetric shaping, the world fusion program has no plans for an experimental study. High beta and low collisionality would be required. The U.S. funds experiments at this level, so quasi-axisymmetry is a route for addressing the priorities of (1) developing the knowledge base of fusion, (2) having a world leading fusion program, and (3) advancing the ITER mission of demonstrating the feasibility of fusion power.