Abstract

High field designs could reduce the cost and complexity of tokamak reactors. Moreover, the certainty of achieving required plasma performance could be increased. Strong ohmic heating could eliminate or significantly decrease auxiliary heating power requirements and high values of $n \tau_\psi$ could be obtained in modest size plasmas. Other potential advantages are reactor operation at modest values of beta; capability of higher power density and wall loading; and possibility of operation with advanced fuel mixtures. Present experimental results and basic scaling relations imply that the parameter $B^2a$ where $B$ is the magnetic and $a$ is the minor radius may be of special importance. A super high field compact ignition experiment with very high values of $B^2a$ (e.g. $B^2a = 150$ T$^2$m) has the potential of ohmically heating to ignition. This short pulse device would use inertially cooled copper plate magnets. Compact engineering test reactor and/or experimental hybrid reactor designs would use steady state water cooled copper magnets and provide long pulse operation. Design concepts are also described for demonstration/commercial reactors. These devices could use high field superconducting magnets with 7T - 10T at the plasma axis.