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Implications of Recent Physics Advances for the Design and Operation of Burning Plasma Experiments such as ITER and FIRE DALE MEADE, CHARLES KESSEL, Princeton Plasma Physics Laboratory — New operating modes have been developed for tokamaks including improved H-modes, modes for long duration inductive operation and advanced tokamak(AT) modes aimed at high-β steady-state operation. The new H-mode scaling with reduced beta degradation developed by the ITPA projects to significantly higher fusion gains in FIRE and ITER. The hybrid inductive mode developed on ASDEX-U and DIII-D leads to improved confinement at moderate β that would be suitable for burning plasma studies (Q = 10 to 20) on ITER and FIRE, and increased duration for neutron production on ITER. Using the Tokamak Simulation Code (TSC), an AT scenario has been developed for FIRE with β_N= 4, $f_{bs} \approx 80\%$ and Q = 5 – 10 that would provide DT fusion power densities of 5 MWm^{-3} and a neutron wall loading of $\approx$ 2 $MWm^{-2}$for durations of 3-5 plasma current redistribution times. Recent experiments on DIII-D with $\beta_N \approx 4$ sustained for 2 sec provide confidence that this regime can be attained. Studies are underway to develop similar AT modes for ITER. For both ITER and FIRE the exploitation of AT modes is limited by power handling capability of the present first wall designs. Work supported by DOE Contract No. DE-AC02-76CH03073.

Dale Meade
Princeton Plasma Physics Laboratory

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