Transient formation of internal transport barriers in configurations with either negative or
weak central magnetic shear profiles have resulted in high performance discharges in a
number of tokamaks. In the DIII–D tokamak, ion transport approaching neoclassical values
across the entire plasma cross section has been obtained in discharges that combine an
internal transport barrier with an H–mode edge barrier [1]. However, these high performance
H–mode discharges are typically limited by MHD instabilities driven by high pressure
gradients at the edge. Negative Central Magnetic Shear (NCS) discharges without an edge
transport barrier but with an L–mode-like edge do not encounter edge instabilities but can
suffer from pressure driven instabilities in this case. MHD stability studies with a systematic
scan of simulated equilibria with model \( q \) and pressure profiles show that the stability limit
improves with increasing width and radius of the internal transport barrier (ITB). Modeling is
crossed on the key issues of how to obtain such a configuration and how to maintain it for
steady-state tokamak operation. The ECH power available at the DIII–D facility is being
upgraded from the present three 1 MW gyrotron system to a six gyrotron system by the year
2001, four of which will be equipped with a diamond window enabling longer pulses. In order
to help plan and guide the experiments, we are carrying out self-consistent, time-dependent
 simulations using both ONETWO [2] and CORSICA [3] transport codes. For the baseline
performance predictions, we use transport coefficients normalized to ITER89P in an existing
NBI discharge with an ITB. For maintenance of the desired configuration, it is essential to
align well the electron cyclotron current drive (ECCD) profile with the off-axis bootstrap
current profile, and to increase the ECCD efficiency to overcome the dissipating ohmic
current profile. Self-consistent calculations indicate that off-axis (\( \rho \sim 0.43 \)) ECCD with 3 MW
absorbed ECH power in a beam-heated target plasma can sustain the enhanced confinement
condition with a bootstrap current fraction of \( \sim 60\% \), normalized beta, \( \beta_N \sim 2.7 \) and
confinement enhancement factor, \( H_{89P} \sim 2.2 \). More theory-based models (e.g., IFS-PPPL
model [4]) with and without E×B flow shear suppression [5] of turbulence are also used to
study the sensitivity of the simulation results to the transport model employed and to study the
possible formation of an internal transport barrier.

Lancy, Switzerland, 1996).

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