Optimum Safety Factor Profile for an Advanced Tokamak with Negative Central Shear

B.J. Lee,[†] A.D. Turnbull, and T.S. Taylor
General Atomics
San Diego, California 92186-9784, U.S.A.

Abstract

The effect of the wall location on the stability of magnetohydrodynamic equilibria is considered for the case of an Advanced Tokamak with negative central magnetic shear. The equilibria have pressure and current profiles consistent with the proposed Second Stable Core VH–mode [Turnbull *et al.*, Phys. Rev. Lett. **74**, 718 (1995)]. In particular, the pressure profile has a finite edge pressure gradient that is consistent with high confinement as seen in experiments. The stability analysis shows that for $q_0 = 3.9$, all $q_{\min}$ in the range $1.8 \leqslant q_{\min} \leqslant 3.3$ are stable to $n = 1$ and $n = 2$ modes at $\beta_{\rm N} = 5.0$ with the DIII–D wall. However, there are two optimum minimum q ($q_{\min}$) with respect to the wall distance from the plasma. For $n = 1$ modes with $q_0 = 3.9$, the optimum $q_{\min}$ is 2.1, with a secondary optimum also at $q_{\min} = 2.85$. The wall position for the $n = 2$ mode is more restrictive than for $n = 1$ but the optimum $q_{\min}$ values for both $n = 1$ and $n = 2$ are almost identical.

[†] Fusion Energy Research Program, University of California, San Diego, La Jolla, California 92093-0417, U.S.A.