Parameter Space for Self-Consistent High $\beta_N$, High $\ell_i$ Discharges in Steady-State$^1$ J.R. FERRON, T.C. LUCE, GA, C.T. HOLCOMB, LLNL, J.M. PARK, ORNL — A tokamak scenario with a peaked current profile ($\ell_i\approx0.9$), is a promising candidate for a high $\beta_N$ and Q power plant because of the increased stability limits and confinement. Model equilibria have been used to show that the present DIII-D experiments in this range of $\ell_i$, with $\beta_N=5$ and evolving current density (J) profile, can be extended to 100% noninductively driven current with stationary, self-consistent J and pressure (P) profiles. $\beta_N=4$, $q_{95}\approx6.5$, bootstrap current fraction $f_{BS}\approx0.46$ is predicted stable to ideal low-n modes without requirement for a conducting wall, while $\beta_N=5$, $f_{BS}\approx0.6$ is predicted stable when the effect of the vacuum vessel is included. These results reflect the trade-off between high $f_{BS}$ and high $\beta_N$ that is required because, as $\beta_N$ is increased, bootstrap current in the plasma outer half, from the H-mode pedestal and the broad pressure profile, reduces $\ell_i$ and the ideal stability limit. Full simulations using the TGLF transport model and the DIII-D current drive/heating sources yield similar parameters.

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