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Advanced Scenario Development on NSTX[1] D.A. GATES, S.P. GERHARDT, H. KUGEL, J.E. MENARD, Princeton Plasma Physics Laboratory, S.A. SABBAGH, Columbia University, AND THE NSTX TEAM — The NSTX plasma operational space has been expanded to simultaneously include the extreme shaping regime ($\kappa \sim 3$, $\delta \sim 0.8$) and $\beta_N \sim 6$, an increase from initial attempts in 2007 which achieved $\beta_N \sim 4$. The observed non-inductive current drive fraction is calculated to be $f_{BS} \sim 65\%$. Many such discharges now extend beyond the maximum toroidal field flat-top as determined by thermal limitations, an important achievement for a device such as NSTX with severely limited transformer flux. These plasmas are demonstration discharges for proposed future spherical torus devices, such as NHTX and ST-CTF which plan to operate in this strongly shaped regime. These plasmas utilized several additional advanced control techniques. In particular, the non-axisymmetric coil set on NSTX was operated with simultaneous n=1 RFA/RWM suppression and preprogrammed n=3 error field correction. The non-axisymmetric correction fields were observed to maintain plasma rotation, thereby suppressing deleterious MHD mode activity. Lithium evaporation was used to improve plasma confinement, and may have contributed to control of the plasma density, which was observed to be lower than in similar discharges without lithium.

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