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Exploring an Alternate Approach to Q=10 in ITER

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Stable and robust ITER Baseline Scenario demonstration discharges have been achieved in DIII-D at zero injected input torque (matching the ITER LSN shape including the aspect ratio, betaN=1.9-2.05, and q95=3), and repeated under various conditions (Ip, density, wall conditions). However, an alternate route to Q=10 conditions has been explored that starts at higher q95 and maximum BT. Performance to reach 500 MW of fusion power is reached at all torque levels. With co-NBI, the goal is reached by 11 MA equivalent, and the achieved beta does not increase above 12.5 MA. At zero torque, 13.5 MA may be sufficient to reach P_fus=500 MW. The gain metric βτ does not improve above 13 MA equivalent (which corresponds to q95~3.7), and all torque curves show the same trends for the evolution to saturation. This indicates that this saturation effect, observed previously in DIII-D, is not likely to be due to an ExB shear effect.
Comparing 15 and 13 MA equivalent cases, three causes for the confinement changes will be assessed: (i) differences in dimensionless parameters such as rho, *beta, nu*, q; (ii) increase in the sawtooth inversion radius at higher current; (iii) broadening of the NBI deposition profile. The fusion gain metric beta*tau saturates around the 13 MA equivalent mark for all torque values, so the benefits to fusion energy performance of increasing current may not be fully realized. Further study is needed to determine the origin of this.

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