

## Development, physics basis, and performance projections for hybrid scenario operation in ITER on DIII-D

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**Abstract.** A new standard in stationary tokamak performance is emerging from experiments on DIII-D. These experiments have demonstrated the ability to operate near the free boundary,  $n=1$  stability limit with good confinement quality under stationary conditions. The normalized fusion performance is at or above that projected for  $Q_{\text{fus}} = 10$  operation in the International Thermonuclear Experimental Reactor (ITER) design over a wide operating range in both edge safety factor (2.8–4.7) and plasma density (35%–70% of the Greenwald density). Projections to ITER based on this data is uniformly positive and indicate that a wide range of operating options may be available on ITER, including the possibility of sustained ignition. Recent experiments have demonstrated the importance of a small  $m=3$ ,  $n=2$  neoclassical tearing mode in avoiding sawteeth and the effect of edge localized modes (ELMs) on tearing mode stability at an edge safety factor near 3. Transport studies using the GLF23 turbulence transport code indicate that  $E \times B$  stabilization is important in reproducing the measured profiles in the simulation. Even in cases in which the toroidal rotation is moderate, confinement quality is robustly better than the standard H-mode confinement scalings.