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Improving Fast-Ion Confinement by Reducing Alfvén Eigenmodes in the qmin>2 Steady-State Tokamak Scenario[1] CAMI COLLINS, M.A. VAN ZEELAND, GA, C.T. HOLCOMB, LLNL, E. BASS, UCSD, C. MARINI, ORAU, DIII-D TEAM — Experiments in the DIII-D tokamak show that a broadened fast-ion pressure profile enables better control of Alfvén Eigenmodes (AEs), improves fast-ion confinement, and allows access to new regimes with 15% higher normalized plasma beta (β_N) than previously achieved in high-field, steady-state scenarios with negative central shear and $q_{min}>2$. Reversed Shear Alfvén Eigenmodes (RSAEs) were reduced in the current ramp by increasing the off-axis neutral beam power fraction, resulting in ~24% higher ratio of measured neutrons to calculated classical neutrons. The neutron fraction was further improved using Electron Cyclotron Current Drive aimed on-axis, which suppressed RSAEs by moving the q_{min} location inward toward reduced beam pressure gradient and higher plasma pressure, resulting in a ~36% higher neutron ratio than the reference shot. In flattop, fast-ion confinement improved by ~25% after reducing beam pressure gradient (thus AE drive) by increasing the off-axis beam power fraction from 30% to 70%. Record parameters were achieved by increasing the relative density, reaching β_N ~3.1 and H_{89} ~2.3 at B_T =2.0 T and q_{95} =6.0. These experiments mark significant progress in understanding potential optimized regimes for steady-state advanced tokamaks that can avoid AE-induced fast-ion redistribution, loss, reduced heating efficiency, and limits to the achievable β_N.

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