

State-of-the-Art Neoclassical Tearing Mode Control in DIII-D Using Real-time Steerable Electron Cyclotron Current Drive Launchers

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Abstract: Real time steerable electron cyclotron current drive (ECCD) has been demonstrated to reduce the power requirements and time needed to remove 3/2 and 2/1 neoclassical tearing modes (NTM) in the DIII-D tokamak. In a world first demonstration of the techniques required in ITER, the island formation onset is detected automatically, gyrotrons are turned on and the real-time steerable ECCD launcher mirrors are moved promptly to drive current at the location of the islands. This shrinks and suppresses the modes well before saturation using real-time motional Stark effect (MSE) constrained equilibria reconstruction with advanced feedback and search algorithms to target the deposition. In ITER, this method will reduce the ECCD energy requirement and so raise Q by keeping the EC system off when the NTM is not present. Further, in the experiments with accurate tracking of pre-emptive ECCD to resonant surfaces, both 3/2 and 2/1 modes are prevented from appearing with as little as one fourth the ECCD peak power required for removal of a saturated mode.

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