Complete suppression of the $m = 2/n = 1$ neoclassical tearing mode using electron cyclotron current drive on DIII-D

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Abstract

The first suppression of the important and deleterious $m = 2/n = 1$ neoclassical tearing mode (NTM) is reported using electron cyclotron current drive (ECCD) to replace the "missing" bootstrap current in the island O-point. Experiments on the DIII-D tokamak verify that maximum shrinkage of the $m = 2/n = 1$ island occurs when the ECCD location coincides with the $q = 2$ surface. The DIII-D plasma control system is put into "search and suppress" mode to make small changes in the toroidal field to find and lock onto the optimum position, based on real time measurements of dB_θ/dt, for complete $m = 2/n = 1$ NTM suppression by ECCD. The requirements on the ECCD for complete island suppression are well modeled by the modified Rutherford equation for the DIII-D plasma conditions.