Resonant Field Amplification and Rotational Screening in DIII-D RMP Simulations*

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The application of resonant magnetic perturbations (RMP) to DIII-D plasmas at low collisionality has achieved ELM suppression, primarily due to a pedestal density reduction. NIMROD RMP simulations investigate the mechanism of enhanced particle transport. The simulations are initiated with realistic vacuum fields form the DIII-D I-coils, C-Coils and measured intrinsic error fields added to an EFIT reconstructed DIII-D equilibrium. The plasma responds to the applied fields while the boundary conditions maintain effectively constant coil currents. A non-rotating plasma amplifies the resonant components of the applied fields by factors of 2-5, which is theoretically predicted for marginally tearing stable plasmas. The poloidal velocity forms E×B convection cells crossing the separatrix, which push particles into the vacuum region and reduce the pedestal density. Low toroidal rotation at the separatrix reduces the resonant field amplitudes, but does not strongly affect the particle pump-out. At higher separatrix rotation, the poloidal E×B velocity is reduced by half, while the enhanced particle transport is entirely eliminated. The anticipated resonant field amplification in ITER and DIII-D are assessed with NIMROD dimensionless parameter scaling studies in conjunction with analytic error field theory.

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