Theory and simulation of quasilinear transport from external magnetic field perturbations in a DIII-D plasma

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Abstract. The linear response profiles for the 3D perturbed magnetic fields, currents, ion velocities, plasma density, pressures, and electric potential from low-n external resonant magnetic field perturbations (RMP) are obtained from the collisional two-fluid M3D-C^1 code [N.M. Ferraro and S.C. Jardin, J. Comp. Phys. **228**, 7742 (2009)]. A newly developed post-processing RMPtran code computes the resulting quasilinear ExB and magnetic (JxB) radial transport flows with respect to the unperturbed flux surfaces in all channels. RMPtran simulations focus on ion (center of mass) particle and transient non-ambipolar current flows, as well as the toroidal angular momentum flow. The paper attempts to delineate the RMP transport mechanisms responsible for the switched-on RMP density pump-out seen in DIII-D [M.A. Mahdavi and J.L. Luxon, eds., Fusion Sci. Technol. **48**, 2 (2005)]. The starting high toroidal rotation does not brake to a significantly lower rotation after the pump-out suggesting convective and ExB transport mechanisms dominate. The direct JxB torque from the transient non-ambipolar radial current expected to accelerate plasma rotation is shown to cancel most of the Maxwell stress JxB torque expected to brake the plasma rotation. The dominant ExB Reynolds stress accelerates rotation at the top of the pedestal while braking rotation further down the pedestal.

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