Maintaining the Quasi-Steady State Central Current Density Profile in Hybrid Discharges

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Abstract

Experimental observations in a number of tokamaks operated in the hybrid regime revealed that the presence of a rotating neoclassical island substantially reduces the occurrence of sawtooth. This possibility of a rotating mangetic island driving counter currents near the plasma center in present day tokamaks is studied. Three mechanisms are investigated with two of them driving sufficient current. They rely on estabilishing an oscillating parallel electric field by the rotating neoclassical island. First is the excitation of an electrostatic side band through diamagnetic and curvature drifts; second is the excitation of the kinetic Alfvén wave at the plasma center through the polarization drifts. The third mechanism is the "prompt" modification of the energetic particle distribution function by the neoclassical island and has been found to be relatively weak. Effect of the energetic particles on counter-current drive due to modification to the energetic particle distribution function on the long (energetic particle slowing down) time scale has been simulated using a particle simulation code. A firm conclusion has not yet been obtained. Transport simulations indicate that present experimental observations could be the effect of either a negative current drive in the background plasma or due to the anomalous transport of the energetic particles.

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