Convective Radial Energy Flux Due To Resonant Magnetic Perturbations

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Transport barriers at tokamak plasma edge are typically unstable and exhibit quasi-periodic relaxation oscillations associated with high energy flux peaks known as Edge Localize Modes (ELMs)[1]. The control of these modes is achieved by changing the magnetic topology at the plasma edge imposing an external Resonant Magnetic Perturbations (RMPs)[2] and has been shown on different tokamaks such as DIII-D[3], JET[4] and TEXTOR[5]. The efficiency of ELMs' control by RMPs is enhanced when the RMP amplitude is increased, which is generally attributed to field line stochastisation, induced by overlapping of magnetic islands, and it is due to a reduction in pressure gradient by a radial energy flux. Although the experiments confirmed RMPs as an important tool to control barrier relaxations, the mechanisms of how they work are not well understood, in particular if the penetration is sufficient to produce stochasticity. Here we study an additional mechanism leading to convective radial flux even in the absence of stochasticity. This new mechanism is based on the coupling between electrostatic potential and pressure via magnetic curvature, also leading to poloidal ExB flow generation. By using the 3D toroidal electromagnetic edge turbulence code, EMEDGE3D[6], we show that two different equilibrium plasma states exists in presence of a RMP in the basic situation without turbulent fluctuations and without imposed mean velocity shear. One is characterized by the absence of mean poloidal flow and a low level of convective transport and other that shows mean poloidal rotation and large convective transport.

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