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Effect of poloidal density asymmetries on shear flows and radial electric field at the plasma edge

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In the simplest, magnetohydrodynamic (MHD) description of the plasma equilibrium, rapid transport along the field lines leads to a state where the plasma density and temperature are constant on flux surfaces, exhibiting symmetry in both the poloidal and toroidal directions.
This idealization, however, breaks down at the plasma edge where both the magnetic topology and various perpendicular transport processes introduce at least a poloidal asymmetry.
We show that the mass flows and radial electric field driven by edge poloidal density asymmetries can be used as a highly effective control mechanism for the edge and thus the global confinement in tokamaks. The underlying physics can be demonstrated
entirely within a simple magnetohydrodynamic equilibrium model with an appropriate flow damping mechanism. As an example, strong dependence of the low to high (LH) transition power threshold on the magnetic topology, an experimental observation still poorly understood, can be easily explained within this framework. Similar arguments also indicate that some of the ITER fueling ports are misplaced from an operational point of view and may lead to higher input power requirements.

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