



Turbulence-driven Vortex-Flow around a magnetic island

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We predict a new state of plasma self-organization in presence of magnetic islands, namely turbulence-driven island Vortex-Flows, which are non-axisymmetric flows. The interaction between an ExB sheared Vortex-Flow and the Drift-wave (DW) turbulence driving it is derived in presence of a coherent static magnetic island. The turbulence is driven by a 3D density profile due to quasi-linear island-induced profile flattening. The Drift-waves thus follow the local electron diamagnetic drift along the island.

The metric tensor is introduced, making the analysis more transparent in island geometry. An extended Charney-Hasegawa-Mima equation describes the DW turbulence – Flow interaction, from which a wave-kinetic equation (WKE) is obtained in island geometry. This yields a DW-Vortex Flow predator prey model which predicts a nonlinear threshold for island Vortex-Flow formation. The Vortex-Flow threshold decreases as the inverse-square of the island width, which shows that wider islands may more easily drive flows.