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Intrinsic parallel current generation from ETG turbulence in a cylindrical plasma

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The mean axial current in a cylindrical plasma is shown to obey a collisional advection diffusion equation. In addition to turbulent diffusion of large scale electron momentum due to small scale turbulence, a negative turbulent viscosity appears, coming from $\langle k_y k_z \rangle$ symmetry breaking[1], the likely source of which is an initial seed current shear. Note that the current shear creates an asymmetry in the growth rate, and therefore a corresponding asymmetry in the fluctuation spectrum. When the negative turbulent viscosity exceeds the ambient positive diffusivity, the axial current shear goes modulationally unstable, leading to generation of intrinsic current in a current less non-inductive linear device. This modulational instability mechanism of intrinsic current in linear device is fundamentally different from the intrinsic current generation via $\langle k_{//} \rangle$ symmetry breaking in tokamak pedestal[2,3].

References

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