Electrostatic dynamo in Reversed Field Pinch plasmas: simple common fundamental nature of laminar and turbulent regimes

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Within the framework of magnetohydrodynamic (MHD) numerical modelling the Reversed Field Pinch (RFP) has been found to develop turbulent or laminar regimes switching from the former to the latter in a continuous way depending on the strength of dissipative forces [1, 2].

The laminar solution corresponds to a simple global helical deformation of the current channel. A helically-modulated electrostatic field arises in order to account for the helical modulation of the current density along magnetic field lines. The associated electrostatic drift yields the main component of the dynamo velocity field [3]. The continuity of the transition between the two regimes suggests that the simple laminar helical solution can provide a fruitful intuitive description of the RFP dynamo in general. In fact, the electrostatic drift remains the main component of the dynamo velocity field in the non-stationary turbulent regime for a sustained RFP [3]. We show that the same dynamo action, due to the electrostatic drift, is provided either by one single mode and its harmonics, as in the laminar regime, or by a rich spectrum of modes with the action of full nonlinear coupling, as in the turbulent one [4].

Here, we review our previous work and present new elements to clarify the physics of the RFP dynamo. Many of the MHD predictions are in good agreement with experimental findings.

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