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P1.1049 Effect of a realistic boundary on the helical self-organization of the RFP

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The reversed-field pinch (RFP) is a configuration for the magnetic confinement of fusion plasmas, in which most of the toroidal field is generated by the plasma itself through a self-organized dynamo process, instead of being produced by external coils as in the tokamak. In the RFP, the nonlinear saturation of resistive-kink/tearing modes brings to the spontaneous emergence of helical states with improved confinement. This is observed both in nonlinear magnetohydrodynamics (MHD) modelling [1] and in RFP devices, especially at high current [2]. A major advance in the predictive capability of nonlinear MHD modelling for RFP plasmas was made possible by allowing helical perturbations of the radial magnetic field at the plasma boundary [3]. A proper use of helical magnetic perturbations (MPs) in MHD modelling allowed to obtain experimental-like helical states [4] and to predict new helical states with chosen helical twist, successfully produced in RFX-mod [5]. Here, we describe a further refinement of the magnetic boundary modelling. Instead of applying fixed helical MPs, we study the helical self-organization in the presence of a thin resistive shell and a vacuum layer between the plasma and the ideal shell. Two main results are discussed. On the one hand, by varying the distance between the plasma and the ideal wall it is possible to provide a nonlinear estimate for the decrease of secondary modes by increased shell-plasma proximity. This is of interest in view of the upgraded RFX-mod2 device (starting operation in 2020), in which the shell-plasma proximity will change from b/a=1.11 to b/a=1.04 [6]. On the other hand, it is observed that with a proper choice for the resistivity of the conducting shell at the plasma boundary, experimental-like helical states do emerge in a self-consistent way, as in the experiment, without the need to impose a fixed helical MP. Finally, further extensions of the realistic boundary implementation, in order to take into account a double resistive shell and a feedback control system, will be discussed.

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