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TH/P2-16: Nonlinear Modeling for Helical Configurations in Toroidal Pinch Systems

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We present the current status of research in nonlinear modeling studies developed about the RFX-mod experiment, where several pinch configurations can be compared ranging from the self-organized helical RFP, to circular Tokamak passing through Ultra Low q ones, thus providing a flexible experiment in view of a future validation stage for several modeling tools. We focus presently on 3D nonlinear MHD modeling and nonlinear gyrokinetic tools for studies of helical configurations in the Reversed Field Pinch regime.
We present new results of 3D nonlinear visco-resistive MHD simulations, which address the issue of stimulating -by suitable helical magnetic boundary condition- a helical QSH configuration with different toroidal periodicity (in particular a non resonant one) with respect to the self-organized one. On a parallel side, we present first MHD toroidal simulations with the PIXIE3D code. Preliminary indications show that QSH state is not stationary like it was in the cylindrical case. Instead, it is interrupted by crashes which may be reminiscent of the experimental phenomenology. A discussion of the magnetic topology obtained both as a result of stimulated nonresonant QSH regimes and of toroidal geometry effect will be presented, including results of code's benchmarking of available tools like NEMATO and ORBIT.
Concerning nonlinear gyrokintic studies, Ion temperature gradient (ITG) modes have been studied in the last years as a possible source of ion heat transport in the RFP. Such instabilities have revealed to be strongly stabilized compared to tokamak plasmas, due to the Landau damping acting in low-q configurations. However, for strongly outwardly peaked impurity profile –which is the case for RFX-mod plasmas –they can be more relevant. In this contribution, we address the nonlinear problem still in axisymmetric RFP geometries. A large set of 2-species gyrokinetic turbulence simulations with GS2 is presented, in order to compare the linear and nonlinear stability threshold. An up-shift in a/LTi,c is found, consistently with the picture given in tokamak plasmas (the so-called Dimits shift).

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