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Reconnection Processes in 3D pinch configurations

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We will briefly recall the features of the basic reconnection process within viscoresistive 2D nonlinear numerical MHD approximation for both the *Reversed Field Pinch (RFP)* and *Tokamak* pinch configurations. After the current sheet formation, plasmoid formation is observed [Fig.1(a,b)], when proper numerical resolution is used, which speeds up the process.

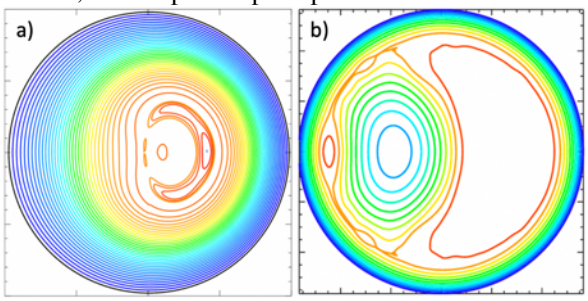

Fig. 1 Magnetic helical flux function contour plot at reconnection event showing plasmoids formation (poloidal sec.). a) Reversed Field Pinch b) Tokamak.

Then, the full three dimensional reconnection processes will be revisited for the experimental-like RFP quasi helical regimes [1, 2]. The 3D RFP simulations show much larger and abrupt magnetic energy conversion into kinetic one, with respect to the 2D reconnection processes, overriding the fine structures observed in 2D approximation. Relaxation-reconnection events cyclically interrupt the formation of quasi helical regime, featuring 3D current sheets formation (Fig.2), mode-mode- phase locking, excitation of Alfvèn waves (Fig.3) [3, 4]. The process reflects in several respects the features highlighted in the past, including typical scaling laws, within the fully developed 3D MHD turbulence obtained in low collisional ideal boundary conditions [5, 6]. Such reconnection processes have been envisaged to provide direct ion heating in the RFP [7].
We will describe how we manage to suitably pace the relaxation cycle in simulation and experiments [8].

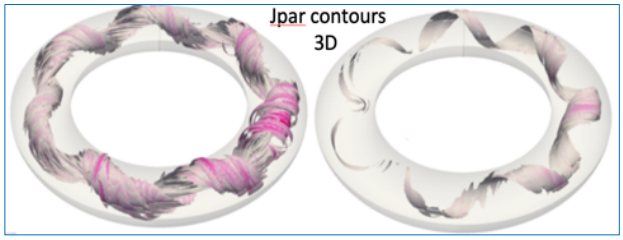

Fig. 2 Parallel current density contour plot at two instants during reconnection event. Current sheet formation is shown by local intense fuchsia color.
(3D rendering of RFP toroid – RFX-mod device aspect ratio R/a ~ 2m/0,5m = 4)

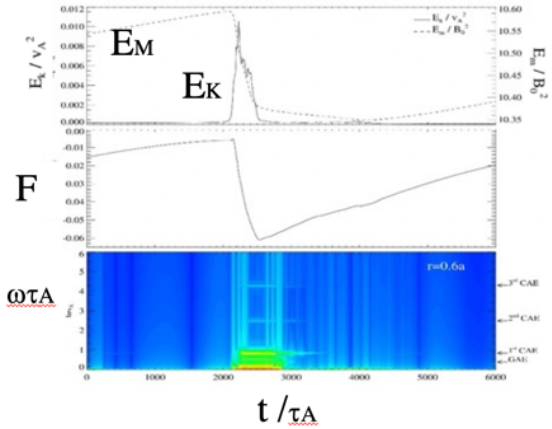

Fig. 3 Alfvèn waves excitation at reconnection event in 3D numerical simulations of RFP.

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