Equilibrium and stability with \( m=0 \) magnetic islands

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Axially symmetric \( m = 0 \) magnetic islands are studied in a cylindrical plasma with longitudinal magnetic field reversal. Applying an 2D deformation on the equilibrium plasma boundary results in the breaking of magnetic surfaces topology into chain of islands. Axially symmetric equilibrium with islands are described by the Grad-Shafranov equation for the longitudinal flux function with a periodicity condition in \( z \).

It was shown in [1] that axially symmetric equilibria with toroidal field reversal satisfying the Ohm’s law do not exist and at least helical symmetry is required. The ohmic states are observed in 3D closed configurations as the self-organized helical reversed field pinch (RFP) equilibria [2]. So the \( m = 0 \) islands are 3D objects in realistic toroidal configurations. To model them in 2D we use force-free equilibria with a constant ratio between the current density and the magnetic field, \( j = \lambda B \), across the plasma. In a cylinder it coincides with the Bessel function model (BFM) with finite current density at the plasma boundary [3].

Plasma stability with chains of \( m = 0 \) magnetic islands is investigated for high aspect ratio RFP-relevant configurations. The unstructured grid MHD_NX code is used to compute ideal MHD stability of 2D axially symmetric equilibria with arbitrary topology of magnetic surfaces [4].

References