Effects of the external current drive on three-dimensional magnetic islands in the CFQS quasi-axisymmetric stellarator

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Magnetic island physics is a major topic of interest for the Chinese First Quasi-axisymmetric Stellarator (CFQS) in case of high-β operation [1-3]. Electron cyclotron current drive (ECCD) can be one of the options for adjusting the rotational transform, and hence modifying magnetic islands in the CFQS [4]. This study focuses on the influence of the external current drive on the three-dimensional magnetic islands by the HINT code [5] for the CFQS. By applying toroidal magnetic field produced by the auxiliary toroidal field coil (TFC), of which coil current is 30 kA, m/n=5/2 magnetic islands are generated without the bootstrap current effect. It is found that the islands can be significantly suppressed by using the external flat or Gaussian current, depending the direction and amplitude of the current. Figs. 1(a) and (b) show the 5/2 islands without and with the external current, respectively. The region of the plasma pressure p/p_0>10 % is marked by the red line. The width of islands is reduced with increasing of external current as plotted in fig. 1(c), where the minus means the counter toroidal direction.

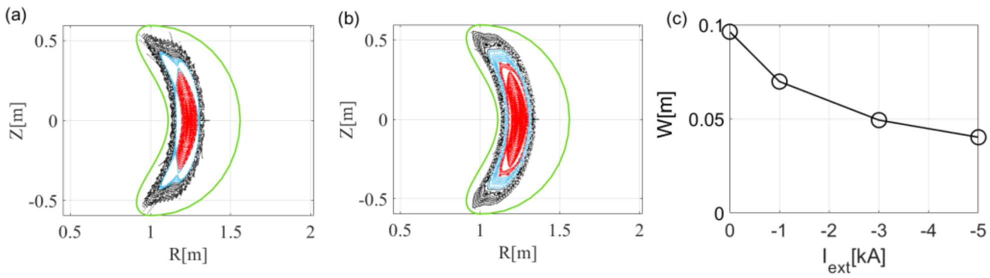

Figure 1 The poincaré plots of magnetic surfaces (a) without the external current (I_{ext}=0 kA), (b) with the Gaussian external current (I_{ext}=-5 kA), (c) The averaged width of magnetic islands (W) as a function of the Gaussian external current, where volume averaged beta is ~0.5 %. In all cases, toroidal magnetic field by TFC is applied to generate 5/2 islands.

References:

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