Search for very high-β MHD-stable quasi-isodynamic configurations

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Quasi-isodynamic [1] (*qi*) configurations with high-β stability limit, good neoclassical confinement properties and excellent fast particle collisionless confinement have been previously found through computational optimization procedures [2,3]. It has been analytically demonstrated [3] that the secondary parallel current density in *qi* configurations remains contained within each plasma field period, namely, between the cross-sections with maximal magnetic field strength B. In the *qi* configurations then considered, the divergence of the current density perpendicular to the magnetic field lines changes sign only once along the magnetic field within one field period. It follows from this condition that the parallel current density cannot change sign along the magnetic field inside one period. Thus, the parallel current density exhibits a dipole component because of the vanishing net parallel current, which impairs MHD stability at very high β ($\langle\beta\rangle > 0.1$) for configurations with shallow magnetic well in the associated vacuum magnetic field.

Recently it has been shown [4] that a change of the internal structure of a field period can be achieved for which the vanishing of this dipole component and the stationarity of the condition for quasi-isodynamicity simultaneously hold. In the present work, additional shaping of the flux surfaces is used to search for very high-β MHD-stable quasi-isodynamic configurations.

References

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