

## Loss of the second stability regime for ideal MHD ballooning modes in three-dimensional equilibria

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The effect of three-dimensional geometry on ideal MHD ballooning stability boundaries is investigated. In particular, we use the construction of local 3-D equilibria [1] as a tool to distinguish the role of three dimensional shaping and plasma profiles. The relationship between the symmetry properties of the local shear and the magnetic curvature is addressed for a model quasi-helically symmetric configuration. The presence of three-dimensional symmetry breaking terms in the local shear can produce localized ballooning instabilities in regions of small average magnetic shear [2]. In the presence of the incommensurate helicities, the first stability boundary pressure gradient threshold is lowered and the second stability regime can be eliminated [3].

A simple geometric interpretation can explain the occurrence of ballooning instabilities in 3-D geometry. Ballooning instabilities on a particular flux surface tend to arise when regions of local shear intersect with regions of unfavorable curvature. In axisymmetric systems, these regions are functions of poloidal angle only and therefore ideal ballooning instabilities arise when the local shear is small on the low field side. However, in three dimensional configurations, the presence of an incommensurate helical component of the local shear produces a configuration where the regions of small shear and unfavorable curvature overlap at distinct points on the magnetic surface. These regions only appear on particular field lines. Unlike the axisymmetric case, in general the Pfirsch-Schlüter current induced modulation of the local shear cannot remove these regions. This results in a configuration without a second stability regime.

[1] C. C. Hegna, *Phys. Plasmas* **7**, 3921 (2000).

[2] P. Cuthbert and R. L. Dewar, *Phys. Plasmas* **7**, 2302 (2000).

[3] C. C. Hegna and S. R. Hudson, to appear in *Phys. Rev. Letters* (June, 2001).

MHD Equilibrium and Stability

Poster is preferred: No