Influence of pressure-gradient and shear on ballooning stability in stellarators

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Abstract

The sensitivity of ballooning stability boundaries to profile variations is addressed for stellarator equilibria. A semi-analytic method for calculating the ballooning growth rate as functions of the pressure gradient and averaged magnetic shear is introduced. The simplicity of the expressions allows for interpretation of the important physical effects at work in determining instability thresholds. The analysis determines whether or not a given stellarator configuration will possess a region of second stability and the strength of this second stable region. Whether such regimes can be accessed in a given device depends upon the interaction of the pressure gradient with curvature and the local shear. This interaction is cleanly accounted for using the method of profile variation whereby self-consistent local 3-D equilibria are calculated for arbitrary changes in the pressure and rotational transform gradient. The theory is applied to various configurations of experimental interest.