Reduced turbulent transport in toroidal configurations through shaping

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In recent work[1], we have demonstrated a method by which stellarator configurations can be evolved by 3D shaping to designs with their turbulent transport substantially reduced, using the STELLOPT optimization code[2] in conjunction with the GENE gyrokinetic code[3]. The original applications of the method focused on ion temperature gradient (ITG) transport in a quasi-axisymmetric stellarator (QA) design. Here, we extend the application of the method to both other starting configurations, including tokamaks, and other turbulence channels.[4] It is found that the designs evolved for transport from ITG turbulence also display reduced transport from other transport channels whose modes are also stabilized by improved curvature, such as electron temperature gradient and ballooning modes. The optimizer is also applied to evolving from non-QA stellarator classes and from tokamaks, finding appreciable turbulence reduction for some of these devices as well. From these studies, improved understanding is obtained of why the deformations found by the optimizer are beneficial, and these deformations are related to earlier theoretical work in both stellarators and tokamaks.

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