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Minimizing stellarator turbulent transport by geometric optimization

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Up to now, a transport optimized stellarator has meant one optimized to minimize neoclassical transport,[1] while the task of also mitigating turbulent transport, usually the dominant transport channel in such designs, has not been addressed, due to the complexity of plasma turbulence in stellarators. However, with the advent of gyrokinetic codes valid for 3D geometries such as GENE,[2] and stellarator optimization codes such as STELLOPT,[3] designing stellarators to also reduce turbulent transport has become a realistic possibility. We have been using GENE to characterize the dependence of turbulent transport on stellarator geometry,[4] and to identify key geometric quantities which control the transport level. From the information obtained from these GENE studies, we are developing proxy functions which approximate the level of turbulent transport one may expect in a machine of a given geometry, and have extended STELLOPT to use these in its cost function, obtaining stellarator configurations with turbulent transport levels substantially lower than those in the original designs.

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