Temperature gradients are supported by cantori in chaotic fields

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With the tantalizing prospect that localized regions of chaotic field can effectively be used to suppress ideal instabilities, as shown by the resonant magnetic perturbation (RMP) experiments on DIIID [1], it becomes necessary to understand the impact of chaotic fields on confinement. Using a model of heat transport for illustration, we show that chaotic fields can support significant temperature gradients. Despite the fact that flux (KAM) surfaces may be destroyed by applied error fields, the remnants of the KAM surfaces, the cantori [2], present extremely effective barriers to field-line transport, and thus present effective barriers to any transport process that is dominantly parallel to the field. Coordinates adapted to the structure of the chaotic magnetic field, which we call chaotic coordinates [3], can be used to reduce the representation of the temperature from generally a function of three-dimensional space to the much simpler form $T(s)$, where s labels that chaotic coordinates surfaces. In chaotic coordinates, the temperature profile will generally be a smoothed devil's staircase.

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[2] R. S. MacKay, J. D. Meiss, and I. C. Percival, Phys. Rev. Lett. **52**, 697 (1984).

[3] S. R. Hudson and J. Breslau, Phys. Rev. Lett. (2008).