Temperature gradients are supported by cantori in chaotic fields

S. Hudson, PPPL

With the tantalizing prospect that localized regions of chaotic magnetic field can be used to suppress ideal instabilities in fusion devices, as suggested by the resonant magnetic perturbation (RMP) experiments on DIIID, it becomes necessary to understand the impact of chaotic fields on confinement, particularly so considering that RMP fields are being considered as an ELM mitigation strategy for ITER.

Using a model of heat transport for illustration, this paper will show that chaotic fields can support significant temperature gradients, despite the fact that flux surfaces may be destroyed by applied error fields. The remnants of the irrational flux surfaces, the cantori, present extremely effective partial-barriers to field-line transport, and thus present effective barriers to any transport process that is dominantly parallel to the field. We extend the concept of magnetic coordinates to chaotic fields [Hudson & Breslau, PRL], and show that the temperature, generally a function of three-dimensional space, takes the simple form T(s), where s labels the chaotic-coordinate surfaces.