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Ideal and Relaxed equilibrium β-limits in classical stellarators

J. Loizu[1], S. R. Hudson[2], C. Nührenberg[1], and J. Geiger[1]

1. Max-Planck-Institut für Plasmaphysik, Greifswald, Germany

2. Princeton Plasma Physics Laboratory, Princeton, New Jersey, USA

An unprecedented numerical investigation is carried out to understand the equilibrium β-limit in a classical stellarator [1]. The SPEC code [2, 3] is used in order to assess whether or not magnetic islands and stochastic field-lines can emerge at high β. Two modes of operation are considered: a *zero-net-current* stellarator and a *flux-conserving* stellarator, in which the rotational transform is mantained constant. Despite the fact that relaxation is allowed, the former is shown to maintain good flux surfaces up to the equilibrium β-limit predicted by ideal-MHD, above which a separatrix forms. The latter, which has no ideal equilibrium β-limit, is shown to develop regions of magnetic islands and chaos at sufficiently high β (Figure 1), thereby providing a "relaxed β-limit". We compare our results to the High-Beta-Stellarator theory [4] and derive a new robust prediction for the critical value of β above which chaos emerges (Figure 2). Implications for the interpretation of high-β equilbria in the Large Helical Device in Japan are discussed.

Preference: Oral Contribution

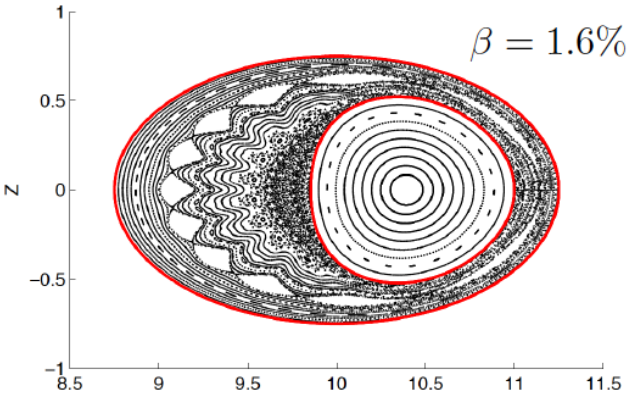

Figure 1. Example of equilibrium with chaotic magnetic field-lines emerging radially outwards from the pressure pedestal.

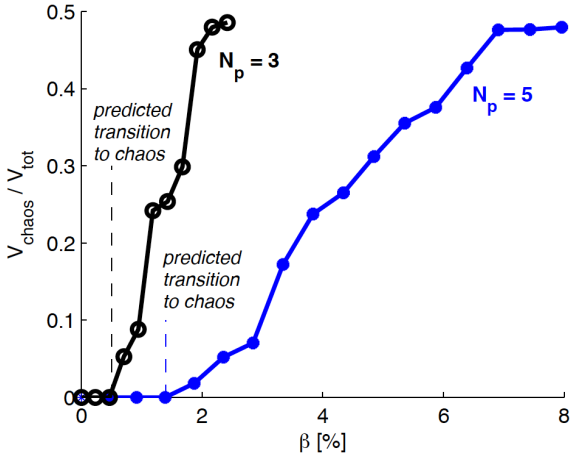

Figure 2. Volume of chaos as a function of β for a stellarator with 3 (left) and 5 (right) field periods.

References

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Corresponding author: J. LOIZU *joaquim.loizu@ipp.mpg.de*