# Advanced MHD models of anisotropy, flow and chaotic fields

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Large scale neutral beam heating, the growing importance of either deliberate or spontaneous equilibrium 3D structure, and the increased diversity, accuracy and resolution of plasma diagnostics have driven more advanced force balance models as well as new approaches to equilibrium reconstruction, such as Bayesian inference techniques [1]. In this work we focus on the development of two MHD force balance models, discuss their constraint to laboratory data, and scope their potential to describe astrophysical phenomena.

EFIT TENSOR is an implementation of the axis-symmetric guiding centre plasma which supports pressure anisotropy and toroidal flow.[2] The free functions are one dimensional poloidal flux functions and all non-linear contributions to the toroidal current density are treated iteratively. The parallel heat flow approximation chosen for the model is that parallel temperature is a flux function and that both parallel and perpendicular pressures may be described using parallel and perpendicular temperatures. In addition to benchmark tests, the code has been applied to MAST data in cases with significant anisotropy.

We also report on the development and numerical implementation of multi-region relaxed MHD variational principle MRXMHD, which comprises different Taylor relaxed regions separated by singular currents at ideal MHD interfaces. This model, which supports stepped pressure profiles, enables the resolution of chaotic fields and magnetic islands which occur in toroidal asymmetric plasmas. We have applied the MRXMHD code SPEC to describe the emergence of the quasi-single helicity state in RFX-mod.[3] Both magnetic axes can be reproduced in addition to island structure and significant amounts of chaos.

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