3D MHD equilibrium calculations for Tokamaks with resonant magnetic perturbations: TEXTOR as an example

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The application of resonant magnetic perturbations (RMP) to tokamaks recently gained a lot of attention due to the possibility of ELM suppression or mitigation [1]. The iron core tokamak TEXTOR with circular plasma cross-section is specially suited to study the 3D effects of RMPs due to its **D**ynamic **E**rgodic **D**ivertor (DED) [2]. The DED consists of 16 helically aligned perturbation coils installed in-vessel at the high-field side and can be operated in several base modes ($m/n = 12/4$, 6/2 and 3/1) with either DC or AC current supply. The penetration depth of the RMPs depends on the choosen poloidal mode number m.

Knowledge of the magnetic field topology is a necessary prerequisite for further studies concerning e.g. the transport charateristics. Generally, a vacuum superposition approach is used at TEXTOR, i.e. a 2D equilibrium solution is superposed with the vacuum perturbation field and any plasma response is neglected.

This study focusses on the effect of the RMPs on the plasma equilibrium itself as the equilibrium force balance is distorted. The exitation of Pfirsch-Schlüter and diamagnetic currents due to the RMPs leads to a reestablishment of the equilibrium force balance. To investigate the resulting 3D equilibrium the HINT2 code [3] is applied. This code is an initial value solver which relaxes the given initial magnetic field configuration into an equilibrium by solving resistive MHD equations. Screening of the RMPs due to the finite plasma rotation is not taken into account.

First results of the HINT2 calculations will be presented for the 6/2 and 3/1 base mode with an underlying L-mode plasma as it is typical for TEXTOR discharges. In case of the 6/2 base mode, observed changes to the magnetic topology are rather minor, indicating that the vacuum superposition approach is a good approximation. This can actually be expected due to missing steep pressure and current gradients at the edge of L-mode plasmas. Furthermore, this finding is also in agreement with the experimental observations [4].

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