(2) Transport of energy in stochastic fields

3D Numerical Simulations of Energy Transport in the Edge of TEXTOR-DED Tokamak

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The effect of magnetic-field-line ergodisation that eliminates poloidal magnetic surfaces (either by a resonant magnetic perturbation like in TEXTOR-DED or by intrinsic plasma effects like in W7-X) imposes the need for plasma transport models being able to describe this properly. The resulting transport is strongly linked to a three dimensional, complicated magnetic topology. In this work we perform calculations for TEXTOR-DED case, where the plasma structures and transport are closely related to the structure of the magnetic field lines. It has been shown in [1] that the resonant ergodic pattern, in particular field lines with short connection length (i.e. laminar zone) dominates the plasma properties at the plasma edge.
A prerequisite for a proper transport model is the concept of local magnetic coordinates allowing a correct discretization of the transport equations with minimized numerical errors [2]. For the simulation of plasma transport in perturbed volume, a numerical method based on the finite difference concept has been developed, using a custom-tailored unstructured grid in local magnetic coordinates [3]. This grid is generated by field-line tracing to guarantee complete isolation between the large parallel transport along B and that perpendicular to B. Therefore, the radial and parallel fluxes can be effectively separated and the parallel and radial dynamics can be treated independently in the numerical method which has been implemented in the FINITE code [3]. Numerical grids have been prepared in order to simulate experimental shots #95592 and #100972 corresponding to 12/4 and 6/2 mode of the DED operation, respectively. Until recently, a fully implicit algorithm has been employed in the FINITE code to solve the descritized energy transport equations and due to large number of mesh points ($\sim 10^5$) the memory and CPU requirements have been strongly demanding. Therefore, we follow the idea to base the solution method on a semi-implicit ansatz, alternating the implicit treatment between the parallel and radial directions.

In the present paper, we use the finite difference code FINITE, to investigate the energy transport in the 3D TEXTOR-DED tokamak geometry. In particular, we concentrate on the question what is the role of long and short magnetic field lines in the heat transfer from the core plasma to divertor surface. The results are compared to experimentally determined temperature profiles and heat fluxes at the target.

[1] M. Jakubowski, O.Schmitz, et al., Phys. Rev. Lett., **96**, 035004 (2006)
[2] A.M.Runov, et al., Physics of Plasmas, vol.8, No.3 (2001) 916
[3] R.Zagórski et al., Comp. Phys. Com., vol.164 (2004) 318